香港科技大學
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Undergraduate Research Opportunities Program

Proceedings 2016-17

UROP

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Summary of **UROP** Courses

UROP 1000

Undergraduate Research Opportunities Program
(0 credit with stipend option, offered in summer session only)

UROP 1100

Undergraduate Research Opportunities Program Series 1
(1 credit, offered throughout the year)

UROP 2100

Undergraduate Research Opportunities Program Series 2
(1 credit, offered throughout the year; prerequisite is pass in UROP1100, with approval by project advisor)

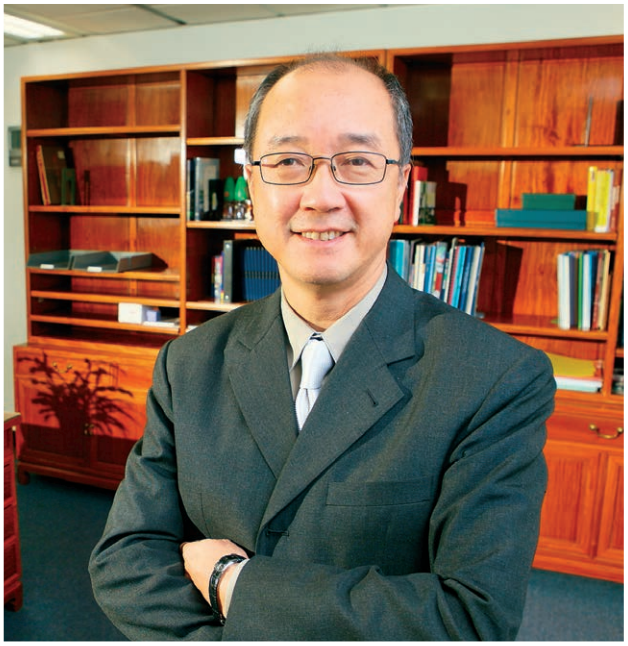
UROP 3100

Undergraduate Research Opportunities Program Series 3
(1 credit, offered throughout the year; prerequisite is pass in UROP2100, with approval by project advisor)

UROP 4100

Undergraduate Research Opportunities Program Series 4
(1 credit, offered throughout the year; prerequisite is pass in UROP3100, with approval by project advisor)

Message from the **President**



The year 2016 marked an important milestone for HKUST as we celebrated our 25th anniversary. Since establishment in 1991, HKUST has become one of the best universities in the Asia Pacific region and risen rapidly in the global academic arena with our outstanding achievements in teaching and research.

The Undergraduate Research Opportunities Program (UROP) has no doubt been playing a valuable role in our journey to pursue research excellence. Over the past decade, more than 2,500 students have participated in the program and nearly one third of them chose to continue their research endeavors by going to graduate schools in Hong Kong and overseas.

In the 2016-17 academic year, I'm glad to see sustained growth of both faculty and student participation in the program. Extra funding opportunities were provided to project supervisors to relieve their financial pressure while they took up the extra responsibilities to supervise UROP students, this in turn, help to improve the quality of the projects and provide a better learning and research experience for the students.

I'm also delighted to see a dozen of students were awarded UROP sponsorships to present their research findings in international conferences, publish papers in leading journals and attend summer schools to conduct research with scholars from all over the world. The International Research Opportunities Program (IROP) continued to partner with the Massachusetts Institute of Technology to offer the MIT-HKUST Summer Research Exchange for undergraduate students from both universities to learn from influential researchers at each other's campus.

I believe these young men and women will become full-fledged researchers in the near future and help to extend our research strengths and presence to the international stage.

Tony F Chan
President
HKUST

Sharing by Student

CHEUNG Yuen Man Kathy
Major in Biochemistry and Cell Biology
Supervised by: **Prof. QI Robert Zhong,**
Division of Life Science

I enrolled in UROP in my first year of university. UROP makes a very good starting point for my research journey. Before that, I had no clue about doing research or how the life of a master or PhD student is like. I was also uncertain about going to graduate school. UROP offers me hands-on experience of being a researcher. I realized that undergraduate and postgraduate studies are so radically different. As an undergraduate student, I spend most of my time sitting in a classroom and attending lectures. But once you get to graduate school, research dominates your studies instead of lectures.

Of course, this does not necessarily make life easier. Being a postgraduate student, you need to be equipped with the ability to work and solve problems independently, as well as to develop a skeptical mind, which is basically the prerequisite for a successful researcher. In the UROP project, I encountered many unexpected problems, which are very common in doing research. These problems may offer new insights into our research, but they can also direct our project to a wrong direction, or simply get us into trouble. So knowing the right approach to handle problems is critical. I learned quite a lot in how to develop a right attitude when facing problems in UROP, particularly troubleshooting, which I believe will definitely benefit me a lot in the future.

The most important lesson or take home message I have learnt from the UROP experience is to work hard and stay humble. Undoubtedly research requires a lot of effort, so it's important to work hard all the time. However, we are only human. No matter how much effort you have paid, you can't possibly know everything. The universe is boundless and we are but saw dusts drifting through the air compared to it. Despite the many scientific or technological breakthroughs in human history, there is still so much we don't know. We still can't fully understand ourselves; a lot of questions still remain in how our body functions or coordinates itself, or how the earth is formed. What we know is so little compared with what we don't know. So humbleness is a must for every successful researcher.

Last but not least, I would like to share a famous quote from one of my most admiring scientists, Fred Sanger, who invented the DNA sequencing method. Despite all the hurdles and frustrations, scientific research is still one of the most exciting and rewarding occupations.

UROP Overview
2016–17

The Undergraduate Research Opportunities Program (UROP) recorded steady increase in the 2016-17 academic year. Around 150 faculty members offered research projects to undergraduate students through UROP during the year, and over 400 students participated in the program to explore their areas of interest, within and beyond their own major disciplines.

To provide financial support to faculty members who usually use their own research funding to mentor UROP students, we launched the **UROP Faculty Support Grant** in Spring 2016-17 to help lighten their extra burden. This initiative was warmly welcomed by the faculty supervisors and we received over 70 applications in combined for the Spring and Summer semesters. In total, over $300,000 research funding were awarded to the supervisors to support their UROP projects.

With this funding support, we hope to encourage more faculty members to join UROP and provide better research experience for our undergraduate students.

2017 Mr. Armin and Mrs. Lilian Kitchell Undergraduate Research Award and UROP Faculty Research Award

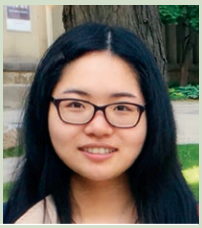
The **Mr. Armin and Mrs. Lilian Kitchell Undergraduate Research Award** entered into its eighth year in 2017. With the continuous support from our donor, 6 students were awarded the Champion, First Runner-up and Second Runner-up with a cash award of $20,000, $10,000 and $5,000 respectively. We also introduced the **Best Poster Award** for the first time, asking the competing students and their supervisors for a peer voting of the research posters to select the winner.

The Award Presentation Ceremony was held on April 19, 2017 with a full house of guests, faculty members and students to honor the outstanding performance of these UROP participants, and to present the UROP Faculty Research Award to their supervising team for their contributions to undergraduate research. The **UROP Week 2017** was held during April 19 to 26 to showcase these students' achievements and to encourage more faculty members and students to join our endeavor to make HKUST an elite research and education institution.

Mr. Armin and Mrs. Lillian Kitchell Undergraduate Research Award 2017

List of Awardees

Champion



GUO Wenshuo

Major/Year: PHYS & COSC / Year 3

Supervised by: **Professor SZETO Kwok Yip** / PHYS

Project Title: Minimization of Systemic Risk for Directed Network Using Genetic Algorithm

First Runner-up

CHOW Tsz Kiu Aaron

Major/Year: MATH / Year 3

Supervised by: **Professor FONG Frederick** / MATH

Project Title: Self-Expanders To Inverse Curvature Flows by Homogeneous Functions

First Runner-up

DING Mucong

Major/Year: PHYS & COSC / Year 2

Supervised by: **Professor SZETO Kwok Yip** / PHYS

Project Title: Selection of Random Walkers that Optimizes the Global Mean First Passage Time for Search in Complex Networks

Second Runner-up

CHEUNG Yuen Man Kathy

Major/Year: BCB / Year 2

Supervised by: **Professor QI Robert Zhong** / LIFS

Project Title: Animal Cell Engineering: A Living Test Tube for Microtubule Cytoskeletal Research

Second Runner-up

REN Da Wei David

Major/Year: PHYS / Year 3

Supervised by: **Professor LI Larry** / MAE

Project Title: Low-cost Multispectral Imaging for Remote Sensing of Lettuce Health

Second Runner-up

SULAIMAN Jordy Evan

Major/Year: CBME / Year 4

Supervised by: **Professor SHAO Minhua** / CBE

Project Title: Morphology Controlled Pt-Ni Alloys as Electrocatalyst for Direct Ethanol Fuel Cells

Best Poster Award

PANG Yu Hin

Major/Year: BCB / Year 4

Supervised by: **Professor ISHIBASHI Toyotaka** / LIFS

Project Title: Biochemical Characterization of Histone Variants and Post-translationally Modified Nucleosomes

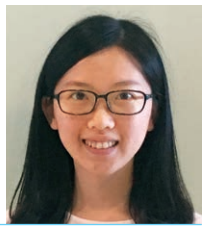
List of
UROP Sponsorship Recipients

The UROP sponsorship scheme is intended to give UROP students financial support to publish their papers in international journals, to present their posters or papers at academic conferences, or to participate in research-related summer schools or workshops during their undergraduate studies.

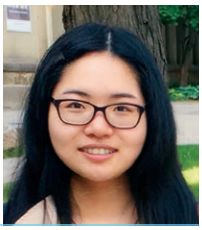
Students who have been awarded UROP sponsorships in 2016-17 are listed as follows:

UROP Research Travel Sponsorship

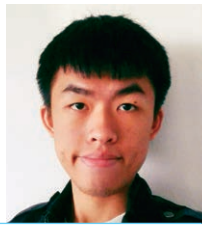
Student: **HUANG Silin**
Major: MAEC
Supervised by: **Professor KWOK James Sai Ho** / ISOM
Conference: Academy of International Business - Northeast Conference
Venue: Philadelphia, Pennsylvania, United States
Duration: October 27 – 29, 2016



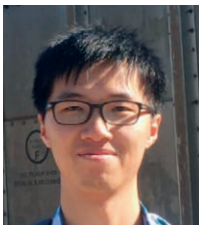
Student: **GUO Wenshuo**
Major: PHYS & COSC
Supervised by: **Professor SZETO Kwok Yip** / PHYS
Conference: The EvoStar 2017 Conference
Venue: Amsterdam, Netherlands
Duration: April 19 - 21, 2017



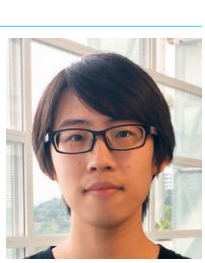
Student: **YIP Chun Yin**
Major: PHYS
Supervised by: **Professor SZETO Kwok Yip** / PHYS
Conference: The 12th International Conference on Hybrid Artificial Intelligence Systems (HAIS)
Venue: Logroño, Spain
Duration: June 21 - 23, 2017



Student: **ZHU Lingbang**
Major: PHYS
Supervised by: **Professor DU Shengwang** / PHYS
Conference: The 48th Annual Meeting of the American Physical Society Division of Atomic, Molecular and Optical Physics
Venue: Sacramento, California, United States
Duration: June 5 - 9, 2017



Student: **WANG Juntao**
Major: PHYS
Supervised by: **Professor SZETO Kwok Yip** / PHYS
Conference: 2017 IEEE/WIC/ACM International Conference on Web Intelligence
Venue: Leipzig, Germany
Duration: Aug 23 - 26, 2017

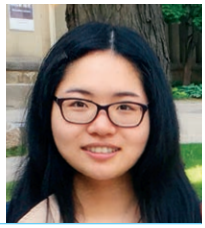


UROP Publication Sponsorship

Student: **REN Da Wei David**
Major: PHYS
Supervised by: **Professor LI Larry** / MAE
Publication: Journal of Applied Remote Sensing
Issue: Jan - Mar 2017, Vol. 11(1)
Paper: Low-cost multispectral imaging for remote sensing of lettuce health

UROP Summer School Sponsorship

Student: **GUO Wenshuo**
Major: PHYS & COSC
Supervised by: **Professor SZETO Kwok Yip** / PHYS
Activity: Summer School on Random Graphs and Probabilistic Methods
Venue: University of Toronto, Ontario, Canada
Duration: May 29 - June 9, 2017



Student: **WANG Juntao**
Major: PHYS
Supervised by: **Professor SZETO Kwok Yip** / PHYS
Activity: Summer School on Random Graphs and Probabilistic Methods
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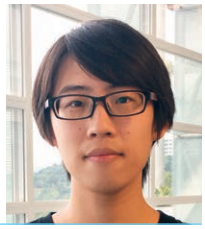
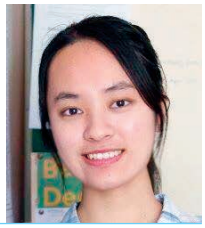
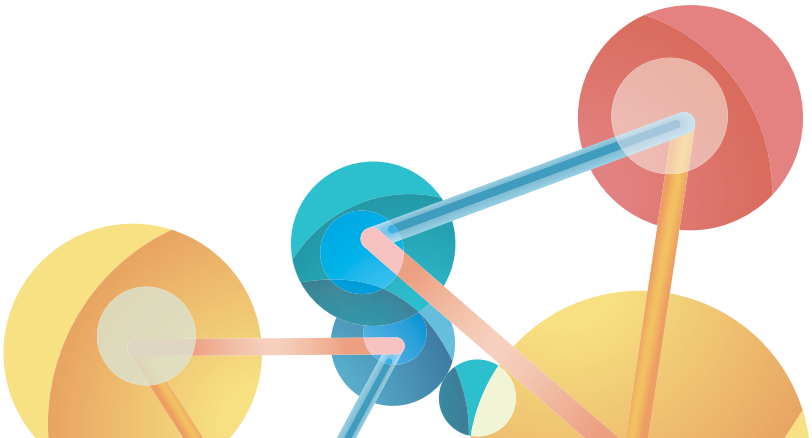


Student: **JI Caixuan**
Major: GCS
Supervised by: **Professor SAUTMAN Barry Victor** / SOSC
Activity: International Junior Research Associate (IJRA) Scheme
Venue: University of Sussex, Brighton, England
Duration: June 19 - August 11, 2017



Student: **YAU Ting Wai**
Major: MECH
Supervised by: **Professor YAO Shuhuai** / MAE
Activity: Summer School in Nanotechnologies
Venue: Grenoble Institute of Technology, Grenoble, France
Duration: June 12 - July 13, 2017



Undergraduate Research Opportunities Program

Proceedings 2016-17

SCHOOL OF
SCIENCE

Department of Chemistry

Mechanisms of Influenza A Virus Replication and Implication to New Drug Discoveries

Supervisor:	HUANG Xuhui / CHEM	Co-supervisor:	CHEUNG Pak Hang Peter / CBE
Student:	LEE Jiyoung / CHEM-IRE	Course:	UROP1000, Summer

Ribosomal RNA (rRNA) depletion is an essential step to get rid of any rRNA in total RNA sample extracted so as to increase coverage in sequencing. rRNA depletion could be conducted via various methods including subtractive hybridization (ribo-zero rRNA removal kit) and columns with oligo dT that captures the poly-A tail of mRNA (Oligotex kit). Each of the depletion methods has unique characteristics and often it is important to decide which one to use when it comes to the shortage of time to go over further steps like sonication for sequencing.

However, quantitative and qualitative differences between two methods have not been tested. Based on the experiment result, one can choose either of them according to the standard one needs to meet.

Mechanisms of Influenza A Virus Replication and Implication to New Drug Discoveries

Supervisor:	HUANG Xuhui / CHEM	Co-supervisor:	CHEUNG Pak Hang Peter / CBE
Student:	LEONG Ho Ki / CBME	Course:	UROP1100, Summer

To uncover their properties, proteins must be isolated in sufficient amounts. This process involves many experimental steps, including protein purification, obtaining a protein of interest from the heterogeneous proteome of the cell; protein identification, confirming the success of purifying the protein; and protein quantification, assigning a concentration value to the protein purified. Affinity column chromatography, polyacrylamide gel casting, and a BCA protein assay were carried out in full or at least in part over the past month on yeast proteins. Only one of two affinity column chromatography experiments showed promising results; the polyacrylamide gel failed to solidify; and the BCA assay failed to quantify a significant concentration of yeast protein. Lessons learned from these failures are delineated in the discussion.

Modeling Protein-ligand Interactions Using Docking and Other Computational Tools

Supervisor:	HUANG Xuhui / CHEM		
Student:	CHEN Rui / CHEM	Course:	UROP1100, Summer

To reveal and have a deep understanding of the AIE mechanism, we investigated the influences of substituent groups of TPE and its derivatives on AIE efficiency through the combined quantum mechanical and molecular mechanical simulations. Under a series of calculations at the TD-DFT method, we optimized the equilibrium geometric structures of these molecules from the ground state S_0 to the excited state S_1 and obtained the frequencies in both of the gas phase and solid phase. It's found that the rotation of dihedral angles dominates the nonradiative deactivation for TPE

and its derivative. TPE and its derivatives with small intramolecular hindrance are predicted to be AIE active theoretically. The final result supports the Restriction of Intramolecular Rotation (RIR) mechanism and paves a way for rational design of new AIE luminogens.

Modeling Protein-ligand Interactions Using Docking and Other Computational Tools

Supervisor: HUANG Xuhui / CHEM
Student: CHUA Wan Zhen / PHYS-IRE Course: UROP2100, Fall

PSII (Photosystem II) is the region where photosynthesis is initiated through the absorption of light and charge separation at the reaction center PSII binds with light harvesting complexes (LHCII) to form PSII supercomplexes. The supercomplex consists of a LHCII trimer, two monomers (CP26 and CP29) and a core complex. The light harvesting step is initiated at the core complex, which has a dimer structure and contains antenna proteins. The core complex consists of four large intrinsic subunits (D1, D2, CP43 and CP47), four extrinsic subunits (PsbO, PsbP, PsbQ and PsbTn) and twelve low-molecular mass-spanning subunits. PSII would extract electrons from the water molecules through a reaction catalyzed by the Mn4CaO5 cluster. The antenna complexes in the PSII absorb light energy and transmit it to the reaction center for charge separation in P680. The low molecular mass spanning subunits perform several functions, including dimerization of the core complex, stabilization of the core, mediating the association of peripheral antenna complexes with core complexes and to protect the PSII from photodamage.

Modeling Protein-ligand Interactions Using Docking and Other Computational Tools

Supervisor: HUANG Xuhui / CHEM
Student: NG Wai Pan / CHEM-IRE Course: UROP1000, Summer

Molecular docking enables researchers to accomplish structured-based drug design by docking the ligands into specific pockets of the target receptor protein. Some commercial docking programs have been developed by research institutes and groups in order to predict the best-fit conformation of ligand at the receptor's binding site by evaluating scoring functions. However, during the research experience, a non-commercial software AutoDock Vina is used for rational design of drugs.

Synthesis and Reactivity of Transition Metal Nitrido Complexes

Supervisor: LEUNG Wa Hung / CHEM
Student: LEI Chin Wang / CHEM-IRE Course: UROP1100, Fall

Having various applications, nitrido compounds and its transition metal complexes is one of the interested topics. It can be useful in material science (Greenwood & Earnshaw). Maleonitriledithiolate (mnt) and Toluenedithiolate (tdt^{2-}) and was also popular for quite a while due to their special electronic property. Here we use Tetrachloronitrido ruthenate ($RuNCl_4$-) and the ligand mnt^{2-} / tdt^{2-} to synthesize the $Ru(N)(mnt)_2$ complex and the $Ru(N)(tdt)_2$ complex

(Figure 1). (Gray, 2011) It will be further tested its reactivity with other ligands and bases. Afterwards, we will try out other transition metals instead of Ruthenium to form new nitrido complexes.

Synthesis and Reactivity of Transition Metal Nitrido Complexes

Supervisor: LEUNG Wa Hung / CHEM
Student: TSE Yuen Wah / CHEM-IRE Course: UROP1100, Fall

High-valent oxo-metal complexes are involved in important chemical process of selective catalytic oxidation. Through radical reactions of oxo-metal complexes, oxidation of strong C-H bonds in organic compounds is made possible. In some biological species, oxo-metal complexes play an important role in reproducing the ability of certain types of enzymes to oxidize harmful chemicals to harmless substances. In this report, the preparation and the catalytic activity of $Fe^{IV}TPPS(\mu\text{-}N)Ru^{IV}Cl_2L_{OEt}$ will be studied, characterized by ultraviolet-visible and by infrared absorption. It exhibits a high activity for transfer of oxygen atom towards hydrocarbons, including ethylbenzene. These findings provide potential alternative methods for environmentally friendly oxidation process, in particular the transformation of strong C-H bonds.

Development of Asymmetric Reactions

Supervisor: SUN Jianwei / CHEM
Student: HAN Yaodong / CHEM Course: UROP1100, Spring

Chiral amine is a very commonly found subunit in biological system and pharmaceutical drugs, and it is important to the total synthesis of natural products as well. Though a lot of work has been done to discover new methods of effectively synthesizing chiral amine, the effective asymmetric addition of nitrogen-based nucleophile to *ortho*-quinone methides has not yet been reported. This report shows a more efficient way to synthesize chiral amine from *ortho*-quinone methides using chiral phosphoric acid catalyst. The reaction is compatible of a range of different substituents and generates products with good to excellent enantioselectivity that could be further modified and used in many other areas as well.

Design and Synthesis of Functional AIE luminogens and Exploration of their Biological Applications

Supervisor: TANG Benzhong / CHEM
Student: CHEN Rui / CHEM Course: UROP1100, Fall

Aggregation-Induced Emission, AIE, is nowadays an extended worldwide phenomenon that has allowed to effectively use organic molecules in many important research fronts. Many AIE luminogens (AIEgens) have been built by using the well-known Tetraphenylethene TPE. However, the investigation of a new scaffold can be very important for building new promising AIE active molecules. In this study, an innovative AIEgen, Tetrathienyletehene TTE with thiophene rings instead of phenyl ones, has been synthesized and for the first time its chemosensitivity has been

investigated and compared to another new AIE luminogen featured by four furan rings linked to the double bond. The study here reported has allowed us to acquire the basic knowledge on organic synthesis and photoluminescence as well as get into the fantastic world of Aggregation-Induced Emission phenomenon.

Design and Synthesis of Functional AIE luminogens and Exploration of their Biological Applications

Supervisor: TANG Benzhong / CHEM
Student: DENG Weisi / CHEM Course: UROP2100, Fall

The area of self-healing polymer has attracted much attention from scientists as the automatic expansion of useful lifespan improves the reliability of the mechanical component and helps to avoid unnecessary waste of resources. Self-reporting is also a hot topic drawing many interests. Herein we review one photoactivated self-healing method and light-assisting detection of fracture. Then we explore the possibility to combine these two functions in a single reaction by involving TPE derivative in self-healing process based on living free radical polymerization.

Development of Fluorescent Bioprobes with Aggregation-induced Emission Characteristic

Supervisor: TANG Benzhong / CHEM Co-supervisor: SUNG Hoi Pang / CHEM
Student: BAE Yeo Jin / CHEM Course: UROP1000, Summer

Light is a very important source of life and it is crucial to understand the mechanism of it. In 2001, Professor Tang and his colleagues discovered a new scientific concept of light, which is known as the Aggregation-Induced Emission (AIE). This paper explored some basic working principles of this phenomenon and evaluated some of its applications in biomedical research such as detecting cancerous cells and pH of certain regions of a cell. Furthermore, some experiments (cell imaging) were conducted with AIE probes and cells which facilitated the deeper understanding about the mechanism of AIE phenomenon and its biological applications.

Making Valuable Organic Molecules with Green Chemistry

Supervisor: TONG Rongbiao / CHEM
Student: LAM Tak On / CHEM-IRE Course: UROP1100, Summer

This report documents the progress of the synthesis of the aldehyde 10 starting from (+)- Sclareolide. The synthesis is based on previous work done by the RTong Lab.

Making Valuable Organic Molecules with Green Chemistry

Supervisor: TONG Rongbiao / CHEM
Student: LEE Seungyeon / CHEM Course: UROP1100, Summer

The Wharton reductive reaction has a potential in 1, 3-transposition of allylic alcohol which can be versatile in organic synthesis. The traditional method of the Wharton reaction was to use hydrazine, acetic acid and methanol. However, acetic acid might reduce the product yield. In this paper, the new method except for acids was discussed to determine the efficiency and the effectiveness in limited examples with small molecules. In the new method, different solvent, hexafloroisopropanol was used to avoid acids, and six hydrazine derivatives were tested with HFIP. This research is aimed to find the most efficient hydrazine reagent in HFIP and the product yield compared with the traditional method. Among six hydrazine derivatives, hydrazine monohydrate was the most efficient and commercially available reagent with high yield for the new method. The product yield was calculated with internal standard, CH_2Br_2 for proton NMR.

Making Valuable Organic Molecules with Green Chemistry

Supervisor: TONG Rongbiao / CHEM

Student: WEN Chi Ho Ethan / CHEM Course: UROP1100, Spring

Nitrile oxide has been generally used as a 1,3-dipole to generate five-membered heterocycles via 1,3-dipolar cycloadditions. Hydroximoyl chloride has been a viable precursor for the relatively unstable nitrile oxide. A new method of catalytic chlorination of aldoxime would be using potassium peroxomonosulfate (oxone) and sodium chloride. Cinnamaldehyde oxime is used as a model substrate for optimisation of reaction conditions. In optimised conditions, the reaction finally achieved around 85-93% yield. More study has to be done to further optimise the conditions for alkane substituted aldoximes.

Division of Life Science

Molecular Regulation of Muscle Stem Cell Quiescence by Non-coding RNAs

Supervisor:	CHEUNG Tom / LIFS		
Student:	URIP Brian Anugerah / BIOT	Course:	UROP1100, Spring

The fate of each cell having identical genetic information is controlled at the epigenetic level. In muscle stem cells, or satellite cells (SCs), the knowledge for the association of the epigenome and their abilities to be quiescent, activated, or differentiated is still limited. This report studied a histone modification trimethylation of histone H3 at Lys27 (H3K27me3), that is known to be associated with transcriptional repression. Muscle fibers were directly stained after isolation (Day 0) or cultured for 48 hours (Day 2) then stained. The collected data showed the expression of H3K27me3 had no effect on Pax7 expression for Day 0 fibers and MyoD expression for Day 2 fibers. It also showed a consistent percentage of expression of the trimethylation among the fiber-associated satellite cells in both Day 0 and Day 2 fibers.

Molecular Regulation of Muscle Stem Cell Quiescence by Non-coding RNAs

Supervisor:	CHEUNG Tom / LIFS		
Student:	YEUNG Chun Kit / BIOT	Course:	UROP1100, Fall UROP2100, Spring

Cytoplasmic polyadenylation element protein (CPEB) has been suggested to be related to the gene activation and quiescence through mRNA activation and silencing observed in oocyte model, with CPEB family of CPEB 1, 2, 3, 4 for the vertebrates (Ivshina, Lasko, & Richter, 2014). CPEB moderates the translation with the help of various proteins components, of which they work together to control the mRNA translation in the cell. In this experiment, we wanted to investigate and prove the effects of the CEPBs, of which CPEB4 was knocked down in our experiment.

Control of Cell Number in the Brain

Supervisor:	HERRUP Karl / LIFS	Co-Supervisor:	HUNG Siu Chun / LIFS
Student:	ERESTA JAYA Luna / BIOT	Course:	UROP1100, Spring UROP2100, Summer
	LI Tak Sui / BCB	Course:	UROP1100, Fall UROP2100, Spring UROP3100, Summer

A new protocol of immunostaining has been formulated and the sampling method has been reexamined this semester. It is now possible to achieve immunostained sample with crystal clear background and sharp signal by using lower concentration of antibody and longer incubation period. Also, it has been observed that aliquoting 100 µl samples into eppendorf before loading onto hemocytometer can significantly make the nuclei density shifted.

Therefore, it is vital to recount the sample directly from the stock homogenate in order to get new sets of data to make sure the data obtained is indeed homogenised. Last but not least, the setting of ImageJ, especially brightness, has a significant effect on the estimation of NeuN, it is required to be optimised to suit the varying brightness of samples.

Control of Cell Number in the Brain

Supervisor:	HERRUP Karl / LIFS	Co-Supervisor:	HUNG Siu Chun / LIFS
Student:	LEUNG Hiu Yu Cherie / BCB-IRE	Course:	UROP1100, Fall

In this project, mouse was used as model organism to further study how mammals control the cell number in the brain during development; whether it is mainly controlled by cell lineage related intrinsic properties or influenced by extrinsic factors, and whether the developmental process is similar in different regions of brain i.e. cerebellum and cerebrum. Estimation of the cell number in 10 mice cerebrum was done using isotropic fractionator coupled with antibody stain against different neuron-specific transcription factors, followed by fluorescent microscopy. Statistical analysis shows the total number of cells in the right cortices is significantly different between the 2 sexes. Little difference in composition was found between right and left cortices regardless of the cell type studied.

Biochemical Characterization of Histone Variants and Post-translationally Modified Nucleosomes

Supervisor:	ISHIBASHI Toyotaka / LIFS		
Student:	SIU Ho Ping / BIOT	Course:	UROP1100, Spring

Throughout the semester, efforts had been made to express histone protein H4G using recombinant DNA technology with bacterial host Escherichia coli and several biochemical and molecular methods involved in production of targeted protein had been practiced. During the course, three different plasmid vectors had been employed to identify which was able to produce the desired protein. At the end of the investigation, H4G had been successfully expressed utilizing plasmid vector pGEX and bacterial host *E. coli* strain BL21 (DE3) codon plus and purified by affinity chromatography using glutathione sepharose 4B to specifically bind to and retain the fusion protein while impurities were separated.

Understanding the Key Elements of Nucleosome/Chromatin Dynamics

Supervisor:	ISHIBASHI Toyotaka / LIFS		
Student:	PWINT Phyu Win / BCB	Course:	UROP1000, Summer

Mitochondria are organelles which have vital role in numerous cellular functions of eukaryotic cells. They are the mechanisms for transcription and protein synthesis. They replicate independently from the cell, and have their own genomic DNA. In contrast with the genomic DNA of the nucleus, that of mitochondria does not have nucleosomes, and so, is covered by transcription factors. Thus, transcription regulation by transcription factors is more important in

mitochondria. Mitochondrial transcription is regulated by several transcription factors including mitochondrial ribosomal protein L12 (MRPL12), which is one subunit of mitochondrial ribosome which synthesize proteins from RNA in mitochondria. MRPL12 is reported to interact with mitochondrial RNA polymerase (mtRNAP) directly, and enhance transcription elongation. However, the detail effects of the factor in transcription are unknown. In this study, MRPL12 is cloned and extracted to characterize and quantify its effects in mitochondrial transcription using biochemical and single-molecule optical tweezers.

Understanding the Key Elements of Nucleosome/Chromatin Dynamics

Supervisor: ISHIBASHI Toyotaka / LIFS
Student: SIU Ming Shing / BCB-IRE Course: UROP1000, Summer

Mammalian spermatogenesis involves massive epigenetic reprogramming. Recent advances have provided ample evidence that testis-/sperm-specific histone variants are involved in the reprogramming process and suggested their potential roles in epigenetic inheritance. Interestingly, they appear to localize on specific genomic loci, which infer specific functions in remodeling chromatin three-dimensional structure. In this study, I present the evidence for suggesting novel histone variant H2BFM as a testis-specific histone variant., I have also purified the H2BFM recombinant protein for biochemical and biophysical characterization in order to simulate the process of replacement of canonical histone with histone variants during the germ line maturation and analyze the influence of histone variant replacement in the nucleosomal stability.

Proteomics Approach to Decipher Gravity Signaling in a Flowering Model Plant

Supervisor: LI Ning / LIFS
Student: CHAN Shiu Kai / BCB-IRE Course: UROP1100, Summer

The development of digital phenotyping involves automation and going three-dimensional. Somehow with reference to one or more external sources, automation is related to the use of computer software applications analysing images, while going three-dimensional can involve three-dimensional “reconstruction from” two-dimensional images. Thigmomorphogenesis is related to phenotyping. Somehow with reference to one or more researches, genes are somehow suggested to be involved in the generation of responses, and it can be thought of to be for environmental adaptation. In this experiment, the response of five mutants and one wild type of Arabidopsis thaliana to touch was investigated, making use of two-dimensional imaging and automated image processing.

Proteomics Approach to Decipher Gravity Signaling in a Flowering Model Plant

Supervisor: LI Ning / LIFS
Student: KO Cheuk Kei / BCB Course: UROP2100, Fall
UROP3100, Spring

In this project, we wanted to identify the genes in Arabidopsis thaliana (Col-0) related to cold sensing. A set of 14 Arabidopsis genes which exhibited signaling potential were selected. Seeds of tDNA insertion lines targeting these 14 genes were bought from *tair*. The first part of the project was to select for pure line seeds from each tDNA insertion line. Currently, 2 of the 14 insertion lines were chosen for pure line selection. Pure lines were found in one of them but not in the other. Next semester, our project will commence with the remaining tDNA insertion lines. After that, pure line seeds will be tested whether they could respond to cold induction. Details will be discussed later.

Proteomics Approach to Decipher Gravity Signaling in a Flowering Model Plant

Supervisor: LI Ning / LIFS
Student: RICE Keira Lee / BIOT Course: UROP1100, Spring

Whilst the transcriptome of the cold response is well studied, the primary thermosensing element of plants remains ambiguous. This progress report reflects a portion of the ongoing study to uncover cold sensing in Arabidopsis. Genotyping using PCR and gel electrophoresis was used to identify homozygous mutants that are potentially defective in a gene encoding the primary sensing element of cold. Of the two lines that were analyzed in this study, seeds of SALK_069962C emerged as pure lines; whereas the results of SALK_061141 reveal all wild type plants thus far. Prior to the discovery of any thermosensors, more genotyping experiments need to be conducted with the remaining seeds and mutant lines.

Proteomics Approach to Decipher Gravity Signaling in a Flowering Model Plant

Supervisor: LI Ning / LIFS
Student: SEO Heukjin / BCB Course: UROP2100, Fall
UROP3100, Spring

Plants are known to respond to stimulations of their environments. Change in morphology of plants due to mechanical stress is termed ‘thigmomorphogenesis’. In order to reproduce natural thigmomorphogenesis in the laboratory, plants were blown regularly with an air blower and the physiologies of treated and untreated plants were observed and compared.

Wild type Arabidopsis was selected as the model flowering plants and grown for about one week. When plants were germinated, one group of plants were blown with a hair dryer three times a day for 40 seconds and the other group of plants were blown four times a day for 40 seconds and another group of plants were untreated. 3 weeks after, physiologies of all three groups were observed and compared.

The time required for plants to develop flowering stems longer than 1cm was chosen to be the observed physiology. The result was that the untreated group of plants has bolted about one full day earlier than both treated groups of plants on average. This result was shown to be significant with student’s t-test analysis. From the result, it can be hypothesized that the air treatments mimicked natural wind and artificially caused thigmomorphogenesis of model

plants in controlled environment.

DNA Replication-initiation Proteins in Budding Yeast

Supervisor: LIANG Chun / LIFS
Student: KONG Deyue / BISC Course: UROP1000, Summer

Nucleolar complex associated protein 3 (Noc3) plays a crucial role in DNA replication initiation. Fully elucidating the role and function of this protein will enhance our understanding of DNA replication and lay the foundation for further application in cancer-related treatment. It is hypothesised that Noc3p (which is continuously bound to the chromatin throughout the cell cycle) dimerizes in G1 phase of the cell cycle enabling pre-RC formation. To verify this hypothesis, wild type yeast cells were transformed with plasmid pESC-HIS- Noc3 x 2, and Co-Immunoprecipitation Assay was carried out on protein extraction of the cells to check the cell cycle dependent self-interaction of Noc3. The result of Co-IP indicates that Noc3 dimer only exists in G1 phase but not in S phase or M phase. This result confirmed the Noc3 dimer hypothesis mentioned above.

DNA Replication-initiation Proteins in Budding Yeast

Supervisor: LIANG Chun / LIFS
Student: YE Ziyun / BCB Course: UROP2100, Fall
UROP3100, Spring

Origin Recognition Complex (ORC) is one of the most important protein complexes related to the initiation of the DNA replication. Therefore, the study on ORC can improve the understanding of the DNA replication and cell cycle progression which may have many potential applications such as cancer therapy. We hypothesize the ORC dimerization model which suggests that the single ORC hexamer binds to the chromatin all the time and a second ORC is loaded in G1 phase to initiate the DNA replication. In this experiment, protein complexes containing Orc3p were separated in G1 and M phase by the sucrose gradient centrifugation. The results of both WT303-1A strain and cdc6-1 strain showed that double ORC hexamer only exists in G1 phase but single ORC hexamer exists in both G1 and M phase. Therefore, this experiment provided an evidence to the ORC dimerization model.

DNA Replication-initiation Proteins in Budding Yeast

Supervisor: LIANG Chun / LIFS
Student: FAN Wing Chak / BCB Course: UROP1000, Summer
YUEN Ka Wing Gary / BIOT UROP1000, Summer

Under the supervision of Professor Liang Chun and PhD student Cheung Man Hei Marco, our study examines the effect of different concentration of M2 to the DNA replication of survived human cell line HeLa cell after one treatment of M2. The aim of this experiment is the select the HeLa cell that can survive the treatment of M2 from the whole population and find out what leads to the drug resistance that might help understanding the mechanism

of this drug. This study examines two aspect of DNA replication of HeLa cell, the amount of pre-replication complex and the cell cycle distribution of HeLa cell using western blotting and flow cytometry respectively. The result shows that the survived HeLa cell has a decreasing amount of MCM as the concentration of M2 used increase. Overall, the results showed that the M2 have a significant effect to interrupt the the DNA replication of HeLa cell which is very important to the drug development of cancer drug.

DNA Replication-initiation Proteins in Budding Yeast

Supervisor: LIANG Chun / LIFS
Student: CHOY To To / BCB Course: UROP1000, Summer

The cell cycle and ciliogenesis have a great relationship between them. Cilia usually start growing in G0/G1 phase in the cell cycle, which is the arrest growing stage of a cell. Serum is important for growth of cell in the cell cycle as it provide both the materials and hormones. Not enough or no supply of serum would lead to the entering of G0 phase of cell and ciliogenesis started, cilia formation would be induced. The human lung cancer cells, A549 cells, are used to test and show that the serum starvation provided by culturing cells with medium without FBS would induce the assemble of cilia in human lung cancer cell.

Mechanisms of Lung Cancer Metastasis

Supervisor: LIANG Chun / LIFS
Student: CHEN Zhuojian / BISC Course: UROP1000, Summer

MicroRNA (miRNA) is a kind of non-coding RNA which can regulate gene expression in cell. MicroRNA can bind mRNA and cause mRNA degradation or inhibition according the bases' similarity between miRNA and the target mRNA. Now we find that miRNA-495-3p and miRNA-370-3p have negative effect on MCM2 expression. MCM2 is a member of MCMs and MCMs are the primary control factors eukaryotes DNA duplication. The overexpression of MCM2 strongly relates to cancer cells' proliferation. The goal of this research is to find some kinds of miRNA which can inhibit MCM2 expression so that we can further explore their ability that inhibit cancer cell proliferation.

Water Quality Survey for Hong Kong's Marine Fish Farming Zone

Supervisor: LIU Hongbin / LIFS Co-supervisor: LAU Wing Keung / LIFS
Student: CHOW Tsz Ting / BCB Course: UROP1000, Summer

Water quality is important for conserving fish industry. The Agriculture, Fishers and Conservation Department (AFCD) conducted monthly water quality survey on 29 fish culture zones with HKUST, monitoring the parameters. Water samples collected were analysed in laboratory for data of suspended solid, chlorophyll-a and nutrients. Nutrients are the focus of this report. The data are analysed by Skalar autoanalyser (San Plus) by method equivalent to USEPA. Average values of nitrogen oxides, ammonia, phosphate, and silicate in five biweekly monitored stations in April to

June 2017 were presented with table and graphs. A brief discussion on seasonal and regional effect on concentration of nutrient was included.

Water Quality Survey for Hong Kong's Marine Fish Farming Zone

Supervisor:	LIU Hongbin / LIFS	Co-supervisor:	LAU Wing Keung / LIFS
Student:	LAM Chun Man / BISC	Course:	UROP1000, Summer

There are different kinds of phytoplankton living in the seawater, which is of paramount importance of contributing marine biodiversity. Different microorganisms feed on bacteria or other inorganic materials in the seawater in order to sustain their lives. Through the measurement of different parameters of the seawater, a more in-depth reasoning behind the fluctuating number of phytoplankton can be more easily figured out. The water quality of Hong Kong's Marine Fish Farming Zone depends on the environmental effect as well as human activity (Novotny V, 1994), thus through the sampling of seawater and the laboratory work of measuring a variety of parameters, the water quality of Hong Kong's Marine Fish Farming Zone can be evaluated.

The Rules of Packaging Fat in Cells

Supervisor:	MAK Ho Yi / LIFS		
Student:	YUN Sangeun / BISC	Course:	UROP1000, Summer

Seipin, a membrane protein of the endoplasmic reticulum (ER), has been found to cluster around lipid droplets (LDs). Though its detailed functions remain unclear, it is evident that mutations in BSCL2/seipin result in congenital generalized lipodystrophy (CGL). To deeply understand the protein's function and its link to LDs, Caenorhabditis elegans (C. elegans) is used for mutagenesis and transgenesis. The aim of this project is to generate additional fluorescent protein markers that label LDs, in order to further characterize the spatial relationship between LDs and seipin-associated ER domain. To this end, I attempted to generate a recombinant DNA construct that would allow the expression of Perilipin1, which coats the LDs, with Blue Fluorescent Protein (BFP) as its fusion partner. I first review C. elegans' development and research use, and then shift the focus to the project procedure and result.

An Exploration of Nuclear Dynamics in Cells and Syncytia of Developing Zebrafish Embryos

Supervisor:	MILLER Andrew L / LIFS	Co-supervisor:	HO Sarah E / LIFS
Student:	DOROTHEA Mike / BIOT	Course:	UROP1100, Spring

Calcium signaling is an important secondary messenger which controls the activation of cellular programs during development of neural cells from neural stem cells. To investigate the intracellular calcium signaling in neural stem cells, adult zebrafish neural stem cells at two different stages of neurogenesis (P5 and D7) were used as a model for studying the calcium signal upon the activation of IP_3R or RyR by ATP or caffeine. Fluo4-AM intracellular calcium indicator was used to visualize the intracellular concentration of calcium. Regardless of the stage of neurogenesis,

two types of calcium signal were identified, a signal showing a transient increase in calcium concentration then drops back to basal level and a signal that keeps increasing with a slight jump in calcium concentration upon drug administration.

Mitotic Regulators as Targets for Anticancer Therapies

Supervisor: POON Randy Yat Choi / LIFS
Student: BHARADWAJ Atulya / BCB Course: UROP1100, Fall

Cancer is a disease marked by uncontrolled cell proliferation. 3 Proteins that play an important role in regulating the cell cycle- CDK1, CDK2 and MASTL - were chosen to study their potential role in cancer development. The genes encoding these proteins were fused with the AID tag to enable their inducible degradation on treatment with auxin. This report will focus on the first phase of the project – which is to establish stable Hela (HtTA1) cell lines and isolate single colonies each expressing TIR1 and one of the 3 fusion proteins AID-CDK1, AID-CDK2 and AID-MASTL with inducible degradation of these fusion proteins in response to treatment with Dox and IAA. These single colonies will be used in subsequent research projects to investigate the role of these 3 key proteins in the regulation of the cell cycle. We were successful in identifying single colonies which expressed both AID-MASTL and TIR1, whose function will be studied in future experiments.

Mitotic Regulators as Targets for Anticancer Therapies

Supervisor: POON Randy Yat Choi / LIFS
Student: FUNG Chun Wing / BCB Course: UROP1100, Spring

In this research project, conditional knockout of cyclin dependent kinase 1 and 2 (CDK1 and CDK2) in human cervical cancer cells, i.e. HeLa cells, were created by using the clustered regularly interspaced short-palindromic repeats /CRISPR-associate protein-9 nuclease (CRISPR/Cas9) system together with auxin-inducible degron (AID) technology. The CRISPR/Cas9 system adopted in this study could specifically disrupt endogenous *CDK1* or *CDK2* expression, whereas the exogenous AID-tagged *CDK1* or *CDK2* cDNA in HeLa cells can complement the expression of respective genes and maintain cell viability. After infecting these cell lines with protein transport inhibitor response 1 (TIR-1), the encoded AID-CDK1 and AID-CDK2 could be degraded rapidly by the addition of indole-3-acetic acid and doxycycline (IAA/Dox) in the cell culture. At this stage, conditional knockout cell lines have been established. These cell lines can be used in the future to study the molecular functions of CDK1 and CDK2.

Targeting Mitotic Regulators in Cancer Cells for Potential Treatment

Supervisor: POON Randy Yat Choi / LIFS
Student: CHU Siu Ki / BICH Course: UROP1100, Summer

Cell division cycle requires several proteins in order to maintain its accuracy during replication of genetic information.

Cyclin-dependent kinase 2 (CDK2) is known to be one of the most important protein kinases for cell cycle control. In this project, CDK2 was knocked out in HeLa cells using CRISPR-Cas9. As CDK2 is expected to be an essential gene, a degron-tagged CDK2 was also introduced to the CDK2-depleted cells. Auxin was then added to induce the degradation of the degron-tagged CDK2 to generate CDK2 knockout cells. Western blotting and flow cytometry were then performed to examine the effects of the loss of CDK2. Interestingly, I found that HeLa cell could still grow normally without CDK2. Most of the cell cycle regulators, including cyclin A, E, and B did not alter significantly in the absence of CDK2. More experiments will be performed in the future to elucidate the mechanisms leading to the compensation of the functions of CDK2.

Investigating Microtubule Regulation during Cell Proliferation, Migration and Morphogenesis

Supervisor:	QI Robert Zhong / LIFS		
Student:	TAM Man Yee / BCB-IRE	Course:	UROP1000, Summer

Microtubules, composed of α/β-tubulin heterodimers, are a major cytoskeleton that plays an important role in mechanical support, intracellular material transport, and mitosis. Microtubules are nucleated by γ-tubulin ring complexes (γ-TuRCs) at microtubule-organizing centers (MTOCs), such as centrosomes. CDK5RAP2, a centrosomal protein that regulates microtubule nucleation, not only recruits γ-TuRCs to centrosomes, but also activates γ-TuRCs to initiate microtubule nucleation. In this study, chimeric proteins consisting of the γ-TuRC-binding motif of CDK5RAP2 and the mitochondria-targeting motif, TOM20, have been generated by molecular cloning for examining the microtubule nucleating-activity of γ-TuRCs that are targeted to mitochondria. It is shown that γ-TuRCs recruited to mitochondria by the chimeric proteins can initiate microtubule nucleation.

Development of Advanced Controlled Release System for Natural Product based Antifoulants

Supervisor:	QIAN Peiyuan / LIFS	Co-supervisor:	MA Chunfeng / LIFS
Student:	LAM Wai Yun / CHEM	Course:	UROP3100, Fall

Monitoring the releasing rate of antifoulant is crucial in application since it is highly related to the efficiency in antifouling action. If the releasing rate is too high, it will cause the unsustainability of antifoulant. While if it is too low, the low concentration of antifoulant cannot reach the effective dosage to kill the biofouling species. The optimum releasing rate needs to be found by coupling the antifoulant with different polymers. In this investigation, two polymers, polycaprolactone based polyurethane (PCL-PU) and polycaprolactone based polyurethane/rosin (PCL-PU/rosin), are focus to study the releasing rate. Throughout the investigation, polycaprolactone based polyurethane/rosin (PCL-PU/rosin) had better control in releasing rate of antifoulnt and the releasing rate can remain higher than that of polycaprolactone based polyurethane (PCL-PU). This shows the PCL-PU/rosin is more suitable for the use in field with the antifoulant.

Metatranscriptome Analysis of Microbial Communities in Natural Biofilms for the Larval Settlement of a Major Fouling Organism in Hong Kong Waters

Supervisor: QIAN Peiyuan / LIFS

Student:	MAN Ka Ho / BIBU	Course:	UROP1000, Summer
	TAM Chun Kit / ENVS		UROP1100, Summer

This study focuses on examining the effect of man-made materials on biofilm development in marine surface waters. Biofilms were developed on various man-made materials in a subtidal region of the Port Shelter (牛尾海), where nearby water samples were also collected. By using microscopic and metagenomic analyses, we will be able to compare the similarities and differences in taxonomic compositions and genomic functions between the bacterial communities developed on different engineering materials and also their planktonic forms.

Metatranscriptome Analysis of Microbial Communities in Natural Biofilms for the Larval Settlement of a Major Fouling Organism in Hong Kong Waters

Supervisor: QIAN Peiyuan / LIFS

Student:	PEI Bite / CHEM	Course:	UROP1000, Summer

Psychromonas arctica sp. nov. is a cold-adapted micro-organism, and we reckon that the formation of biofilm has an effect on its cold-tolerance characteristic. Therefore, we plan to use transcriptomics and other molecular techniques such as gene mutation to study its cold adaptive mechanisms and the relationship between cold adaptation and biofilm formation. Gene expression levels of this bacterium grown at different temperatures at biofilm and free-living states will be compared. Specifically, the bacterium will be cultured under three different temperatures, 4°C, 12°C and 20°C，both in free-living and gregarious state. Physical properties such as growth curves will be characterized first, following RNA extraction and transcriptomic sequencing and analysis. After we locate the specific gene which has the decisive role on its cold-tolerance ability, further researches such as knocking out the gene will be further performed.

Metatranscriptome Analysis of Microbial Communities in Natural Biofilms for the Larval Settlement of a Major Fouling Organism in Hong Kong Waters

Supervisor: QIAN Peiyuan / LIFS

Student:	WU Wei / BCB	Course:	UROP1100, Fall
			UROP2100, Spring
	YANG Xin / BCB		UROP1100, Fall
			UROP2100, Spring

Pseudomonas Aeruginosais a Gram-negative bacterium that is one of the common components of biofilm. It can easily initiate and trigger the formation of biofilm and it can also mutate in different living conditions rapidly thus has relatively high resistance to different antibiotics in several generations. Therefore, studies regarding the specific reaction mechanism of repression effect of different antibiotics and their derivatives on this bacterium have been

carried out with important indications of the control strategies and further implications. We have participated in the research on investigation of *Pseudomonas Aeruginosa* cultured with minimum inhibitory concentration of *Amikacin*, *Colistin* as well as *Gentamicin*, respectively. To find out the specific minimum inhibitory concentration of each of the antibiotics, a series of preliminary experiment sand repeat were done. DNA extraction of samples cultured in minimum inhibitory concentration were collected and sent to company for detecting DNA methylation and would be compared with wild type. Similarly, both the whole proteome and immune-precipitation proteome of the samples were collected and run in mass spectrometer and would be compared with wild type. Investigation of difference between wild type and these samples may indicate some possible specific reaction mechanism between different antibiotics and *Pseudomonas Aeruginosa* thus more experiment can be done to verify the result and further application of antibiotic drugs could be carried base on the result.

Computational Study of Long Noncoding RNAs in Cancer

Supervisor: WANG Jiguang / LIFS
Student: SHI Hongyu / BCB Course: UROP1000, Summer

Glioblastoma (GBM) is one of the most aggressive cancers derived in the brain. Though treatment could extend patients' survival period, GBM usually recurs after treatment. To explore the role of long non-coding RNAs (lncRNA) in the process of resistance towards treatment in GBM, a new computational strategy was applied to assembly non-coding transcriptome from longitudinal RNA sequencing data. Differential analysis on lncRNA expression was carried out between matched initial and recurrent tumors to detect lncRNAs that may contribute to treatment failure. Transcripts from 12399 novel loci and differentially expressed lncRNAs were identified, yet further investigation is still required to validate their existence and clarify their functions.

Study of Blood Cell Development using Zebrafish Model

Supervisor: WEN Zilong / LIFS
Student: HASSAN Shaoli / BCB Course: UROP1100, Fall
UROP2100, Spring
UROP3100, Summer

Disorders associated with hematopoiesis are highly prevalent in the society. In order to enrich our understanding of these disorders, the different stages in the development and migration of blood cells must be studied. The zebrafish is extensively used as a powerful model organism in these studies, with its csf1r pathway often being analyzed. This pathway plays a key role in the immune response and bears significant importance in the development of macrophages. It involves three ligands in zebrafish – namely csf1a, csf1b and il34. *Csf1a* and *csf1b* are likely to be paralogues. This report describes in detail the attempts taken to characterize the functional diversification of the three ligands. Neither of the ligands have any function in the development of macrophages, but *il34* plays a role in the development of microglia. *Csf1a* mutants were observed to have defects in the migration of neural crest derived cells while *csf1b* mutants were observed to possess traits of abnormal differentiation of these cells.

Big Data: Bioinformatic Analysis of Single-cell Genomic Data

Supervisor:	WU Angela Ruohao / LIFS	Co-supervisor:	WANG Jiguang / LIFS
Student:	WANG Tianci / COSC	Course:	UROP1100, Spring

This project is composed of two parts, namely paper study of single-cell sequencing and cancer cell analysis, and analysis of caner cell's drug sensitivity from a machine learning view. Firstly, I studied the next-generation DNA sequencing to inspect the process of single-cell sequencing, the features of several sequencing methods in markets. Meanwhile, I studied how sequencing data of cancer cells are exploited to analyze the cancer mutation.

Secondly, I researched on a series of open Kaggle challenges of drug sensitivity. I implemented and regulated several machine learning models to reveal the relation between the genomes of cells and their drug sensitivities. Furthermore, I am working on the preference ranking problem in order to resolve priorities of drug for medical use.

Human Complex Disease Genomics and Bioinformatics

Supervisor:	XUE Hong / LIFS	Co-supervisor:	LIANG Chun / LIFS
Student:	CHAN Cheuk Yin / BCB	Course:	UROP1100, Summer

Cutting edge genomic and bioinformatics technologies have played an important role in terms of determining the genetic causes of human complex diseases, such as cancers and mental disorders. In this project, inter-Alu PCR is used as pre-sequencing capture method so as to complement next-generation sequencing technologies after some steps. The reason that Alu elements could be used to facilitate genome-wide sequence amplification is they are well distributed throughout the genome. Hence, these regions could then be captured effectively along with a wide range of genome-wide sequences for analysis purpose.

Receptor based Drug Development from Chinese Herbal Medicine

Supervisor:	XUE Hong / LIFS		
Student:	MA Junwei / PHYS	Course:	UROP1100, Summer

Drug resistance is a general difficulty encountered by many cancer therapies. Wogonin, one kind of flavonoids, was found being capable to inhibit many kinds of human cancer cells. In this study, we tried many methods in vitro to verify wogonin's ability to inhibit MCF7/LCC2 cell line after prolonged wogonin treatment. Results of MTT assay suggested that prolonged treatment with wogonin will invoke a short-time resistant effect in LCC2 cells, which would resist any drug it encountered. Cell adhesion assay showed that the cell line became adapted to the stressful environment after prolonged pre-treatment with wogonin and could perform better adherent ability in small-dose environment. Morphology images indicated that cell proliferation will be inhibited by wogonin, while cell adhesion will first increase and then decrease as the drug dose increases.

School of Science

Division of Life Science

Molecular Mechanism of Cell Competition and Tumorigenesis

Supervisor: YAN Yan / LIFS

Student: LI Dazhi / BCB-IRE Course: UROP1100, Fall

Cell competition evolved as a mechanism responsible for surviving winner cells and eliminating loser cells in developing organisms, with the aim to optimize the fitness of a normally-functioned tissue. Although the mechanisms remained elusive, the recognition of unfit cells was reported connected with *Drosophila* innate immune signaling pathways in *Myc*-induced supercompetition and Minute mutation competition model. Here, we expected to similarly utilize a generic genetic screening for innate immunity genes that are relevant to *Scrib*-induced competition and checked whether an innate immunity pathway was also involved. A very commonly utilized Flp-FRT and UAS-GFP system was applied by stepwise recombination. This report is going to provide details of the project designation and the latest progress.

Department of Mathematics

Low-Rank and Sparsity Reconstruction in Data Science

Supervisor:	CAI Jianfeng / MATH	Co-Supervisor:	YE Guibo / MATH
Student:	DONG Chenyang / MAEC	Course:	UROP1100, Spring

Traditional methods for webpage mainbody extraction are mainly based on the HTML code. Due to the variety of webpage structures, there exist limitations for the compatibility of such techniques. Therefore, this study aimed to analyse the feasibility of the text positioning from the perspective of computer vision. We implemented discriminative K-SVD algorithm for the classification task. We found that when Atom Number = 52 and Support Number = 2, a F-measure of 0.8313 could be achieved. A dynamic programming approach was then proposed for positioning.

Low-Rank and Sparsity Reconstruction in Data Science

Supervisor:	CAI Jianfeng / MATH	Co-Supervisor:	YE Guibo / MATH
Student:	HE Wuxian / MATH-PMA	Course:	UROP1100, Spring

In data science, people always need to recover a set of data from some of their pairwise differences. Such problem is called joint alignment problem and when the data represent discrete values it is called discrete joint alignment problem. To solve such problem, people need to deal with the maximum likelihood estimates, which have been proved to be a nonconvex optimization. A nonconvex structure is much more Di cult and intractable than the convex case, and mathematicians have come up with various of approaches to solve it. This report will introduce and study a recently proposed method in discrete joint alignment problem and add some modifications and variations on it.

Low-Rank and Sparsity Reconstruction in Data Science

Supervisor:	CAI Jianfeng / MATH	Co-Supervisor:	YE Guibo / MATH
Student:	HOANG Do Kien / MATH-PMA	Course:	UROP1100, Fall

Abstract In this report, we study the problem of Robust Principal Component Analysis (PCA), specifically about recovering the low-rank matrix from corrupted information. By going through three papers about robust PCA: Robust Principal Component Analysis? Non-convex Robust PCA Guarantees of Riemannian Optimization for Low Rank Matrix Completion we study and give a summary on approaches and motivation of these methods, analyze the algorithms developed. On the theoretical aspect, the first paper can be applied for general problems with slightly weak conditions but giving high exaction; the next two papers look at the problem from optimizing viewpoint, so the range of problems is smaller and require some more restrictions to get smallest possible error. However, on the calculation aspect and application on *m-by-n* matrix , the methods of first paper has a running time of $O(m^2n)$ per iteration which is much slower than $O(r^2mn)$ running time of the second method. The last paper studies a more specific

problem on recovering low rank matrix from sampled entries, but it provides the effective calculation which can probably be applied to improve the algorithm of general problems. From these observations, we finally discuss some potential refinements for calculations and carry out some numerical experiments.

Low-Rank and Sparsity Reconstruction in Data Science

Supervisor:	CAI Jianfeng / MATH	Co-Supervisor:	YE Guibo / MATH
Student:	WAN Ching Pui / MATH-IRE	Course:	UROP1100, Fall

Data of high dimension is usually determined by a few major factors. Therefore, the data can be approximated by a linear combination of few basis. Data of different types, such as the text images and other images, possess different major features. By learning dictionaries for both data sets and trying to reconstruct the sample in concern, we can find out which data set our sample is more likely belonging to. This project examines this kind of approach, using K-SVD algorithm for dictionary learning, to classify texts from general images on a webpage. Regions in a webpage are traversed by a sliding window and classified by examining the errors of reconstruction from the 2 dictionaries.

Statistical Analysis in Portfolio Construction

Supervisor:	CHEN Kani / MATH		
Student:	LO Tsz Cheung / COMP	Course:	UROP1100, Spring UROP2100, Summer

In last report of UROP 1100, we provided a self-contained 4-step routine to formulate an automated and general portfolio selection process, taking the advantage of deep learning structure. Then we tried to verify and demonstrate our theory in an example of IBB Index. And finally, we concluded and put down a few ideas of potential improvement. During this summer, we revised the reference paper and, Prof. Chen provided some suggestions into this project. So, for this UROP 2100 report, we will introduce some small modifications and improvements that we have implemented into our research. Furthermore, we come up with a task list that will focus on in the following semester. After all, this is more like a progress report.

Statistical Analysis in Portfolio Construction

Supervisor:	CHEN Kani / MATH		
Student:	ZHANG Kao / MATH	Course:	UROP1100, Spring

In this report, we first try to look at the drawback of classic portfolio construction methods such Markowitz's risk-return. Then we provide a self-contained 4-step routine to formulate an automated and general portfolio selection process, taking the advantage of deep learning structure. Afterwards, we try to verify and demonstrate our theory in an example of IBB Index. And finally, we conclude and would like to put down a few ideas of potential improvement.

Geometric Flows

Supervisor: FONG Tsz Ho / MATH
Student: AU Kam Cheong / MATH Course: UROP1000, Summer

The curve-shortening flow is an important example of geometric flow for plane curves. It is governed by the equation

$$\frac{\partial F}{\partial t} = kN \quad (1)$$

where $F = (x(t); y(t))$ is the curve locus, k is the curvature and N is the inward pointing normal. The geometric significance of the equation is evident. In a paper by M. Gage and R.S. Hamilton [1], the behavior for convex curve under the curve-shortening flow is elucidated: the curve shrinks to a point as it becomes progressively rounder. This report is divided into two parts. The first part is some supplement to Section 3 and 4 of [1], where we verify the details that the authors omitted; emphasis is put on bounding the derivatives of curvatures, which I think contains many novel ideas. In the second part, I discuss some thought-provoking problem that came up during my reading of the paper.

Geometric Flows

Supervisor: FONG Tsz Ho / MATH
Student: CHOI Hong Wang / MATH-PM Course: UROP1000, Summer

The aim of this project is to further understand the paper: “The Heat equation shrinking convex plane curves” and fill in some missing detail. This paper is about the curve-shortening flow. This flow will shrink the curve and make it become circular. We will focus on section three and four of the paper. We would suggest another proof on Theorem 3.2.1 and in section four we will give brief explanation on Integral estimate and Pointwise estimate.

Geometric Flows

Supervisor: FONG Tsz Ho / MATH
Student: CHOW Tsz Kiu Aaron / MATH-PMA Course: UROP2100, Spring

In this report we will review the Riemannian Positive Mass Theorem, which concerning the relation of local energy density and the total energy of the spacetime. We will investigate this special case of the Positive Mass Theorem using the minimal surface method by Schoen and Yau.

Geometric Flows

Supervisor: FONG Tsz Ho / MATH
Student: CHOY Ka Hei / CBME Course: UROP2100, Summer

In this UROP 2100R project, Ricci flow related to time behavior of within the frame of compact, strictly Ricci positive and three-dimensional Riemannian manifold (*M*) equipped with time-varying Riemannian metric *g*(*t*) will be examined. Time profile of Riemannian Curvature and Ricci Curvature Tensors, Scalar Curvature and their gradients are also in the study. By applying time derivative and their corresponding gradients of these tensors aforementioned, the Riemannian manifold (M, g(t)) with strictly positive Ricci scalar curvature will obey the strictly Ricci positive by maximum principle of 2-tensors and become sphere globally during Ricci flow if the Ricci flow equation is rescaled by mathematical analysis.

Geometric Flows

Supervisor: FONG Tsz Ho / MATH
Student: HUNG Chun Kit / PHYS Course: UROP1100, Summer

This report reviews the paper: *The heat equation shrinking con-vex plane curve*, by M. Gage and R. S. Hamilton and implements some details for better understanding of the paper. By outlining the logic behind the paper, the useful techniques and key concepts of differential geometry have been learned, such as the application of various inequalities and maximum principle. Besides, Wirtinger's inequality has been generalized to two cases, (i) the interval with length greater than π but less than 2 π, (ii) the two endpoints gave same nonzero function values.

Geometric Flows

Supervisor: FONG Tsz Ho / MATH
Student: LI Han / MATH-PMA Course: UROP1100, Summer

In *Three*-manifolds with positive Ricci curvature, the author managed to demonstrate that every compact 3-manifold without boundary equipped with a Riemannian metric with strictly positive Ricci curvature admits a metric of constant positive curvature. This report goes over the train of thoughts, rearrange the orders of some contents, and fills in most of the details that were left out in the original paper. We will first study various curvatures at a point, then enlarge our scope to its neighbourhood (i.e., to study their gradients), and finally compare the curvatures globally. Methodogically, the Ricci flow equation is unnormalised to give a simpler expression, and a tensorial maximum principle was developed in advance to serve for the heavy needs for establishing inequalities.

Geometric Flows

Supervisor: FONG Tsz Ho / MATH
Student: WAN Jingbo / MATH-PMA Course: UROP1100, Summer

This paper aims to prove that a curve which evaluates under the heat equation will become circular and eventually a point. Due to previous effort, this paper will just discuss about whether the geometric flow will keep going before the curve shrink to a single point. To do that, in this paper, I will go through some basic background of this problem and

state some basic set-up, then I will focus on how each quantity evaluates, and finally, I will use the above results to show that the curvature function will exist before the area vanishes in order to complete my proof.

Geometric Flows

Supervisor: FONG Tsz Ho / MATH
Student: WONG Sing Lam / MATH-IRE Course: UROP1000, Summer

In this project, we mainly focus on the section 3 and 4 in the paper titled "THE HEAT EQUATION SHRINKLING CONVEX PLANE CURVES". In this report, I would try to fill in some non-trivial details in the paper. The aim of this paper is to give a proof of when convex plane curves shrinkle according to the heat equation

$$\frac{\partial F}{\partial t} = \Delta F \ \ or \ \ \frac{\partial F}{\partial t} = \kappa N$$

the courves would eventually deform to a circle. The two expressions here are equivalent to each other. To prove the results, we firstly derive different equations for the curves in the plane in section 3.1 which provide us tools to apply in the later parts. In section 3.2 authors illustrate that there will be no intersection under the process. The main ingredient of this paper is in section 4. The purpose of section 4 is firstly to transform the curve shortening problem into a problem of partial differential equation in 4.1. Section 4.2 provides a proof to show that convex curves under this curve shortening process will remain convex. Section 4.3 introduces three estimations which eventually bound the curvature from above. Section 4.4 proves that under the condition that is bounded, then we can bound all the higher derivatives for *K*. At the end of section 4, we use the previous results to conclude that the solution to the partial differential equation continues until the area finally goes to zero. The fact that we used here to reach the target is the bounding of the higher derivative of *K*. For section 5 the authors show that if we know that the area enclosed by curve goes to zero, we can know that the curve becomes circular eventually. There are two different ways to achieve this. One is using the previous results from two articles of one of the author M.Gage. Another one which is presented in detail in this paper is using the approach of showing that $\frac{K_{max}}{K_{min}}$ goes to 1 which means the curve becomes a circle. However in this report, we are not going deeply to the details of section 5.

Geometric Flows

Supervisor: FONG Tsz Ho / MATH
Student: ZHANG Shiyu / MAEC Course: UROP1100, Summer

In 1980s, Richard Hamilton devised the Ricci Flow, which was used in 2002 by Grigori Perelman to solve the 100-year long-standing Poincare Conjecture, and in 2007, Brendle and Schoen apply it to prove the Differentiable Sphere Theorem in general case. The paper THE HEAT EQUATION SHRINKING CONVEX PLANE CURVES (Gage; Hamilton, 1986) mainly discusses the two-dimensional case of Ricci Flow, i.e. the curve shortening flow, and this article aims at

displays most of the omitted steps and the technique used in session 3 and 4 of this paper.

Integro-differential Equations: Theory and Applications

Supervisor: JIN Tianling / MATH
Student: CHUNG Kam Hin / MATH-IRE Course: UROP1100, Summer

The paper deals with fractional Laplacian operator $(-\Delta)^{\alpha/2}$. First, we define the fractional Sobolev space in order for us to develop the integral representation of the fractional Laplacian operator, and show that we can reach the same result using the definition of being the multiplier of the Fourier transform. Afterwards, we want to prove that the eigenfunction and the eigenvalue is nonnegative for the standard Laplacian case. Then, we make use of the integral representation to prove that the first eigenfunction of the fractional Laplacian operator is concave for some specific exponent.

Integro-differential Equations: Theory and Applications

Supervisor: JIN Tianling / MATH
Student: YIP Chi Hoi / MATH-PMA Course: UROP1000, Summer

To study the first eigenfunction of fractional Laplacian with boundary Dirichlet condition (based on [2]), we first study properties the first eigenfunction for the standard Laplaican case and the motivation of defining fractional Laplaican via Fourier Transform and its integral representation. Then, we studied the definition and properties of Sobolev Space, weak derivative and weak solution. It is surprising that weak solutions are in fact smooth and Holder continuous. Lastly, we try to consider the superharmonicity for the first eigenfunction, we are able to understand the proof for the standard Laplaican case and $\alpha = \frac{2}{k}$ for some positive integer *k* for the fractional Laplaican case.

Efficient Algorithms for Visualizing Dynamical Systems

Supervisor: LEUNG Shing Yu / MATH
Student: DU Donghong / ELEC Course: UROP1100, Spring

Delay differential equations (DDEs) are widely used mathematic tools to model many physical phenomena. This project uses the so-called finite-time Lyapunov exponent (FTLE) to extra Lagrangian coherent structure (LCS) in dynamical systems modeled by these differential equations. This report first elaborates some basic applications of the FTLE to ordinary differential equations (ODEs) and then extends the discussion to some interesting DDE examples.

Numerical Methods for Solving PDEs on Surfaces

Supervisor: LEUNG Shing Yu / MATH

Student: LEE Young Kyu / MATH-PM Course: UROP1100, Spring

Eigenvalues and eigenfunctions of the Laplace operator and the Laplace-Beltrami operator arise in many fields in mathematics and physics. This paper demonstrates a simple numerical algorithm to compute the eigenvalues and the eigenfunctions of the Laplace operator and the Laplace-Beltrami operator. The idea is to first construct a matrix which approximates the Laplace operator or the Laplace-Beltrami operator and then compute the corresponding eigenvalues and the eigenvectors of this matrix. The algorithm works well for the Laplace operator. Further research might be required for the Laplace-Beltrami operator. The idea might also be easily generalized to other linear operators.

Financial Engineering Problems in Trading and Investment

Supervisor: PENG Xianhua / MATH

Student: YIN Lu / RMBI Course: UROP1100, Fall

ETF 50 option is the first exchange trade option and currently the only one in Maitland China. This project aims to find the arbitrage opportunity in the options market by using C++ language to do data analysis and lay the foundation for future study on developing effective strategies and building trading and investment model.

Financial Engineering Problems in Trading and Investment

Supervisor: PENG Xianhua / MATH

Student: ZHANG Kao / MATH-SF Course: UROP1100, Fall

Kiefer-Wolfowitz stochastic approximation algorithm, widely used as a technique to stochastically estimate the maximum of a stochastic function, was introduced by Kiefer. J. and J. Wolfowitz in 1952. However, it may suffer from long runtime due to fixed length of searching step. A more advanced version of Kiefer-Wolfowitz algorithm would be the Scaled-and-Shifted Kiefer-Wolfowitz (SSKW) algorithm which dynamically scale and shift the tuning sequences so that they match better with the unknown function and the level of noise. This paper introduces the way of implementing this algorithm in C language.

Mathematical Model of Water Droplet Behavior on Solid Surfaces

Supervisor: WANG Xiaoping / MATH

Student: FAN Wenjie / MAEC Course: UROP1000, Summer

WANG Xinyi / MATH-IRE UROP1000, Summer

The objective of this project is to set up a mathematical model for liquid droplet behavior on solid surfaces based on

the interface energy minimization. The model of capillarity behavior in tube is also set, which is known as Young-Laplace Equation in physics. Since it is hard to found analytical solutions to Young-Laplace Equation, approximation and substitution are used to found potential approximated solution in those models. In MATLAB, we use numerical methods to solve ODEs and check the precision of our solutions. Graphs of vertical section (2D) and liquid surfaces (3D) with different surface tensions and contact angles are provided.

The Effect of Measurement Error in Regression

Supervisor: WONG Man Yu / MATH

Student: CHENG Hok Laam / MATH-ST Course: UROP1100, Spring

The classical linear regression model assumes the predictors are fixed. In practice, this assumption is always be violated because of measurement error on predictors. Measurement error causes inaccuracy when collecting raw data, resulting in the biased estimation on the parameter interested, especially the regression coefficients in the linear regression model. We here focus on developing the unbiased estimators of regression coefficients for univariate and bivariate situation. Results will be generalized for higher dimension. Tables showing the values of different estimates are included to illustrate the effectiveness of the unbiased estimators.

Department of Physics

Laser Pulse Broadening and Energy Dissipation in Solids

Supervisor: ALTMAN Michael Scott / PHYS
Student: CHOW Chun Yu / PHYS-IRE Course: UROP1000, Summer

The first part of the paper discusses how a short laser pulse is broadened by a two-ring cavities system based on Kojima and Nguyen's paper. By calculations with computer programs, the parameters are optimized. A system with beam splitters and mirrors is designed to stretch a laser pulse, so that it has a larger width and lower peak power. The second part of the paper discusses how energy dissipates inside a solid if bombarded by a stretched laser pulse. The heat equation, a partial differential equation, is solved numerically with a finite difference method, the forward in time, central in space (FTCS) scheme. The temperature evolution of the solid over time is simulated using computer programs.

Quantum Optics and Atomic Physics

Supervisor: DU Shengwang / PHYS
Student: LI Bohan / PHYS Course: UROP1100, Summer

During several months working with PG students, I learned some basic skills which is required in the laboratory, including learning to do the electric welding and the use of program Mathematica and Solidworks. Acquired with these skills, I mainly worked on the design of the bias coil for the new system being built. The bias coil is used to eliminate geomagnetic field and produce a constant magnetic field for the Zeeman Effect. I calculated the magnetic field produced by the coil and by setting parameters of the coils to make the magnitude and gradient of the magnetic field reach the expected value.

Quantum Optics and Atomic Physics

Supervisor: DU Shengwang / PHYS
Student: ZHU Lingbang / PHYS-IRE Course: UROP1100, Fall
UROP2100, Summer

We minimize the size of our previous biphoton generation system by using water heating and alignment on an optical breadboard. Furthermore we did OD test and some preparation work for cavity design to prepare generation of biphoton via optical cavity plus vapor cell.

Activated Motions of Ants on a Hot Plate and/or Granular Particles on a Vibrational Stage

Supervisor: HAN Yilong / PHYS
Student: TAM Tsz Yan / PHYS Course: UROP1100, Fall
UROP2100, Spring

The report presents the current progress of the project. In this project, the motion for ants under the effect of heating was observed. Ants were placed inside a petri dish under constant heating, and their motions were recorded by the CCD camera. Motions of ants are then observed and analyzed. Results show that ants are more activated under high temperature. Ants' motions were accelerated under heating and their movements were more prolonged when compared to the ones placed under room temperature. The findings may lead us to study more on ants' motion under different circumstances, such as temperature and the surrounding environment.

Activated Motions of Ants on a Hot Plate and/or Granular Particles on a Vibrational Stage

Supervisor: HAN Yilong / PHYS
Student: ZHANG Chi / PHYS Course: UROP1100, Fall

In this report, it is mainly discussing about the project of Undergraduate Student Research Opportunity pro-gram. The project is about studying the behavior of single vibrated granular particle, and the focus of this report is about how to track the movement of the particle and how to determine the rotation of the particle which is under the vibration of the platform. In this report, it will put more weights on the image processing part, including tracking the movement of particle and plot the trajectory of the ball movement. The main programming language that has been used is IDL and the OpenCV of Python.

Building an Apparatus Cooling and Trapping Erbrium Quantum Gas

Supervisor: JO Gyu Boong / PHYS
Student: TSO Yee Ming / PHYS Course: UROP1100, Summer

In this report, progress in building a quantum gas apparatus for cooling Erbium atoms is presented. Electronic control systems with the use of Cicero, a customized control software suite designed for atomic physics experiments to control Transistor-transistor Logic circuits will be presented with improvements. Besides, a laser system providing 401-nm transition of Er atoms for Zeeman Slowing and 583-nm transition for Bi-chromatic magneto-optical trap (MOT) is in progress.

Monte Carlo Simulation of 2D Supramolecular Assembly

Supervisor: LIN Nian / PHYS
Student: CHAN Chi Wai / PHYS Course: UROP1000, Summer

Molecular self-assembly is an important subject in fabricating nanoscale object. Large molecular or metal-organic structure could be formed without the external guidance by using self-assembly process. Simulation is one of the useful computational techniques to obtain informative knowledge about such process. This paper investigated the supramolecular self-assembly process on the two-dimensional square lattice substrate by conducting Kinetic Monte Carlo simulation. The simulation program was written for simulating the reaction between lead atoms and 5,10,15,20-Tetra(4-pyridyl) porphyrin molecules (TPyP) on the substrate Au (111) and aimed to obtain factors that

enhance the rate of forming metal-organic structure. Simulation results showed that by reducing the deposition rate of lead atoms would increase the chance of forming TPyP-Pb network even for unfavorable conditions.

Monte Carlo Simulation of 2D Supramolecular Assembly

Supervisor: LIN Nian / PHYS
Student: LAI San Yu / PHYS-IRE Course: UROP1000, Summer

This investigation employed the Pybinding module, written mostly in the Python programming language, to calculate the distribution of densities of states on a graphene quantum dot with defects, by the tight-binding approximation. It is concluded, from the research, that the defects mostly cause new states at zero energy to arise; that defects close to existing states can amplify the zero energy states if the defect and the hole are on the different sublattices, and if they are on the same sublattice, the states would be suppressed; and that defects can suppress states in radial directions perpendicular to the carbon-carbon bonds from the holes.

Monte Carlo Simulation of 2D Supramolecular Assembly

Supervisor: LIN Nian / PHYS
Student: NGAI Tsz Ue / PHYS Course: UROP1100, Spring

Improved MATLAB program on quantum state calculation of 2-dimensional periodic potentials can produce self-consistent band structure, total density of states (TDOS) and local density of states (LDOS). Brief introduction of the program is included. This project focused on the comparison between three simulations and the experimental results produced by scanning tunneling spectroscopy (STS) on coronene systems on Cu (111) surface. TDOS produced by simulations agree with the experimental result in terms of the energy difference among peaks. However, relative abundance of states in LDOS at positions of interests is inconsistent with the STS from experiment. The progress of this project has not achieved a conclusive remark but the direction of this study is confirmed.

Monte Carlo Simulation of 2D Supramolecular Assembly

Supervisor: LIN Nian / PHYS
Student: ZHU Yuxiang / CPEG Course: UROP1000, Summer

This UROP project is aimed to ues Monte Carlo method to simulate supramolecule assembly. In this project, I write the simulation program in C++ first to understand the reaction of Pb and 5,10,15,20-tetra(4-pyridyl) porphyrin (H2TPyP). In the simulation, temperature, ratio of Pb number and TPyP number and their bonding energy are taken into consideration. By comparing the result, we can get more perfect product by control temperature and ratio of substrates. However, this program still needs modifying to be more accurate and more efficient. Some other factors that may affect the result need to be discovered and add some more constraint to the program.

School of Science

Department of Physics

Organic Molecular Beam Deposition in Ultra-high Vacuum

Supervisor: LIN Nian / PHYS

Student: TAM Tsz Yan / PHYS Course: UROP1000, Summer

The report demonstrates the current progress of the project with detailed experimental procedures, while discuss the possible improvements which can be made in the future experiments. In this project, deposition of a chemical on a glass substrate is done under high vacuum. The glass sample is then taken out for observation. The process is repeated on the targeted chemical under different temperature for determining the critical temperature for the chemical to undergo deposition. Over this process, an organic thin-film is prepared and the thermal properties of the chemical could be determined. A sample successfully deposited on a glass substrate is reported.

Quantum State Calculation of Two-dimensional Supramolecular Nanostructures

Supervisor: LIN Nian / PHYS

Student: GAO Yuxiang / PHYS Course: UROP1100, Spring

A program ran in MATLAB is used to calculate the quantum state of a given lattice pattern and potential, and can be applied to simulate the band structure, total density of states(TDOS) and some other interesting features that are interested in the experiment. The program is previously used to simulate and plot the key features of a graphene lattice. Prediction from theory reveals interesting things about properties of certain 2Dfinite system. After modifying some part of the program, I managed to use the program to calculate the important factors of the pattern that we are interested in. I managed to find out the characteristics of some patterns but haven't done the study of one complicated pattern. Some key features of the pattern are revealed and compared.

Quantum State Calculation of Two-dimensional Supramolecular Nanostructures

Supervisor: LIN Nian / PHYS

Student: WANG Tong / PHYS Course: UROP1100, Spring
UROP2100, Summer

In this report, a Python package named pybinding is used to do the tight-binding calculations. With this program, some finite-size graphene structures are simulated to compare properties of these structures with the ones given by another MATLAB program which directly solves the schrodinger equations of artificial graphene structures. The properties of those finite graphene structures include total density of state (TDOS), local density of state (LDOS) and the spatial distribution of states at a specific energy.

Order Parameter Symmetry of Iron based Superconductors from DC Magnetization Measurements

Supervisor: LORTZ Rolf Walter / PHYS

Student: KAO I-hsuan / PHYS Course: UROP1100, Summer

The temperature dependence of lower critical field $H_{c1}(T)$ $FeSe_{0.937}S_{0.063}$and $FeSe_{0.86}S_{0.14}$ was investigated by magnetization measurements with the VSM-SQUID. The onset of trapped magnetic moment M_t was utilized to obtain the $H_{c1}(T)$. The $\lambda_{ab}(T)$ derived from $H_{c1}(T)$ was compared with theoretical models; the single s-wave, d-wave, anisotropic s-wave, and the 2-gap s+s. The fitting results for both samples agreed with the 2-gap and anisotropic s-wave scenarios, but not with the s and d-wave. The effect of the lower gap was found to be strengthened and then weaken with the increasing doping of sulfur. The method using the onset of M_t to obtain $H_{c1}(T)$ was reviewed, and the results suggested this technique as a promising approach to study unconventional superconductivity.

Chaotic Dynamics in a Complex Network

Supervisor: SZETO Kwok Yip / PHYS
Student: WONG King Chun / PHYS
Course: UROP1100, Fall
UROP2100, Spring
UROP3100, Summer

A simple dynamical model is built based on the physical picture of stock investment of two agents. By mixing the actions of the two agents, a Parrondo effect is observed. The observed Parrondo effect was then being analyzed through the method of Markov chain and a direct examination of the input time series, in the aim of optimizing the investment actions sequence.

Damage Spreading in Networks

Supervisor: SZETO Kwok Yip / PHYS
Student: GUO Wenshuo / PHYS
Course: UROP1100, Fall

In directed networks, cascade failures may be triggered by node or link removal. A mathematical model for banking network is used to study the cascade dynamics focusing on key parameters, based on mean field analysis and numerical simulations. The results show a non-monotonic correlation between the system stability and connectivity, a positive nonlinear correlation with capitalization and a negative nonlinear relation with interbank exposure size. To optimize the network topology in order to reduce the percentage of failed banks under shocks to financial system. We use genetic algorithm and observe that networks with same connectivity but with higher degree variance are more robust to external shock. Systemic risk could be decreased by increasing the degree variance of the associated network.

Evolutionary Computation for Optimization

Supervisor: SZETO Kwok Yip / PHYS
Student: BU Qi / PHYS-PM
Course: UROP1100, Fall

In this report we define a new concept named average communicability by taking the average of communicability between pairs of nodes in the network, which, according to the original definition of communicability, can be used to

measure the efficiency of information flow as well as communication ability among nodes throughout the whole network. With the help of the adjacency matrix and spectrum analysis, we investigate the relationship between the average communicability and other properties of the network. Hypothetic lower bound and upper bound of the average communicability as well as the corresponding network topologies with fixed number of nodes and edges are also introduced.

Evolutionary Computation for Optimization

Supervisor: SZETO Kwok Yip / PHYS
Student: CHUNG Yuen Ting / PHYS
Course: UROP1100, Fall
UROP2100, Spring

Genetic Algorithm is one of the most effective evolutionary algorithms used to solve the optimization problems, which is inspired by biological evolution. On the other hand, random walk is used to describe a path that consists of a succession of random steps on some mathematical space. We attempted to solve the transportation problem using the above methods.

Evolutionary Computation for Optimization

Supervisor: SZETO Kwok Yip / PHYS
Student: GUO Wenshuo / PHYS-PM
Course: UROP1100, Spring

The systemic risk in financial systems, which is associated with financial crises triggered by sudden external failures, could be modelled by a complex network. We study the stability of the financial networks using a homogeneous model. The stability is measured by the minimum value of capital of the nodes after a fixed time of money ow in the network. The smaller the minimum value, the higher the probability of the first bankruptcy. We did the stability analysis and purtabations in money distribution. We observed the linear relation between net change and PageRank centrality is robust under certain conditions. Our results may be useful in practical financial applications, with possible applications to other physical systems.

Evolutionary Computation for Optimization

Supervisor: SZETO Kwok Yip / PHYS
Student: WANG Juntao / PHYS
Course: UROP1100, Fall
UROP2100, Spring

Directed network with ow dynamics is an important topics in realistic complex system such as banking systems. We study the stability of these financial networks using a more general inhomogeneous model. The nodes of the networks are banks and they are under discrete transaction of money that may lead to bankruptcy, which is defined by the condition that the capital value of the bank is below a critical value, such as 0.6 of its initial capital. A network would be considered as more unstable, if it has a smaller minimum value of the capital of the nodes. By means of

genetic algorithm with network as the chromosome, the edges between nodes as gene, we can perform evolutionary computation using rewiring of edges as the genetic operators to search for a network topology with high stability.

Evolutionary Computation for Optimization

Supervisor: SZETO Kwok Yip / PHYS
Student: WONG Yat / PHYS Course: UROP1100, Summer

Genetic algorithm is applied, and then an adaptive mutation algorithm about a mutation matrix coevolving with the population matrix is introduced. This method allows many variations, including different implementations of mutation matrix and multiple variations methods based on the matrix, which gives different rate in different conditions. It is then applied to a classical NP problem, the 1/0 knapsack problem. It is also applied to some of the variants of the knapsack problem, including the multiple knapsack problems and the layered knapsack problem. Based on the mutation method's performances in these problems, the suitability of each of the implementations on different types of optimization problems is stated.

Evolutionary Computation for Optimization

Supervisor: SZETO Kwok Yip / PHYS
Student: ZHANG Tianpeng / COSC Course: UROP1100, Spring
UROP2100, Summer

The Artificial Ant Problem is a benchmark for genetic programming in which an artificial ant searches in a grid lattice for food pellets on a specific trail. This paper generalizes this problem by considering more general food distribution, search by a team of genetically programmed ants using specific strategy. The strategy is evolved using a recently developed algorithm MOGA (mutation only genetic algorithm) where the strategy is the chromosome and the mutation is adaptive without the need of presetting mutation rate. Simulations using different number of ants and food density reveal a set of good searching strategies. The relationship between the number of ants and searching efficiency with food density indicate the existence of a critical density, above which the artificial ants outperform the random walking ants. We also observe saturation in efficiency when food density is high. Applications of this generalized search problem using genetic programming are discussed.

Maxwell Demon and Information Thermodynamics

Supervisor: SZETO Kwok Yip / PHYS
Student: CHEUNG Long Him / PHYS Course: UROP1100, Spring
UROP2100, Summer

There are two kinds of mutation only genetic algorithm, namely Mutation Only Genetic Algorithm Row (MOGAR) and Mutation Only Genetic Algorithm Column (MOGAC). It is found that MOGAR and MOGAC represent two complement strategies of searching optimal, which are exploration and exploitation respectively. Through intelligent switching

between the two MOGA, it can enhance the performance for optimal searching. A Spy-Voting Problem refers to the opinion formation in a community, where at the initial, half of the population support blue and the other half support red; the goal is to figure a way to put spy in the opposite camp to reach dominance in the shortest time. The new MOGA is applied to solve the Spy-Voting Problem.

Maxwell Demon and Information Thermodynamics

Supervisor: SZETO Kwok Yip / PHYS
Student: SO Chak Pui / PHYS Course: UROP1000, Summer

The linear dynamics of simple harmonic motion is studied through a spring-mass system. The general solution of harmonic oscillators is derived by solving its second-order linear differential equation. The displacement-time graph and the phase space trajectory of the oscillator are also illustrated. After that, the nonlinear duffing oscillator is investigated. The case of an undamped, unforced oscillator is considered first. Its phase space is illustrated numerically by the law of conservation of energy. Lastly, a forced duffing oscillator with small damping is investigated. Through simulation, it is found that the oscillator shows chaotic behaviour when the periodic driving force is strong enough.

Random Walk on Complex Network and Application to Numerical Simulation for Statistical Physics

Supervisor: SZETO Kwok Yip / PHYS
Student: DING Mucong / PHYS Course: UROP1100, Fall
UROP2100, Spring

In this report, we general classified the finite rectangular lattice with various boundary conditions into five categories: plane, cylinder, torus, Mobius strip and Klein bottle. We schematically discussed how to calculate their partition functions using the method of transfer matrix. We then focus on especially the non-orientable surfaces, i.e. the Mobius strip and the Klein bottle and analyze a toy model of size 2 x N. We calculate the partition function of the 2 x N lattice embedded either on the Mobius strip or the Klein bottle. We finally obtain the two-point correlation function in both cases and analyze the finite size effect.

Random Walk on Complex Network and Application to Numerical Simulation for Statistical Physics

Supervisor: SZETO Kwok Yip / PHYS
Student: FENG Zhijie / PHYS-IRE Course: UROP1000, Summer

Random walk is a random process describing paths of successive steps made by objects that have identical transition function at any time and any position in the given space. This project focuses on the elementary case of simple random walk on an integer number line with discrete time and constant steps size. In this project, two simple random searching models are made for numerical simulations, which are limited random walk with multiple walkers, and random walk with symmetrical targets with sinusoidal oscillation and Gaussian noise. The simulation result gives the

relationship between mean first passage time or mean reciprocal of first passage time and independent variables including upper limit of man-hour, number of random walkers, angular frequency of oscillation and standard deviation of the Gaussian noise.

Random Walk on Complex Network and Application to Numerical Simulation for Statistical Physics

Supervisor: SZETO Kwok Yip / PHYS
Student: LIU Chung Him / PHYS Course: UROP1100, Spring

Complex network is a network with non-trivial topological features like small-world and clustering property. Many things represented as a complex network like the World-Wide-Web (WWW), communication network, social network. Some real-world networks exit some interesting characteristic like power-law distribution and those networks called Scale-free networks. This phenomenon may show the “six-degrees of separation”. And some literatures show that random walk model can apply on complex network for searching and find other features like mean first mean first passage time. The random walker basically generates a path by a series of random processes and those random processes can show the topology of the network. Therefore, I apply the random walk model to traffic network to estimate the network flow by the path generated by random walkers. The final estimation can be used for simulation the damage of broken edge problem.

Random Walk on Complex Network and Application to Numerical Simulation for Statistical Physics

Supervisor: SZETO Kwok Yip / PHYS
Student: NEPPOLEON Gowtham Amirthya / PHYS Course: UROP1000, Summer

We study the factors affecting the choice of the number of search agent in the search of an unknown target in a complex network which topological properties are not specified, but with a fixed budget. The search agent is modeled by random walker. A model for the random walker, whose intelligence is modeled by a parameter so that the traditional random walker is called a non-intelligent agent and a walker that can avoid sites that have been visited is called an intelligent agent. The dependence on intelligence of the search agent, nature of the network and cost for recruitment of an agent are analyzed. An optimization problem for resource allocation is formulated by finding the maximum number of sites visited by the team of M walkers, using genetic algorithm. Insights into the ratio of initial investment cost for the formation of the team of M walkers to the fixed expenditure for search are discussed for different networks and different levels of intelligence of the walkers.

Random Walk on Complex Network and Application to Numerical Simulation for Statistical Physics

Supervisor: SZETO Kwok Yip / PHYS
Student: YIP Chun Yin / PHYS Course: UROP1100, Fall
UROP2100, Spring
UROP3100, Summer

As information technologies, like social media, advance, complex network is a useful concept to model our society. Based on this kind of modeling, we can make predictions related to topics like information spreading. This UROP report mainly studies sales potential optimization in a complex network. Sales potential of a node is defined as the ratio of the number of its second-degree neighbors to that of its first-degree neighbors. The higher sales potential a node has, the more efficient it is in spreading information in the complex network. In this report, we tried to optimize the quantity for a particular network with some biased random walkers that preferentially move towards a low-degree node.

Sequence Analysis in Multi-agent Games

Supervisor: SZETO Kwok Yip / PHYS
Student: IYER Aditya Varna / PHYS-IRE Course: UROP1100, Fall

The aim of this project is to study the interaction between agents on a network capable of existing in a two-state configuration. The agents evolve in a parameter space called wealth by means of a game model whilst being subject to opinion formation and changes in colour space. The interaction is supplanted by rewiring steps that plays a dominant role in the colour evolution of the players. Statistics pertaining to colour dominance and wealth evolution are presented in considerable detail.

Sequence Analysis in Multi-agent Games

Supervisor: SZETO Kwok Yip / PHYS
Student: LAU Ka Ki / PHYS Course: UROP2100, Fall
UROP3100, Summer

When investing in stock market, it is already known that the more risk the investor is willing to take, the larger the expected return will be. However, people tend to form social network when a group of players are investing, exchanging information by adopting follow the winner (FW) and avoid the loser (AL) strategy based on their previous round of result. Parrondo's effect refers to two long-term losing games, A and B, when switching using specific frequency, will result in a winning game. In this report, real stock data of HSI and GSPC are used to simulate and check the existence of the Parrondo's effect of changing between FW strategy and AL strategy constantly, in a ring-structure social network consisting of 6 players. Each of the players can only communicate with two neighbors. Although previous study reveals that for this ring-structure, Parrondo's effect occurs when a game machine is used. However, for these two real stocks Parrondo's effect is not found. It might due to the randomness and unpredictable character of real stock market, or a better method might be needed. Further study on this topic will be continued.

Negative Refractive Index Meta-materials

Supervisor: TAM Wing Yim / PHYS
Student: BRACKE Vincenz / PHYS Course: UROP1100, Summer

In this progress report, I briefly introduce the topic of the project I will continue to work on over the next year. I summarize the most significant and basic aspects of negative refractive index metamaterials and detail my current understanding of the topic. Then I outline the area of research in which I will be working and how the processes I will be utilizing function in general. This report is to be understood as an indication of my future work, as I have so far been preparing for my lab work by completing the necessary safety trainings and improving my understanding of the topic and the processes in the laboratory.

Negative Refractive Index Meta-materials

Supervisor: TAM Wing Yim / PHYS
Student: LI Wing Shun / PHYS-IRE Course: UROP1100, Summer

By using an interferometer, we are able to find out the phase change for the reflection at a metamaterial interface, which has a negative or complex refractive index. In this report, we measured the phase change of single layer sawtooth patterned metamaterials under different rotation angle to a linearly polarized light. The metamaterials used in the experiment include one with 'N' pattern and another with 'И' pattern, which is the mirror image of each other. The two samples are chiral in properties and behave unnaturally in terms of optical activities. The results show a difference in the phase change in the two samples.

Quantum Oscillations in Low Dimensional System

Supervisor: WANG Ning / PHYS
Student: LIANG Shu / PHYS Course: UROP1000, Summer

In classical mechanics, people use Newton's Laws to predict the state of object which includes position and momentum (x, p). And classical ways give the certain results of (x, p). Mathematically, given an equation of X(t) and an initial condition (in one dimension), we can trace forward or backward about the state of that object. However, there's a completely different story in Quantum Mechanics in which the state of the particle is governed by the wave function Ψ. The wave function itself doesn't have any physical meanings, but it includes all the information that we need to describe a quantum object.

Quantum Oscillations in Low Dimensional System

Supervisor: WANG Ning / PHYS
Student: YU Yue / PHYS Course: UROP2100, Fall
UROP3100, Spring

The experiment on quantum hall effect and Shubnikov-de-Haas oscillation on multilayer WSe2 shows strikingly large g-factor. We propose a model for quasi-2D material with interplanar hopping. We approximate the interplanar hopping by an effective confining potential perpendicular to the material. The confining potential leads to correction to the Landau levels, and thus the g-factor measurement. We analytically proved that there is an enhancement in

g-factor if the original fitting method is applied to the quasi-2D material.

Understanding Particle Physics from Cosmic Inflation

Supervisor: WANG Yi / PHYS
Student: WU Dake / PHYS Course: UROP1100, Summer

This article is about both the spontaneous breaking of continuous symmetries and the quasi-single field inflation. The symmetries breaking is briefly introduced and such properties of the quasi-single field is roughly analyzed.

Develop 2D Luminescence Imaging System

Supervisor: WONG Kam Sing / PHYS
Student: LAU Albert Wai Kit / PHYS Course: UROP1000, Summer

The following is a progress report for the project of developing a 2D Luminescence Imaging System during this summer semester. In this summer semester, I have started the project, investigated a sample program GPScan.vi, construct an alpha version of a customized program and set up a basic optics to test the Imaging system.

Exciton Dynamics in Organic/Inorganic Solar Cells

Supervisor: WONG Kam Sing / PHYS
Student: LI Veronica Qin Ting / PHYS Course: UROP1000, Summer

This progress report references earlier studies on organic and perovskite solar cells. Based on the methods described in the earlier reports, a time-resolved photoluminescence (TRPL) experiment was designed and conducted to observe the properties of Y5. The current report documents the process to measuring the PL lifetime of Y5. Results from an experiment indicated that the lifetime was between 92 to 134 ps for Y5 with ZnO as a quenching layer, and between 108 to 170 ps for Y5 on a glass substrate. From these results, the corresponding exciton diffusion length was 17.5 nm. Thus, it can be inferred that ZnO was an effective quencher for Y5.

Dynamics of Housing Prices

Supervisor: WONG Michael K Y / PHYS
Student: FONG Kin Long / PHYS-IRE Course: UROP1100, Summer

Turbulence of housing market is a concern of the society as it is closely related to the public's wellbeing and therefore worth studying. Different studies suggested that physics models and knowledge, such as log-normal distribution, log periodicity and power-law functions, can help us analyze trends in housing markets and find out potential speculative bubbles that may cause catastrophic events in future. Methods for analyzing housing price distributions and for detecting potential bubbles in housing markets have been reviewed.

Dynamics of Housing Prices

Supervisor: WONG Michael K Y / PHYS
Student: MA Ka Long / PHYS-IRE Course: UROP1000, Summer

This project investigates different phenomena observed just before and during the bursts of bubbles. The goal of this project is to quantify common phenomena observed from the price data of Taipei, Singapore, and Hong Kong, which are metropolitan cities and look for precursors to bursts of bubbles from their price data. At this stage, for the sake of finding clues and methods of investigating the housing market, we read some articles and papers about housing prices and bubbles. I discuss some of the major findings, such as frequencies in the frequency spectrum and deviations to empirically fitted distribution of a CDF are indicators of bubbles and critical transitions.

Dynamics of Housing Prices

Supervisor: WONG Michael K Y / PHYS
Student: WANG Juntao / PHYS Course: UROP1100, Summer

Housing markets not only has a close relation to residence livelihood but could affect the overall economy of a whole country, so researchers invented several methods to predict the housing price of different countries. Many scientists are seeking the non-stationary behavior in housing price time series to detect the rapid growth, which is considered as asset price bubbles. Thus, statistical techniques are used to confirm the existence of explosive behavior, such as root test, augmented Dickey Fuller test and PSY method. However, though these methods are plausible in some special case, they are still far from practical. Thus, I first introduce some of the common approaches and show their deficiencies in future prediction. Then by introducing the Hidden Markov Model, we try to gain a better prediction for future Hong Kong housing market.

Dynamics of Housing Prices

Supervisor: WONG Michael K Y / PHYS
Student: WEI Junyi / PHYS-PP Course: UROP1100, Summer

Differences in the market structure of cities or countries may lead to different distributions and features of housing prices. Some recent research on the statistics of housing prices in Singapore and Taiwan had a detailed study about the price distribution and the Dragon King phenomenon, and gave some possible understanding and indications of the result. The research of Hong Kong housing market was carried on based on the previous results. It mainly focused on the relationship between the price and purchasing volume, especially about the cause and effect relationship and periodic features. Some useful phenomena have been observed by us, but there are still problems remaining to be solved.

School of Science

Department of Physics

Dynamics of Housing Prices

Supervisor: WONG Michael K Y / PHYS

Student: YAM Wun Kwan / PHYS-IRE Course: UROP1100, Summer

A literature review was conducted in order to better understand the phenomenon of housing price bubbles. Tay et al. analyzed the real estate markets of Singapore and Taiwan. It found that the per-square-foot home price cumulative distributions followed the Gibbs-Pareto form. Housing bubbles were indicated in Condominium Apartments of Singapore, and in Zhu Zai Da Lou and Gong Yu/Hua Sha of Taiwan. Zhou et al. analyzed the real estate markets of the United Kingdom and the United States. It used a Weiserstrass-type function to detect housing bubbles and predict bubble end time. A housing bubble was detected in the United Kingdom, predicted to burst near the end of 2003, while no bubble was found in the United States.

Neural Dynamics

Supervisor: WONG Michael K Y / PHYS

Student: CHAUDHRY Mukund / PHYS Course: UROP1100, Spring

Progress was made in understanding the role of the intermediate layers in deep neural networks used for image classification, explaining the importance of the architecture used in modern day neural networks and how it is specifically designed to account for invariances and other properties of real-world images. The study is divided into three sections. The first part discusses the architecture of modern deep neural networks, the second part discusses the reasons for choosing a particular architecture. The final section elaborates on the abstract properties of an image that the intermediate layers detect, and the techniques used to discover those properties. I also discuss the results of some simple experiments done on the famous MNIST data set using the Tensorflow library.

Neural Dynamics

Supervisor: WONG Michael K Y / PHYS

Student: KONG Kangyi / PHYS Course: UROP1100, Summer

"A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P if its performance at tasks in T, as measured by P, improves with experience E." In supervised learning, we want the program to find the rule behind the given data and generalize it to predict new ones. From image recognition to customized advertising, with great potential in daily life and scientific research, this project aims to have a detailed introduction to the current supervised deep neural nets in a gradual manner, and the intuition along the way. Hopefully, it can provide some guidance for people who want to have a general view of this method.

Neural Dynamics

Supervisor: WONG Michael K Y / PHYS

Student: TAI Wai Ting / PHYS Course: UROP1100, Summer

Artificial neural network, a biologically inspired machine learning algorithm, has been an increasingly popular machine learning algorithm. Conceptualizing a brain as layers of neurons connected through synapses to each other, neural networks use many kernels interconnected to each other to simulate a brain. Multilayer neural networks with backpropagation and gradient descent can be used to synthetize a complex model capable of learning from a set of examples. However, the theoretical basis behind neural networks is still ill-understood. In light of this, the project aims to investigate more the behavior of neural networks so as to achieve a better understanding of how a neural network functions.

Neural Dynamics

Supervisor: WONG Michael K Y / PHYS
Student: YUAN Weijun / PHYS-IRE Course: UROP1100, Summer

Understanding how the brain works is one of the most challenging issues in modern scientific research, but many questions remain unanswered. One possible approach to address this problem is to consider how deep neural networks process images and how features in the intermediate layers are classified. This project will briefly introduce the concept and the structure of the convolutional neural network, which is the prototype of many state-of-the-art deep learning models. Recently, different visualization techniques are proposed to visualize the intermediate layers of CNN. Therefore, a review of these techniques is covered and a CNN model is used to implement the activation maximization in Keras.

Space Orbit Design

Supervisor: WONG Michael K Y / PHYS
Student: CHEUNG Yik Kin / ELEC Course: UROP1100, Fall
UROP2100, Summer

This project presented a trajectory optimizer integrated with laser light sail model which successfully generated a trajectory traveling from Earth to Mars. The project first considers the laser sail model based on the solar sail and laser sail model presented by others. Then we will consider the reasons behind choosing the circle sail model to be integrated into the optimizer. The choice of the laser sail parameters for mission was adopted from the literature that described the prospective of using laser propulsion in the future. Finally, the result of the optimizer was presented and compared to another trajectory generated by the same optimizer using traditional rocketry model.

Space Orbit Design

Supervisor: WONG Michael K Y / PHYS
Student: LAU Albert Wai Kit / PHYS Course: UROP3100, Fall

Determining the reachable area of a low thrust trajectory is highly computational power demanding by direct iteration. To solve the reachability problem in reasonable time, and of good accuracy, an estimation algorithm is

needed. There exist a few such algorithms including the linearized model. A new approach is developed by me with help of Tony Shing in this semester, using the superposition method to estimate the reachable region.

Space Orbit Design

Supervisor: WONG Michael K Y / PHYS
Student: NG Yat Hei / PHYS Course: UROP2100, Spring

In this project I developed a method to design a preliminary orbit by matching patched-integrated trajectories for low energy Earth-Moon transfer mission. The aim of the project is to search feasible and optimized orbits for a spacecraft to transfer into the lunar orbit by matching incoming forward trajectories with elliptical orbits and quasi-halo orbits about the Moon. A metric will be developed to rate the feasibility of pairs of trajectories and the correlation of the metric and actual ΔV involved on the mission will be discussed.

Space Orbit Design

Supervisor: WONG Michael K Y / PHYS
Student: SHING Ming Tony / PHYS-IRE Course: UROP4100, Fall

In celestial mechanics the ballistic two-point boundary value problem, i.e. the Lambert Problem, can be solved analytically for a given transfer time, initial and final positions. The solutions to the Lambert problem are often expressed as the initial and final velocities. When generalizing the problem to low-thrust trajectories, one needs to search a range of feasible velocities instead of discrete point solutions with computationally intensive approaches such as grid searches.

Space Orbit Design

Supervisor: WONG Michael K Y / PHYS
Student: YAU Wan Yee / PHYS Course: UROP2100, Fall

The search for an optimal sequence is needed in space orbit design to reduce time of flight and fuel consumption in order to maximize the cost of the mission. I have studied the asteroid billiard problem in the last two semesters to find a sequence of asteroid flyby. I have mainly focused on studying the transfer between each flyby in the last semester.

Elastic Wave Metamaterials

Supervisor: YANG Zhi Yu / PHYS
Student: BAI Kehang / PHYS Course: UROP1000, Summer

Noise and vibration reduction is one of the most significant problems in real life. The research project on Elastic Wave Metamaterials is focusing on an easier and more practical way of reducing noise or vibration. It can be widely used in

realistic conditions such as constructions, transportations and industries. The main responsibilities of me are analyzing experimental data and testing the quality of a music box including building the music box and testing the Noise Reduction Level of the music box. As a result, we found the method to improve the quality of the music box. In conclusion, the structure of the music box is the main cause of existing problems.

Elastic Wave Metamaterials

Supervisor: YANG Zhi Yu / PHYS

Student: LAU Cheuk Lun Joshua / PHYS Course: UROP1000, Summer

Traditional earmuffs were made of ordinary material. Their sound attenuating ability was governed by Mass-density law and has a poor performance at low frequency region. Subwavelength Membrane-type Acoustic Metamaterial was reported to have achieved high transmission loss for low frequency sound. This report shows the manufacturing process f a new generation of earmuffs by combining the metamaterial and Decorated Membrane Resonators as dampers. Two different types of experimental setups were used to obtain the transmission loss spectrum of the earmuff. With 4-layers of the metamaterial, which has a thickness of only 1cm, a promising and consistent performance of over 50dB transmission loss was obtained. The high sound attenuation ability of the metamaterial at low frequency region was verified. Possible improvement plans will also be discussed.

Undergraduate Research Opportunities Program

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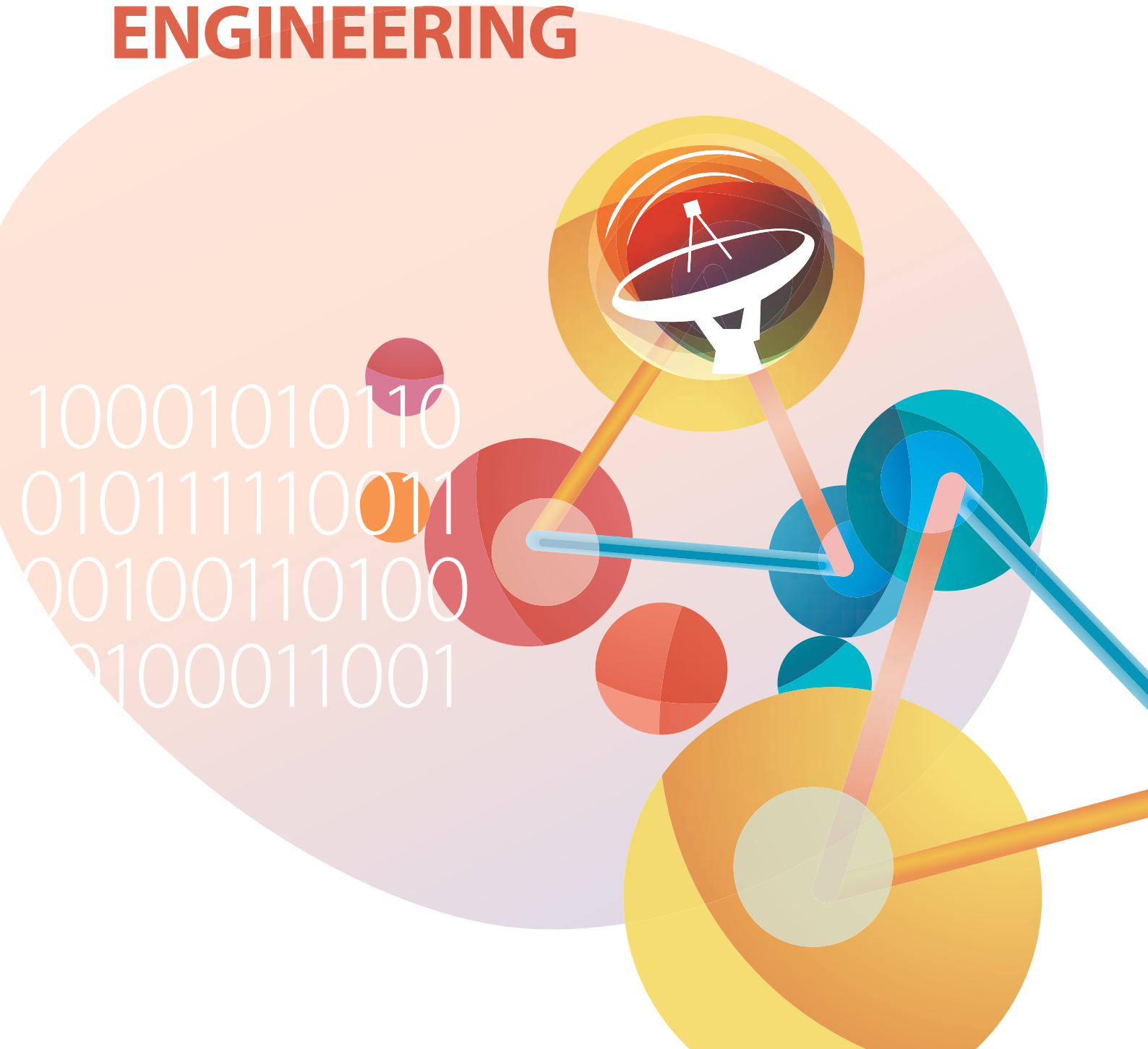


Department of Chemical & Biomolecular Engineering

Nanoparticles for Delivering Peptide Drugs to the Brain

Supervisor: CHAU Ying / CBE
Student: FAN Bohan / CBME Course: UROP1000, Summer

So far, nanoparticles (NPs) have gained increasing attention in the studies of target-specific drug delivery. The entire project focuses on the design of polymeric nanoparticles as a cargo to delivery peptide drugs into the targeted area in cerebellum of the brain across the Blood Brain Barrier (BBB). Various in-vitro characterization techniques are used to obtain the most basic information of NPs, including particle size, surface charge and drug release kinetics. Current methodology for preparation, synthesis and characterization of polymers, peptides and nanoparticles will be introduced. In addition, measurement of drug release profiles by HPLC will also be provided for data analysis. Hence, the purpose of this project is to design and characterize nanoparticles in a condition that mimics the physiological environment in human body in order to correlate drug effects and their biological outcomes as well as predicting the therapeutic windows of medicines.

Supersoft Hydrogel for Extended Drug Delivery on the Eye Surface

Supervisor: CHAU Ying / CBE
Student: CHEN Longfei / CENG Course: UROP1000, Summer

Crosslinked hydrogel refers to a class of hydrogel synthesized through bond formation of polymer molecules. In this study, we chemically modified two polymers, with two functional groups that can go through spontaneous crosslink and form hydrogel. From a perspective of engineering, the two significant features of hydrogel in control drug delivery researches are *gelation* and *biodegradation* (Li, Rodrigues and Tomás, 2012). To have a comprehensive understanding of hydrogel and some of its properties, we've done various experiments on its gelation condition, degradation kinetics and characterizations.

Green Processing of Seafood Shell Waste

Supervisor: HUI Chi Wai / CBE
Student: HO Cheuk Hei / CENG Course: UROP1100, Fall

Shrimp waste can be a raw material for producing chitosan, a useful polymer. It can be done via appropriate industrial practices, which are deproteination, demineralization and deacetylation (Toan, 2009). This report emphasizes on optimization of shrimp waste demineralization and solvent extraction cycle study. Our result shows that reaction duration of demineralization should be less than or equal to 4 hours using 0.15M hydrochloric acid. Similarly, reaction time should be less than or equal to 2 hours for 0.3M hydrochloric acid. For solvent extraction cycle study, which decolorization of shrimp shell is accomplished through pigment extraction using methanol, the

solvent can be re-used again for more than or equal to 5 times before pigment is recovered by evaporation.

Towards Zero-waste Pharmaceutical Processes: Mapping Complex Process Behavior of a Novel Membrane-assisted Crystallization Process

Supervisor: LAKERVELD Richard / CBE
Student: MADEJ Dominik / CENG Course: UROP1100, Spring

Optimization of process operating conditions with fixed solvent type and integrated optimization of the process and solvent selection using PC-SAFT based continuous mapping method for crystallization of paracetamol were successfully conducted using GAMS software. The results suggest that, for conditions stated in the study, pair DMSO/t-butyl acetate is the optimal solvent/anti-solvent pair for continuous crystallization of paracetamol. Moreover, the accuracy and correlation between predicted hypothetical and empirical data indicate that PC-SAFT model combined with continuous mapping method can be successfully utilized in prediction of solubility and selection of optimal solvents for crystallization processes.

Improving the Efficiency of Spectral Library Searching in Mass Spectrometric Data Analysis

Supervisor: LAM Henry Hei Ning / CBE
Student: LI Yan Chak / CPEG Course: UROP1000, Summer

Retention time (RT) alignment is a well-known problem in mass spectrometry data analysis. In this study, we extended LWBMatch, our previously proposed algorithm for RT alignment, to data-independent acquisition data, with scan-wise alignment by dynamic time warping (DTW) and feature-wise alignment. In DTW step, MS1-based and MS2-based method result in robust warping curves, while MS2-based takes longer time. Here, we propose a new MS2-based method - cosine similarity of random pairs (CS-RP). Employing CS-RP, recall and precision are above 80% and 95%, comparable to MS1-based method with 84% recall and 96% precision. CS-RP finished 1.4~2.0 times faster than previous MS2-based method. This method enhances retention time alignment by SWATH or other DIA-MS2 data, also validating RT alignments with MS1-based method.

Investigation of Bacterial Antibiotic Persistence by Proteomics

Supervisor: LAM Henry Hei Ning / CBE
Student: CHAN Shek Nga / CBME Course: UROP1100, Summer

Bacterial persistence is a phenotypic change that allows a subpopulation of bacteria to survive high dosage of antibiotic and is a leading cause of chronic infections. The eventual aims of this study aims to characterize the persistence mechanism of bacteria against antibiotic stress on a systems-wide basis and identify protein biomarkers that can serve as potential drug targets. The experimental plan involves treating bacterial cells with sub-inhibitory doses of antibiotic to induce persistence. Persistent cells and untreated cells are then analyzed using label-free

quantitative proteomics. In the initial stage of this project, proteomic sample preparation methods were tested on bacterial cells and optimized for sensitivity to handle limited samples. Preliminary work has been carried out to identify suitable experimental conditions for bacterial culture.

Extraction of Stevia Glycosides as Food Additives Production

Supervisor:	LAM Leung Yuk Frank / CBE		
Student:	LEUNG Ka Fung / CHEM	Course:	UROP1100, Fall UROP2100, Spring

Stevia Glycosides are essentially non-caloric but having higher sweetness level than that of caloric natural sweeteners. Rebaudioside C, one of the active species in Stevia Glycosides from Stevia extract, was used as food additives for calorie-reduced food. In this research, the main purpose is to extract Rebaudioside C from Stevia extract with higher purity by recrystallization. Recrystallization with reflux was performed for extracting Rebaudioside C, using solvent of methanol, ethanol and water in order to increase the concentration of Rebaudioside C. The crystallization rate of Stevioside was higher for ethanol system while crystallization rate of Rebaudioside A was higher for methanol system. The ratio of water and organic solvent for solvent was important for content and yield for crystals.

Humanitarian Chemical Engineering - A Summer Expedition

Supervisor:	MAK Andrew Tsz Chung / CBE	Co-supervisor:	LIU Yuanshuai / CBE
Student:	LI Yongyi / IIM	Course:	UROP1000, Summer

In this investigation report, efforts are made to design a decentralized waste-to-energy (WTE) system for household food waste, and conduct a feasibility study under the context of Hong Kong. The objective is to develop a more efficient way to alleviate the problem of household food waste in Hong Kong, and minimize the pressure of landfills being filled up. Some literature reviews and quantitative interpretations have been made within the time constraint. It was concluded that a decentralized WTE system in Hong Kong is economically feasible while challenges exist in energy performance and technical parts, and still some possible improvements are available in discussion section.

Humanitarian Chemical Engineering - A Summer Expedition

Supervisor:	MAK Andrew Tsz Chung / CBE	Co-supervisor:	LIU Yuanshuai / CBE
Student:	PURNAMA Vincentius Mario / CBME	Course:	UROP1000, Summer

The investigation report is created because of the concern on the water scarcity problem in India. India has a lot of population yet the clean water supply is not plenty. Therefore, this project aims to find a new solution for the problem. A water purifier tank was developed before in India's rural area. Referring to that water purifier technique, a new portable water purifier might be designed with practical, simple and cheap attributes. It should be humanitarian; hence, it should be affordable and easily produced. By considering the guidelines provided by World

Health Organization, the product design should be able to produce potable water with certain safety measurements as cheap as possible.

The Effect of Particle Size on Solids Suspension in a Stirred Tank Reactor

Supervisor:	MAK Andrew Tsz Chung / CBE	Co-supervisor:	HUI Chi Wai / CBE
Student:	TAI Siu Ting / CBME	Course:	UROP1100, Summer

This report attempt to find factors that may affects the exponent of particles diameter as a possibility in improving the Zweitering correlation (1958). A literature survey and an analysis of exist experiment data was made. It was suggested that particles with settling speed above and below 0.177shows different behavior and off bottom clearance of impeller may pose influence in the particle size effect. This behavior may suggest that the suspension mechanisms of particles are divided into providing energy to pick up particles and avoiding settling.

Advanced Catalysts for Water Splitting and Hydrogen Production

Supervisor:	SHAO Minhua / CBE		
Student:	LIU Yuebin / CIVL	Course:	UROP1000, Summer

The environmental problems, raising energy demand and energy shortage have motivated the development of renewable energy resources. Fuel cell through hydrogen evolution reaction (HER) is one of the focuses in order to produce clean energy and meet the energy demand for long-term use. Yet, platinum catalysts have finite practicality in energy generation in fuel cell because of unaffordable cost and low energy output in alkaline environment. Therefore, we work on PtRu alloys particles with different temperatures so as to find out alternatives. Mixed with Ru, PtRu showed higher electrocatalytic activity in both acidic and alkaline conditions than Pt/C. One possible reason could be the existence of Ru which helps remove H_{ad} intermediate through the reaction with OH_{ad}.

Advanced Catalysts for Water Splitting and Hydrogen Production

Supervisor:	SHAO Minhua / CBE		
Student:	WOO Nam Jae / CENG	Course:	UROP1000, Summer

Hydrogen is a valuable resource that would be very useful as an energy carrier in the future. As it not only has high efficiency of producing energy but also is free from pollution, producing and storing hydrogen efficiently is an important challenge that we face. Hydrogen Evolution Reaction (HER) can be a major production method, and catalysts play an important role for its high efficiency. Thus, efficiency, which is activity of catalysts, is an essential property that should be under sufficient research. Existing highly efficient catalyst is platinum. However, its low cost-effectiveness hinders itself to be widely utilized. In this research, cobalt will be tested to find its potential to replace platinum for efficient hydrogen production. In addition, variation of sampling conditions is also conducted to find its optimal condition as a catalyst.

Advanced Catalysts for Water Splitting and Hydrogen Production

Supervisor: SHAO Minhua / CBE
Student: YOU Chae Young / CHEM Course: UROP1000, Summer

Current outlook on hydrogen production through water-splitting has low cost-effectiveness due to expensive Pt-based catalysts. Although Pt-based materials exhibit high efficiency, its preciousness and susceptibility in alkaline medium hinder wider usage of hydrogen as an energy source. To augment the application of hydrogen, other non-precious transition metals (Co, Ni, Fe, Ru) have been suggested as the substituents, but activities of these metals are inferior to that of Pt. Encapsulating these metals into the nitrogen-doped carbonaceous matrix through electrospinning may remedy the inefficiency. This report aims to optimize conditions to synthesize electrospun catalysts and examine their performance. Ru-based material required the minimal overpotential to proceed the reduction, validating higher efficiency, but it still has limitations with its universality in different pH.

Catalysts for Direct Ethanol Fuel Cell

Supervisor: SHAO Minhua / CBE
Student: HAN Eunhye / CHEM Course: UROP2100, Fall

The soaring energy demand, environmental concerns and limited fossil fuels have triggered the development of hydrogen-based energy production via hydrogen evolution reaction (HER), with an aim to obtain clean energy production as an alternative to fossil-fuel technologies. However, state-of-the-art Pt-metal catalysts exhibit finite practicality in fuel cell systems due to the high cost and relatively low energy output in basic media. Here, we present PdRu alloy catalysts with different composition ratios to be positive substitution for Pt. With the presence of Ru, PdRu showed better activity in both acidic and alkaline media than Pd/C. This could be due to the presence of Ru which helps to remove H_{ad} intermediate through the reaction with OH_{ad}.

Catalysts for Direct Ethanol Fuel Cell

Supervisor: SHAO Minhua / CBE
Student: MADEJ Dominik / CBME Course: UROP1100, Fall

Platinum is one of the most popular catalysts utilized in Direct Ethanol Fuel Cell. To tackle a few limitations of pure platinum as catalyst, it is often alloyed with other metals in order to increase its selectivity and resistance to CO poisoning. As transition metals seem to be especially promising in this application, their formation of alloys with platinum and catalytic activity is extensively investigated. Here, we report the synthesis of Pt_2Co and Pt_2Fe alloys. Their electrocatalytic activity in electro-oxidation of ethanol was investigated and compared with pure platinum catalyst. The results suggest that Pt_2Co and Pt_2Fe alloys have much higher catalytic activity than unalloyed platinum in ethanol electro-oxidation reaction.

School of Engineering

Department of Chemical & Biomolecular Engineering

Fuel Production from Carbon Dioxide

Supervisor: SHAO Minhua / CBE

Student: HUI Yiting / EVMT Course: UROP1100, Fall

Reducing CO_2 into hydrocarbon fuels has long been a popular concept since it could significantly ease global warming and help to prevent energy crisis. Given the low chemical reactivity of CO_2, strong catalysts are required and thus many novel materials are synthesized in an attempt to figure out an optimal one with greatest catalytic activity and product selectivity. After reviewing the capability of copper to catalyze CO_2 reduction, the affinity to CO of Pd nanoparticles, and the important influence of alloy composition in catalytic traits, this report aims to test whether Pd-Cu alloy with different composition ratios possess favorable characteristics. This report involves detailed experimental procedures, followed by results and discussions on observed phenomenon. Finally, it concludes that Pd-Cu alloys may not be suitable for catalyzing CO_2 reduction and proposes some hypothesis for future study.

Air Quality Survey at Various Sites in Hong Kong

Supervisor: YEUNG King Lun / CBE

Student: FAN Yuwen / EVMT Course: UROP1000, Summer

ZHUANG Qinru / EVMT UROP1000, Summer

Malodor is an obsessing environmental issue, on which many engineers work hard. This is a study about testing the effect of a new type of hydrogel in various sites of Hong Kong. We are assigned to help do the researches in Jordan Valley Box Culvert and Shing Mun River. In Jordan Valley Box Culvert, the midstream and downstream were polluted more seriously than upstream. After hydrogel treatment, both BOD value and COD value of the water are lower, which indicates the concentration of chemical pollution and the biodegradable organics content decrease. In Shing Mun River, the BOD value decreases overall after hydrogel deployment while COD value has no significant change. In conclusion, the hydrogel is efficient on reducing biology pollution.

Bioactivity of Indoor Dust and Particulates

Supervisor: YEUNG King Lun / CBE

Student: KIM Solin / CBME Course: UROP2100, Fall

SAMIN Felicia / CBGBM UROP1100, Fall

Dust and particulates in indoor environment are known to contain various chemical compounds originating from various household products. Furthermore, the widespread use of disinfectants in many household cleanser expose risks of having unwanted reactions with dust and particulate matters resulting in toxic byproducts. This project is a continuation of a previous project aiming to measure the bioactivity of dust and particulates collected in indoor offices so as to investigate its effects upon living organism post-reaction with common household disinfectants: bleach and antimicrobial coating. Particularly in this project, the bleach was exposed directly to the solid dry dust. In addition, customized antimicrobial coating without copper was used to eliminate the chance of cross-toxicity effect

from the copper.

New Technologies against Malodors

Supervisor:	YEUNG King Lun / CBE	Co-supervisor:	HAN Wei / ENVR
Student:	WINATA Olivia / CBME	Course:	UROP1000, Summer

This project investigates the effectiveness of the technology to reduce the malodor in water drainage in several sites in Hong Kong. The project aims to reduce health risks of residents and complains received by the Drainage Services Department (DSD), as well as preventing corrosion of sewer. The technology that is currently used is hydrogel with active ingredients which are biocide acid and metabolic inhibitor to reduce generation of H2S gas, by killing and suspending the growth of Sulphur-Reducing Bacteria (SBR). Under anaerobic condition, SBR consumes the Sulphur and produce H2S, therefore good control of SBR will avoid the formation of H2S. The effectiveness of the gel is analyzed by monitoring the level of malodor gases and water sampling during and after the deployment of hydrogel.

Department of Civil & Environmental Engineering

Deep Learning for Aesthetic Assessment of Bridges

Supervisor:	CHANG Chih-chen / CIVL		
Student:	LAI Yong Xin / CIEV	Course:	UROP1100, Spring
	NG Zhi Yong Ignavier / COMP		UROP1100, Spring
	TANTIVANGPHAISAL Pishun / CIGBM		UROP1100, Spring

Hand-sketch image is a crucial and intuitive way to express's people thought in Civil Engineering. To calculate corresponding responses such as internal forces, engineers and academicians often need to manually reconstruct the entire structural system in Finite Element Model (FEM) software. This study proposes a novel machine learning architecture that can specifically reconstruct civil structural diagram from a hand-sketch image domain to a finite-element mathematical domain. The proposed architecture consists of a classification system using convolutional neural network (CNN) and an object segmentation system using selective search. The former system achieves 91% accuracy while the latter system is able to segment objects at fairly performance in simple structural diagrams.

Image-based Structural Analysis Using Deep Convolutional Neural Network

Supervisor:	CHANG Chih-chen / CIVL		
Student:	BERNADINO . / CIVL	Course:	UROP1100, Summer
	SAN JUAN Justin David Quitalig / CIGBM		UROP1100, Summer

Hand-drawn diagrams are the most intuitive and direct way to express concepts and designs in Civil Engineering. However, a structural analysis system for such diagrams is yet to be developed. The conventional way of using Finite Element Model (FEM) requires time to construct the mathematical model from the hand-drawn diagram in the software. To speed up the reconstruction time, this study proposes a system that can recognise hand-drawn diagrams, segmentise and classify their structural elements for further analysis. Selective Search and a Convolutional Neural Network (CNN) are used in this project for the objectives respectively. At the current stage, this study combines the segmentation and classification process with a maximum empirical accuracy of 89.8%. Faster R-CNN is also presently being investigated to replace the CNN.

Personalized Learning for Civil Engineering Using Recurrent Neural Network

Supervisor:	CHANG Chih-chen / CIVL		
Student:	TAN Ke Yi / COMP	Course:	UROP1100, Summer

Solving problem sets is essential for students to master key concepts taught in a course. Often, the instructor assigns problem sets for students to work with, to check students' progress and understanding. However, it is difficult to serve students varying in learning style and learning progress with a single subset of questions. Questions for each

student can therefore be personalized based on his or her learning needs, for an effective learning experience through problem solving. Recommender system serves as an automated process to select appropriate questions for each student. In this paper, we reviewed and implemented two fundamental approaches to designing recommender systems, specifically for educational purposes. Content based method is then chosen as our approach to recommend questions.

UROP Research on the Assessment of Population Exposure to Air Pollution

Supervisor: LAU Alexis Kai Hon / CIVL
Student: CHAN Yat Suet / EVMT Course: UROP1100, Fall

According to a research done by the World Health Organization, about 92 percent of the world population is suffering from air pollution that exceeds the WHO standards. The unsafe level of air pollution leads to over 3 million deaths a year. This report studied how the Criteria Air Pollutants link to different health problems in Hong Kong, especially for the Nitrogen dioxide and Particulate matters by comparing the statistics from the Environmental protection department and researches.

A Big Data Landslide Early Warning System with Apache Spark and Scala

Supervisor: WANG Yu-Hsing / CIVL
Student: CHANG Bing An / MATH Course: UROP1100, Fall
WONG Wen Yan / COSC UROP1100, Fall

This report provides a detailed description and running-time analyses of the functions written to extract information from the Metadata Event Log (MEL) over the Fall semester of 2016. Two new functions were added to the API, namely getLatestStatus() and partitionDF(). The former returns the latest metadata of each distinct station in the given Dataframe, whereas the latter partitions the given Dataframe based on the given list of start and end times. Also, the previously written query() function was edited to include getLatestStatus(), which improved its running time by 500% for our test case. Some other minor adjustments were also made to improve modularity, generalizability, and user readability, which are not elaborated here. Finally, we discuss potential future function implementations and optimizations.

A Big Data Landslide Early Warning System with Apache Spark and Scala

Supervisor: WANG Yu-Hsing / CIVL
Student: SUN Ji / CIVL Course: UROP1100, Fall

Big data analysis is the new concern for researchers and company which deals with a vast database. Since we can place more sensors to collect more data, the crucial part is the way we deal with the data, especially for seismic monitoring field. This report provides an overview about why the conventional programming is not that powerful

when dealing with the vast database and what we can achieve with Scala functional programming with some explaining examples.

Advanced Landslide Identifications, Classifications, and Prevention in Hong Kong using Deep Learning

Supervisor: WANG Yu-Hsing / CIVL
Student: CHAUDHRY Mukund / PHYS Course: UROP1100, Summer

This study looks at the use of deep learning techniques for segmentation of satellite imagery, in an attempt to detect and segment landslide scars. For this approach, two main image segmentation models: U Net and Dilated Convolution were applied. The network was trained over satellite data of landslide scars with the help of gradient descent over a weighted loss function. This report contains the results of these trained models. It also contains a discussion of possible improvements to the models.

Advanced Landslide Identifications, Classifications, and Prevention in Hong Kong using Deep Learning

Supervisor: WANG Yu-Hsing / CIVL
Student: SUN Yimeng / COMP Course: UROP1000, Summer

Deep learning is the revolutionary application of neural networks in computer science field, and it helps to learn tasks using more than one layer. This UROP project aims to figure out the location of an arbitrary picture taken from the aerial view, and the convolutional neural network is implemented to train the model. In the report, the basics of convolutional neural network will be talked about, and the implementation will be illustrated as well.

Advanced Landslide Identifications, Classifications, and Prevention in Hong Kong using Deep Learning

Supervisor: WANG Yu-Hsing / CIVL
Student: WONG Ho Kan / CIGBM Course: UROP1100, Summer

Hong Kong is a mountainous city with lots of landslides happening every year. It is a huge challenge for the HKSAR government to monitor and keep a clear record of them because there is no way to identify the location of landslide and its scale in real time. This research addresses the problem by applying deep learning in landslide recognition. The use of artificial intelligence (A.I.) has been emerging in the past decade. Deep learning, as a branch in A.I., is used mainly in computer vision problem, while the application on civil engineering-related problem is still limited. Hence, this report aims at testing different well-established deep learning model and evaluates their performance in landslide recognition.

Advanced Landslide Identifications, Classifications, and Prevention in Hong Kong using Deep Learning

Supervisor: WANG Yu-Hsing / CIVL
Student: YIU Ka Yan / CIGBM Course: UROP1000, Summer

In recognition of the increasing involvement of technology such as artificial intelligence in the engineering industry as an important factor of more accurate and stable creations, together with my personal interest in programming and incorporating software technology, I have taken up this Civil Engineering based UROP project.

With no background in big data or machine learning, I aspire to learn how to make use of Deep Learning by first tackling the task of learning how to program in Python with basic knowledge in Java programming, as without so I will not be able to contribute to the project. Hence this progress report aims to reflect how I have adapted my knowledge in programming to the Python language.

Designing Reliable, Scalable Software Systems for Internet of Things (IoT)

Supervisor: WANG Yu-Hsing / CIVL
Student: TAN Tun Jian / CPEG Course: UROP1100, Summer

In this work, we address the task of semantic segmentation with Deep Learning to classify the aerial photograph and try to find a model suitable for this task. U-Net has been chosen based on its straightforward architecture. The model has been modified to suit the task. We have been able to achieve an accuracy of 87 percent in segmenting and classifying the Potsdam dataset in phase 2 of our work. The accuracy is considerably high; however, there are better state of the art network models available. We plan to experiment on other models in the future to achieve better performance.

Practical Data Analyses with Scala and Spark

Supervisor: WANG Yu-Hsing / CIVL
Student: WONG Kok Yiu / CIVL Course: UROP1100, Spring

The engineering industry is forecasted to profoundly benefit from the knowledge of computer science, in which machine learning algorithms could serve to detect anomalies and problems from large datasets. Such advancement in the Internet of Things era shall contribute to the potential challenges, such as predictive maintenance, which is a kind of maintenance techniques that determine the real-time condition of in-service equipment, subsequently predict the need for maintenance work. This strategy, being applied in urban infrastructure, could facilitate engineering practices like landslide risk assessment, which is recognized as the key to one of the catastrophic natural disasters in engineering industry. Adoption of distributed computing and exploratory data analyses on regional data shall help prevent those catastrophes, enhancing the public livelihood.

Computer Visualisation of Sand Grains

Supervisor: ZHAO Jidong / CIVL
Student: CHAU Shun Wai / CIVL Course: UROP1000, Summer

This research aims to visualize non-overlapping sand grains using the ray-tracing software POV-Ray (The Persistence of Vision Ray Tracer). The coordinates and radii of each sand grain would be calculated using Python and then plug into the POV-Ray for visualization. This method is quick when generating non-overlapping sand grains as distance formula is applied to the neighbor objects only instead of all previous objects. The principle of the code is to stack numerous of cubes together, in which each cube contains one sphere only, to build a large cube. After that, a 'noise' function would be added to the surface of each sphere to generate a randomly shaped surface and make them look more realistic.

Determination of Permeability in Porous Media

Supervisor: ZHAO Jidong / CIVL
Student: LI Meibai / CIVL Course: UROP2100, Fall

Tortuosity is an important factor when estimating permeability of porous media. Different methods are introduced to determine tortuosity in porous bed. The article reviews several methods employed by scholars to calculated tortuosity and the focus is given on a relatively new method named Path Tracking Method. The algorithm, advantages and limitations are briefly introduced, and a comparison is made between Path Tracking Method and two other methods used for determination of tortuosity.

Department of Computer Science & Engineering

Indoor Localization and Mobile Computing

Supervisor: CHAN Gary S H / CSE
Student: CHEN Liangwei / COSC
Course: UROP1100, Fall
UROP2100, Spring

In the real life signal map for indoor localization, the data can be easily modified due to environmental change. However, complete-map re-crowdsourcing is time and human source consuming. In order to reduce the work needed for reconstruction of signal map, researchers have brought up many ideas. Methods such as Gaussian Process Regression leads to efficient auto-reconstruction of signal map theoretically, however, the detection of new Access Point from a certain Reference Point is locally dense and auto reconstruction may suffer from missing the new AP for nearby RPs, which will lead to high mistake rate. In this project, we proposed to apply clustering algorithm for RPs in order to find out the local clusters. This idea is based on the fact that the RPs having similar RSSI-vector tends to belong to the same group in special distribution and have tendency to react similar to new added APs. In the following passages we will introduce the flow and details of the clustering, 1.Unsupervised learning for primitive cluster, and 2.SVC for mature cluster.

Indoor Localization and Mobile Computing

Supervisor: CHAN Gary S H / CSE
Student: KIM Minkyung / COMP
Course: UROP1000, Summer

This project proposes an indoor positioning system to localize the position of user in indoors. The application that is used for this project uses the localization technique which makes use of the geomagnetic field. This localization technique does not require any physical infrastructure thus, it is possibly low cost. To estimate the user's position using the geomagnetic field, the device measures the magnetic field on selected position using a magnetometer in the mobile device and compares this measurement with the magnetic field map for the location specific context that has already been created previously. This project aims to make 'walking while site surveying' application to collect the magnetic field data of the area while the user is moving its position. This report will discuss development process about implementing this technique on existing Android application.

Indoor Localization and Mobile Computing

Supervisor: CHAN Gary S H / CSE
Student: TA Ngoc Linh / COMP
Course: UROP1100, Fall
UROP2100, Spring

Geomagnetic-based indoor localization using Conditional Random Field (CRF) is promising because its accuracy is higher than previously-invented geomagnetic-based localization algorithms using Particle Filter. However, due to the

"offline" nature of the algorithm as well as the relatively high degree of similarity of geomagnetic fingerprints in different places within the same floorplan, CRF is unable to produce highly accurate localization result within a very large area in real-time. This report proposes several methods to tackle this issue. First, CRF is fused with a WiFi-based localization algorithm to accurately narrow down search space for possible user's location and thus effectively eliminate the matching with similar geomagnetic fingerprints in inaccurate locations. Second, the geomagnetic fingerprint matching part in CRF is modified to increase the accuracy of localization result per step, which represents what users see in real-time in their indoor-localization mobile app. Finally, small implementation improvements are introduced to increase the responsiveness of the whole localization system.

Indoor Localization and Mobile Computing

Supervisor: CHAN Gary S H / CSE
Student: ZHAO Ziqi / COMP Course: UROP1100, Summer

Pedometer based on smartphones' inner accelerator has been widely used to estimate the walking distance and do rough navigation in indoor localization service. Though latest smartphones have built-in step counters already, the limitations are apparent and annoying. Therefore, a set of algorithms based only on accelerator should be proposed. This paper focuses on walk detection (WD) using standard deviation and magnitude threshold, step counting (SC) using moving average and peak detection, and step length estimation (SLE) using walking frequency and deviation. Experiment results show that the combination of WD and SC part works pretty well, where nearly all normal walks are detected and other interference will be ignored. But SLE doesn't give a satisfying performance, whose average error rates are around -5%.

Indoor Localization and Mobile Computing

Supervisor: CHAN Gary S H / CSE
Student: ZHU Xinyu / COMP Course: UROP3100, Fall

In this report, we will focus on the localization algorithm based on maximum likelihood. Some optimization methods will be introduced to improve the performance and accuracy of the algorithm. We will also try to reduce the influence of GPS error in our system so as to improve the accuracy of localization. In the end, we will do some simulation of localization based on this method and compare it with some other RSSI localization methods.

Video Cloud and Data Center for Pervasive Streaming

Supervisor: CHAN Gary S H / CSE
Student: FENG Xuming / MAEC Course: UROP1100, Summer

Cloud computing is playing an increasingly essential role in the modern society. A key process of cloud streaming is passing values between server and web application. This project has made an attempt to implement JSON on

video-server assignment in cloud streaming field. The key method of this project is passing values between the web page and web servlets with AJAX “GET” and “POST” method. This project has enabled server information attainment from the database with AJAX “GET” method as well as modifications to the server database with AJAX “POST” method. Further improvements need to be implemented to accomplish multiple video-server assignment simultaneously.

Video Cloud and Data Center for Pervasive Streaming

Supervisor: CHAN Gary S H / CSE
Student: KHAN Irtaza Ahmad / COMP Course: UROP1100, Fall

Spending on Digital marketing campaigns amounted to 27.9 billion USD [3] in 2014 in USA alone. Advertisers in general were not satisfied with the return generated by these advertisement campaigns and were afraid that their advertisements were posted on in-appropriate websites. This paper describes resent development in Programmatic advertisement technology and evaluates its limitations. Furthermore, current pricing strategies are evaluated and recommendation on the need for a minimum quality score cut-off is made. Then the important research topic of detecting publisher fraud is explored in the second part and existing techniques to prevent such frauds are elaborated.

Video Cloud and Data Center for Pervasive Streaming

Supervisor: CHAN Gary S H / CSE
Student: WU Yun-ju / COMP Course: UROP1100, Fall

This UROP report can be divided into two major topics. One is about video streaming the other is about Revive ad server. For video streaming, I divided it into three main data managements: codecs, containers (take MP4 as example), transport network (take HLS as example). The other topic is about reviving ad server that manages ad serving on websites. For Revive ad server, I simply described what it is and how it works. In the result part of Revive ad server, the invocation code in javascript was given to demonstrate how to insert ad banner on a website using Revive.

Wi-Fi Tracking and User Analytics

Supervisor: CHAN Gary S H / CSE
Student: LI Tianze / RMBI Course: UROP1000, Summer

Indoor positioning has always been a barrier to conquer since positioning technique first came into being. Obviously, it’s nearly unachievable using traditional positioning methods, like satellite positioning. Among the seven hottest ways of indoors positioning (infrared, ultrasonic, RFID, Bluetooth, ZigBee, UWB, Wi-Fi), the most comprehensive and convenient way is to use Wi-Fi, which is exactly what this project is trying to achieve. Thus, with the hope of getting

more knowledge of this positioning method, I took part in this project. During the whole project, I got to know things from basic theory behind to advanced application of smart AP, the fundamental part of the project. Aside from indoor positioning, user analysis is also an important part. Not invading users' data and privacy, we could still grab useful information out of the data stream passed to the router (our smart AP). In this way could we do some simple statistics on people walking by a specific area without letting them fill a paper or electric form. The survey could be about the type of smart phone, the change of density of visitors flow by time, etc. While providing excellent indoor positioning service to visitors, we could also get our useful statistical results for merchants and shopping malls to get themselves better equipped, for example, improve their promoting strategies. It's a win-win game.

Wi-Fi Tracking and User Analytics

Supervisor: CHAN Gary S H / CSE
Student: VERMA Kshitij / COMP Course: UROP1100, Spring

The project in question was regarding localization in indoor areas using WiFi, under which the sub-project in focus was about predicting missing data collected during the localization process. The report will give a brief overview of the project. It will then describe in detail my contributions and key takeaways.

Wi-Fi Tracking and User Analytics

Supervisor: CHAN Gary S H / CSE
Student: ZHOU Yusheng / MAEC Course: UROP1100, Fall
UROP2100, Summer

Fingerprinting is one of the most popular techniques when developing an indoor localization system. Although fingerprinting provides a rather accurate localization result, the process of offline site survey is usually tedious and time consuming. In this report, we provide a new method which reduces the workload of site survey and meanwhile keeps the localization error on a low level. The method is mainly based on Gaussian process regression which adopts a log-distance path loss model as the mean function. By introducing the new method in a fingerprint-based localization system, the workload of site survey can be reduced to 1/9 to 1/3 of the original system.

Fast Planar Point Location

Supervisor: CHENG Siu Wing / CSE
Student: TSANG Hauton J. / COMP Course: UROP1100, Spring
UROP2100, Summer

The objective of this project is to create a point location data structure that can optimize running time for trajectories. The structure used in this project is a simplified implementation of Cheng and Lau, which implements a location structure that can query the cell of a Voronoi diagram that a point belongs to quickly. In comparison to the model proposed by Arya et al. (implemented in UROP1100), this algorithm optimizes itself in an online fashion, and does

not require the access frequencies of the cells being queried to be known ahead of time. In order to do this, the algorithm assumes that points queried recently are more likely to be queried again, as in the case of most trajectories. Using this intuition, a secondary point location structure consisting of the regions queried the most in a fixed window of previous queries can be built.

Fast Planar Point Location

Supervisor: CHENG Siu Wing / CSE
Student: XIE Yiqing / MATH-CS Course: UROP1100, Summer

Point location is a category of problems of computational geometry. Given a region on the Cartesian plane divided by several disjoint polygons, the purpose of point location is to determine which polygon a query point lies on. This project discusses the situation where the probabilities for points to fall on each polygon are different. It consists of four steps and this essay mainly focuses on the third one. In the first step, a special data structure is created to store the location and weight of the polygons. Then the region is divided into polygons by generating a Voronoi Diagram. In the third step every polygon is further divided into triangles, which simplifies the location of the point. The final step is to determine the weight of each polygon through experiments. In this essay, two algorithms for the sub-division part are introduced and compared in time complexity and other aspects.

Spreadsheet Error Detection

Supervisor: CHEUNG Shing Chi / CSE
Student: BEHERA Anwesha / COMP Course: UROP1100, Fall

Spreadsheets have an immense impact on the way business is conducted across the world. Certain habits of user may cause smells that lead to future faults and inconsistencies in the data stored in spreadsheets. Smells and clusters broadly could be caused by easy reference cells or the bad practices of the users in creating tables and could cause other smells in the same spreadsheet or beyond its own scope. Analysing various versions of the spreadsheets has led to interesting findings where switching between manually entered values and formulated data have speculative causes and implications. Cross-table analysis, conversion of raw data to formulated numbers and digging deeper into the email contexts of the spreadsheet dataset can provide further insights.

Spreadsheet Error Detection

Supervisor: CHEUNG Shing Chi / CSE
Student: ZHANG Xinqi / ECON Course: UROP1000, Summer

This is a UROP project on spreadsheet error detection. The research is based on extensive research of 2194 excel worksheets derived from three business companies (Jaxworks, Enron, PDS), covering financial analysis, operation management, marketing strategy, etc. The main objective is to build spreadsheet error taxonomy, detect clustering

errors and optimize clustering results. The methodology included VBA for combining spreadsheets, 'Kutools for excel' for separating spreadsheets, java program CC2s developed by Prof. Cheung Shing Chi for clustering and detecting smells, and manual inspection. The report provides structured spreadsheet error taxonomy (2 categories and 4 subclasses) in correlation to latent causes, statistical analysis of CC2s results, 6 types clustering errors by CC2s, and 4 types clustering optimization methods compared to spreadsheet user-analyzed charts and manual inspection.

Analyzing Graph Evacuation Protocols

Supervisor: GOLIN Mordecai Jay / CSE
Student: ZHAO Lucen / COSC Course: UROP1100, Spring
UROP1000, Summer

Graph evacuation protocols are a problem defined on dynamic network flow, with the number of out-going edges from each vertex restricted to 1. In this project, we studied one version of this problem with weight at each vertex defined as probability distribution instead of plain number. Based on the results of spring semester, we went one step further to the study of sink location deviation. Some recurrence relation have been developed on the number of vertices in the last group with respect to the size of path, and based on that, a distribution of sink location deviation is found.

A Data-Mining-based System for Trip Planning

Supervisor: HUI Pan / CSE
Student: SIM Kyu Doun / COMP Course: UROP1100, Spring

The following report compares the market trend of smartphone batteries and the actual consumption pattern of smartphone battery of the people. The data collected from the application Device Analyzer, created by Cambridge, shows that what people really need is a battery that could be charge fast enough to make them through the day. A common pattern shown by the people is that they will mostly charge their smartphone devices when they are asleep or when they are in their office, and people mostly charge through AC, rather than through USB charging. Although the battery capacity has not increased dramatically, there are still manufactures that provide fast charging functions or even wireless charging to allow charging not necessarily though plugging the electric source to the device.

Algorithms and Games in Android Devices

Supervisor: HUI Pan / CSE
Student: GAO Shenlai / COMP Course: UROP3100, Spring

As the usage of the mobile smartphones keeps increasing and becomes more and more common, lots of ideas are proposed to furtherly utilize the idle computing resources like mobile data offloading. Mobile data offloading allows devices to share their extra computing resources with others by sending request and response using peer-to-peer

connection. However, human nature can be selfish, which means that a reputation mechanism may be helpful in sharing. And we design and implement an Android application that uses WiFiP2p service. This application allows devices to exchange data so that data offloading can be achieved and the reputation mechanism is also included. And by doing experiments about the time to offload a task, the effectiveness can be also reflected.

Algorithms and Games in Android Devices

Supervisor: HUI Pan / CSE
Student: HUANG Chia-hung / COMP Course: UROP1100, Spring

The final goal of the research is to implement game theory in to the data transfer procedure. This report will first provide the understanding about data transfer APIs of Android application development, including Wifi Peer-to-Peer (P2P), and Bluetooth. It will then go through the development procedure, and implementation details will also be given, including possible bugs, difficulties and corresponding solutions. After the implementations, some experiments about the device details and connection speed have been done and the result will be discussed in the third part of the report. Finally, the total research process will be reviewed and related directions of research will be pointed out, which could serve as future improvements.

Augmented Reality on Wearable Devices

Supervisor: HUI Pan / CSE
Student: HUANG Shan / CPEG Course: UROP1100, Spring

ReadMe is a real-time recommendation system which can detect and present the most suitable virtual objects depends on the mobile users' context. We consider using the phone camera to detect objects like buildings and statues and print corresponding information on the screen.

Blockchain Applications

Supervisor: HUI Pan / CSE
Student: HU Yao-chieh / COMP Course: UROP1100, Summer
LEE Ting-ting / COMP UROP1100, Summer

As the technology took the wind off to the zenith in the recent decades, the industrial of finance can no longer live their halcyon days, havening from the incoming hurricane that grows harder to disguise. Blockchain took its precious initiative to skew the structure of the elephantine financial conventions, in a view to giving a disparate result. One aspect that has set Blockchain apart is its independence, as the fact that people like us who are granted the hands to transact without any third party, inevitably thwarting the business of the banks. And the great clash that is to come, spilled by the prophet, is here at our foot.

This report examines the availability and feasibility of Blockchain via Ethereum network and the relevant technologies. The private network as well as several contracts have been designed and built toward the mind of testing out the value of the smart contract, along with the means it employed to make an impact of our life. Two dedicated parts, concepts and practices respectively, are allocated into seven sections for the purpose of exploring every single facet of Blockchain. To expound and to fathom the secret behind the scenes, the report on one hand looking for the nexus between concepts, and on the other, setting thoughts toward the applications in real.

Blockchain Applications

Supervisor: HUI Pan / CSE
Student: QI Gengmo / CPGBM Course: UROP1100, Summer

The increasing interest in Internet-of-Things (IoT) devices due to their capabilities and low cost has brought advances in new technologies. IoT devices can collect data, share them with other connected devices, infer events and act as they have been instructed. Conventional IoT ecosystems use shared databases and perform queries to infer events.

In this paper, we advance on previous works and we develop and deploy smart contracts on top of a blockchain that processes the collected data from the IoT devices. In order to present the applicability of our proposal, we conduct experiments on three types of contracts by having in mind three cases: (i) data analytics on the blockchain, (ii) real-time data processing and (iii) real-time event inference.

Dissecting WhatsApp Messages and Calls

Supervisor: HUI Pan / CSE
Student: LI Haoran / COSC Course: UROP1100, Summer

This project focuses on the network protocol and database used by WhatsApp, a widely used chat application in the world. To study its network traffic, packet sniffing and traffic flow statistics were performed. Due to changes in whatsapp's protocol and improvement in its encryption, in April 2016, whatsapp successfully implemented its end-to-end encryption(crypt12) application for subsequent versions of whatsapp. This indicates most previous ways to decrypt whatsapp are out of date and become powerless. Based on these factors and my limited knowledge background, most of my work is just some simple guesses about whatsapp client in computer and android phone with the usage of wireshark, the packet sniffer. In addition, I have also successfully performed one attack by decrypting the database with a rooted android phone.

Dissecting WhatsApp Messages and Calls

Supervisor: HUI Pan / CSE
Student: YU Wang Leung / COMP Course: UROP1100, Spring

This project aims to investigate the network protocol used by WhatsApp, a popular mobile messaging application widely used in the world. To study its network traffic, packet sniffing and traffic flow statistics were performed. While we were unable to find unencrypted messages, nor to decrypt the message transmitted, we observed that there were some changes in its protocol over the recent years. Furthermore, we have also examined how WhatsApp Web Client, an official tool which allows WhatsApp users to check and send messages in web browsers, made use of Web Socket and local storage. Finally, we have extended Wagner's work by proposing an implementation of session hijack of WhatsApp Web Client.

Indoor Localization Using Mobile Augmented Reality

Supervisor: HUI Pan / CSE
Student: CAO Yankun / COMP Course: UROP1100, Fall

Mobile augmented reality applications are getting increasingly popular. Among many of such applications, the ability to display an object that responds to user events and moves in a natural way is required. In our work, we have developed such a system where the displayed object can smoothly move to where the user touches on the screen of a mobile device. We implemented it by separating the display and the controller and offering two different modes for the controller, so application programs can still be flexible while utilizing our system. In addition, our system is designed to be thread safe.

Machine Learning on Wearable Devices

Supervisor: HUI Pan / CSE
Student: CHEN Liang-yu / COMP Course: UROP1100, Summer

Artificial intelligence and machine learning have been used in many applications in modern days. People collect data and build models, and create what we called a smart application to make human-like decisions for users and improve the life quality by making it easier. The ultimate goal of this project is to investigate machine learning methods and potential application on wearable devices, and here our aim is to focus on how we can make a model to classify food related data which including text and images, and this process report will discuss how we find a proper way to obtain the greatest outcome for the text data only. With all models as discussed in following paragraphs, our W2V two-layer neural network performs the best among other two classifiers, and we will illustrate on it in part 3 and 4.

Machine Learning on Wearable Devices

Supervisor: HUI Pan / CSE

Student:	CHIU Mang Tik / COMP	Course:	UROP1100, Spring
	LI Andrey / COMP		UROP1100, Spring
	JOO Minhyung / MATH-CS		UROP1100, Spring
	PARK Chun Ho / MATH-CS		UROP1100, Spring

Emotion recognition has been introduced and heavily researched on for a long time. With recent advancement in deep learning, state of the art emotion classification applications have been developed which can reach up to 99% accuracy. These applications mainly analyze facial features and classify subject's emotion. Due to much effort being put into the area and the high practicality of the application, facial recognition for emotion detection has been successful and even commercialized. Yet, compared to facial analysis, emotion recognition through motion seemed not to have gained as much attention. It is believed that similar with facial expression, human emotions can also be hinted from motion. While there have been research on emotion recognition from motion, most were carried out in a controlled environment with little variation in background. In practice, it is difficult to capture human motion from a dynamic background. Therefore, we propose an emotion recognition method through pose estimation of human motion.

Machine Learning on Wearable Devices

Supervisor: HUI Pan / CSE
Student: LEE Kyuhong / FINA Course: UROP1100, Summer

Korean secondhand car market suffers from mistrust between consumers and dealers. Abusing loopholes of existing system, unscrupulous used car dealers fabricate past accident and repair history to make unfair profits. This paper aims to resolve this issue by applying blockchain to secondhand car market. Key characteristics of blockchain – immutability and publicity – will play significant role in making efficient market. With immutable records, blockchain will prevent unconscientious dealers from deleting accident and repair history. In addition, potential market participants will have easier access to information about market price, as all the information is public. By alleviating information asymmetry between used car dealers and customers, secondhand car market will clear its stigma as 'lemon market'.

Machine Learning on Wearable Devices

Supervisor: HUI Pan / CSE
Student: LIANG Zhibo / CPEG Course: UROP1100, Fall

Emotion testing is very important for efficient communication in our daily life. However, for some people with visual imperfection, emotion recognition becomes very difficult, which makes them very difficult to communicate with others efficiently. So many companies try to develop system to recognize people's emotion by using machine learning. However, many of them use picture with exaggerated emotion as train and test set which will give a good performance in laboratorial environment but give poor performance in recognize people's daily emotion. So, I try to train a classifier using picture with non-exaggerated emotion and it can give better performance in daily emotion detection. Experiments have been conducted to demonstrate both the feasibility and usability of this classifier.

Machine Learning on Wearable Devices

Supervisor:	HUI Pan / CSE		
Student:	CHIU Mang Tik / COMP	Course:	UROP2100, Summer
	LIU Qinhan / CPEG		UROP1100, Summer
	MA Qiurui / COGBM		UROP1100, Summer

Previously, we have attempted estimating pedestrians' emotions through motion. By analyzing meta-features of pedestrian poses from captured videos, we have found certain degrees of correlation between motion characteristics and emotions. Yet, features extracted and preprocessed from video data might not be able to fully represent emotion. Some motion features such as acceleration and step counts are either difficult to process from image or are not present in image data at all. By analyzing sensor data in addition to image data, we hope to make use of all motion characteristics to predict emotions.

Security on Internet of Things (IoT) Devices and Network Protocols

Supervisor:	HUI Pan / CSE		
Student:	LAM Ho Shan / COMP	Course:	UROP1100, Spring

The low power consumption nature of Bluetooth Low Energy (BLE) permits it to become more prevalent with the expansion of the Internet of Things. Yet, with low energy comes with low security, there exists many related attacks due to the simplification of the protocol stack. This paper first examines the architecture of BLE that enables it to drastically reduce its energy consumption. Then some of the known attacks will be reviewed and they will be illustrated with real-life scenarios.

Buffer Overruns from Source Code using Deep Learning

Supervisor:	KIM Sung Hun / CSE		
Student:	GAO Tong / COMP	Course:	UROP1000, Summer

Neural dialog system has been an active area of research. Most neural dialog systems follow the sequence-to-sequence framework, that is, to generate an answer for a given question. However, traditional models have a 1-to-1 assumption between questions and answers and neglect the distributions of the target sequences, thus producing monotonous answers. In our research project, we apply a variational sequence to sequence model to generate diverse answers. First, we introduce the mathematical background. Second, we implement DIAL-LV, a model proposed recently to generate diverse answers. Finally, we evaluate the performance of the implemented model.

Learning Code Suggestion with Deep Neural Network

Supervisor:	KIM Sung Hun / CSE		
Student:	FANG Haoyang / MATH-PM	Course:	UROP1000, Summer

Neural dialog system has been an active area of research. Most neural dialog systems follow the sequence-to-sequence framework, that is, to generate an answer for a given question. However, traditional models have a 1-to-1 assumption between questions and answers and neglect the distributions of the target sequences, thus producing monotonous answers. In our research project, we apply a variational sequence to sequence model to generate diverse answers. First, we introduce the mathematical background. Second, we implement DIAL-LV, a model proposed recently to generate diverse answers. Finally, we evaluate the performance of the implemented model.

Learning Code Suggestion with Deep Neural Network

Supervisor: KIM Sung Hun / CSE
Student: HOU Kaijun / COMP Course: UROP1100, Summer

Chatbots such as Siri and Cortana have been widely used in our daily lives. The key requirement of a chat bot is to generate more human-like responses for a user message. To this end, in this project, I conduct research on the text generation techniques. First, I search for existing papers and survey related work in this domain. Second, I implement a typical text generation model named TextGAN. TextGAN consists of a modified LSTM and a modified CNN. To address the mode-collapsing problem, it matches the high-dimensional latent feature distributions of real and generated sentences, viaa kernelized discrepancy metric. Finally, I evaluate the model using BLEU and KDE score and report the results on these metrics.

Neural Dialogue Systems with Diversity

Supervisor: KIM Sung Hun / CSE
Student: SAMBAMURTHY Vikram / CPEG Course: UROP1000, Summer

In a day and age wherein our dependence on technology is greater than ever before, we are also at a great position to exploit modern-day advancements to greatly ease life for us. It is not uncommon for a working professional to receive more than 100 emails a day. Replying to all of those is becoming increasingly infeasible. To resolve this, Google has introduced a feature into their mail client, known as smart reply. The objective of writing this paper is to gather an understanding of related technologies, and explore the field of deep-learning. Although the smart reply mechanism was challenging to accomplish satisfactorily, many other working models were produced, including an effective compression algorithm, an insightful word embedding representation, along with an auto-encoder using a bidirectional LSTM. This is followed by a summary of findings as well as potential tactics to improve the effectiveness of the model.

Neural Dialogue Systems with Diversity

Supervisor: KIM Sung Hun / CSE
Student: ZHAO Zixuan / MATH-PMA Course: UROP1100, Summer

This report will discuss the details of implementing the MEMN2N model and its application on Ubuntu Dialogue Corpus in TensorFlow. MEMN2N is an end-to-end trained recurrent attention model with external memory. The model is designed for sequential data with long term dependencies, which is fit for dialogue systems. The Ubuntu Dialogue Corpus consists of about one million multi-turn dialogues from Ubuntu IRC channel. The implementation is based on an existing chatbot retrieval project by swapping the model with MEMN2N. Three preprocessing schemes and two model types are implemented and compared.

Create a MOOC Course of ARM Assembly

Supervisor:	LI Xin / CSE	Co-supervisor:	BENSAOU BRAHIM / CSE
Student:	BAI Jiaxin / COGBM	Course:	UROP1000, Summer

Equipped with a quad-core ARM Cortex A53 (ARMv8) cluster, Raspberry Pi is an ideal platform to running ARM assembly programs. This paper will introduce how to write and run assembly programs. These programs will focus on basic arithmetic, the reading and writing of memory, standard input and output and the control of GPIO pins.

Create a MOOC Course of ARM Assembly

Supervisor:	LI Xin / CSE	Co-supervisor:	BENSAOU BRAHIM / CSE
Student:	ZHANG Xinyu / COMP	Course:	UROP1000, Summer

In program *Create an MOOC course of the ARM assembly*, the major objective is to design a testing program which can efficiently assess learners' academic and application knowledge on ARM assembly language. In order to achieve this outcome, knowledge on ARM language (e.g. ARM Instruction Set Architecture, ARM development environment setting, development tools etc.) and techniques that are possibly helpful to the final project's establishment (e.g. python/pygame, MCU hardware and programming) were successively studied. Simultaneously, multiple assessing methods were raised and assessed. In the end, the approach that employing .acsii window as IO interface and building a pure ARM-based game was adopted and is currently being worked on.

HCI Application for Fun: Gesture-Enabled Games

Supervisor:	MA Xiaojuan / CSE		
Student:	DAS Prasenjit / MATH-CS	Course:	UROP1000, Summer
	FAN Ziqian / COMP		UROP1000, Summer
	LI Xiang / CPEG		UROP1000, Summer
	XU Muyu / COMP		UROP1000, Summer

With every passing day, the world is coming closer to the best of motion control and gesture recognition technologies. Specifically, the world of gaming has been changing exponentially. From tilting mobile phones back and forth to punching aimlessly in the air to control characters, gaming technology has come a long way. The purpose of this

research was to understand one such technology and develop a game that would use this technology. The communication between Welle and PC was tested using CoolTerm. A more refined communication was established using C#. An adventure game was then developed using Unity2D as the final game for the project. The results of this research can be used to further improve the accuracy of the device and consider the feasibility of use it with games.

Multimodal Interaction with Sensor Fusion in VR/AR

Supervisor:	MA Xiaojuan / CSE		
Student:	CHEN Yuan / COMP	Course:	UROP1100, Summer
	LIANG Zhibo / CPEG		UROP1100, Summer

Gesture is becoming an increasingly popular means of interacting with computers. Meanwhile, virtual reality (VR) and augmented reality (AR) enhance and diversify the interaction between people and computers. However, handles and other handy devices are required for current VR/AR environments to accomplish signal transmission, which weakens the usability of hands and the variety of gestures. We present *WellVR*, constituted by Welle and VR animator. Welle is a sonar device that detects hand movements while VR animator constructs a virtual environment and enables animating objects. In this note, we will analyze the user need, devices, tasks and control system, design gestures and test gesture-mapping control, implement the system architecture and present an informal evaluation on the robustness of this approach.

Smart Home Solutions with Gesture Interaction

Supervisor:	MA Xiaojuan / CSE		
Student:	CHANG Yingshan / COMP	Course:	UROP1000, Summer
	PRATAMA Kevin / COMP		UROP1000, Summer

Our team presents a Welle integration with Philips Hue light, by using finger gestures, we are able to control the brightness and saturation by horizontal and vertical swiping as well as the different colors of the light by a circular motion. We achieve this by allowing the gesture detecting device, Welle, to communicate with Philips Hue via wifi and further give control signals. To ensure accuracy and effectiveness of the gestures, we limit the gestures to three at the time being. Stability check function and multiple thresholds are also involved to filter out random input and environmental noise. Our further plan of implementation is to increase the diversity of the gestures to achieve more user-friendly designs.

Smart Home Solutions with Gesture Interaction

Supervisor:	MA Xiaojuan / CSE		
Student:	FENG Zihan / COSC	Course:	UROP1000, Summer
	WU Tan Tania / COGBM		UROP1000, Summer

Our team presents a Welle integration with Philips Hue light, by using finger gestures, we are able to control the

brightness by swiping up and down as well as the different colours of the light by using a circular motion. We achieve this by allowing the gesture detecting device Welle to communicate with Philips Hue via wifi and further give control signals. To achieve accuracy and effectiveness of the gestures, we limit the gestures to three at the time being. Our further plan of implementation is to implement more gestures to allow more functions of control for the light bulb(s).

Event Summarization on Twitter

Supervisor:	NG Wilfred S H / CSE		
Student:	RYAN Budi / CPEG	Course:	UROP1100, Spring

This project is aimed to survey crawling data from social media such as Facebook, Twitter, Quora, Instagram, Pinterest et cetera. In this project, the researcher is expected to learn how various social media website structure their data, learn to use their public APIs to crawl their data, and use various unofficial methods (e.g. writing a web crawling script using a webdriver framework for example). During the research, it is expected that the researcher would be able to gain a significant knowledge of how to use public social media APIs, web crawling frameworks, and understand the principle of REST (Representational State Transfer) API. Finally, researcher is expected to apply that knowledge to develop a proof-of-concept in the form of a Quora data crawling library which is open-sourced on Github.

Making Sense of Images on Twitter via Contextual Text

Supervisor:	NG Wilfred S H / CSE		
Student:	BAI Chunyan / COSC	Course:	UROP1100, Fall

Following our previous research, we have shown that Twitter, as one of the largest streaming multimedia information source in the world, could provide valuable texts which we can query image with, thus achieving an image search methodology with better timeliness than traditional image search methods. In this semester, further study has been done to strengthen this methodology, optimizing it by studying and comparing more frameworks, minimizing the implication of duplicated images along with state-of-the-art technology and engineering a better search engine based on the research outcome. Our experiments and tests have demonstrated further improvement for this study, along with the first updated prototype.

IEEE VAST Challenge

Supervisor:	QU Huamin / CSE		
Student:	GU Qiao / ELEC	Course:	UROP1000, Summer
	LI Haotian / CPEG		UROP1100, Summer
	YIN Hang / COSC		UROP1000, Summer

School of Engineering

Department of Computer Science & Engineering

The Visual Analytics Science and Technology (VAST) Challenge is an annual contest with the goal of advancing the field of visual analytics through competition. This year, the theme of challenge is to explore reasons why the number of a kind of birds is decreasing in a preserve, and it is divided into four parts, three Mini Challenges with one Grand Challenge. We firstly use Python/Matlab scripts or other visualization tools like Tableau to analyze the data, and then implement a system based on HTML+CSS+JavaScript to demonstrate our findings. We have concluded our work in the required format by the competition and submitted on time.

IEEE VAST Challenge

Supervisor: QU Huamin / CSE

Student: LIN Zizheng / MATH Course: UROP1100, Spring

Quantities of cities in China has witnessed a sharp fluctuation in its housing price for the past ten years, and without doubt, the living quality of Chinese people is closely related with the variation of housing market and stock market. Meanwhile, the constant deterioration of the air quality has become widespread throughout eastern China, such as the haze which currently agitates Beijing. However, few research projects have been conducted to reveal the interrelation between these three factors, let alone the efforts to figure out the patent impacts of air pollution on house market. This academic “vacuum” might be attributed to the complexity as well as the randomness of the current data sets. Hence, to get a deep insight of the relationship between the air pollution, house market and stock market, sophisticated data visualization as well as data mining skills will be applied to perform big data analysis.

Visual Analysis of Big Data

Supervisor: QU Huamin / CSE

Student: HU Qibang / CEGBM Course: UROP1100, Spring

SHAO Yuqing / RMBI UROP1100, Spring

Our project aims to use data visualization method to analyze 2015 yellow taxi data in New York City to gain insights into the time patterns, pick-up and drop-off location pattern and income pattern of taxi trips. From all the available data provided by New York City Open Data, we used Socrata Open Data API to retrieve three suitable datasets of different sizes for analysis. The analysis was composed of spatial and temporal sections, addressing pickup/drop-off patterns and time pattern respectively, with the analytics tool Tableau. The result of analysis will be summarized in conclusion section, followed by discussion and evaluation of our work.

Visual Analysis of Big Data

Supervisor: QU Huamin / CSE

Student: LI Bo / COMP Course: UROP1100, Spring

LIANG Geyu / MATH-PMA UROP1100, Spring

This report, as an outcome of our group’s UROP1100 research during the spring semester, contains 3 parts. The first

part is the process of the data collection during our research. It is usually the initial step of data analysis since to find something from the data, first we have to acquire them. The second part of the report consists of some brief introduction to the basic visualization tools that our group learned or used during our research. The last part of the report is devoted to present some visualization results that come from the data we collected.

Visual Analysis of Big Data

Supervisor: QU Huamin / CSE
Student: LI Junrong / COMP Course: UROP1100, Fall

An attempt has been made to combine skyline operation and top-k operation into an integral method for data set analysis. We go through the existing algorithms for skyline operation and top-k query, selecting and adapting some of the most suitable ones according to the characteristics of the target data. Besides, a next-best computation algorithm is also devised and implemented as an extension of top-k query, in order to improve human-computer interaction and visualize the result.

Visual Analysis of Big Data

Supervisor: QU Huamin / CSE
Student: SAMBAMURTHY Vikram / CPEG Course: UROP1100, Spring

University life brings with it a plethora of choices and the responsibilities that come with them. Most students, having never had to make so many decisions that have far reaching consequences, tend to find this transition extremely difficult. What major to do, which courses to take, which professors are good or bad, these questions are ones that, if left unanswered, can have a negative impact on studies.

With this in mind, HKUST students came together to create a review sharing platform, called ust.space, which allows all students to write reviews for their courses, giving ratings and comments in areas of that course. This provides researchers with a data set that can then be analyzed to answer some of the key questions that students have. We will use this data set to analyse instructor and course evaluations, attempting to find patterns in teaching style and course design that can aid future students when it comes to choosing their courses. The secondary purpose of this paper is to investigate techniques to display review based information in an intuitive way for people who want to find out the best/worst options even when the meaning of best is not readily apparent. We accomplish this by creating an online platform for our data analysis using the aforementioned techniques.

Visual Analysis of Big Data

Supervisor: QU Huamin / CSE
Student: SUN Xinyu / COSC Course: UROP1100, Spring

School of Engineering

Department of Computer Science & Engineering

Quantities of cities in China has witnessed a sharp fluctuation in its housing price for the past ten years, and without doubt, the living quality of Chinese people is closely related with the variation of housing market and stock market. Meanwhile, the constant deterioration of the air quality has become widespread throughout eastern China, such as the haze which currently agitates Beijing. However, few research projects have been conducted to reveal the interrelation between these three factors, let alone the efforts to figure out the patent impacts of air pollution on house market. This academic “vacuum” might be attributed to the complexity as well as the randomness of the current data sets. Hence, to get a deep insight of the relationship between the air pollution, house market and stock market, sophisticated data visualization as well as data mining skills will be applied to perform big data analysis.

Visual Analysis of Big Data

Supervisor: QU Huamin / CSE

Student: WANG Binren / COMP Course: UROP1000, Summer

There are several professional university rankings that evaluate the performance of universities in general or on certain subjects based on different attributes. Nowadays, people place more and more emphasis on university rankings. However, as university rankings include rank, score and sub-scores, they might not be so straight forward and people can hardly get the information they want efficiently. Visual exploration tools can make rankings a lot easier for people to understand and analyze. This UROP project will take one of QS subject rankings (computer science) from year 2014 to 2017 as example and use web-based visualization tools (d3) to present and analyze them.

Visual Analysis of Big Data

Supervisor: QU Huamin / CSE

Student: WANG Yanbang / COSC Course: UROP1100, Fall
UROP2100, Summer

This report serves as a work summary of the primary achievement of face recognition segment in BabyFace project. To conduct face recognition with satisfactory accuracy in an unconstrained setting, where single face samples are provided and test images contains noticeable noises, a pre-trained deep convolutional neural network (CNN) is employed after comparison with several other algorithms. Decoding of the flat layer is improved with integration of priori knowledge and leverage of the temporal information in face sequences. Experiment result proves a significant improvement of recognition accuracy compared with ones achieved by using general classification algorithms based on single face image.

Visual Analysis of Big Data

Supervisor: QU Huamin / CSE

Student: XIE Xinyi / IS Course: UROP1100, Spring

Air quality is a sophisticated issue that is highly relevant to our health. Air Quality Health Index (AQHI), a common scale measuring the level of air contamination, is determined by different sources of pollutants. Thus multiple dimensions are often involved, calling for a more effective tool. Based on a comprehensive visualization analysis, this research focuses on the case of Hong Kong from 2013 to 2016. Seasonal patterns are observed in RSP and RVP while nitrate level (NOx) has shown a steady drop over the years. A peak in ozone level is found in October. Interesting cases of particular stations with distinct characteristics are also examined. To learn the effects of non-local factors, this research also includes an analysis on how wind direction and wind speed are related to the level of small particulates.

Visual Analysis of Financial News Articles

Supervisor: QU Huamin / CSE
Student: LEE Kyuhong / FINA Course: UROP1100, Spring

Although predictive power of analyst recommendations has been investigated for a long time, part of it is still shrouded in mystery. With eidetic understanding of analyst recommendation through visualization, it may yields new investment opportunities, or at least chances to refine current investment strategies to maximize profit. To visualize how powerful and persistent their impacts are on daily stock returns, analyst recommendations from 1997 are extracted from the web and combined with daily stock returns. Analyst recommendation changes are effective indicator of daily stock returns, but only for one or two days after their releases. After that, analyst recommendations seem not to have any meaningful influence on stock returns. Average stock returns on release date are 1.88% and -2.20% respectively in case of positive and negative recommendation change.

Visual Analysis of Financial News Articles

Supervisor: QU Huamin / CSE
Student: PURI Abishek / MAEC Course: UROP1100, Spring

University life brings with it a plethora of choices and the responsibilities that come with them. Most students, having never had to make so many decisions that have far reaching consequences, tend to find this transition extremely difficult. What major to do, which courses to take, which professors are good or bad, these questions are ones that, if left unanswered, can have a negative impact on studies.

With this in mind, HKUST students came together to create a review sharing platform, called ust.space, which allows all students to write reviews for their courses, giving ratings and comments in areas of that course. This provides researchers with a data set that can then be analyzed to answer some of the key questions that students have. We will use this data set to analyse instructor and course evaluations, attempting to find patterns in teaching style and course design that can aid future students when it comes to choosing their courses. The secondary purpose of this paper is to investigate techniques to display review based information in an intuitive way for people who want to find

out the best/worst options even when the meaning of best is not readily apparent. We accomplish this by creating an online platform for our data analysis using the aforementioned techniques.

Visualization Techniques for 3D Urban Environments

Supervisor: QU Huamin / CSE
Student: HE Zhou / COGBM Course: UROP1100, Fall

This Undergraduate Research Opportunities Program project aims to analyze the taxi trajectory data recorded in Shenzhen, and to discover useful patterns from the data in order to provide advice for Shenzhen's urban planning. Specifically, approximately 80 million entries of taxi location information recorded on 2nd January 2016 were used as data source, and two parts of work were completed. The first part was a simple web application which provides interactive graphical user interface to draw the trajectory of one single taxi during a userspecified time period, while the second part is the analysis of Openness Index of four different areas of Shenzhen at four different time periods of a day. For the second part of work, evaluation was carried out based on the visualization result and advice for urban planning was generated after the evaluation. The complete source code of this project is available at https://github.com/samuelzhouhe/urop-data-visualization.

Automatic Photo Capturing Using Drones

Supervisor: QUAN Long / CSE
Student: LI Yefeng / CPEG Course: UROP1100, Fall

With the experience from my last time's participation here, I continued to work on programming tasks which utilize 3D models reconstructed by Altizure and UAV platforms (mainly DJI). My task in this semester is to project a desired point in 3-dimensional space (usually a target location on a building) onto the UAV's monitor screen. Whatever in the view of a UAV's camera can be transmitted onto the user's handset's monitor. To integrate the ability of UAV with reality, and to extend user's view by UAV'sview, one can mark the position of a target on UAV camera's feedback display. To achieve that, not only the geographical information of the camera on UAV, but also that of the target one expect to locate, is required. With the data stored in Altizure 3D models, one can get all necessary data information of a target position.

Exploring Algorithms for Vertex Caching in Real-time Rendering

Supervisor: SANDER Pedro / CSE
Student: DU Yinwei / CPEG Course: UROP1100, Summer

With the development of the GPU architecture, modern GPUs have gained incredible computing power. Meanwhile CUDA points a way for programmer that they can design efficient parallelized GPU algorithms compared to the traditional CPU serial algorithms. This efficiency appears most in the data-clustering area as tons of data need to be

processed at the same time. DBSCAN is such a clustering algorithm which is widely used in analysis for modern chemistry and biology laboratory experiments. Most of the former studies have used kd-tree for k-nearest-neighbors-search in DBSCAN algorithm but it has relatively low performance in high dimension space (Yianilos, 1993). This report will show a way to implement vp-tree using cuda that can be used to increase the efficiency of DBSCAN.

Interactive n-way Facial Image Morphing

Supervisor: SANDER Pedro / CSE
Student: HE Zhou / COSC Course: UROP1100, Spring

Generating morphs between two human faces has been a long-studied topic, but few have been done to extend the investigation into multiple faces. In this project, I propose a new method to generate smooth transition videos between facial images of different people. This morphing pipeline can be decomposed into three parts. Firstly, measure the facial landmark distortion and face color difference between each pair of faces, and use their weighted sum as the amount of difference between a pair of faces; secondly, run Travelling Salesman Problem (TSP) and find out the optimal sequence to transition from one image to the last one; finally, use image subdivision and Barycentric interpolation to generate key frames between two faces and then link them and form a video. The source code of his project is available at https://github.com/samuelzhouhe/Multi-face-morphing.

Natural Language Processing for News and Social Media with Low-resource Languages

Supervisor: SONG Yangqiu / CSE
Student: ZHOU Sheng / COSC Course: UROP1100, Summer

We present a new approach for bilingual word embedding: treat two monolingual word embeddings as manifolds of similar underlying structure, and use a bilingual lexicon as seed to align the two manifolds. Under the low resource language setting, our approach achieves higher monolingual and crosslingual performance comparing to the BiCCA baseline. To address the scalability of the manifold alignment algorithm, a variant called batch Laplacian is proposed. The method has linear running time and demonstrates higher robustness when the aligned samples are sparse. Our model is tested on English-English and Chinese-English embedding alignment tasks with various parameter settings, and the performance on bilingual lexicon induction and monolingual semantic similarity benchmark are reported.

Natural Language Processing for News and Social Media with Low-resource Languages

Supervisor: SONG Yangqiu / CSE
Student: ZHOU Wenxuan / COSC Course: UROP1100, Summer

The Machine Comprehension (MC) task is to answer a question given a context paragraph, which requires deep understanding of the text and interaction between the question and context. Since the publication of the SQuAD

dataset, many models have been presented, which boosts the development of machine comprehension. In this report, we first discuss some of the state-of-art models, and then focus on the R-Net model. The experiments show that our implementation successfully realized the R-Net model.

Efficient Queries over Database

Supervisor: WONG Raymond C W / CSE
Student: WANG Guanzhi / COSC Course: UROP1100, Spring

This report mainly focuses on how to find similar trajectory in a short time by using a mathematics concept - Fréchet Distance. The first part introduces the definition of Fréchet Distance and the method of deciding whether the Fréchet Distance of two given trajectories is not greater than the given bound. The second part elaborates on the data structure of R-tree which is used as a spatial access method and tells how it is used in the project. The total time complexity of this algorithm is O(pt + t*log t + qt*log p + qmp*log p) and total space complexity is O(pt + qmp*log p).

Efficient Queries over Database

Supervisor: WONG Raymond C W / CSE
Student: WANG Haoqi / COSC Course: UROP1000, Summer

The goal of this project is to write a guideline with improved readability for a research software installation. The research software, terrain toolkit, can run on three different versions, MacOS, Windows, and Linux. Based on the original guideline, which is mainly illustrated with Windows, I added more demonstrations for MacOS version, notified some possible errors that the software could generate when running on MacOS and gave the solutions respectively. I also elaborated certain main functions of the software so that the software will be handier for a new user.

Efficient Queries over Database

Supervisor: WONG Raymond C W / CSE
Student: YEUNG Yu Ching / COSC Course: UROP1000, Summer

Finding shortest path between two points on a terrain surface is a common operation in the domain of computer graphics. Several algorithms have been proposed to find the exact shortest path but all of them require long computational time. The best-known algorithm is the Chen & Han (CH) algorithm running in $O(n^2)$, which is still too costly to be applied in real time application. In this paper, we proposed part of an algorithm for finding shortest path between two points on a 3D terrain surface. By eliminating most of the edges and vertexes, the algorithm should be more efficient in terms of both time and space.

Efficient Queries over Database

Supervisor: WONG Raymond C W / CSE
Student: ZHAI Qinwen / MAEC Course: UROP1100, Spring

This is a report for my UROP1100 course this semester. The goal for this semester is to learn the basic knowledge required for understanding research in this field such as common data structures, optimization algorithms and some graph algorithms. To achieve this goal, I read 'Introduction to Algorithms' for the first half of this semester. For the rest of this semester, I tried to read papers in this field, including my supervisor's paper of spatial database, query processing and graph database.

Knowledge Discovery over Database

Supervisor: WONG Raymond C W / CSE
Student: LI Fuzhe / MATH-CS Course: UROP1000, Summer

K-regret minimizing set is a recent approach to selecting a small amount of points which can represent a dataset while the difference between the selected sample and any top-k query is minimized considering all the utility functions. This paper will start with settling the definitions. Then it will introduce what I have learnt about this problem including its hardness, a trivial inefficient algorithm and a plane-sweep algorithm for 2-dimension instances. At the end, a proof for the inapproximability of k-regret minimizing sets problem is shown and the possibility to discover a polynomial-time algorithm for 3- dimension k-RMS problem is discussed. The idea of Section 3.1 & 3.3 belongs to the former study and the the idea of Section 4.2 belongs to a previous student Phoomraphee, and then I just summarized and displayed it. The rest of the paper is my thoughts on kRMS problem.

Knowledge Discovery over Database

Supervisor: WONG Raymond C W / CSE
Student: PAN Linfei / COMP Course: UROP1100, Summer

Massive Online Open Courses (MOOCs) are regarded as a revolution in higher education. While providing open access for many students, online learning limits the interactions between instructor and students. In order to improve students' performance as well as assist course material design, we use data mining methods to analyse students' behaviours and give advice to both students and instructor. Based on the idea of learning dependency within a course, recommendations can be generated by recognizing highly dependent relationship between learning concepts. Continuing Mr. CHEUNG, Tsz Him's and Mr. Du Xinnan's work, this project puts main focus on interpreting data and providing advice on e-learning platform.

School of Engineering

Department of Computer Science & Engineering

Knowledge Discovery over Database

Supervisor: WONG Raymond C W / CSE

Student: SHI Zhenmei / COSC Course: UROP1100, Spring

This report mainly focuses on how to find similar trajectory in a short time by using a mathematics concept - Fréchet Distance. The first part introduces the definition of Fréchet Distance and the method of deciding whether the Fréchet Distance of two given trajectories is not greater than the given bound. The second part elaborates on the data structure of R-tree which is used as a spatial access method and tells how it is used in the project. The total time complexity of this algorithm is O(pt + t*log t + qt*log p + qmp*log p) and total space complexity is O(pt + qmp*log p).

Knowledge Discovery over Database

Supervisor: WONG Raymond C W / CSE

Student: SO Boon Hong Donovan / CPEG Course: UROP1100, Fall

Over the 2016 fall semester, a UROP1100 research under the topic of “Knowledge Discovery over Database” was conducted under the supervision of Prof. Wong Raymond Chi Wing. The research focused on two types of recommender systems, including collaborative filtering and content-based recommendation. A number of texts in this field were analyzed during the research. This report first introduces the definition and the functions of recommender systems. Then, it describes the algorithms of implementing each of the system, with detailed explanation of the model used and the reasoning behind. This report concludes by comparing the two systems and discussing their strengths and their weaknesses.

Knowledge Discovery over Database

Supervisor: WONG Raymond C W / CSE

Student: ZHOU Wenxuan / COSC Course: UROP2100, Fall

The massive open online course has become an important method of learning. There have been many universities getting interested or involved in the program; some even give certificate to the students. Despite its flexibility, in online learning, the students are not forced to learn. When they start to get bored or find the course difficult, they may simply drop the course. According to the report, the general dropout rate of MOOC is 91% to 93%. To enhance the effect of MOOC, it’s necessary to fully make use of the online materials and put forward some new methods to help the students better understand the learning materials.

Research on Mining Course Structure

Supervisor: WONG Raymond C W / CSE

Student: CHENG Xiaohe / COSC Course: UROP1100, Summer

Massive Online Open Courses (MOOCs) are regarded as a revolution in higher education. While providing open access for many students, online learning limits the interactions between instructor and students. In order to improve students' performance as well as assist course material design, we use data mining methods to analyse students' behaviours and give advice to both students and instructor. Based on the idea of learning dependency within a course, recommendations can be generated by recognizing highly dependent relationship between learning concepts. Continuing Mr. CHEUNG, Tsz Him's and Mr. Du Xinnan's work, this project puts main focus on interpreting data and providing advice on e-learning platform.

Research on Mining Course Structure

Supervisor: WONG Raymond C W / CSE
Student: DU Xinnan / COSC Course: UROP1100, Spring

Massive Online Open Courses (MOOC) has largely transformed today's education. However, online e-learning makes interactions between instructor and students more difficult than traditional classes. Thus, data mining in e-learning has become increasingly important. By mining students' performance and behavior, instructor can adjust their teaching strategy to make teaching more effective. This project puts major focus on the evaluation students' performance using data mining method and this project is a continuation of Mr. CHEUNG, Tsz Him's work. Some part of Mr. CHEUNG's work will also be introduced.

Research on Mining Course Structure

Supervisor: WONG Raymond C W / CSE
Student: HARB Elfarouk Yasser Farouk Mohamed / MATH-CS Course: UROP1100, Fall
UROP2100, Spring

Our problem involved diversifying topological sorts of a graph. We developed an efficient algorithm to solve the problem. In this semester, we devised the theory behind the algorithm as well as proved several theorems about it and began implementing the algorithm. The work is summarized in the following document. We also build on the work done in the previous semester. We first defined the diversity metric chosen and then proved several theorems that are necessary to show the correctness of the algorithm. Finally, we explicitly wrote the algorithm as well as analyzed its running time and we have begun implementing it in C++. Subsequent work is to be done in the next semester.

Research on Mining Course Structure

Supervisor: WONG Raymond C W / CSE
Student: LU Xiuyuan / COMP Course: UROP1000, Summer

Massive Online Open Courses (MOOC) has a significant impact on today's learning pattern. However, right now, most

courses online only have single pathway which students have to learn according to. Students cannot get education based on their own characteristics which greatly affects the outcome of online learning. Thus, the concept of self-pace learning is born. In accordance with students' specific conditions, the system recommends the most suitable pathway to them. Last year Mr. CHEUNG, Tsz Him designed a demo system for this concept. This project is the continuation of his project aimed at implementing the system in the Open edX system (the student interface).

Artificial Intelligence with Application to Finance

Supervisor:	YANG Qiang / CSE		
Student:	CHEN Minghui / MAEC	Course:	UROP1100, Fall
	ZHANG Jingyang / COSC		UROP1100, Fall

In this semester, we tried to analysis the models of stock and stock index option. From the model and the equations derived, it is possible to implement the prediction of the stock price as well as the option. Specifically, we tried to obtain the intrinsic parameters from the history data of the stock price, and then plug the parameters into the model implemented to predict the stock and option price. In the future, it is possible to combine the prediction result from other methods to make the simulation and prediction more precise.

Artificial Intelligence with Application to Finance

Supervisor:	YANG Qiang / CSE		
Student:	DING Hantian / COSC	Course:	UROP1100, Fall
	LIU Boyu / COSC		UROP1100, Fall

This project implemented a news sentiment analysis system to predict Hong Kong stock price by analyzing news from Hong Kong media and the fluctuation of the related price stock using convolutional neural network. The basic idea comes from the Kim Yoon's paper: Convolutional Neural Networks for Sentence Classification.

Artificial Intelligence with Application to Finance

Supervisor:	YANG Qiang / CSE		
Student:	HU Yao-chieh / COMP	Course:	UROP1100, Spring
	HUANG Kung-hsiang / COMP		UROP1100, Spring

As the development of the artificial intelligence geared toward the unlimited applications to various fields of recent life, the financial world is not an exception. This paper aims at exploiting the underlying pattern or rule of the stock data that generated daily in an irresistible speed. By the real stock data, the paper utilizes an advanced recurrent neural network named LSTM (Long Short Term Memory) neural network to classify the stock data into two groups. One with ascending triangle, a meaningful pattern hidden in stock data, and one without it. This paper will lead readers through the development of the machine learning model and the application to real stock data.

Artificial Intelligence with Application to Finance

Supervisor:	YANG Qiang / CSE		
Student:	NG Zhi Yong Ignavier / COMP	Course:	UROP1100, Fall
	THAM Brendan Guang Yao / COGBM		UROP1100, Fall

In recent years, Big Data and Artificial Intelligence is prevalent in all functions of the financial services industry. In sales and trading, traders, portfolio managers and quants improve their decision making process to maximize profit by utilizing these capabilities; in compliance and risk management, risk managers use AI to evaluate the institution's risk exposure and liquidity. This report provides an overview of our findings of regulations on the financial services industry, backtesting approaches, and an overview of our simple backtesting program. We will discuss the first half of our project: to replicate portfolio analytics software using Python libraries *pandas* and *numpy* to manage relevant financial data to generate a historical outlook on the trader's position. Finally, we discuss lessons learned and future developments.

Artificial Intelligence with Application to Finance

Supervisor:	YANG Qiang / CSE		
Student:	WANG Luqi / CPEG	Course:	UROP1100, Fall
			UROP2100, Spring
	YAN Rui / MATH		UROP1100, Fall
			UROP2100, Spring

The main objective for this UROP project is to apply the sequence to sequence model to construct a chat robot to be able to respond to specific chat input so as to communicate with human in Chinese with a proper and reasonable manner. We adopted the sequence to sequence model from tensor flow to train with the data retrieved from different sources with different methods. The data set is further analyzed with CoreNLP to produce more accurate result. The basic model is designed during the process, however more refinement is needed. Different models and refinement methods for the data set are required to be tested and compared in the future development.

Artificial Intelligence with Application to Finance

Supervisor:	YANG Qiang / CSE		
Student:	SU Yanzhe / COMP	Course:	UROP1100, Fall

Artificial intelligence is a hot topic today. In this report, I will describe what I learnt about artificial intelligence, RNN (Recurrent Neural Network), sequence-to-sequence model and TensorFlow framework. An experiment using TensorFlow is also conducted to show the effectiveness of the sequence-to-sequence model.

School of Engineering

Department of Computer Science & Engineering

Artificial Intelligence with Application to Finance

Supervisor: YANG Qiang / CSE

Student: ZHAO Lucen / COMP Course: UROP1100, Fall

As the intelligent dialog system evolves, how to order a set of Chinese characters correctly remained as a problem. This report shows a model that could judge the correctness of Chinese sentences. Given a set of Chinese sentences formed with same character set but in different order, this model could calculate the probability of each sentence to stand in correct order. RNN is used to build this model, and LSTM is adopted to ensure that it could memorize contents explicitly and improve the performance of language modeling. After being implemented and tested, this model has shown to be capable of finding the sentence that is most likely to be correct.

Learning Analytics for a Personalized E-Learning Platform

Supervisor: YEUNG Dit Yan / CSE

Student: GUO Wenshuo / PHYS Course: UROP1100, Summer

In this project, learning analytics for personalized E-learning Platform is focused. The work done by the team could be summarized into four parts: the pre-stage data management, the Markov model, feature extractions and the application of RNN model. Given the real log data from the edX online learning platform generated by the course “Introduction to computing with Java” which was offered by HKUST, we aimed to gain insights on students’ learning behaviors and the relationships between learning behaviors and the academic performance. By using machine learning techniques, the grade up to each week during the course offering period and the final grade could be predicted. The results may help on the design and upgrade of the online learning platform.

Learning Analytics for a Personalized E-Learning Platform

Supervisor: YEUNG Dit Yan / CSE

Student: HUANG Kung-hsiang / COMP Course: UROP1100, Summer

Deep Knowledge Tracing (DKT), a technique which a Recurrent Neural Network (RNN) is applied to model students’ knowledge, has been a hot research topic for the past couple of years. The advantage of DKT over other modelling technique is that there is no need for feature-engineering; instead, feeding raw data into RNNs has already shown prominent results. However, this characteristic of deep learning can also be the drawback of it as it is hard to know what is happening in the RNN. Therefore, understanding the how DKT work is essential in improving the model as well as helping instructor delivering more appropriate materials to the students. After trying to visualize the RNN, nevertheless, it seems that there is no implication of the visualization of either the output or the hidden states of RNN at all. In addition, although the sliding window technique improves Area Under a Curve (AUC) during training, the AUC during testing drops, indicating the problem of overfitting associated with this technique.

Learning Analytics for a Personalized E-Learning Platform

Supervisor: YEUNG Dit Yan / CSE
Student: LEE Ho Ting / COMP Course: UROP1000, Summer

This program aims at improving learning preferment on online learning platform by predicting learners' results and hence recommends personalized remedial learning activities through raw clickstreams data. This paper will focus on analysing raw clickstream data of video interaction events to find potential learners who are likely to fail the course. The first part of paper discusses the Markov Model and eigenvector of Markov Model built from video seek sequences. In the second part of paper, focus is shifted onto predicting grade of current chapters and finalized by running Recurrent neural network (RNN) with extracted video features. With the result of academically at-risk learners, it is hoped that some early intervention could be taken to help them pass the course.

Learning Analytics for a Personalized E-Learning Platform

Supervisor: YEUNG Dit Yan / CSE
Student: LIU Ji / COMP Course: UROP1000, Summer

As the number of E-learning platforms grows rapidly, education has been available to everyone with Internet access. However, the huge amount of online students makes it extremely difficult for online learning platforms to cater for every body's characteristics. Since course instructors are not directly connected to students, they are not clear about their learning behavior. As a result, helps cannot be offered effectively and timely and students' learning outcomes are not promised and under control. Hence, in this paper, a student grade prediction model based on clickstream data will be introduced to personalize current E-learning platforms. This model will help online instructors to identify problematic students in time and offer effective help to them.

Machine Learning Algorithms for Predicting Student Performance in Massive Open Online Courses

Supervisor: YEUNG Dit Yan / CSE
Student: HIRANANDANI Anish / COMP Course: UROP1100, Fall

The project I was involved in for the UROP 1100 course in Fall 2016 was entitled "Machine Learning Algorithms for predicting student performance in Massive Open Online Courses" and was supervised by Professor Dit Yan Yeung in the CSE department. While I joined the project this semester, it had already begun in 2016 with progress in a few areas especially concerning the Coursera database. During this semester, our undergraduate group consisted of 3 students, Aron, Felix and me. Our aim for this semester was to study the Open edX structure, gather information and provide useful insights on student performance based on the course data received from 2014. The overall goals of the project include predicting performance as well as building a recommendation system for students.

School of Engineering

Department of Computer Science & Engineering

Machine Learning Algorithms for Predicting Student Performance in Massive Open Online Courses

Supervisor: YEUNG Dit Yan / CSE

Student: ZHAO Zixuan / MATH-PMA Course: UROP2100, Fall

This report will discuss some extension and application of the models to predict students' performance in MOOCs. In the extension part, previous recurrent neural network with LSTM is rewritten in Tensorflow to gain more transparency and flexibility. A new experiment with sequence to target RNN model featuring building only one model is also carried out. Attempts on removing early dropped out students from training data are also made. None of these experiments has better performance than Gradient Boosting Tree model. In the application part, the Gradient Boosting Tree model is chosen to work on the back end of an e-learning analysis platform to solve regression and classification problems of predicting students' performance.

Security Analysis for HTML5+Javascript Applications

Supervisor: ZHANG Charles Chuan / CSE

Student: CHANG Hsin-wen / COGBM Course: UROP2100, Fall

SourceBrella Pinpoint is a static analytic tool that can identify critical bugs and I have been joining the team as a UROP participant since last summer. Throughout the process, I witnessed how Pinpoint could perform source code analyzation and generate bug reports on the web-based user interface. Also, by getting familiar with the developing team, I learned some of the anticipated difficulties they are currently facing. One of them is the improvement required on the overall user interface appearance and its functionality. According to Xiao and Zhang Yu, there are several UE objectives expected to be completed in the future. To have a deeper understanding of the product as well as practice my front-end development knowledge, I was assigned a task of implementing the two slide bars which can adjust the panel width. This report focuses on the implementation attempts as well as the encountered challenges. Last, a personal feedback is followed by the explanations of the codes.

Security Analysis for HTML5+Javascript Applications

Supervisor: ZHANG Charles Chuan / CSE

Student: CHEN Lian / CPEG Course: UROP1100, Fall

This paper is aimed to provide methods of solving websites security bugs and serve as a simple instruction for personal website owner. There are two main kinds of attacks discussed in this paper, XSS attack and directory traversal attack. This paper will analyze simply the basic mechanism of these bugs and the potential way hackers use to do these attacks. The most important part of the paper is to provide general methods to deal with these bugs, one is a XSS cleaner and another is a website structure involved with directory deployment, htaccess and "Gatekeeper" main page with While-List. Both methods are provided with code details.

Department of Electronic & Computer Engineering

Nano-Transistor Modeling for Circuit Simulation

Supervisor:	CHAN Man Sun / ECE	Co-supervisor:	ZHANG Lining / ECE
Student:	BEN AYED Ahmed / ELEC	Course:	UROP2100, Fall
	MEHTA Jainam Bharatkumar / ELEC		UROP2100, Fall

This project report outlines our work and research performed over a period of 4 months on the topic of Nano Transistor Modelling for Circuit Simulation. For this semester, our project work was divided into two major sub-sections, namely GFET and MoS2 devices. Taking the scope of our work from the previous semester, firstly, this report discusses GFET devices and suggests an improved Matlab model. The updated simulations are displayed, along with some corrections to the underlying equations. Next the report examines MoS2 devices along with displaying the obtained simulations and results in various conditions. Finally, we discuss the MoS2 model implementation on the i-MOS platform.

Nanomaterial-based Novel Solar Cells

Supervisor:	FAN Zhiyong / ECE		
Student:	CHAN Teresa / BIBU	Course:	UROP1000, Summer

Anodic aluminum oxide membranes gain attention over the past few decades, due to its various applications to different fields by the utilization of diverse nanostructure types. However, it is also noticeable that its large-scale fabrication is seldom studied, since various parameters that affect the morphology of the nanostructures become hard to control upon the increase in fabrication size. In this experiment, we observed the effects of various conditions on the formation of nanopores, as well as discuss the possible improvements that could be made in future attempts. It was confirmed that large-scale fabrication of AAO with self-ordered nanoholes requires delicate control on anodization time, voltage control, and choice of electrolytes, and improvements on anodization parameters are recommended for highly-ordered nanohole arrangement.

Semiconductor Nanowire-based Sensors and Electronics

Supervisor:	FAN Zhiyong / ECE		
Student:	JING Ying / ELEC	Course:	UROP1100, Fall

The project mainly focuses on the characteristics of nanowires under the supervision of Professor FAN Zhiyong. It is about the Random Access Memory research for nanowire carried out by the Professor FAN Zhiyong, Mr. Swapnadeep PODDAR, etc. The interests fall on the relationship between the change of current and voltage, through which the memory process could be recorded. The hypothesis of the ideal I-V diagram is shown as Figure 1. Up to now, the Figure 1 idea for the positive current has been proved, but the negative part is still in progress. My task in the project

is assisting Mr. PODDAR in preparation, including making aluminum chips and polishing them.

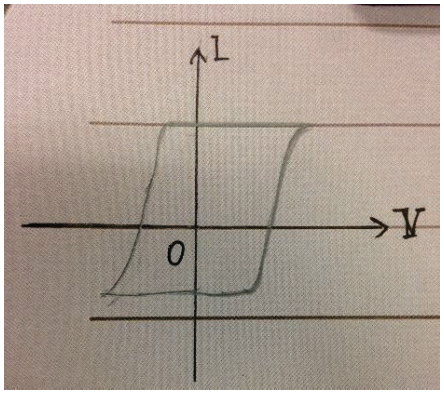


Figure 1

Flight Controller Development for Novel Efficient and Quiet Amphibious Aircraft for General Aviation

Supervisor:	LI Zexiang / ECE	Co-supervisor:	ZHANG Fu / ECE
Student:	GU Qiao / ELEC	Course:	UROP1100, Spring
	YUAN Junbin / ELEC		UROP1100, Spring

This final goal of this project is to design the next generation manned amphibious fixed-wing aircraft for a specific market in China. The scope of the project has been adjusted as the related research on marketing is conducted and new understanding of the marketing demands is acquired. The project has been on progress for two semesters, and in this semester, the emphasis is getting master of the autonomous flight of an Unmanned Aerial Vehicle as well as conducting more marketing research to find the proper entry point of the UAV application situation.

Flight Controller Development for Novel Efficient and Quiet Amphibious Aircraft for General Aviation

Supervisor:	LI Zexiang / ECE	Co-supervisor:	ZHANG Fu / ECE
Student:	LEI Zhao / ELEC	Course:	UROP1100, Fall
	YANG Shaohui / COMP		UROP1100, Fall

The project aims to develop the next generation manned amphibious fixed-wing aircraft in cooperation with the MAE department of HKUST for the growing general aviation market in China. The finished product is expected to be equipped with next generation flight controller capable of fully automated navigation and better handling for manual control. The entire development process is divided into several stages and the first stage is to achieve autonomous flight of a UAV. This report describes the early stage development of the project, including the testing UAV platform construction and operation, along with the research on the current manned aircraft flight controller.

Object Detection and Recognition for Underwater Computer Vision

Supervisor:	LI Zexiang / ECE	Co-supervisor:	WIDY Andreas / ECE
Student:	YOON Hongseo / CPEG	Course:	UROP1100, Fall

The aim of this project is to be able to detect an object of interest from a live video stream and to be able to locate the object on the frame from the video in order to apply object tracking algorithm. More specifically, the goal is to detect a diver from a live footage from a camera on an Automated Underwater Vehicle (AUV) and to be able to locate the diver in the frame. This involved an exploration of different object detection methods with different feature extractions, in which cascade classifier using haar-like features was chosen to be the focus of this project, and the ways to achieve better detection of the diver using this method was studied in this project. This project had begun in previous UROP project and in this project; the work was built on top of the works from the previous project.

Vision-based Formation Flight of Micro Aerial Vehicles

Supervisor: SHEN Shaojie / ECE

Student: CHEN Shixi / ELEC Course: UROP2100, Summer

Monocular Visual-Inertial System (VINS) is designed for state estimation and feedback control of autonomous drones. In this project, a compact and versatile implementation of VINS has been built as a portable development platform for development or deployment of this system in the future. This system includes a flight controller, a camera and an Intel Next Unit of Computing (NUC) computer. They are assembled and used for collecting visual and inertial data in real time. Then all components are encapsulated in a specially customized box to allow the platform to be handy and portable. After that, VINS is optimized and adapted to the underlying hardware, capable of providing accurate and robust localization. The following report will be divided into hardware and software sections and shows the tasks we have accomplished in detail.

A Robot Tour Guide

Supervisor:	SHI Bertram E / ECE	Co-supervisor:	LIU Ming / ECE
Student:	GOBINDRAM Tavish / COMP	Course:	UROP1100, Spring
	GUO Jixin / ELEC		UROP1100, Spring
	LI Haotian / CPEG		UROP1100, Spring
	PRANATA Christian Edwin / ELEC		UROP1100, Spring
	YAO Xinjie / CPGBM		UROP1100, Spring
	YU Chun Fai / ELEC		UROP1100, Spring

This paper describes the design and implementation of a robot tour-guide for the Electronic and Computer Engineering Department at The Hong Kong University of Science and Technology. This robot utilizes localization techniques using ROS's adaptive Monte Carlo localization (AMCL) package with the aid of a laser range-finder and Wi-Fi localization using RSSID fingerprinting modelled with a Gaussian Process Regression. Additionally, it supports a web-based communication interface, which supports communication from a mobile application and from an on-board tablet. These technologies enable visitors of the department to command the robot to come to their location and instruct it to navigate to different professors' offices.

School of Engineering

Department of Electronic & Computer Engineering

Camera-based Smart Vehicle Control System

Supervisor:	SHI Ling / ECE		
Student:	LIU Jie / ELEC	Course:	UROP1100, Spring
	LU Yunan / EEGBM		UROP1100, Spring

Nowadays, more and more researchers focus on the development of computer visualization to realize the 3D reconstruction and indoor localization, and the fundamental technique behind these is to track objects and identify specific patterns. Depending on the information contained in the image captured by the camera, computer vision technologies can be used to extract and analyze the characteristics such as object's shape and locations. Inspired by the effectiveness of computer vision in information extraction, in this project, we focus on the camera-based tracking system, which allow multiple vehicles to follow a specific formation or path under PID control in a constrained area.

Secure Networked Control Systems

Supervisor:	SHI Ling / ECE		
Student:	OU Yanghui / ELEC	Course:	UROP1100, Spring

Wireless controlled systems have found many applications nowadays. Security of such systems has raised more and more attention. This project aims to build a security-aware system when different cyber-attacks in the form of Denial-of-Service (DoS) or data modification (integrity) exist. We examine some of the most common cyber-attacks and discuss the techniques to defend against them. Malicious attack detection shall be developed and illustrated on a hardware platform.

Indoor Autonomous Driving Robots

Supervisor:	SONG Shenghui / ECE		
Student:	DONG Tian / ELEC	Course:	UROP1000, Summer
	LIN Yuanqiao / ELEC		UROP1000, Summer
	YIP Chun Yi / AE		UROP1000, Summer

Autonomous driving is becoming increasingly popular in the recent years. Sensor is a critical component in extracting information around the robot in navigation and constructing the map. In this project, we try to enhance the function of the existing Kobuki turtlebot, by enabling the detection of transparent objects using ultrasound sensor. Ultrasonic sensors, also known as transducers, estimate the distance of objects by the traveling time of ultrasonic pulses. With careful selection of ultrasonic sensor and investigation of its placement, we are currently at the phase of integrating the map generated by the ultrasonic sensor with the one generated by the kinect sensor. One problem that remains to be solved is the long response time of the ultrasonic sensor, which leads to the inaccurate generation of map.

Indoor Autonomous Driving Robots

Supervisor: SONG Shenghui / ECE

Student: JIN Menghe / ELEC Course: UROP1100, Summer

In order to build an indoor autonomous driving robot which can locate itself, we have to compare the WiFi signal intensity with the WiFi signal database built beforehand to get a rough location as the basic information for further processing. The fingerprint method could help with locating the robot by only collecting the signal information and compare it with the database through the algorithm. In this perspective, fingerprint-based WiFi localization stands out among indoor localization schemes with its convenience in collecting data and designing the algorithm. This project introduces a method that can find several most probable locations of the robot.

Indoor Autonomous Driving Robots

Supervisor: SONG Shenghui / ECE

Student: KANG Youwen / COMP Course: UROP1100, Summer
LI Xuanyi / COMP UROP1000, Summer
LU Chenbo / COMP UROP1100, Summer

In order to build an indoor autonomous driving robot which can locate itself, we have to compare the scanned environment information with the available map to get the location precisely. This project introduces a method that can find specific patterns in a picture and identify their locations by using erosion function of image processing. Using erosion could help locating the structuring element (also known as Kernel) in a larger picture efficiently. Therefore, it is helpful for the robot to locate itself comparing the scanned environment picture with the map.

Indoor Autonomous Driving Robots

Supervisor: SONG Shenghui / ECE

Student: NIU Yutong / EEGBM Course: UROP1100, Summer

This project involves discovering the mechanism of Wi-Fi Positioning System (WFPS) and applying the technology of WFPS to ZTE Airport Project. As the number of wireless access points rapidly grows in urban areas during the past decade, WFPS has been widely used as a localization technique for indoor positioning systems, especially preferred when other positioning systems, for example GPS and GLONASS are ineffective due to signal blockage indoors. Thus, WFPS is suitable for localization in the airport terminals for its intensive wireless access points, indoor environment and demand for localization by passengers. WFPS is achieved by measuring the intensity of the received signal (RSSI) and the method of fingerprinting, which is convenient and cost-effective.

Department of Mechanical & Aerospace Engineering

Development of Diamond Clarity Optics Scope

Supervisor: CAI Lilong / MAE
Student: CHAN Ka Hung / MECH Course: UROP1100, Summer

The project is to investigate how we can create a diamond clarity optics scope. Clarity is one of the important factors affecting the quality and the diamond, and the grading of clarity mainly relies on the expert gemologist. Creating the diamond clarity optics scope could allow the people, who have no knowledge of diamond, can observe the small inclusion of diamonds. Two major problems, small inclusion observation and reflection reduction is required to solve to create the clarity optics scope, and different purposed method would be talked and verified in the report through different software. To combine all the components, the first draft of diamond clarity optics scope design could be given.

Feasibility Study of Oil-free Type Chillers for Hong Kong Buildings

Supervisor: CHAO Christopher / MAE Co-supervisor: TSO Chi Yan / MAE
Student: TO Tsz Ho / MECH Course: UROP1100, Spring

In order to reduce energy consumption and the associated green-house gas emissions, Hong Kong Hospital Authority (HA) intended to widen application of air-cooled oil-free package type chillers (OFC) to numerous hospitals in Hong Kong. In this connection, HA scheduled to replace the conventional air-cooled chillers with OFCs in their venues in the coming years. The pilot batch of chiller replacement has been commenced in the year of 2015/16.

To examine the cost effectiveness on retrofitting air-cooled chillers, the Electrical and Mechanical Services Trading Fund (EMSTF) was entrusted by HA to engage the Consultant (hereinafter referred to as “the Consultants”) to carry out a study about the energy performance, the cost effectiveness of using OFCs and the optimum system operational strategy of chiller plants with respect to the building energy profile in each HA’s venue. The Consultants shall carry out site survey, data acquisition, verification and analysis, preparation of reports, providing professional advice, recommendations and suggestions to save energy for the air-conditioning installations in HA’s venues and also to undertake and perform the Services as set out in the Service Order to be issued by the Director’s Representative.

Study of Nanofluid Heat Transfer

Supervisor: CHAO Christopher / MAE
Student: CHOW Pok Man / MECH Course: UROP1100, Spring

Nanofluids are the suspension of nanoparticles (typically 1-100 nm in particle size) in fluids. Nanofluids have many potential uses in the industry, such as in industrial cooling, transportation and nuclear reactors. Determination of

various characteristic of nanofluid (surface tension, contact angle on superhydrophobic and superhydrophilic surfaces, evaporation rate on superhydrophobic and superhydrophilic surfaces and their respective residue patterns) is important in these applications. Surface tension, contact angle on superhydrophobic and superhydrophilic surfaces of water-based nanofluids with various nanoparticle size and concentration are measured. Nanopartical concentration dependency of these parameters is observed. Further measurements on evaporation rate and residue pattern will be carried out and to verify the data collected.

Electrochemical DNA Sequencing

Supervisor: CHEN Qing / MAE
Student: WANG Zhien / CHEM-IRE Course: UROP1000, Summer

In the last four decades, DNA sequencing technology has been developing at a rapid speed. New robust sequencing platforms are gradually established and become predominant, which make great contributions to scientific research and medicine. Among the novel sequencing platforms, electrochemical DNA sequencing stands out as being cost-effective and time-efficient. Relying on direct electrical detection rather than optical readouts, electrochemical sequencing identifies the type of bases via detecting the proton released during DNA synthesis. Based on literature review, the report firstly presents a snapshot of the development of DNA sequencing by introducing six sequencing platforms, and then reviews electrochemical DNA sequencing in terms of its rationale, strengths and problems. Current challenges, possible prospects and potential applications of these new sequencing platforms are discussed at the end.

Double Perovskite Sensors for the Automotive Industry

Supervisor: CIUCCI Francesco / MAE
Student: JHA Animesh Kumar / MECH Course: UROP1100, Spring

With rising interest in sodium ion batteries as an alternative to the ubiquitous lithium ion batteries, it is essential to develop and validate a model to stimulate the former. Such a model has been proposed by Meyer, which also accounts for the volume changes experienced by electrode using sodium ions as the primary charge carriers. This project aimed at conducting extensive literature review and establishing concurrence of the model developed with previous experimental findings. A sizeable list of open circuit voltages, diffusivity values and electrical conductivities of different cathode materials for sodium ion batteries has been presented. Additionally, the impacts of electrode and electrolyte diffusivity values were examined. It is shown using the nonlinear finite strain model that diffusivity values considerably alter the charging profile of the a $Na[Ni_{1/3}Fe_{1/3}Mn_{1/3}]O_2$ under study.

Photon Upconversion for Efficient Solar Energy Harvesting

Supervisor: HUANG Baoling / MAE
Student: CHAN Hok Fung Elijah / MECH Course: UROP1000, Summer

School of Engineering

Department of Mechanical & Aerospace Engineering

Our world is facing an impeding energy crisis; with the rapid depletion of non-renewable fossil fuels which drive most of the modern world, solar energy is quickly emerging as a potential alternative. Although solar energy was first discovered in 1839, its widespread use has been hampered by its many limitations, the most significant of which is the low energy efficiency of solar cells (see Figure 1). One way to greatly improve the efficiency is to convert the low-energy photons in sunlight (such as the infrared or near-infrared radiation part of the spectrum) to higher-energy photons (visible light) that can be harvested by solar cells, using an appropriate "upconverter" material.

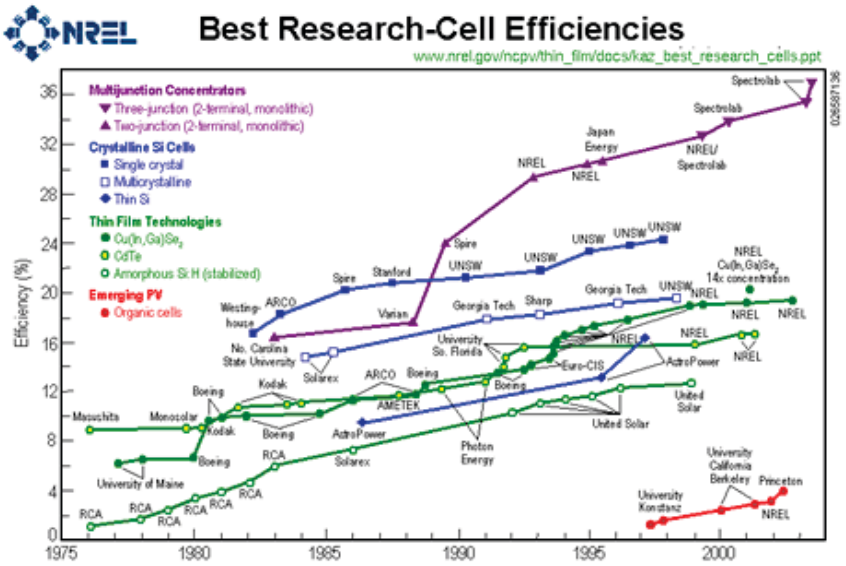


Figure 1. Efficiencies of various solar cell technologies over the past 40 years or so

This ongoing project seeks to apply the principle of "photon upconversion" to solar cells in order to utilize these photons with lower, sub-band gap energy which would normally be transmitted through the cell and be wasted, thus improving the overall energy efficiency. This report will summarize the concepts learned during this project, as well as the progress made so far. Other applications and approaches to the principle of photon upconversion made by other teams and individuals will also be discussed.

Digital Image Analysis of Multi-color Fluorescence Microscopy of Microfluidic Elasto-Filtration CTC Chips for Cancer Diagnosis

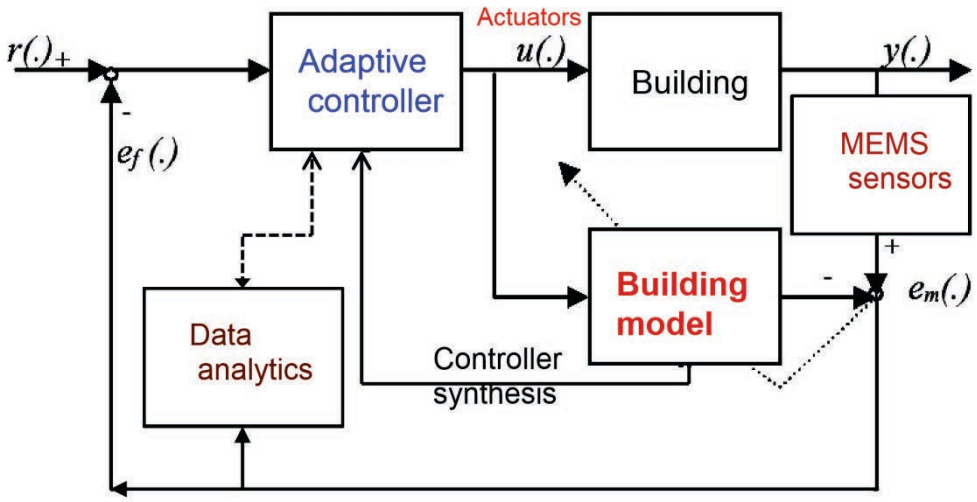
Supervisor:	LEE Yi-Kuen / MAE	Co-supervisor:	WANG Yang / LIFS
Student:	ZHU Songhao / MATH-PMA	Course:	UROP1100, Fall

We intensely studied an efficient way to detect circulating tumor cells (CTC) in the images taken from the blood samples. Images were prepared by the methods of cell fluorescence staining, providing three different channels for various purposes. Based on both real and artificially generated images, a program which is able to detect CTCs, count the number of CTCs and output other significant data has been developed in Matlab environment. The program is proved to be highly reliable, with diverse outputs. Also, we compare the program with other researchers' results. Both the outputs results and the comparison tests results are given.

Low-cost Wireless Arduino-based Micro Energy Sensor for Smart Energy-Efficient Buildings in the era of Internet of Things

Supervisor:	LEE Yi-Kuen / MAE	Co-supervisor:	XU Wei / MAE
			DUAN Mingzheng / MAE
Student:	CHEN Yifei / ELEC	Course:	UROP1100, Spring
	LYU Shengrui / ELEC		UROP1100, Spring

One essential milestone for realizing our ultimate smart building system is to design a good control system. To build a powerful control system which can optimize the energy efficiency for environment controlling (such as room cooling), we need the assistance of modern computer science tools, machine learning, to build a smart control system, which will adjust the settings for the cooling system according to the real-time environment data.



As is shown in the figure, the controller and the data analytics is the brain of the whole system, however, in order to achieve precise control, we need huge amount of raw data to train our machine learning network so that it can model the building use deep learning algorithms.

To solve the problem about the source of the raw data, our target in this UROP project focused on the data collection and analyzes part, which made use of some environment sensors (including temperature and humidity sensors) to detect surrounding physical situations continuously. At last we collect all the data and send them to the internet to support the analyzing and prospective intelligent controlling of Smart Energy-Efficient Buildings project.

Low-cost Wireless Arduino-based Micro Energy Sensor for Smart Energy-Efficient Buildings in the era of Internet of Things

Supervisor:	LEE Yi-Kuen / MAE	Co-supervisor:	XU Wei / MAE
			DUAN Mingzheng / MAE
Student:	WICAKSANA Jeffry / ELEC	Course:	UROP1100, Spring

Energy has become one, if not the scarcest thing in the world. As a consequence, energy conservation has become more and more important. Control of HVAC (heating, ventilation, and air conditioning) takes up around 26.1% to 57% of total energy consumption of a building. By utilizing a smart-automated energy efficient building approach, up to 27% of the consumption can be reduced and thus lead to a higher rate of energy conservation. In order to do so, an automated data collecting device of both temperature and humidity of an environment has to be designed. This research project will focus on developing the data collecting device using commercial products. Data collected can be easily accessed through cloud system which will be updated every minute.

Robot-Assisted Biomedical Experiments to Speed Up Low-Cost Cancer Diagnosis: Software Track

Supervisor: LEE Yi-Kuen / MAE
Student: YIU Tak Shing / MECH Course: UROP1100, Spring

This report is about the analysis of actuation and choosing of the actuator and sensor system for the rotation of the roundtable as designed by Jose, of which its main function is to rotate the sample (the plastic container with the chip inside), to the appropriate location for injection of appropriate liquid into the sample for specified amount of time. In the report, the moving characteristics, speed profile, accuracy requirement, power and torque requirement for motors, and motor choice will be discussed. Recommendations of which motor to use will also be provided with discussion about the advantage of stepper motor in this application.

Development of a 3D Printing Pen for Producing Metallic Objects

Supervisor: LI Larry / MAE
Student: REN Da Wei David / PHYS Course: UROP1100, Summer

For engine manufacturers and plasma torch welders alike, the stability of their gas injectors is paramount to safety and efficiency. Variable density jets display global self-excited oscillations, even at relatively low Reynolds numbers, and are prone to synchronizing to external forcing. For thermoacoustic systems, this could lead to catastrophic failure under some conditions. To better understand the onset of global instability, local absolute instability has been discovered by Monkewitz & Sohn and a bifurcation pathway to global instability has been proposed by Chomaz et al. Numerous linear stability analyses, numerical simulations (from RANS to DNS), and laboratory experiments have adequately informed the community on the stability mechanisms. Forced synchronization, however, is less well understood. Herein lies a summary low-density phenomena and identification of novel frontiers.

Development of an Unmanned Aerial Vehicle (UAV) for Agricultural Spraying and Monitoring

Supervisor: LI Larry / MAE
Student: REN Da Wei David / PHYS Course: UROP1100, Spring

Classical linear stability analysis developed in the wake of World War II has dominated the past several decades.

More recently, progress has been made on non-modal stability analysis, especially pertaining to non-normal phenomena. This enables a better understanding of short-term flow evolution. Coupled with non-linear effects such as the gas dynamics, damping, heat release rate, non-normality provides more accurate prediction of thermoacoustic triggering. Non-normality could also help explain Poiseuille flow's transition to turbulence.

Forced Synchronization of a Capillary Jet for 3D Printing Optimization

Supervisor:	LI Larry / MAE		
Student:	FAN Zhiyuan / MECH	Course:	UROP1000, Summer
	PARK Jungjin / MECH		UROP1000, Summer

This research project aims to discover the effects of forcing on capillary jets, to aid in the development of more precise 3D printers. Three iterations of tests have been performed to collect data pertaining to the natural frequency of water droplet formation for capillary tubes of 1.0mm, 1.5mm, 2.0mm, 2.5mm, and 3.0mm diameter, at various flowrates, producing a range of Weber numbers (We): $0<We<1$. While quantitative data analysis of the natural frequency is still in progress, some insightful qualitative observations have already been made.

Review and Exploration of Nanofluidics

Supervisor:	LI Zhigang / MAE		
Student:	LI Chun Min / MECH	Course:	UROP1100, Spring

Molecular dynamics is a N-body simulation method that can be applied to study nanofluidic systems. In this project, a three-dimensional parallel plate system was studied with molecular dynamics. Specifically, obstacles are added into the system to block the flow, whose sizes are varied to obtain different values of flowrate. Then these resulting values measured from the simulation will be compared with the value predicted by the Navier-Stokes equation that governs classic fluid dynamics. Several simulations have been done on obstacle of different sizes. However, the post processing has not been done such that the numerical results are yet to be generated.

Designing Novel Efficient and Quiet Amphibious Aircraft for General Aviation

Supervisor:	LIEM Rhea Patricia / MAE	Co-supervisor:	ZHANG Xin / MAE
Student:	CHEN Ruihong / MECH	Course:	UROP1100, Spring

The eight-seater project amphibious aircraft, which has a great potential market with respect to leisure and short-distance travels, is expected to achieve smooth takeoff and landing on both water and land. After both empirical and numerical examinations, the final configuration is proposed, which is a high-wing, T-tail, two-engine aircraft with hydrofoil mounted at the bottom of the fuselage. My main tasks for the project are to help conduct research on suitable hydrofoil shapes, carry out water tunnel tests and come up with possible hydrofoil system configuration that fits with the whole aircraft and can fulfil the mission requirements. Considering cavitation and lift

transfer during takeoff, a sweeping design is proposed, which can reduce the pressure drop and lift simultaneously via changing the sweeping angle.

Designing Novel Efficient and Quiet Amphibious Aircraft for General Aviation

Supervisor:	LIEM Rhea Patricia / MAE	Co-supervisor:	ZHANG Xin / MAE
Student:	DONG Zhenyang / AERO	Course:	UROP1100, Fall

Attention should be paid to the noise of small aircraft. In this project, the design of ICON-A5 will be modified to conquer the noise problem. The noise regulations are reviewed, in which the maximum noise level and measurement methods of FAA and ICAO are illustrated. The noise sources of LSA are categorized in the airframe, propulsion, and interference, and they are explained in general. The noise reduction methods for airframe and propeller noise are listed and discussed. After identifying the existing noise sources in original ICON-A5 design, the flap tip fence and propeller duct are chosen and combined into the design. Their principles are stated and the performances are shown analytically based on theoretical explanations and data from past reports.

Designing Novel Efficient and Quiet Amphibious Aircraft for General Aviation

Supervisor:	LIEM Rhea Patricia / MAE	Co-supervisor:	ZHANG Xin / MAE
Student:	FAN Zhiyuan / MECH	Course:	UROP1100, Spring

This UROP project is aimed to develop a more efficient and quiet amphibious aircraft for general aviation. The main design principle adopted to achieve the aforementioned requirements is by integrating hydrofoil beneath the fuselage. Our contributions to this project focus on the hydrofoil configuration development and its physical testing experiment. Major challenges encountered in this hydrofoil design mainly come from: 1. cavitation effect occurred at high speed and the control method to transform the lift from hydrofoil to main wing of the aircraft. Multiple configurations of hydrofoil were considered: the inverted V-shape, the inverted T-shape or multiple sets of hydrofoils. The inverted T-shape configuration was selected for its simplicity and the variable sweep feature. The variable sweep enclosed in an inverted T-shape envelope was proven to be the most feasible way to solve both cavitation and lift transfer challenges. Physical experiments were conducted. Unfortunately, they did not receive satisfactory result. A numerical experiment was then performed to obtain the result required in the design process.

Designing Novel Efficient and Quiet Amphibious Aircraft for General Aviation

Supervisor:	LIEM Rhea Patricia / MAE	Co-supervisor:	ZHANG Xin / MAE
Student:	LAI Yu Him / AERO	Course:	UROP1100, Fall UROP2100, Spring

As regional air transport grows rapidly, there is a great potential in developing small to medium-sized general aviation aircrafts for ultra-short haul flights. Yet the limitation of saturated airports and insufficient land supply for new

airports severely hinder such development. Thus, a medium-sized amphibious general aviation aircraft was proposed in this project as a solution. Base on the design and findings in the previous stages, the refined takeoff performance estimation, static stability, and the dynamic response of the proposed aircraft were investigated in this study. Possible improvements and development of the project in the future were also discussed.

Designing Novel Efficient and Quiet Amphibious Aircraft for General Aviation

Supervisor:	LIEM Rhea Patricia / MAE	Co-supervisor:	ZHANG Xin / MAE
Student:	MURAMATSU Kiko / AERO	Course:	UROP1100, Fall

The ever increasing purchasing power of people around the world has made air travel more and more popular for decades. However, the constraints of land in cities and saturated capacity of airports limits further development in ultra-short-haul air travel and utility air services. As a result, medium-sized amphibious general aviation aircraft is proposed as the solution. In this study, a design of amphibious aircraft was proposed to serve the above purposes. The focus of the design will be investigating measures to improve takeoff performance like maximum takeoff weight, takeoff power and takeoff distance and hydrofoils were proposed as the solution. Mission requirements, conceptual design, preliminary sizing, dimensioning, structural and hydrostatic analysis and takeoff performance analysis had been studied in the progress of the design. Also, plans for design milestones to be achieved in the future were also discussed.

Designing Novel Efficient and Quiet Amphibious Aircraft for General Aviation

Supervisor:	LIEM Rhea Patricia / MAE	Co-supervisor:	ZHANG Xin / MAE
Student:	TANG Hsun-yun / MECH	Course:	UROP1100, Spring

The project focuses on designing an eight-seater amphibious aircraft, which can take off from both land and ocean. Our aim is to figure out the optimized aircraft design so that it can satisfy the mission requirements and perform smoothly. The student group can be divided into three subgroups, consisting of the landing gear design group, the hydrofoil design and the simulation group. I am working in simulating the structure of the tail wing, to see how it performs under circumstances when the aircraft takeoff. Specifically, the performances include the pressure distribution on the tail wing, the stability of the loaded structure by using a proper material. The process and result will be presented in this report.

Designing Novel Efficient and Quiet Amphibious Aircraft for General Aviation

Supervisor:	LIEM Rhea Patricia / MAE	Co-supervisor:	ZHANG Xin / MAE
Student:	WONG Cheuk Hang / AERO	Course:	UROP1100, Fall

The UROP group and FYDP group cooperated to design an innovative amphibious light sport aircraft which emphasize on efficiency and quietness. The joint design team researched on the potential market of the new aircraft. Defining

the new aircraft as a two seated moderate range amphibious aircraft, the team proceeded to study relevant regulation and aeroacoustics technology. Preliminary weight analysis, power-to-wing-loading analysis and preliminary flight performance analysis were done and initial specification of the new aircraft was defined. Aircraft engine has been studied and selected. The team has reached a conceptual design for the new design aircraft with major configuration decided. A computer model was drawn for the conceptual design.

Development of Robotic Assistive Aids to the General Public

Supervisor:	MA Lok Wang / MAE	Co-supervisor:	CHAO Christopher / MAE
Student:	HUR Jun / MECH	Course:	UROP1000, Summer

HKUST's wheelchair team won silver medal in Cybathlon 2016. Despite the outstanding performance in the competition, it requires improvement to be used in general publics. The significant problems are the low energy efficiency and stability and the poor driving comfort. The wheelchair is first divided into three subsystems: Stair and slope climbing system, power transmission and chassis. Studying the existing power wheelchairs and machinery design of the previous wheelchair, the appropriate designs are generated. The new design allows the wheelchair can climb up the stairs or slope facing forward while driving comfortably on the even surface. This report will evaluate the process of the new design generation.

Development of Robotic Assistive Aids to the General Public

Supervisor:	MA Lok Wang / MAE	Co-supervisor:	CHAO Christopher / MAE
Student:	KIM Eunyoung / MECH	Course:	UROP1100, Spring

This paper presents a third generation of the continuing wheelchair project design, in comparison with the previous second generation. The main changes made were the belt and wheel structures by using thinner belt with stair shapes teeth, adding four external wheels to provide sufficient power, as well as replacement of the battery from lead-acid to Li-ion batteries. Considering the linear relationship between the maximum tractive force developed and the surface area of the belt in contact with the ground, further improvements were suggested to make the belt wider and exclude the four external wheels added to reduce the width of the structure.

Biomimetic Design of Flexible Flapping Wings for Micro Air Vehicles

Supervisor:	QIU Huihe / MAE		
Student:	BERTIN Celia Marielle Estelle / MECH	Course:	UROP1100, Fall

This paper discusses the aerodynamic characteristics of tandem flapping wings configuration on dragonflies. The results of this study can be used in the development of bioinspired flexible flapping wings for micro air vehicles (MAV). In a first section, wing kinematic mechanisms will be detailed including forewing and hindwing amplitude, frequency and phasing, wings pitching angle, tail oscillations as well as velocity and acceleration for the wings and

body. The second section is focused on the interactions between the wings and the near wing vorticity field around the dragonfly test subject. The micro flow behaviours can be responsible for additional aerodynamic forces and flight efficiency. The results were obtained using Particle Image Velocimetry (PIV) experiments with high speed cameras.

Biomimetic Design of Flexible Flapping Wings for Micro Air Vehicles

Supervisor: QIU Huihe / MAE
Student: HUI Wai Mong / AERO Course: UROP1100, Spring

Design of Micro air vehicles (MAVs), utilizing flexible flapping wings that can outperform rigid wing or rotary wing models are in the focus of ongoing research and development. Such flapping wing aircraft can profit from a number of unsteady flow phenomena such as clap and fling, vortex wake capture, delayed stall of a leading edge vortex (LEV). Natural flyers, operating in the low Reynolds number regime, under similar conditions and scale length as MAVs, can be used to inspire and help design. Dragonflies as one of nature's most sophisticated fliers are studied to aid such design efforts. The wing kinematics of a dragonfly as with all insects has highest importance to control aerodynamic force development and flight control. In this work, wing kinematics of both tethered and free flight dragonflies are studied through high-speed cameras. A flight chamber is designed to investigate the free flight kinematic parameters of the free flight dragonflies. Observations of wing kinematics are summarized and evaluated to aid biomimetic MAV designs.

Biomimetic Design of Flexible Flapping Wings for Micro Air Vehicles

Supervisor: QIU Huihe / MAE
Student: LAUWRENCE Richard / MECH Course: UROP1000, Summer

Complexity of a biological insect wing can be simplified such that it can be replicated through fabrication. Using micro-electromechanical (MEM) methods, wing of a dragonfly (*Sympetrum vulgatum*) is attempted to be fabricated such that design elements of the wing, such as its nonlinearity in stiffness and aeroelasticity, aerodynamics, and structural mechanics can be optimized for Micro Aerial Vehicle (MAV) use. A too simplistic design, however, will not fruit a faithful replication of the real wing, as revealed in finite element analysis (FEA) results and stiffness measurements. Polydimethylsiloxane (PDMS) and mainly SU-8 are used in this study, due to similarities in their mechanical properties with that of a real insect wing.

Underwater Robot for Maritime Exploration

Supervisor: SEO Jungwon / MAE
Student: KIM Chung Hee / MECH Course: UROP1000, Summer

This report presents an attitude keeping algorithm for an underwater quadrotor ROV. The algorithm calculates relative orientation based on desired orientation and measured orientation using quaternions. The relative

orientation is used as the error in a PID control algorithm, which returns outputs correcting PWM to corresponding rotors based on quadrotor dynamics. The software including the code and logic is examined in detail, along with the hardware specifications and layout of a new prototype ROV.

Development of Novel Icephobic Surfaces for Anti-frosting and Defrosting

Supervisor: YAO Shuhuai / MAE
Student: CHOW Pok Man / MECH Course: UROP1100, Fall

In this UROP project, the relation between the hydrophobicity of surfaces and the micro/nanostructures properties on surfaces are investigated. Different sizes of these nanostructures on the surfaces can be produced using different surface treatment techniques; super hydrophobic/hydrophilic surfaces can be produced. Hydrophobic surfaces on aluminum plates are fabricated using electrospray techniques. Different applications of super hydrophobic surfaces are investigated, especially dehumidifiers. A proposed design of evaporator of domestic dehumidifiers with super hydrophobic/ hydrophilic surfaces is manufactured, in order to improve water condensing and removing rate, however due to time limit of this project, the performance data of the new designed evaporator is not obtained in the project period.

Geometry Induced Droplet Self-Breakup for On Chip Droplet based Digital Polymerase Chain Reaction

Supervisor: YAO Shuhuai / MAE
Student: YAU Ting Wai / MECH Course: UROP1100, Fall
UROP2100, Spring

Electric circuit designs are conducted to support the thermocycler of the digital PCR. The first initial design is based on using existing electric module to achieve the desire voltage output; however, several problems are identified. Then, second circuit board design is implemented to overcome the problem encountered in the first design and carry out more functions at the same time. Further modification is required to optimize the voltage output. Moreover, the gain value of proportion and integration in PID control is adjusted to obtain the overall desire shape of temperature curve and further measures to optimize the curve will be discussed.

Image Processing and Analysis for digital Polymerase Chain Reaction (dPCR)

Supervisor: YAO Shuhuai / MAE
Student: TANG Can-yao / MECH Course: UROP1000, Summer

This report mainly explains the working details of the cell counting program and mention the control method of stepper motor by using LabView code. It first describes the general idea of the counting program and then will focus on the usage and performance of each function inside the program. In the end, it will show the counting result by marking out the points that have been counted. The purpose of the counting program is to achieve an accurate result

with as little error as possible. By using several image processing methods, the counting program can count the cells accurately. In the future, by simplifying and enhancing the quality of the photos, the counting program can provide a more accurate result.

Undergraduate Research Opportunities Program

Proceedings 2016-17

SCHOOL OF **BUSINESS & MANAGEMENT**

Department of Accounting

Web Crawling and Business Information Analysis

Supervisor:	CHEN Szu Fan / ACCT	Co-supervisor:	CHEN Zhihong / ACCT
Student:	WENG Zijie / QFIN	Course:	UROP1100, Fall UROP2100, Spring

With the development of computer science techniques, more and more people choose to use computer programming to help them to analyze business data. This can help researchers and business people gain more insights into the latest issues in corporate governance and business decisions. In this report, the author establishes a web crawling program based on Python, and a VBA program to analyze the data in the press release of all companies on U.S. Securities and Exchange Commission. The author researches into companies' Non-GAAP reconciliation tables and Non-GAAP earnings like bookings, billings, and backlogs. After comparing the data of the same companies in a period, the author believes that the difference in companies' behavior will provide some reference for investors.

Financial Analyst Conflict of Interest

Supervisor:	HUANG Allen Hao / ACCT		
Student:	HE Mengxi / IS	Course:	UROP1000, Summer

In this project, I intended to examine how underwriting relationships can affect analysts' earnings forecast and recommendations. The first question I want to find out is weather affiliated analysts, which refer to lead underwriters and co-underwriters, issue more favorable forecast and recommendation than unaffiliated writers before a company has chosen its underwriter to do the business. The second question I would like to study is the long-term earnings between investors following affiliated underwriter's suggestions and those following unaffiliated underwriter's suggestions. Whether the recommendations given by affiliated underwriters will generate weaker performance. These findings will suggest how banks with different identities (underwriter or non-underwriter) react to the same company's equity offerings and how the investors react to. By analyzing these results, we will be able to understand how the underwriting relationships might affect the forecasts and recommendations they stated in their reports.

Financial Analyst Conflict of Interest

Supervisor:	HUANG Allen Hao / ACCT		
Student:	HU Yunruo / LMGBM	Course:	UROP1000, Summer

This research project aims to analyze the effect of underwriting relationships on analysts' earnings forecasts and investment recommendations from two perspectives: analysts' recommendations and investors' responses; and for different time periods as well as time points, namely, one-year growth forecast & 5-year growth forecast and before-announcement recommendation & post-announcement recommendation. According to definition, analysts can be divided into two groups, affiliated analysts and unaffiliated analysts. To make this analysis more accurate,

affiliated analysts will also be grouped into lead underwriter and co-underwriter analysts. Research on different groups' comparisons will be carried out. Reasons behind, if there is any difference, or not, between groups' forecasts in different time periods, will also be analyzed.

Financial Analyst Conflict of Interest

Supervisor: HUANG Allen Hao / ACCT

Student: LIU Weiyang / QFIN Course: UROP1000, Summer

This paper explores the influence of underwriting relationship on the earnings forecasts and recommendations of analysts. Following the methodology of the previous research conducted by Lin and McNichols (1998) on companies listed in the US, this article examines the effect on their European counterparts. The long-term growth forecasts issued by lead and co-underwriter analysts are considerably more optimistic than those issued by unaffiliated analysts. The recommendations and subsequent year earnings forecasts issued by affiliated analysts are slightly overoptimistic while affiliated forecasts of current year earnings are less optimistic. The findings suggest affiliated analysts are more likely to issue favorable growth forecasts and recommendations and may have conservative estimations of current year earnings to match their higher forecasted growth.

Financial Analyst Conflict of Interest

Supervisor: HUANG Allen Hao / ACCT

Student: WANG Xinyue / QFIN Course: UROP1000, Summer

Financial analysts are necessary intermediaries in capital market for communicating information between listed companies and external investors. Hence the accuracy of earnings forecasts and the quality of recommendations issued by financial analysts are of great significance for investors in terms of investment decisions and valuation of listed companies. This report examines the conflict of interest in underwriting relationship on affiliated analysts' earnings forecasts and stock recommendations. Major emphasis would be laid on initial public offerings (IPOs) and mergers and acquisitions (M&A) in Europe, considering vast majority of prior researches focused on US markets. Findings suggest that earnings forecasts of affiliated analysts are on average less accurate and more biased compared to unaffiliated analysts. Moreover, affiliated analysts tend to issue optimistic stock recommendations which underperform.

Global Macro and Stock Analysis

Supervisor: LI Xi / ACCT

Student:	CHOI Si Young / GBUS	Course: UROP1000, Summer
	DAI Xiaoyi / QFIN	UROP1100, Summer
	HE Zhishan / ECOF	UROP1100, Summer
	JEYAKUMAR Aadhithya Vignesh / MECH	UROP1000, Summer
	OU Huiyi / QFIN	UROP1000, Summer

	YANG Chu / FINA	UROP1000, Summer

The UROP title “Global Macro and Stock Analysis” is a research lead by professor LI Xi (李系), aiming to gather global macroeconomic data as well as stocks, equities and futures data to perceive macroeconomic trends and therefore predict country/sector growth and decline. We used the data service terminals Bloomberg and Thomson Reuters to gather historical macroeconomic, securities and derivatives data, and by the means of html and Javascript (online) and MySQL and Apache (local database), we visualized the data, employing Python as a means to search for and refine data, coming up with potential investments. Moreover, we have improved the functionality of the online visualization, as well as updating the database and also researching various futures contracts in the world.

Global Macro and Stock Analysis

Supervisor:	LI Xi / ACCT		
Student:	LI Xinran / ECOF	Course:	UROP1100, Fall
	WU Shuning / QFIN		UROP1100, Fall
	YANG Xiao / QFIN		UROP1100, Fall

In the 3-month time of this UROP Global Macro and stock analysis, our team updates the quarterly report containing over 20000 stocks in 46 MSCI listed countries, analyzes the US Macroeconomics data such as wage rates as well as dynamically computes the interval returns. During the whole process, other than the financial knowledge, we have also trained various programming skills, for example, Visual Basic of Application, MYSQL and Python. As a result, it is an extremely rewarding project we did in the University.

Global Macro and Stock Analysis

Supervisor:	LI Xi / ACCT		
Student:	WU Shuning / QFIN	Course:	UROP2100, Spring

In the 3-month time of this continuing UROP series Global Macro and stock analysis, our team mainly updated the S&P 500 Sector data and the interval returns for individual stocks as well as sectors in the US, HK, Europe and Japan. We observed the Macroeconomics data such as the US CPI and PPI, and their relationship with the level of S&P 500, USD index, Hang Seng Index, H Share, Shanghai Composite and copper price. We also kept updating the transaction volume of a basket of futures in order to keep track of the popularity of them. Moreover, we learned the technical skills of generating Google graph to display those graphs plotted in excel in a more precise and professional way.

Department of Economics

Internationalization of the Renminbi

Supervisor: LAI Edwin / ECON
Student: BAI Xue / MAEC Course: UROP1100, Fall

This project is mainly about gathering data on RMB bank deposit, RMB as trade payment currency, and offshore RMB bond issuance. The result shows that RMB is on the track of becoming a more internationalized currency, but there are also many obstacles. Some new research directions came up, such as the role of RMB clearing banks, the impact of RMB inclusion in the SDR basket, etc. Basically, this research examined the current situation and long term prospects for the internationalization of the RMB, and carefully explained and differentiated related macroeconomic terms.

Throughout the 'Internationalization of RMB' project, I have gained a lot of insight and research experience through the following tasks: find data on RMB as a payment currency around the world using SWIFT RMB tracker; collect data on RMB bank deposits in offshore centers; collect data on offshore RMB-denominated bond issuance in offshore centers; and some further aspects that I came across and did some research on my own, for example the functions of RMB clearing banks and the IMF SDR basket.

Internationalization of the Renminbi

Supervisor: LAI Edwin / ECON
Student: CHEN Weili / MAEC Course: UROP1100, Summer

This is a progress report summarizing the results of my research on the UROP project of Internationalization of RMB this summer. As a main task driven by the Chinese government, RMB internationalization has been very popular in recent years, which is considered as of potential significance to the global economics. Basically, the two-month project served as a good introduction to the topic, with the main tasks on data collection and simple analysis about the current level of RMB internationalization, and further exploration on factors that would affect the initiative, ultimately to develop a model in prediction of global RMB usage and its complete internationalization.

Internationalization of the Renminbi

Supervisor: LAI Edwin / ECON
Student: CHUNG Wai Chu / ECOF Course: UROP1100, Fall

The purpose of this project is to study the current state and future prospect of RMB as an international payment currency. The research started with studying the use of RMB in trade settlement and invoicing. The share of RMB settlement in total trade increased from 2009Q4 and reached the peak at 2015 Q3, up to 33%, but has a decreasing trend since then. Data of currency swap lines between PBoC and foreign central banks were also collected. The total

swap size is 3159.5 billion Yuan with 31 different countries/ regions as of 13th October 2016 but the amount used is still quite small.

Internationalization of the Renminbi

Supervisor: LAI Edwin / ECON

Student: YAU Cheuk Hin Victor / GBUS Course: UROP1100, Fall

The topic of RMB internationalization is highly relevant for Hong Kong as the main RMB offshore hub. We know that China wants to push for further RMB internationalization but it is also obvious that its primitive financial market has been a major roadblock in RMB's path to become a global currency. In order to understand the prospects of RMB as a global currency, we need to understand China's domestic financial sector reform in great details. Knowing the importance of this question, I chose to focus my research on this area for the UROP project and have subsequently worked on four sub-topics which include 1. Banking sector in China; 2. Interest rate and lending policy liberalization; 3. Domestic bond market in China; and 4. Banking sector reform.

Firms in Globalization: Evidence from China

Supervisor: LI Yao / ECON

Student:	LIN Ching Hsuan / ECOF	Course: UROP1100, Fall
		UROP2100, Spring
	PENG Cong / ECOF	UROP1100, Fall
		UROP2100, Spring
	YANG Rui / ECOF	UROP1100, Fall
		UROP2100, Spring

The project focuses on studying behaviors of domestic- and foreign-invested firms in mainland China under globalization. Our team dealt with custom data of targeted Taiwan-invested firms (TIF). In the previous semester, our work mainly focusing on generating a "year-firm-product" panel data and correcting the problem of inconsistent identifiers of sampled companies. In this semester, we changed our focus to analyze the annual sales growth rate of the sampled companies. We aim at finding out the pattern of appearance of sampled companies before and after 2010 in order to analyze the reason for discontinuity in appearances. We have tabulated the pattern of appearance but have not proceeded to analysis of reasons behind, which shall be the focus of the next stage.

Firms in Globalization: Evidence from China

Supervisor: LI Yao / ECON

Student:	OUYANG Jing / MAEC	Course: UROP1100, Spring
		UROP2100, Summer

In the article 'Sources of Relatedness between Industries and Revealed Comparative Advantage: Evidence from China',

well-organized relatedness measures and regression models were established to discover how the RCA is affected by the 4 sources of relatedness between industries. Based on the empirical evidence, the author reaches a conclusion that each source of relatedness has a positive impact on the RCA. To consolidate the finding, this report is aimed to provide robustness check of knowledge spillover relatedness measure which is one of the 4 sources of relatedness and regression models using US patent citation data and corresponding concordance.

Firms in Globalization: Evidence from China

Supervisor: LI Yao / ECON
Student: PENG Cong / ECOF Course: UROP1000, Summer

The project focuses on studying behaviors of domestic- and foreign-invested firms in mainland China under globalization. Our team dealt with custom data of targeted Taiwan-invested firms (TIF). In the previous semester, our work mainly focused on generating a “year-firm-product” panel data and correcting the problem of inconsistent identifiers of sampled companies, analyzing the annual sales growth rate of the sampled companies, and finding out the pattern of appearance of sampled companies before and after 2010. In this summer, I continued the previous work by calculating average growth rate of sales income for years before 2010, thus projecting sales income for years after 2010 and summarizing the reasons of discontinuity.

Firms in Globalization: Evidence from China

Supervisor: LI Yao / ECON
Student: SO Kwok Wai / ECOF Course: UROP1000, Summer
ZHUANG Xiaoyan / MAEC UROP1100, Summer

With the trend of economic globalization, multinational firms take up more and more important role in terms of industrial output, innovation, etc. To investigate the performance of Taiwan invested firms in China (TIF hereafter), we extended a data set of TIF (in year 2000 to year 2009) to year 2013 using updated Chinese Industrial Enterprises (CIE hereafter) data. We then focused on the sample size, sales income, labor productivity and capital intensity of the identified firms. The figures show that the sample size of TIF grew steadily before 2008, but shrank after 2008. The sales income increased overall. Both labor productivity and capital intensity fluctuated due to unusual performance in some years. In addition, we investigated the effect of change of threshold on our sample size, and our finding suggests that it is not very large to our sample size.

Firms in Globalization: Evidence from China

Supervisor: LI Yao / ECON
Student: YAO Qiyou / ECOF Course: UROP1100, Fall

The project focuses on studying behaviors of domestic- and foreign-invested firms in mainland China under globalization. Our team dealt with custom data of targeted Taiwan-invested firms (TIF). From the data given, we have

generated a “year-firm-product” level dataset, which incorporates detailed trading information such as trading volume under each shipment type, number of shipment types and number of countries the firm has traded in. During the process, we discovered some problems in works of previous students which may result in invalid outcomes. For example, CRCs and party IDs may not uniquely identify each other and hence result in messy outcomes. Thus, we identified firms with multiple party IDs and replaced them with the party ID specified in the custom data.

Firms in Globalization: Evidence from China

Supervisor: LI Yao / ECON
Student: ZHOU Weixuan / ECOF Course: UROP1100, Fall

The project focuses on studying behaviors of domestic- and foreign-invested firms in mainland China under globalization. Our team dealt with custom data of targeted Taiwan-invested firms (TIF). From the data given, we have generated a “year-firm-product” level dataset, which incorporates detailed trading information such as trading volume under each shipment type, number of shipment types and number of countries the firm has traded in. During the process, we discovered some problems in works of previous students which may result in invalid outcomes. For example, CRCs and party IDs may not uniquely identify each other and hence result in messy outcomes. Thus, we identified firms with multiple party IDs and replaced them with the party ID specified in the custom data.

Application of Panel Data Methods in Economics

Supervisor: LU Xun / ECON
Student: BAI Xue / MAEC Course: UROP1100, Summer

The purpose of this project is to study panel data regression models and reproduce the results of the paper Determining Individual or *Time Effects in Panel Data Models* (Xun Lu and Liangjun Su, 2017) using Stata. Apart from gaining knowledge about panel dataset and regression models, I also learned about fixed-effect models and how useful dummies can be in controlling for factors that could lead to bias. Specifically, the proposed cross-validation method can choose the right model with probability approaching one, yet the algorithm is comparatively simpler. Moreover, the implementation in Stata requires careful design of algorithm and rigorous compliance with syntax. The final results are presented at the end as summary tables that show the practicability of CV method.

Application of Panel Data Methods in Economics

Supervisor: LU Xun / ECON
Student: CHAN Chun Kit / ACCT Course: UROP1000, Summer

This paper reveals the progress of the development of a Stata program that can help to implement the leave-one-out cross validation method in panel data models. Such method is proposed by Prof. Lu, which helps to determine

individual effects and time effects in linear panel model. The aim of this program is to facilitate the convenience and efficiency of using cross validation method so that it can apply to all dataset in a more general sense. The program has shown identical results as professor's finding on the three datasets he used, indicating it is on the right path. However, improvements are to be made to generalize the program for greater potential.

Application of Panel Data Methods in Economics

Supervisor: LU Xun / ECON
Student: CHEN Yunyan / ECOF Course: UROP1100, Spring

This report presents the student's works of UROP 1100: Application of Panel Data Methods in Economics. The whole projects consist of three parts, the first part of which is to conduct literature review on four papers related to proper selection over different types of panel data. Secondly, several data collection methods and portals on international trade are illustrated. Finally yet importantly, some real estate market indicators in China, Hong Kong, U.K. and Australia are collected in preparation for future study on financial markets.

Application of Panel Data Methods in Economics

Supervisor: LU Xun / ECON
Student: DENG Boyang / ECOF Course: UROP1100, Fall
TONG Ka Ho / ECOF UROP1100, Fall

This project aims to collect data from the empirical papers of the recent decade in American Economic Review to support re-examining some well-known studies and obtain some new insights with new panel methods. We mainly focus on collecting the key independent and dependent variables, understand the topic of each paper and specify the software used in the analysis (e.g.: Stata, Mat lab).

Application of Panel Data Methods in Economics

Supervisor: LU Xun / ECON
Student: GU Wenxin / QFIN Course: UROP1100, Spring

The goal of this project is about proposing a jackknife method to determine the type of fixed effects in three-dimensional panel data models and determine the individual and time effects in linear panel data methods. In this project, the main job for me is to assist the instructor with the recourse searching. After having brief understanding of panel data method in economics projects by reading several papers related to this area, I started to assist the instructor by summarizing the paper and writing reviews, searching the data which the author used in his paper and find the source of real estate information.

Application of Panel Data Methods in Economics

Supervisor: LU Xun / ECON
Student: HUANG Silin / MAEC
Course: UROP1100, Spring
UROP2100, Summer

The commonly used information criteria (IC), AIC and BIC, tend not to provide consistent suggestions on selecting panel data models. Prof. Lu has proposed a jackknife method to determine fixed effects in linear panel data models, which outperforms the IC-based approaches. The purpose of this continuing project was twofold: (1) to apply the newly developed jackknife method to reproduce results of the three empirical studies introduced in the paper through the software Stata, and (2) to develop a Stata code template for conducting model selection, which should be universally applicable for both static and dynamic linear panel data models. This report mainly outlines the jackknife method, presents the coding work, and reports the empirical findings.

Application of Panel Data Methods in Economics

Supervisor: LU Xun / ECON
Student: YANG Yuan / MAEC
Course: UROP1100, Fall

This project aims to apply some newly developed panel data methods to empirically study some economic questions. We hope to re-examine some well-known studies and obtain some new insights with the new econometrics methods. At the beginning stage of the project, we collect studies from world well-renowned journals including American Economic Review (AER). We screen out empirical studies with panel data available from publications of AER ranging from year 2000 to 2016.

Application of Panel Data Methods in Economics

Supervisor: LU Xun / ECON
Student: ZHANG Kaixin / MAEC
Course: UROP1100, Fall

This is my first time participating in a research program focusing on panel data in economics. Because I don't actually have some insightful research findings, the following contents would mainly be reporting my research progress. Generally, the tasks assigned were not hard but are still really meaningful. At the very beginning, it required a great amount of readings found on American Economic Review. The process was time consuming though, it was a great chance for me to know various current economic research directions and methods. It was also not an easy job determining the key dependent variables and key regressors, but it might be one of the most important components in terms of doing researches.

The Financial Decisions of Migrant Domestic Workers in Hong Kong

Supervisor: VISARIA Sujata / ECON
Co-supervisor: KHANNA Arpita / ECON
Student: LU Yuchen / ECOF
Course: UROP1100, Spring

School of Business & Management

Department of Economics

Filipino domestic workers are faced with many factors that influence their financial decisions, but people have little knowledge of the dynamics of their decision-making progress and their demographic situation. This exploratory UROP study aims to assess the influence of the domestic workers' demographic characteristics, employment situation and financial insights on their financial decision-making. Data were collected through a face-to-face survey in 2017 (N = 117). The data analysis elucidates the influences on their financial behavior.

The Financial Decisions of Migrant Domestic Workers in Hong Kong

Supervisor:	VISARIA Sujata / ECON	Co-supervisor:	KHANNA Arpita / ECON
Student:	PAN Yujie / ECOF	Course:	UROP1000, Summer

In order to examine how risk preference and time preference affect financial decisions, we conducted surveys and experiments with foreign domestic workers. As Filipinos constitute one of the largest ethnic minorities in Hong Kong, we believe data collected from this group would give both behavioral and non-behavioral explanations of their financial decisions. I focused on examining the correlation between time preferences and individual characteristics such as age and education, and examined whether the data support the conclusions of previous studies in other contexts.

The Financial Decisions of Migrant Domestic Workers in Hong Kong

Supervisor:	VISARIA Sujata / ECON	Co-supervisor:	KHANNA Arpita / ECON
Student:	ZHANG Tina Danting / MATH	Course:	UROP1100, Spring

This report considered the interaction between risk preference and demographic factors, specifically, age and education, and addresses three questions: Are MDW's risk-time preference related to age and/or education? Does risk-aversion increase with the stakes? If so, is this increase related to age and/or education? Statistics analysis show insignificant differences in risk preference between old and young domestic workers ,and between high and low education levels; significant differences in increasing risk aversion, and insignificance differences in increasing risk aversion by age and education.

Department of Finance

Global Liquidity and Foreign Currency Debt Issuances by Asian Firms

Supervisor: GOYAL Vidhan K / FINA
Student: CHU Mingyu / FINA Course: UROP1100, Spring

This study represents the updated evidence by investigating the determinants of debt maturity of firms listed in Singapore. I proved that the contracting-cost hypothesis persists in my updated sample, namely smaller-sized firms with greater growth prospects tend to use more short-term debts. On the other hand, I also find that firms with higher leverage level and greater liquidity tend to use more long-term debt financing.

Global Liquidity and Foreign Currency Debt Issuances by Asian Firms

Supervisor: GOYAL Vidhan K / FINA
Student: ISJWARA Felicia Rebecca / GBUS Course: UROP1100, Spring

Alongside South Korean products' prevalence in the global markets, the firms behind its operations have increased their foreign currency corporate bonds issuance, especially the ones that are denominated in US Dollars, which is the world's oldest and most mature bond market. Taking a look at press releases and earning call statements, this report examines the various reasons why companies issue USD-denominated debt. The six companies are Doosan Infracore Co., Korea Gas (KOGAS), LG Electronics, POSCO, Hynix, and SK Innovation. Common reasons for companies to do so include refinancing existing debt and injecting the remaining money into their working capital for business expansion.

Global Liquidity and Foreign Currency Debt Issuances by Asian Firms

Supervisor: GOYAL Vidhan K / FINA
Student: ISKANDAR Angela Lois / GBUS Course: UROP1100, Spring

This paper examines the motives behind foreign debt issuances by Hong Kong corporates in different industries. The paper takes different examples from different major or pillar industries in Hong Kong, and tried to analyze if there is any trend with their foreign bond issuances. The work shows that there are indeed a lot of foreign bond issuances by these firms, mainly denominated in USD, Euro, JPY, and other popular currencies, which exposes the corporates to currency risks. However, these corporates do not have any hedging policy towards these risks, and hence conclusion can be drawn that they want to exploit the benefits of the issuances. Interesting observations happen with huge differences in the cost of borrowings accessible to different companies in different industries.

School of Business & Management

Department of Finance

Global Liquidity and Foreign Currency Debt Issuances by Asian Firms

Supervisor: GOYAL Vidhan K / FINA

Student: RUAN Ting / OM Course: UROP1100, Spring

Firms in emerging market issues a large amount of foreign debt in recent years. Foreign currencies can be used for international trade and to finance long term assets. Firms may benefit from discrepancy between foreign interest rate and domestic interest rate or take advantage of the currency fluctuation by issuing debt in foreign currencies. The research primarily focuses on non-financial firms in Malaysia and examines the relationship between the amount of foreign debt issuance and foreign interest rate and foreign exchange rate and whether firms in some industries issue more foreign debt than firms in other industries. It is evident that firms in telecommunication, oil and entertainment industries trend to issue more foreign debt and they issue foreign debt not only in US dollar, but also Singapore dollar as well as Chinese Yuan.

Global Liquidity and Foreign Currency Debt Issuances by Asian Firms

Supervisor: GOYAL Vidhan K / FINA

Student: TSANG Sin Kiu / ECOF Course: UROP1100, Spring

This paper examines corporate leverage and investment decisions of firms in Hong Kong from 2000-2015, as well as theories on debt issuance between cyclical and secular industries. Cyclical companies generally issue less debt in an imperfect market with asymmetric information, yet overall capital structure depends on firm-level determinants. Both book and market leverage of Hong Kong corporations are growing moderately in recent years, therefore the economy is not exposed to the spectre of over-leveraging on the whole. Book Leverage, Investment in Associated Companies and Long-term Debt are all reliable factors in explaining corporate investment, while debt has been positively related to investment for Hong Kong companies since the early 2000s.

Global Liquidity and Foreign Currency Debt Issuances by Asian Firms

Supervisor: GOYAL Vidhan K / FINA

Student: ZHANG Wenjing / QFIN Course: UROP1100, Spring

This paper examines the issuance of USD denominated debt by Indonesia nonfinancial firms by investigating four key factors of the debt: the size of issuance, the maturity of issuance, the industry of the issuers, and the relationship between issuance and uncovered interest parity. It is found that Indonesia firms may choose to issue debt in USD when they seek a larger issuance or an issuance with longer maturity due to the greater market depth in overseas financial markets. Issuers of capital-intensive industry, such as energy and mining are more likely to issue USD debt due to their international business transactions. As for uncovered interest parity, there is no significant evidence of it being related to the USD dollar debt issuance.

Department of Information Systems, Business Statistics & Operations Management

Deep Learning for Stock Prediction

Supervisor: KWOK James S H / ISOM
Student: JI Xiayan / ECOF Course: UROP1100, Summer

It has been a prevailing trend in recent years to apply machine learning algorithm in a financial context. With randomness in moving direction and abundance in available information, stock price and market trend prediction have attracted considerable attention. Given its gorgeous performance in recognizing the patterns of various kinds of input variables and project the future performance of stocks and markets, artificial neural network, comprised of many different categories of networks, constitutes an interesting direction to look at. In this report, a Multilayer Perceptron (MLP) and a Long Short-term Memory network (LSTM) were constructed to preliminarily generate some insights with the purpose of further improving the prediction accuracy and address some questions came across during the research process.

Deep Learning for Stock Prediction

Supervisor: KWOK James S H / ISOM
Student: JUNAEDI Victoria Amanda / ECOF Course: UROP1100, Summer

Using deep learning methodologies in trading is an increasingly popular field. Numerous researchers have tried to predict the stock market by using sentiment analysis, time-series data, as well as other fundamental or technical indicators. I am currently exploring the possibilities of predicting stock prices using textual analysis and the respective historical prices, specifically in Hong Kong Stock Exchange. Particularly, this report will show the preliminary study of using deep learning for natural language processing (NLP) and time-series data, on top of which will be trained another set of neural networks to classify the stock price movement. In addition, this report will compare different types of neural network to use and discuss which works best for both textual and numerical analysis.

Risk Management

Supervisor: SO Mike Ka Pui / ISOM
Student: HE Jianyao / QFIN Course: UROP1100, Spring

This project is about implementing Bayesian analysis into latent space model to study network relation. The invisibility of actors in network model makes it difficult to implement in daily life and latent space model is used as it can visualize the position of actors enabling us to study actors' interaction by actors' distributions and ties (interactions). To study the possible changes in actors' position after updating current information, Bayesian analysis offers such a way to estimate the unknown parameters of latent space models. Over the past few weeks, I read papers about the latent space model and then further read on Bayesian analysis using Markov chain Monte Carlo

simulation. I also performed model fitting for classic network data using R.

Risk Management

Supervisor: SO Mike Ka Pui / ISOM
Student: WANG Ziyi / RMBI Course: UROP1100, Spring
UROP2100, Summer

The research goal of this stage is to estimate the parameters in the proposed cross-sectional vine copula factor model. Professor Mike So has proposed a cross-sectional vine copula model to incorporate correlations among high dimensional high frequency stock return series and market factors. Based on the rationale behind and supervisor's guidance, I continued to test the model by doing simulation studies. I began from low dimensional data and assume covariance and dependencies are constant, and then expand to high dimensional data, finally further involve the dynamic characteristic of the parameters. The report will summary my research progress in mainly three parts: Understand the model and estimation algorithm in a theoretical base, practical execution, and further improvement of the model.

Application of Deep Learning (Artificial Intelligence) on Natural Language Processing

Supervisor: ZHANG Xiaoquan / ISOM
Student: CHUNG Jihoon / COMP Course: UROP1100, Spring

This research shows possibilities of using deep learning to predict stock price. This research uses two different models to predict HS300 index. First model has one hidden layer, and uses stock history. Second model uses text data from Chinese stock-related forum. First model has shown 86.6% of accuracy, where second model has showed 55.4%. Both results are then combined with linear regression to see the result, which was 83.4%. It was possible to see that deep learning could be used to predict stock price. However, deep learning model with text data has to be significantly improved to have meaningful result.

Application of Deep Learning (Artificial Intelligence) on Natural Language Processing

Supervisor: ZHANG Xiaoquan / ISOM
Student: HUANG Chen / QFIN Course: UROP1100, Spring

The project aims to find arbitrage situation where stock price jumps or falls due to catalyst event caught by social media including Weibo, Facebook, Twitter. These online social media provide platforms for users to express their feelings including their attitude towards a company or a specific stock. We do not aim to make a long/short decision based on media user's opinion of a stock, we use their underlying opinions, their sentiments implicated by the verbs and adjectives, instead. Based on data crawled from these social platforms, we use text analysis to transfer these text data into 40 different sentiment indexes. By observing the trend of the index and the degree they change, we find

out if there is a sudden unnatural jump or fall of the data. These unnatural patterns can indicate a big hit or an event that triggers the users' emotions that they may take actions and meanwhile affect the whole stock market. There have already been some cases before which will be mentioned in the related studies and analysis section. We try to use the 2-year data of social media to find out more about similar cases to test our assumption. And based on the assumptions, we build up models to visualize the fluctuate pattern of users' sentiments.

Application of Deep Learning (Artificial Intelligence) on Natural Language Processing

Supervisor: ZHANG Xiaoquan / ISOM

Student: SRA Jai Singh / COMP Course: UROP1100, Spring

This report describes the progress attained by me in trying to implement topic detection in Chinese documents via Latent Dirichlet Allocation (LDA), an unsupervised learning technique that looks at relative frequencies of words across documents and accordingly puts them in clusters. The report looks into common problems encountered in pre-processing of Chinese data to use in the model, making sense of the results outputted by the model and measuring performance in unsupervised learning tasks.

Department of Marketing

Consumer Food Decision Making

Supervisor:	MUKHOPADHYAY Anirban / MARK	Co-supervisor:	HUH Young Eun / MARK
Student:	JIO Rina Lookman / ECOF	Course:	UROP2100, Fall

The research started from managing gross survey data from six countries about perception of food and inequality. A survey was conducted in six countries regarding the topics. Then the data were analyzed with help of statistical tool SPSS and R and converged the topic into income inequality. The result showed that public income inequality perceptions differ across countries and significantly affected by individual political orientation and opinion on advertisement; liberal believers tend to overestimate income inequality more that conservatives. Similarly, people who think negatively of advertisement have tendency to score a higher level of income inequality level in their respective country.

Undergraduate Research Opportunities Program

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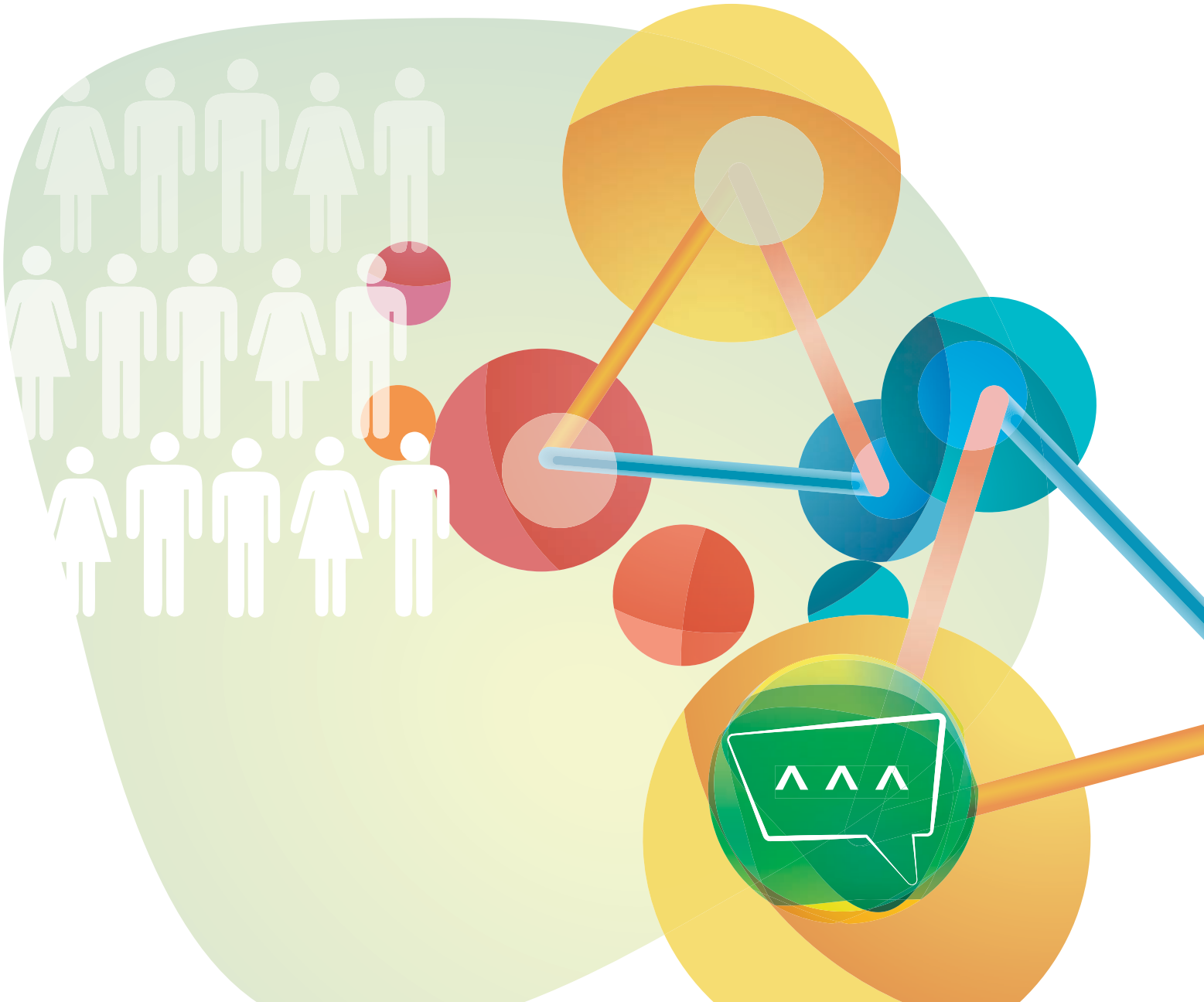


Division of Humanities

Korean War Prisoners Oral History Interview Transcription

Supervisor: CHANG David Cheng / HUMA
Student: KIM Kyung Yeob / GCS Course: UROP1100, Spring

This paper examines oral history interviews with Patrick Vigil and James Bard, part of which the author transcribed. AS former U.S. soldiers, Vigil worked as a prison guard and Bard as an interpreter in the prison camps during the Korean War. By studying their personal experiences, this paper offers a ground-level view about certain events inside the prison camps. Through the personal stories of Vigil and Bard, it shows beyond archival documentation how the subtlety of human emotion and mind played a delicate but critical role in affecting the development certain dramatic events such as October 1 Massacre and the repatriation of Chinese prisoners, as well as the actions of prisoners and others alike.

Korean War Prisoners Oral History Interview Transcription

Supervisor: CHANG David Cheng / HUMA
Student: YEUNG Tsz Wang / GCS Course: UROP1000, Summer

Follow the Second World War came to an end in 1945, and the failure of US mediating, the disputes between the China Communist Party (CCP) and Chinese Nationalist Party (KMT) was inevitable and evolved into civil war from 1946 to 1949. Korean War occurred in 1950, which is the second year after China Communist Party took over the power. One of the soldiers who was involved in this war, Lin Mo Cong (林模叢) was captured by UN forces and was sent to Geoje prison camp on Geoje Island. The oral history narrated by Mr. Lin allowed us to have a deeper understanding and discovery of those difficult times, while Lin's accurate memory and special thoughts on certain events have added values to this period of history. This report consists of three parts: method for transcription, the outline of Lin's story in chronological order, which will include the major phenomenon in the transcription, and a simple analysis of Mr. Lin’s major concern regarding on establishment of law for prisoner of war.

Korean War Prisoners Oral History Interview Transcription

Supervisor: CHANG David Cheng / HUMA
Student: ZHAO Liang / MAEC Course: UROP1100, Spring

During the UROP period for 2016-17 Spring semester, I helped professor CHANG David Cheng to properly record and fully utilize the oral history interview with a former Chinese People’s Volunteer soldier Yu Rongfu who was taken prisoners by the UN forces, and held in prison camps in Korean from May 1951 until January 1954. The interview covers his life experiences before, during and after the Korean War. I verified the historical fact of what he said based on background information and the context of the interview. Once I finished a certain part of my work, I would summarize the doubtful points of Yu’s interview and turned to professor CHENG for help and reported my progress.

Community Heritage and Hakka Food Tradition in Yimtintsai Village, Saikung

Supervisor: CHEUNG Siu Woo / HUMA

Student: LEE Tsz Yan / GCS Course: UROP1100, Spring

This project studies how local food tradition becomes a theme of heritage in the case of Yimtintsai village through an anthropological angle in order to generate insights about the heritage making in Hong Kong. This report (1) outlines the activities and duties of the researcher, (2) presents the key findings regarding the internal organisation of the volunteer community, the interaction between visitors and volunteers as well as how the tradition of Hakka Teacake is transferred to visitors, and (3) highlights certain themes that researchers could explore in the future.

Division of Social Science

Examining the Impact of Technology on Parenting and Children's Language Development

Supervisor: CHEN Eva E / SOSC
Student: SOBANSKA Sandra Anna / GBUS Course: UROP1000, Summer

The quantity of words a child hears in the years 0 to 3 is one of the best predictors of their linguistic and cognitive development. This study examines the impact of mobile technology on the pace of language development in infants. Specifically, we investigate whether delivering interventions through a mobile application impacts the quantity of parental word count and confidence, and in turn, leading to a faster rate of child language acquisition. Parents (N = 24, age range: 23 to 41 years, mean age = 34.5 years old) of infants (N = 25, age range: 16 to 20.5 months, mean age = 18.6 months) used the mobile application for 7 weeks to record at least 30 minutes of their parent-child interactions every day. Additionally, the experimental group was stimulated with a daily word goal, quantitative feedback, and access to learning materials about early childhood development. Preliminary results indicate that parents in the experimental group spoke more words to their children and recorded longer interactions than those in the control group.

Chinese and English Media Representation of Migrant Domestic Workers in Hong Kong

Supervisor: GROVES Julian M / SOSC
Student: NG Lam Wai / GBUS Course: UROP1100, Fall

The objective of this research project is to compare the portrayal of domestic helpers in English and Chinese media in Hong Kong so as to understand the biases in the media and the general attitudes towards domestic helpers. A total of 16 Chinese videos produced between 2006 and 2015 have been quantitatively analyzed with a set of nodes through a software called Nvivo. Analysis so far shows that Chinese media tends to be more biased in reporting issues related to workers, while English media is more likely to be more balanced. The reason behind is related to the scope of target readers, their attitudes towards domestic helpers, and the variety of Chinese and English media in Hong Kong.

Chinese and English Media Representation of Migrant Domestic Workers in Hong Kong

Supervisor: GROVES Julian M / SOSC
Student: SIU Tsz Chun / GCS Course: UROP1100, Spring

The progress report served as updates of project, which started in last semester, concerning media representation of domestic helpers in Hong Kong. It aimed to study whether language variations are possible factor of contributing different views towards migrant domestic workers. The updates involved in few aspects, firstly, updates of coding map, secondly, relationship between codes and finally, similarity in analyzing non-printed media and printed media. As technological advancement, non-printed media, such as video news, became emerging communication form. This form worth discussion and signifies the project. In addition, coding map is refined for further investigation and

reasons for refinement will be discussed in the report.

Economic Development, Pollution and Health in China

Supervisor: HE Guojun / SOSC
Student: DAI Anna / MATH-AM Course: UROP2100, Spring

This study applies distributed lag non-linear models to probe the possible PM10-mortality dependency of 38 cities in mainland China, upon data collected from Jan 1, 2010 to Jan 14, 2013. For each city, this study provides the distribution figure of PM10 concentration along the time, a 3-D graph and a contour graph that both show the relationship of PM10 concentration and relative risk.

The History of Coal Industry in China

Supervisor: HONG Jean / SOSC
Student: JIANG Wenhao / GCS Course: UROP1100, Spring

Datong, the city with a long and prosperous history, discovered high-quality coal reserve after the western invasion in China. Since then, the destiny of Datong became entwined with coals. While the rich coal endowment has brought wealth to some local figures, the environmental pollution in the city and non-guaranteed coal miners' working condition have long been the problems brought by coal mining. In particular, the exploitation of coal workers was extremely serious in Japanese occupation time. Furthermore, in the economic reform, transforming Datong's centralized coal industry to market-oriented economy has been a tough mission which brought about unemployment and economic recession. Focusing on the case of Datong, this report will introduce its history of ancient time and modern coal industry from pre-Communist era to the Republic. The hardship of enhancing social welfare in the presence of coals in Datong will be highlighted. The research of "resource curse" in Datong could be further built based on this history collection.

Who Profits from the Current Anti-corruption Campaign in China? Examining Who Replaces the Fallen Tigers and Flies

Supervisor: KELLER Franziska / SOSC
Student: CHANDRA Kevin / GCS Course: UROP1100, Spring

This paper provides a preliminary analysis about succession patterns for the case of officials removed under Xi Jinping's ongoing anti-corruption campaign in China (2012-present). I specifically focused on analyzing officials holding prefecture-level positions upward. With regard to the dataset, I managed to gather the profiles of nearly 250 removed and succeeding officials. While findings for this paper are largely in the preliminary phase, we found out that the anti-corruption campaign has generally not resulted in Xi Jinping replacing the removed officials with his political allies. In addition, more than half of the successors had served in the same provinces as their predecessors had prior to removal. One particularly important aspect is the role played by the campaign in 'leadership

regeneration', by which many of the successors are of younger age and have had relatively shorter serving periods in the provinces than the predecessors. Further quantitative research needs to be conducted in the future with the provision of additional variables that are still 'missing' in this paper, namely: 1) factional affiliation of predecessors and successors, 2) GDP growth, and; 3) whether the successors remove officials related to the predecessors.

China/Africa Links Project

Supervisor: SAUTMAN Barry V / SOSC
Student: ZHOU Weixuan / ECOF Course: UROP1000, Summer

Since 1990s, China has been promoting domestic firms and individuals in various industries to seek business opportunities in foreign countries. Among all industries where Chinese people explore profitable investment projects abroad, agriculture has some unique features that attracts attention from government officials, journalists and scholars: long term project, large initial investment, moderate and instable rate of return in capital and political sensitivity associated with food security and immigration. This paper will examine "Going Out" policies in agriculture from government perspective. The main method is to review published policies in the past 20 years and look at dynamics in those policies. Two major results are as follow. Chinese government, in general, has been moderately adjusting "Going Out" policies to fit the market situation. In some areas, such as labor export, project registration and capital control, changes are more frequent than in other areas.

The Hong Kong Anti-Mainlandisation Movement

Supervisor: SAUTMAN Barry V / SOSC
Student: JI Caixuan / GCS Course: UROP3100, Spring

The anti-mainlandisation movement has been a prominent theme in Hong Kong society and politics. Overtime, this movement has developed from peaceful protests as in the 2014 Umbrella Movement to more extreme, pro-independence forces. One such force is localism, which is a faction of the political movement in Hong Kong, with a focus on the preservation of the city's autonomy and local culture. This project, the Hong Kong Anti-mainlandisation Movement, involves regular research and analysis on localist movements, as well as carrying out statistical interviews with localist activists. This report is a collection of interview notes from three prominent figures in Hong Kong: Miss Lau Siu Lai, a current member of the Legislative Council, Mrs. Anson Chan, the former Chief Secretary in the governments of the British Hong Kong and the Chinese Hong Kong and Mr. Lau Ming Wai, the chairman of Hong Kong's Commission on Youth. The report will highlight their viewpoints regarding the rise of localism in Hong Kong, the prospect of Hong Kong independence as well as the positions of their respective parties. It will also make a summary on the book The Hong Kong Independence Theory (香港独立论) by Mr Leung Hin Wah.

The Hong Kong Anti-Mainlandisation Movement

Supervisor: SAUTMAN Barry V / SOSC
Student: KWONG Chun Pong / GCS Course: UROP1000, Summer

The paper is to explore the anti-mainlandization campaign in Hong Kong and the reason why there was a quick rise of the emotion and the localism. The research mainly focused on the property market and new immigrants' issue which are credited to the fact that the local Hong Kong people cannot afford the expensive housing price. Some issues like the secret independence campaign in mainland China and conflicts among the localists are to be discussed to figure out the difficulties and possibilities of the success of the localism. Moreover, there was also an interview with the committee of Student Union of the Chinese University of Hong Kong to understand the ideas of the new generation towards the localism and the idea of anti-mainlandization.

The Hong Kong Anti-Mainlandisation Movement

Supervisor: SAUTMAN Barry V / SOSC

Student: WU Wai Ming / CHEM

Course: UROP1100, Fall
UROP2100, Spring
UROP3100, Summer

The idea of localism has been becoming a well-known theme starting from late 2000s or early 2010s. After the handover, many political and social issues happened, including the SARS Outbreak and the Anti-Article 23 Movement in 2003, the Protect Queen's Pier Movement in 2007, Anti-High Speed Rail Movement in 2009, the Anti-National Education Movement in 2012, the Anti-North East New Territories Development Movement and the Umbrella Movement in 2014, the Anti-Parallel Trading Movement and the Causeway Bay Booksellers Incident in 2015, the Fishball Incident and the Legislative Council Disqualification Incident in 2016, which had weakened the Chinese identity, and meanwhile strengthened the sense of Hongkongese.

The Hong Kong Anti-Mainlandisation Movement

Supervisor: SAUTMAN Barry V / SOSC

Student: YAN Jiayi / GCS

Course: UROP1000, Summer

This UROP project is targeted on the localist movement in Hong Kong. How the organizations and student leaders are involved in different social issues, particularly those concern with the Chinese government and the clash of Hong Kong local interests. This essay included three policy-wise issues: Putonghua-as-medium-of-instruction, Comprehensive Social Security Assistance Scheme and Co-located custom at West Kowloon High Speed Express Stations, as well as a brief summary of an interview with the current student union of CUHK. The research results reflected that the localist group are anxious about the increasing extent of interference by the PRC government and diminishing autonomy of Hong Kong citizens and local culture despite some of their advocates might not be accurately reflect the authentic situation in Hong Kong.

Democratic Development in Asia and the World

Supervisor: SING Ming / SOSC

Student: CHANDRA Kevin / GCS

Course: UROP2100, Fall

I use Lipset and Rokkan's cleavage model and two-level game structures in order to explain the relationship between social cleavages and political polarization in these countries, with a focus on Malaysia (Southeast Asia) and Venezuela (Latin America) for a cross-regional, comparative purpose. This paper aims to demonstrate that social cleavages in a domestic political setting can play a two-fold influential role as follow: 1) determining regime-opposition relations, and; 2) influencing the degrees of both regime and opposition unity. I postulate that both the incumbent and the opposition will make use of the existing cleavages in order to maximize their political outcomes, which in turn may explain why some countries are able to democratize, while others are not.

Democratic Development in Asia and the World

Supervisor: SING Ming / SOSC
Student: RASMUSSEN Martin Lynge / FINA Course: UROP1100, Fall

This UROP project has conducted literature review and data collection on the impact of economic factors on political bargaining power for Mainland-Hong Kong relations. Two factors were considered. Firstly, the economic control that China has over Hong Kong. Secondly, the economic dependence of Hong Kong on China. This project did two things. Firstly, literature was reviewed. Secondly, quantitative data was collected and presented. The two most interesting pieces of evidence found is that it appears that the relative economic development of Mainland China and Hong Kong – when measured as competitiveness and cargo handled – indicates that Hong Kong by itself is experiencing a meaningful decrease in performance, while the Mainland does not appear to experience such issues.

Internet Finance and Microcredit in China

Supervisor: TSAI Kellee Sing / SOSC
Student: CHEUNG Ka Ki / GCS Course: UROP1100, Summer

Despite rapid economic growth over the past three decades, China still has a sizable under-banked population. Restricted access to credit on the part of individuals and micro, small and medium enterprises (MSMEs) can contribute to social instability, hinder economic growth and impede poverty alleviation. In order to reduce the size of financially excluded population, in 2015 China adopted the Plan for Promoting the Development of Financial Inclusion (2016-2020). This paper provides an overview of how financial inclusion has evolved in China, identifies the main stakeholders in an inclusive financial system, and analyzes the policy and regulatory environment of financial inclusion of China.

Environmental Movement in the Midst of Democratization: The Case of Hong Kong

Supervisor: WONG James K. / SOSC
Student: LAM Pui Yiu / EVMT Course: UROP1000, Summer

The educational campaigns have become the mainstream of environmental movements in Hong Kong over the past decade. Considerable effort has been put to the government-led promotion for waste reduction. This paper seeks to

analyze the significance of mascots for promoting environmental movements with the case study of 'Big Waster', as well as the reason for educational campaigns being the major approach to waste management. Filling up the research gap of Hong Kong's environmental movements, the cost-benefit analysis is employed to investigate the linkage between different policy instruments focusing on waste, which ultimately explains the role of mascots as an education tool.

Environmental Movement in the Midst of Democratization: The Case of Hong Kong

Supervisor: WONG James K. / SOSC

Student: TSE Jamie Yik Yan / GCS Course: UROP1100, Spring

Notwithstanding the proliferation of social movements in the territory in recent years, Hong Kong is often regarded as environmental-movement-deficient. Yet, it is observed that many movements were indeed initially environmental in nature though the environmental discourse failed to last. This paper seeks to investigate the cause of marginalization of the environmental edges in the movements since 2000 with a case study of the piers preservation movements during 2006-2007. The concept of 'frame' and various factors affecting the construction of the frame are employed to examine the linkage between framing and the weakened environmental discourses in social movements, thereby explaining the cause of such phenomenon.

IROP Overview & Projects

The International Research Opportunities Program (IROP) entered its sixth year in partnership with the Massachusetts Institute of Technology (MIT) in 2017. In the summer, five HKUST students and five MIT students were sent to each other's university to conduct full-time research under the mentorship of the host faculty's research team at an exotic campus.

By the end of the program period, we organized a gathering for MIT students to share their findings to the UROP students who were doing summer research under the same HKUST faculty member, and asked the UROP students to present their projects to the MIT students as well. This helped to stimulate the intellectual and cultural communications for students from both sides.

The projects done by the MIT and HKUST students are listed as follows:

MIT Students

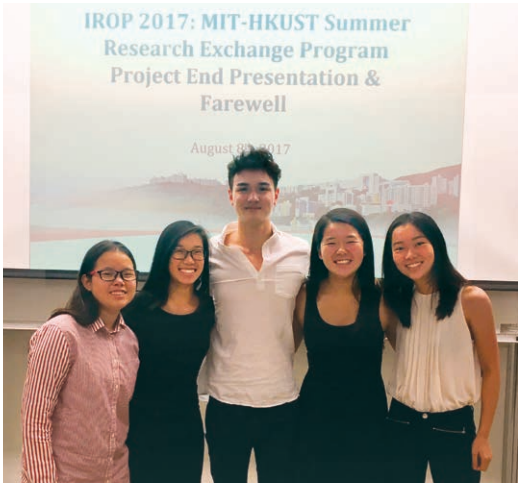
Miss Olivia Leng CHONG
Major in Mechanical Engineering
Supervised by: **Professor Huihe QIU** / Dept. of Mechanical & Aerospace Engineering
Project Title: Biomimetic Flapping Wings for Micro Air Vehicles

Miss Andrea Jessica JABA
Major in Computer Science & Economics
Supervised by: **Professor Gary CHAN** / Dept. of Computer Science & Engineering
Project Title: Updating Wireless Signal Map with Bayesian Compressive Sensing

Mr Brennan Peter LEE
Major in Mathematics
Supervised by: **Professor Minhua SHAO** / Dept. of Chemical & Biological Engineering
Project Title: Palladium Based Nanowire as Advanced Catalyst for CO_2 Electrochemical Reduction Reaction

Miss Nanette WU
Major in Computer Science & Engineering
Supervised by: **Professor Pan HUI** / Dept. of Computer Science & Engineering
Project Title: Mobile Augmented Reality

Miss Jennifer ZOU
Major in Mathematics & Economics
Supervised by: **Professor Yangqiu SONG** / Dept. of Computer Science & Engineering
Project Title: Natural Language Processing for News and Social Media with Low-resource Languages



HKUST Students

Mr Bing An CHANG

Major in Mathematics (Computer Science Track)
Supervised by: **Professor John R. WILLIAMS** / Dept. of Civil and Environmental Engineering
Project Title: Development of VS Code Plugin for Javascript Code Submission

Mr Liangwei CHEN

Major in Computer Science and Mathematics (Pure Math-Advanced Track)
Supervised by: **Professor Dina KATABI** / Dept. of Electrical Engineering and Computer Science
Project Title: Device Free Consistent ID Trajectory Identification

Mr Mucong DING

Major in Physics and Computer Science
Supervised by: **Dr. Una-May O'REILLY** / MIT Computer Science and Artificial Intelligence Laboratory
Project Title: Open Learning Design Data Analytics and Visualization Framework for e-Learning

Mr Animesh Kumar JHA

Major in Mechanical Engineering
Supervised by: **Professor Jing KONG** / Dept. of Electrical Engineering and Computer Science
Project Title: Graphene Synthesis using Chemical Vapor Deposition

Mr Yanghui OU

Major in Electronic Engineering
Supervised by: **Professor Charles SODINI** / Dept. of Electrical Engineering and Computer Science
Project Title: Finger Blood Pressure Monitor Based on Multi-Wavelength Photoplethysmography

HKUST's UROP

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香 港 科 技 大 學
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