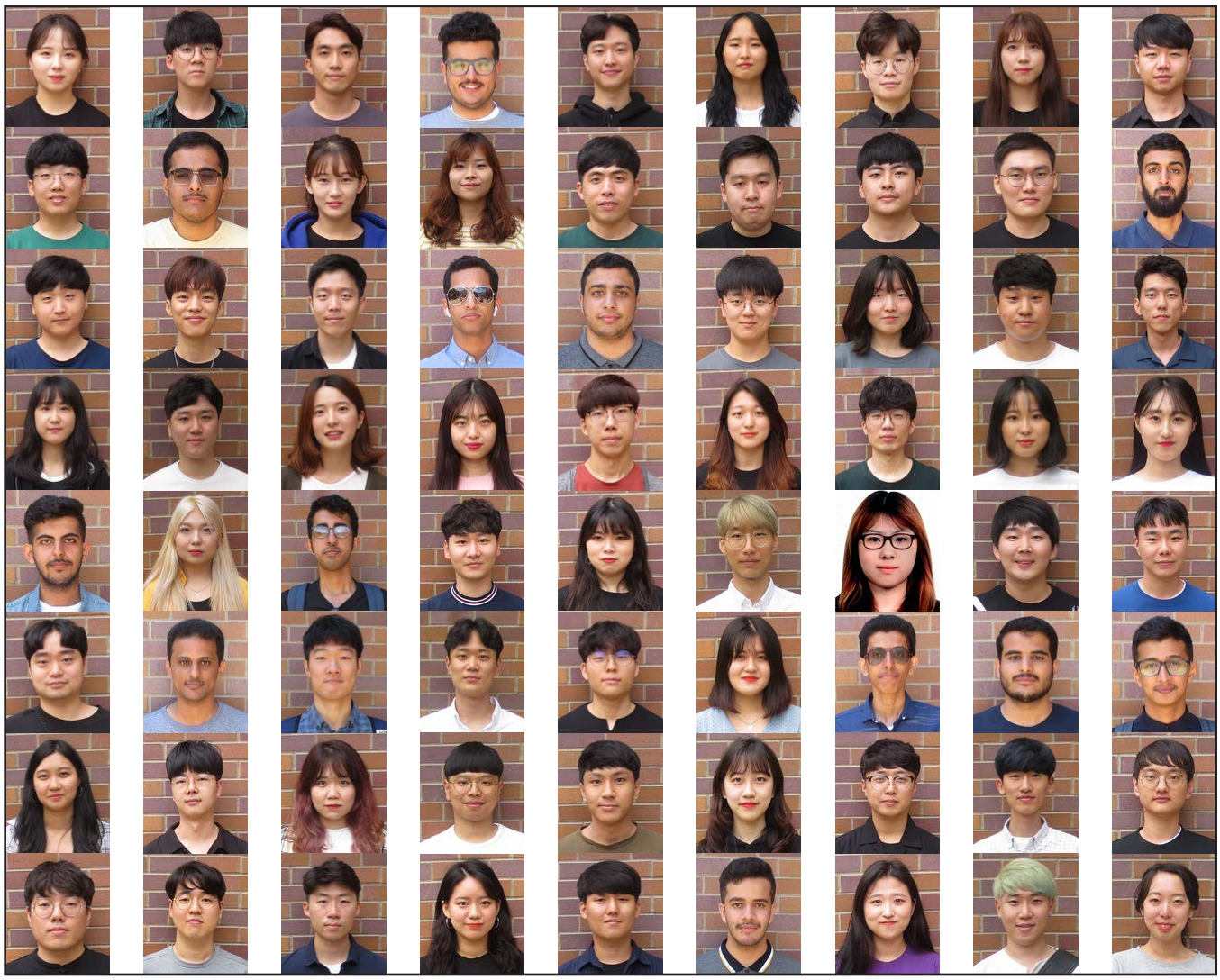
UROP

I-SURF International Summer Undergraduate Research Fellowship

2019 Symposium



SAIP Saudi Arabia International Program

UCI
University of California, Irvine

A Welcome from the Program Director

August 23, 2019

Dear I-SURF Fellows, Faculty Mentors, and Guests:

International collaborations have become an important element in the global research community. By sharing cultures and approaches to research, collaborators gain new perspectives and ideas. Since 2015, UC Irvine's International Summer Undergraduate Research Fellowship (I-SURF) has contributed to this global approach by offering international students the opportunity to conduct research in the United States.

This summer, I-SURF brought 60 undergraduate students from 11 universities in South Korea to participate in faculty-mentored research projects at UC Irvine. In addition, 12 students from Shaqra University in Saudi Arabia were integrated into the program. These students had the opportunity to conduct research under the guidance of distinguished faculty mentors from the Donald Bren School of Information & Computer Sciences and the Henry Samueli School of Engineering. Students chose from an extensive list of cutting-edge projects in the fields of computer sciences, informatics, and electrical engineering. Faculty mentors and their teams of graduate students and research collaborators provided personalized mentoring and training to the Fellows, giving them the unique opportunity to explore their research interests, and to become immersed in UC Irvine's collaborative research culture.

In addition to working on their projects, I-SURF Fellows attended seminars on a wide variety of topics relevant to their research and received intensive instruction in both written and spoken English. They visited a number of successful companies, engaging with entrepreneurs, engineers and project managers. They also had time to experience Southern California, enjoying barbecues, visiting local amusement parks, shopping, and going to the beach.

The continuing growth of the I-SURF program demonstrates the potential for successful collaboration between international universities, facilitated by the Undergraduate Research Opportunities Program (UROP) at UC Irvine. UROP is committed to supporting faculty-mentored undergraduate research and creative activities in all disciplines. In addition to sponsoring the I-SURF program, UROP also advises undergraduate students about on- and off-campus research opportunities, sponsors the UCI Undergraduate Research Symposium and publishes the multidisciplinary *UCI Undergraduate Research Journal*. In addition, the Summer Undergraduate Research Program (SURP) provides students with the opportunity to immerse themselves into a research project or creative activity under the guidance of UC Irvine faculty members. UROP has also collaborated with other units on campus to sponsor undergraduate research programs emphasizing multidisciplinary design, as well as research in biophotonics, health promotion and disease prevention, information technology, the Internet of Things, cardiovascular research, chemistry, and micro/nano technologies.

Thank you for participating and for showing your support for the Fellows presenting here today. I would also like to thank the faculty leadership at UC Irvine and our collaborators from Chosun, Chung-Ang, Chungnam National, Dankook, Hallym, Hanyang, Jeju National, Kookmin, Kyung Hee, Seoul Womens', Shaqra, and Sungkyunkwan Universities. Finally, I want to express my deep gratitude for the faculty mentors and other research collaborators who have devoted their time and effort to mentoring this year's Fellows. We are grateful to have had the opportunity to collaborate with so many distinguished and dedicated people to make the program a success.

Sincerely,

Said M. Shokair
Director

Schedule of Presentations

Presentations are allotted 12 minutes, and 10 minutes for individuals, followed by 3 to 5 minutes for questions and answers.

Friday, August 23, 2019
Calit2 Auditorium

Time	*I-SURF Fellows*	*Project Title*	*Faculty Mentor(s)*
8:00	**Yongtae Kim** **Byeongkeon Lee** **Kihoon Park**	Adaptive Resource Management for CPU and GPU Applications on NVIDIA Jetson TX2 Board	**Nikil Dutt** *Computer Science*
8:15	**Jeonghwa Jeong**	Analyze Data for Alzheimer Caregivers	**Nikil Dutt** *Computer Science*
8:30	**Seoyeong Hong** **Jiwon Park**	Development for Convolutional Neural Networks Accelerator	**Nikil Dutt** *Computer Science*
8:45	**Joonhee Jeong** **Hyunji Oh**	Dynamic Computation Migration at the Edge	**Nikil Dutt** *Computer Science*
9:00	**Wongi Baek** **Joonkyo Seo**	Machine learning on Artifact Removal of Continuously Monitored Blood Pressure Readings	**Nikil Dutt** *Computer Science*
9:15	**Youngwoo Cho** **Hyengjoon Goo**	Pain Assessment with Wearable Electronics	**Nikil Dutt** *Computer Science*
9:30	**Ye Sel Lee**	Ubiquitous Stress Monitoring System	**Nikil Dutt** *Computer Science*
9:45	**Minah Cho** **Ji-ho Kim** **Younkyoung Yoon**	Bone Structure Manipulation	**Alexandru Nicolau** *Computer Science*
10:00		**15-Minute Break**	
10:15	**Atyan Alatyan** **Sultan Albusaymi** **Bandar Alotaibi**	Throttle Actuation and Vehicle Detection for Autonomous Driving	**Ahmed Eltawil** **Fadi J. Kurdahi** *Electrical Engineering & Computer Science*
10:30	**Meshal Alfulayyih** **Turki Alhassan** **Fahad Alsunaydi**	Steering Automation and Lane Line Detection for Autonomous Driving	**Ahmed Eltawil** **Fadi J. Kurdahi** *Electrical Engineering & Computer Science*
10:45	**Seokjun Choi** **Seongyoung Kang**	FPGA Acceleration of Big Data Analytics in Non-Volatile Memory	**Sang-Woo Jun** *Computer Science*
11:00	**Hanjeong Lee**	Massive Data Visualization on NAND-Flash Storage	**Sang-Woo Jun** *Computer Science*

Time	*I-SURF Fellows*	*Project Title*	*Faculty Mentor(s)*
11:15	**Woolim Cho** **Donghyeon Choi** **Donghak Park**	Security Implications of Compressed Neural Networks for Self-Driving Cars	**Sang-Woo Jun** *Computer Science*
11:30	**Jun Nyung Hur** **Byunghoon Park** **Unsang Park**	Learning in IoT Edge	**Eli Bozorgzadeh** *Computer Science*
11:45	**Keon Woo Jang** **Wonjun Jang**	Simulation of Cooperative Multi-Robot Localization	**Eli Bozorgzadeh** *Computer Science*
12:00		**Lunch**	
1:00	**Damin Moon**	Towards a Better Understanding of Deep Learning Outputs	**Weining Shen** *Statistics*
1:15	**Jinwook Jung** **Yeonji Lee** **Jisoo Min** **Dohyun Soung**	Generating Code from Natural Language	**Ian Harris** *Computer Science*
1:30	**Seonghoon Choi** **Sungin Choi** **Jaewon Oh** **Jangmin Son**	Launching Distributed Denial of Service (DDoS) Attacks	**Ian Harris** *Computer Science*
1:45	**Myounghun Han** **Dongcheol Jwa** **Hyun Ji Lee** **Hye Eun Song**	IoT Application to Understand and Improve Campus Life	**Ramesh Jain** **Sharad Mehrotra** **Nalini Venkatasubramanian** *Computer Science*
2:00	**Faisal Aldalbahi** **Ibrahim Alyhyan**	Experimental Analysis of Reduced Scale Steel Bridge	**Ahmed Eltawil** **Fadi J. Kurdahi** *Electrical Engineering & Computer Science*
2:15	**Khaled Alhussaini** **Mohammed Alyahya**	Automated Structural Health Monitoring	**Ahmed Eltawil** **Fadi J. Kurdahi** *Electrical Engineering & Computer Science*
2:30	**Abdulhakim Almarshadi** **Bandar Alosaimi**	Solar Tracker	**Ahmed Eltawil** **Fadi J. Kurdahi** *Electrical Engineering & Computer Science*
2:45	**Jahyeon Hong** **Dongjun Hwang** **Hye Rim Hyun**	Big Graph Visualization	**Chen Li** *Computer Science*
3:00		**15-Minute Break**	
3:15	**Ye Lin Jeong** **Donggun Lee** **Joonyoung Park**	Designing User-Friendly AI Systems for Personal Health Tracking	**Yunan Chen** *Informatics*

Time	*I-SURF Fellows*	*Project Title*	*Faculty Mentor(s)*
3:30	**Dakyung Go**	Surveying Mobile Fitness and Wellness Apps for Inclusion	**Daniel Epstein** *Informatics*
3:45	**Seunghyun Kim** **Sangyeong Lee**	How Can Voice Assistants Support Adjusting Voice Settings for People Who Are Blind?: Improving Voice-Activated Personal Assistants (VAPAs) by Learning from Screen Readers	**Stacy Marie Branham** *Informatics*
4:00	**Minho Heo** **Hyeri Jung** **Byungchan Kim** **Joonhan Park**	Exploring the Conversational Importance of Software Engineering Chatbots	**Andre W. van der Hoek** *Informatics*
4:15	**Seunghwan Hong** **Hyunji Kim** **SangHoon Kim** **Nayoung Lee**	Lightweight, Voice-Based Knowledge Capture and Delivery in Software Design Meetings	**Andre W. van der Hoek** *Informatics*
4:30	**YiJi Bae** **Joohee Kwon**	Improving Computational Tools for Analyzing Health-Related Social Media Data	**Kai Zheng** *Informatics*
4:45	**Suin Lee**	Predicting Frequent Visitors of the Emergency Department	**Kai Zheng** *Informatics*
5:00		**Presentation of Certificates of Completion**	

If you would like further information on the I-SURF Program, please contact:

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Projects are listed in the order in which they are scheduled.

Yongtae Kim
Byeongkeon Lee
Kihoon Park

Project Title: Adaptive Resource Management for CPU and GPU Applications on NVIDIA Jetson TX2 Board

Mentor: Nikil Dutt

Abstract:
The current trend in computing platforms is moving towards multicore and many-core computing resources. These platforms require a comprehensive runtime resource management framework. In this situation, the MARS frameworks is recognized as a promising framework for heterogeneous computers. However, the MARS framework has some room for improvement. The purpose of this research is to develop three enhancements: (1) making computers be controlled by a cloud server server; (2) adjusting hardware operating frequency; and (3) using GPU for running applications on NVIDIA Jetson TX2 boards. First, in order to control computers easily, a communication mechanism is developed by using TCP and Inter-Process Communication. Second, in the hardware frequency part, reinforcement learning, which is reasonable at runtime on embedded, is used. Finally, heartbeat annotation and measurement of modern benchmarks on NVIDIA Jetson TX2 platform was utilized for GPU as well as CPU. As a result, the MARS running on several computers can be maintained by one cloud server. Furthermore, reinforcement learning saves power consumption. Also, GPU part can support GPU cores about heartbeat measuring, add Rodinia benchmarks with Cuda to the MARS-benchmarks. Overall, results increase power efficiency by easily controlling hardware frequency in heterogeneous computers. It will result in expansion of resource usage of other applications in embedded systems. This study shows how the MARS framework improves performance in heterogeneous computer(s) with a single server and allows the MARS benchmarks to be customized.

Jeonghwa Jeong

Project Title: Analyze Data for Alzheimer Caregivers

Mentor: Nikil Dutt

Abstract:
This project is about immigrant family caregivers of persons with dementia (PWD) who suffer from a lack of care information available in their own language and culture. Particularly, Vietnamese-American (VA) and Korean-American (KA) immigrants underuse public services available for dementia care and tend not to seek treatment until the situation becomes a crisis. The VA and KA families of PWD are understudied and less likely to receive the needed assistance for their own health and wellness. One aspect of our intervention uses the wearable Internet of Things (WIoT) technology which is a combination of Smartwatch-Smartphone-cloud, to monitor physiological changes. In this project, we mainly focused on two attributes: stress and sleep. For sleep, we focused on extracting more useful information from collected data so that we can know a user's sleep quantity, quality, and schedule attributes. For stress, we focused on making trends of stress over time. Thus, we developed a culturally sensitive and caregiver-centered home visit program using mindfulness, caregiving education, and WIoT to promote mental health of VA and KA family caregivers of PWD.

Seoyeong Hong
Jiwon Park

Project Title: Development for Convolutional Neural Networks Accelerator

Mentor: Nikil Dutt

Abstract:
CNNs are both computationally and memory intensive, making them difficult to deploy

on embedded systems. To address these limitations, we describe methods to reduce the storage and computation required by convolutional neural networks by an order of magnitude without affecting their accuracy. The methods are Pruning and Quantization: pruning removes unimportant connections that do not affect the accuracy that changes the unimportant weights to zero. The other method is Quantization, which is to quantize weights to increase computation speed and reduce the size of the models. The basic method to quantize is to change weights from 32-bit floating point to 8-bit integer.

Joonhee Jeong
Hyunji Oh

Project Title: Dynamic Computation Migration at the Edge

Mentor: Nikil Dutt

Abstract:
In the era of Fog Computing, where one can decide to compute certain energy-critical tasks at the edge of a network, designers often encounter a question of whether the sensor layer provides the optimal power consumption for a service, or the Fog layer, or a combination of both. In this context, minimizing the total energy consumption by using computation migration is a communication-computation co-optimization issue, as the response time and power consumption do not depend only on the computational capacity of each side. Basically, there is limited hardware architecture on the sensor layer that results in longer computation times than the Fog layer. Otherwise, to compute in the Fog layer, extra transmission time between the sensor and Fog layers will be needed because of data offloading. Instead, if a large amount of data is offloaded to the Fog layer and returns to the sensor layer after computing, performance and energy efficiency would be reduced. In that case, it is important how efficient it is to transmit data between sensor node and gateway to get optimal energy consumption and performance. In this paper, we aim at ERP (Energy Consumption Response Time Product) presenting efficiency of energy consumption and performance to determine it numerically and visually. In IoT (Internet of Things) applications, the ratio of a generated data to the input data can vary, which significantly affects the response time. Therefore, we have classified those to four types, and evaluate how much data is transferred for each application to represent the optimal ERPs.

Wongi Baek
Joonkyo Seo

Project Title: Machine learning on Artifact Removal of Continuously Monitored Blood Pressure Readings

Mentor: Nikil Dutt

Abstract:
Human blood pressure has much information about a person's state, having hypertension and whether a person has a heart disease or not. So, the goal of this research is to recognize and remove artifacts that originate from human motions by analyzing the blood pressure measurements. In order to recognize motion, we use ML (Machine Learning). ML requires much data and the data is obtained from our sensor. The sensor is made to be a wearable device that is piggybacked on a small form factor board carrying AD7745(CDC, Capacitance-to-Digital Converter) on top of MetamotionR(MMR). In this way, we use a specific sensor. The sensor is a variable capacitor and if we put the sensor on our wrist, our blood pulse pushes the sensor and then changes a capacitance value. AD7745 converts the capacitance value to digital signal, communicate with MMR by I2C Communication and send the value to MMR. MMR also can get two data, Accelerator and Gyroscope data. By using the three data, we will recognize human motions. Also, using Deep Learning, we will train patterns of blood pressure and physical data and classify kinds of motion. As a result, we can provide people services like checking which activity a person is doing, sending an alarm if elderly fall on street, etc.

Youngwoo Cho

Hyengjoon Goo

Project Title: Pain Assessment with Wearable Electronics

Mentor: Nikil Dutt

Abstract:
Currently, pain assessment tools are based on self-reporting by patients. However, people who lack communication skills (i.e. infants, the elderly, someone under sedation or anesthesia) cannot manage their physical sufferings themselves. This study aims to help uncommunicative people maintain continuous pain monitoring that is dependent on their physiological signals, which are collected by wearable electronic devices. On that basis, we develop a reliable pain intensity assessment tool with the classification of multiple physiological parameters. For this purpose, we used an available database BioVid from a group in Germany where the participants are subjected to heat stimulus under controlled conditions. The database contains data from 85 participants. From the biopotential database, we conduct signal processing to obtain essential features and get rid of meaningless information. With the collected data, we labeled five different levels as *no pain, low pain, mild pain, moderate pain,* and *severe pain* based on the self-reported scale by study participants. We extracted 159 features from the mathematical groupings of amplitude, frequency, stationarity, entropy, linearity, and variability. The main goal of this study is to build a reliable and continuous pain monitoring method. Various types of classifiers (e.g. Random Forest, Support Vector Machine Kernel Function; linear, sigmoid, poly, RBF) were trained, validated, and tested with the physiological parameters. In addition to the goal of developing a pain assessment model, we hope that our validated tool helps to provide objective and useful information for the medical practitioners and patients.

Ye Sel Lee

Project Title: Ubiquitous Stress Monitoring System

Mentor: Nikil Dutt

Abstract:
Modern people are increasingly exposed to more stress than ever before due to increased mental workload such as professional responsibilities. It is important to prevent stress in advance since continuous and long-term stress can cause serious illnesses like heart disease, asthma, obesity, and diabetes. However, current stress monitoring system do not provide personalized stress assessment in an everyday context. Therefore, the purpose of our stress monitoring system is to measure stress by providing daily healthcare assessments. In controlled settings, the system collects stress-related data from wearable sensors such as an electrocardiogram (ECG), which measures electrical signal of the heart, Galvanic Skin Response (GSR), which measures electrical characteristics of the skin, and Photoplethysmography (PPG), which measures electrical activity of the blood. These data are analyzed and classified in order to define stress and build a stress model. In everyday settings, the system classifies personal physiological signals from daily life to define stress with the model and provide daily stress assessments. Also, we are working on detecting human activity in order to increase accuracy of defining stress even during human movement. Through these processes, we can provide personalized stress monitoring system in everyday context with high accuracy.

Minah Cho

Ji-ho Kim

Younkyoung Yoon

Project Title: Bone Structure Manipulation

Mentor: Alexandru Nicolau

Abstract:
In the medical field, the importance of patients' personal information is growing. However, hospitals have privacy issues when they need a patient's facial data. The purpose of our research is to keep the patient's privacy. When someone sees fake faces of patients, they know the specific medical features doctors need, but not the identity. Therefore, it is beneficial to solve patients' privacy issues. First, we need gender detection and age approximation with face detection. By doing this, we could detect people's

identity. When the code is run, age and gender are slightly different. But, the code distinguished whether they are the same person or different people. Second, we are executing GAN to generate new faces. First, I created a face using DCGAN. The fake face was not created well. Next, we are creating a face using Style-GAN. The interpretation of the results is that result of facial recognition was good but accuracy of age and gender detection was low. In the GAN discriminator, we get the cost we want, but in the generator, we don't get the desired cost. We need a dataset of diverse people and we have to find the best GAN for this research and better layers. So, we will find a better dataset for age and gender detection. And, if we run style-GAN perfectly, we will create a fake face with the real face of the person we want. But, if we don't get the results we want in a style-GAN, we will look for other GAN types.

Atyan Alatyan
Sultan Albusaymi
Bandar Alotaibi

Project Title: Throttle Actuation and Vehicle Detection for Autonomous Driving

Mentors: Ahmed Eltawil, Fadi J. Kurdahi

Abstract:
Two of the main issues that rise during drag racing are wheel stands and competitors' vehicles crossing over lanes. By integrating the autonomous vehicle concept into drag racing, we can eliminate both. We introduced a computer system (PX2) which is connected to both a sensor (Sekonix Camera) and a linear actuator (Kar-Tech CAN Actuator) to provide vehicle detection and throttle control autonomously. We built a wiring connection between the linear actuator and the PX2 and ran multiple tests to verify that the connection is secure. Through Python, we wrote the code which will enable the camera to detect any vehicles in the vicinity by means of the "sliding window method." Using a combination of random vehicle pictures, we ran our codes, which resulted in 99.95% detection rate of any vehicles in the frontal area of our car. Motor racing, especially drag racing is won or lost by milliseconds or even microseconds. By substituting the human factor and its many errors, autonomous drag racing and in the future normal vehicles can negate those errors and avoid the numerous issues associated with it.

Meshal Alfulayyih
Turki Alhassan
Fahad Alsunaydi

Project Title: Steering Automation and Lane Line Detection for Autonomous Driving

Mentors: Ahmed Eltawil, Fadi J. Kurdahi

Abstract:
Our project is about creating an autonomous drag race vehicle which can detect lane lines and autonomously steer. The main goal of the project is to gather data about how an autonomous vehicle can handle high speed. Safety in drag racing can be achieved by making the vehicle stay in the correct lane, even at high speeds. We used Nvidia PX2 as our processing computer and connected it to our actuator using the J1939 protocol and a vehicle CAN Bus to send and receive hex messages. DBC files were created which contain all our hex messages and signals to communicate between components. RTMaps was used to send commands to the steering actuator, with a Simulink model sending the control logic. The result is an automated vehicle steering algorithm. Lane line detection was implemented using python and various libraries to capture frames from our cameras to detect the lane line. This was done using color transformations, image transformations, and a sliding window search. The result can be used to determine lane position and estimate when another vehicle will enter our lane and how best to manoeuvre around it. Since this technology can respond faster and more accurately than a human driver, the application of this research is to increase the safety of drag races and more importantly autonomous driving in general.

Seokjun Choi

Seongyoung Kang

Project Title: FPGA Acceleration of Big Data Analytics in Non-Volatile Memory

Mentor: Sang-Woo Jun

Abstract:
As computer science developments become a critical part of society and scientific discovery, computers must deal with Big Data. The access speed of a huge amount of data is very slow because of the bandwidth limitation of secondary storage, which is generally where data is stored on existing desktop machines. The key insight of this project is to overcome the bandwidth limitation by using hardware-accelerated compression coupled with hardware-accelerated data processing. As a part of this project, we implement a compression/decompression algorithm on an FPGA (Field Programmable Gate Array). An FPGA does not read a program from memory like other general processors, such as CPUs, and GPUs because it reconfigures itself fit to program when we mount that program on it. Compression algorithms implemented on an FPGA can handle the multi GBs per second data rates of modern storage devices, which will be used by the scientific computing accelerators. The resulting system will be able to achieve supercomputer scale performance on a desktop machine. We worked on our project by reading related papers, and references. We learned that implementation on a low-level system is not the same as other works such as application level programs. It requires careful designing and implementation, if not, it will not work. The goal of our project on its own is not entirely novel. However, it will become a critical component of a larger system which will make use of our results.

Hanjeong Lee

Project Title: Massive Data Visualization on NAND-Flash Storage

Mentor: Sang-Woo Jun

Abstract:
In traditional graph analytics, the entirety of a graph's data needs to be put in DRAM due to its random access characteristics. But this incurs a heavy cost as the graph's size gets bigger. External graph analytics that stores both edge and vertex data in an array of SSDs is becoming an attractive alternative because secondary storage devices are much cheaper than DRAM. However, secondary storage devices have a problem that needs to be overcome. Because of its coarse access granularities, updating fine-grained values in secondary storage devices incur a large write amplification. For example, reading and writing a 4 KB page in order to read and update a 4 Byte value results in a 1024-fold write amplification, resulting in a 1024-fold effective performance degradation. Sort-reduce is an algorithm used in external graph analytics, that can perform high-speed analytics on graphs with billions of vertices. Sort-reduce logs update requests and sorts them sequentially. In order to reduce overhead of sorting, whenever update requests directed to the same index are discovered, a reduction function is applied in-place between the two requests. This project aims to implement another version of Sort-reduce using an LSM-Tree (Log-structed merge-tree). LSM-Tree is a data structure with performance characteristics that make it attractive for providing indexed access to files with high insert volume. LSM Tree is designed to provide better write throughput by removing the need to update-in-place operations. It is expected that performance will be improved from the previous design of sort-reduce.

Woolim Cho

Donghyeon Choi

Donghak Park

Project Title: Security Implications of Compound Neural Network for Self-Driving Cars

Mentor: Sang-Woo Jun

Abstract:
In self-driving cars, deep learning is used to classify objects and determine actions, which are the basic and important parts of autonomous driving. However, applying deep learning to self-driving cars has two critical problems. First, deep learning models require a lot of energy. It has been shown that the power consumption of deep-learning

platforms has a significant impact on the driving range of autonomous vehicles, for both electric and gasoline-powered cars. Second, deep learning models often have major vulnerabilities which attackers can use to deceive the model. Attackers can use "adversarial attacks," where they create perturbed images from the originals which are similar to human eyes, but models misclassify as another type of image. This may cause serious physical and financial damage when using self-driving cars, because it may cause the vehicle to operate abnormally. To solve these problems at the same time, we verified existing research and applied those methods to a self-driving car simulator. Our major methods of making robust and lightweight deep learning model are pruning and quantization. In our experiment, we found that an 80% pruned model can be as robust as an original model without losing accuracy, even against adversarial training. Also, we found that quantization can compress the model by four times without losing accuracy. These results show that we can make a robust and lightweight model to solve the two problems simultaneously. In addition, we conducted an experiment to validate these strategies in a real environment by using a self-driving car simulator "Apollo."

Jun Nyung Hur
Byunghoon Park
Unsang Park

Project Title: Learning in IoT Edge

Mentor: Eli Bozorgzadeh

Abstract:
Several studies have shown the benefit of Edge for Machine Learning applications, where Neural Networks require powerful computing resources and communication bandwidth. Edge nodes are near-end-device servers that provide more computing resources for IoT systems. Compared to clouds, edge nodes have fewer computation resources but provide faster data communication due to their closer proximity to end devices. In this project, we investigated computational and communication limits at end devices and edge nodes on a vision application (object recognition). We set up a network of Raspberry Pi embedded boards (RPI3) connected to an edge device running MobileNet SDD object recognition model. Our experiments showed that for a single RPI, using the edge node running the model improves the performance six times better than running the model on the board (3.1 FPS versus 0.5 FPS). Then we expanded the network to four RPI3 boards and increased the number of simultaneous requests from each of them to the edge to find out how that can affect the performance and quality of the application and to find out any threshold of optimal workload distribution for such a system. For example, sending one video per RPI we got 0.6 FPS per video which was still better than running the model on the end devices but when we increased the number of videos to eight (two per RPI) we could see the FPS decreased to 0.3 per video. So the optimal choice for such a case would be running one video on each and sending the rest to the edge. We ran several experiments and studied how different configurations can affect the performance, computation and communication quality of the model.

Keon Woo Jang
Wonjun Jang

Project Title: Simulation of Cooperative Multi-Robot Localization

Mentor: Eli Bozorgzadeh

Abstract:
Cooperative Localization is a scheme for navigating robots in GPS denied environments. In cooperative localization, a group of robots exchange relative position measurements from their sensors (e.g., camera, laser, etc.) and their motion information from sensors (e.g., IMU, encoders, etc.) to collectively estimate their position. In order to achieve accuracy, filters and data fusion algorithms(such as Unscented Kalman Filter, UKF) are deployed for state and position estimation. In this project, the goal is to simulate a decentralized data fusion algorithm on a network of robots. In robotic networks, Robotic Operating System(ROS) is used for scalable implementation of decentralized application across multiple cooperative robots. On the other hand, it also causes "delay." Therefore, one of our goals is to lessen the delay of each robots. In this project, we used ROS2 Dashing Diademata on Raspbian OS, which is installed on Raspberry Pi3 model B.

Initially, the simulation is performed on two Raspberry Pi3, but finally it is performed on three boards. It is very important research because in future there will be many robots, such as autonomous vehicles. It means coordinating each robot's location with cooperative localization when it is in a GPS-denied situation is getting more important.

Damin Moon

Project Title: Towards a Better Understanding of Deep Learning Outputs

Mentor: Weining Shen

Abstract:
Deep learning models are known as black boxes. Interpreting the outputs from a black box model remains a significant challenge in machine learning studies. This project proposes to interpret the results of a black box model by applying a representer theorem, which can decompose the prediction of a neural network into a linear combination of activations of training points, hence providing an intuitive way to interpret the importance of each training point. In the second part of the project, we focus on obtaining a better understanding of outputs from Generative adversarial network (GAN) and considering possible refinement of GAN for imaging studies. We attempt to improve the prediction accuracy of GAN by considering several methods such as feature matching and semi-supervised learning in hope that those methods can fix the potential issues such as gradient vanishing or mode collapse when fitting GAN.

Jinwook Jung
Yeonji Lee
Jisoo Min
Dohyun Soung

Project Title: Generating Code from Natural Language

Mentor: Ian Harris

Abstract:
Selecting proper parameters and functions in code is important. However, writing code after interpreting the given questions is difficult because it is hard to consider the required values and the information to be used. We use three algorithms to find the elements of the code such as loop statements and parameters in function. We propose to use neural network (NN) to predict the existence of loops. With NN with google sentence encoder, we determine whether there are any loop statements when writing code. In addition, in order to identify parameters for writing code, we use slot filling approach. Slot filling is one of the key components in spoken language understanding (SLU), which is often used as a sequence labeling problem. We implemented and compared two algorithms to solve sequence labeling problems, including recurrent neural network (RNN) and conditional random field (CRF). Both of them are frequently used for slot filling, but RNN is a type of network architecture that is common in natural language processing (NLP), whereas CRF is a probabilistic graphical model to express dependence between probabilistic events. We evaluated and compared the algorithms on Codingbat dataset, which contains questions and answers. Our results show that NN achieves a 90% f1-score on predicting loops. For slot filling, our evaluation reveals that CRF achieves a 97% f1-score.

Seonghoon Choi
Sungin Choi
Jaewon Oh
Jangmin Son

Project Title: Launching Distributed Denial of Service (DDoS) Attacks

Mentor: Ian Harris

Abstract:
Today, many IoT devices are developed and used that are very convenient and useful. But at the same time, security becomes more important. The more common these devices become, the more important their security becomes. The goal of this research is to develop DDoS and send malicious packets to a server with the method we implemented. The purpose of this is to consider how to defend against malicious attacks by implementing a DDoS attack. We implemented "SYN Flood Attack" among many DDoS attack methods. Syn Flood Attack is a method that sends packets to a device with a number of time at a high rate which the device can't handle. We implemented methods for IP spoofing which can manipulate IP addresses randomly so that a system can't tell which addresses to block. When we attack the server by Syn Flood Attack, we can send

55,000 packets per second, which overloads the server. We checked that the user cannot connect to the server. Now we can attack many servers such as IOT devices, web servers, etc. It means nobody can connect to the server during attacking. Our purpose is not only attacking the server, but also knowing how to defend the server from the attack. We can find defense methods to know the logic of the method of server attacks. We studied many kinds of server attacks, and found defense methods through these server attacks.

Myounghun Han
Dongcheol Jwa
Hyun Ji Lee
Hye Eun Song

Project Title: IoT Application to Understand and Improve Campus Life

Mentors: Ramesh Jain, Sharad Mehrotra, Nalini Venkatasubramanian

Abstract:
The Internet of Things (IoT) is enabling buildings to become *smart*. Using sensors deployed in such spaces can help dealing with daily problems in a University Campus such as understanding and reducing energy waste (e.g., controlling the temperature of different rooms based on their occupancy) or improving safety. The purpose of this study is to work on the SemIoTic framework designed at UCI to facilitate the development of smart applications. First, in this work we developed a smart campus IoT application to show the occupancy levels of different parts of the UCI campus. This app can be used to improve sustainability and security. Second, we implemented a software component that takes a request from the previous app described at high-level (e.g., "retrieve the occupancy of the meeting rooms with an occupancy higher than its capacity") and translate it into appropriate device commands/actions. This task finds corresponding sensors based on conditions given by the app, generates a feasible plan, and executes it. An essential part of this process is an ontology model that describes the smart campus by defining relationships between the IoT devices and the spaces and people on campus. Finally, we developed the software component that interacts with heterogeneous IoT devices employing different data exchange protocols.

Faisal Aldalbahi
Ibrahim Alyhyan

Project Title: Experimental Analysis of Reduced Scale Steel Bridge

Mentors: Ahmed Eltawil, Fadi J. Kurdahi

Abstract:
The American Association of State Highway and Transportation Officials (AASHTO) recommends field testing for new bridges as an effective approach to measure the structural response of a bridge under various loading conditions and to determine its structure integrity. This project investigates the performance of a reduced scale steel bridge through nondestructive load experimental testing and finite element analysis modeling (FEM). The experimental and analytical plan for this study followed four phases. Phase I, in which the construction and the as built measurements of the bridge have been accomplished. Phase II includes modeling the bridge by introducing the geometric measurements and the boundary condition to the FEM. Phase III involves static and dynamic testing. Static testing has been done by applying gravity loads and monitor the bridge deflection shape, then the field measurements have been used to refine the FEM to produce more reliable model for the bridge by varying the stiffness and the boundary condition to simulate the actual behavior. The dynamic test has been done by applying a lateral vibration to the bridge in which the natural frequency in the lateral direction of the bridge has been measured. Upon the bridge assessment under static and dynamic loading, it was recommended that adding lateral system to the bridge would improve the performance. Phase IV covers the retrofitting design plan followed by a field static and dynamic testing. Upon the successful series of static and dynamic testing of the bridge, an appropriate lateral system has been achieved and the performance has been improved.

Khaled Alhussaini
Mohammed Alyahya

Project Title: Automated Structural Health Monitoring

Mentors: Ahmed Eltawil, Fadi J. Kurdahi

Abstract:
Millions of people use bridges every day, so it is essential to ensure bridges' safety. Due to the high frequency of bridge accidents and the resulting casualties, continuous monitoring of bridges has become indispensable. This project focuses on measuring static and dynamic structural damage indicators. For the static part, displacement is calculated by using a camera that is continuously capturing a video of a specified target. Then, digital image correlation (DIC) using MATLAB software is applied to the video to extract displacement information. For the dynamic part, we focused on measuring the bridge's natural frequency since it is related to the structural health of the bridge. Natural frequency is calculated by using an accelerometer connected to an Arduino board. The acceleration time samples are buffered inside the Arduino and Fast Fourier Transform (FFT) is applied to calculate the frequency spectrum of the buffered data. The spectrum consists of several tones and the one with the maximum amplitude represents the natural frequency of the bridge. Several experiments have been performed on a small-scale steel bridge to validate the proposed monitoring approach, and a high accuracy laser sensor is used as a reference. The proposed methodologies achieved acceptable accuracy in capturing displacement and natural frequency. Using equipment such as cameras and accelerometers achieves acceptable results compared to high accuracy sensors at a much lower cost. Consequently, large scale deployment can be practically be achieved.

Abdulhakim Almarshadi
Bandar Alosaimi

Project Title: Solar Tracker

Mentors: Ahmed Eltawil, Fadi J. Kurdahi

Abstract:
Solar energy is one of the main sources of renewable energy. By using solar panels we can convert solar energy into electrical energy. However, most solar energy is not used due to the low efficiency of the solar panels under current technology. Moreover, more energy is wasted due to the orientation difference between the solar radiation and the panel, i.e. to benefit the most from sunlight, it has to be perpendicular to the panel. In this work, we implement an autonomous solar tracker to maximize the energy absorbed by the solar panel. The direction of the sun is identified by phototransistors whose resistance vary with radiation intensity. The system is modeled using MATLAB simulink, and its performance is compared to fixed panel operation. A prototype has been implemented using 3D printed parts developed using Solid Works software. Two servo motors are used to rotate the panel in two axis, i.e. the mechanical design has two degrees of freedom. The prototype has been tested using external light source and shown to be correctly following the light. The prototype serves as a proof of concept that can be applied to real solar panels to track the sun and maximize the energy generated. Moreover, due to the dual axis operation, the tracker can be implemented on moving objects such as vehicles or boats that do not have fixed orientation to the sun.

Jahyeon Hong
Dongjun Hwang
Hye Rim Hyun

Project Title: Big Graph Visualization

Mentor: Chen Li

Abstract:
Our research is about "Big Graph Visualization," using big data extracted from Wikipedia. The purposes of the research are to visualize non-geometric graph data dynamically and efficiently with query conditions that contain arbitrary keywords and to implement some layout algorithms to decide where to put vertices on the screen. The method of the research is to manage the data of Wikipedia using Elasticsearch, a database based on JSON format. We downloaded the Wikipedia dump files and preprocessed them to JSON format for inserting into the Elasticsearch in cloudberry server. We can search data from Elasticsearch after dumping so that we can put the graph on the web

browser. There are link keywords in every article in Wikipedia which refer to another web page. To visualize, we used two layout algorithm, ForceAtlas2 and Noverlap. The first is for optimization purposes, the algorithm's computations are delegated to a web worker. The other one is used for eliminate overlap between nodes. Recently, the importance of data is emphasized and the amount of data is increasing. Based on our research, we can effectively structure and visualize big data. We also can analyze the relevance of keywords.

Ye Lin Jeong
Donggun Lee
Joonyoung Park

Project Title: Designing User-Friendly AI Systems for Personal Health Tracking

Mentor: Yunan Chen

Abstract:
There has been an increasing number of personal health applications, powered by artificial intelligence (AI), designed to help individuals make informed health decisions. Nevertheless, it is unclear how individual health consumers perceive and trust AI-based personal health prediction. To further investigate these aspects, our team designed a prototype of an application for menstrual tracking called Kaya. Kaya allows individuals to enter various personal health indicators and provides them with predictions about their menstrual cycles. We have designed two versions of the application: one mentioned the use of AI as a prediction mechanism, and the other as a control. We created an online survey to evaluate users' perception, attitude, and trust about the two applications. The survey study will be carried out in Fall 2019 and the results will provide insights into designing consumer-driven AI applications.

Dakyung Go

Project Title: Surveying Mobile Fitness and Wellness Apps for Inclusion

Mentor: Daniel Epstein

Abstract:
Wellness apps are becoming increasingly ubiquitous. Mobile fitness and wellness apps do a great job of helping people understand their fitness level and motivating them to improve their health. However, it is challenging for individuals with physical disabilities. In this project, we explored how people with physical disabilities might experience activity tracking apps by reading related papers and creating personas. Our personas focus on mobility-impaired people because related papers surface a need for activity tracking apps to support this population, but focus only on basketball and wheelchair pushes. We designed three personas with different mobilities, focusing on exercises people with mobility disabilities regularly perform: swimming, cycling, and weightlifting. The application of this research is to suggest better ways to design an activity tracker or tracking app to offer the same benefits to users with physical disabilities.

Seunghyun Kim
Sangyeong Lee

Project Title: How Can Voice Assistants Support Adjusting Voice Settings for People Who Are Blind?: Improving Voice-Activated Personal Assistants (VAPAs) by Learning from Screen Readers

Mentor: Stacy Marie Branham

Abstract:
Many people who are blind rely on screen readers (e.g., Apple's VoiceOver, Google's TalkBack) to interact with visual elements of computers. As Voice-Activated Personal Assistants (VAPAs), like Apple Siri, Google Assistant, and Samsung Bixby have become common on mobile devices and in the home, people with visual impairments increasingly are making use of them. Prior work on VAPAs and disability show that these systems should provide the ability for users to customize voice settings (e.g., speech rate, pitch, and volume), but currently these settings cannot be modified by using voice commands. We examined how screen readers and VAPAs support adjusting voice settings for people who are blind by conducting analysis of documents published by commercial vendors Google, Apple, and Samsung. We propose that developers can combine the positive aspects of screen readers and VAPAs and argue that when we bridge screen readers and

VAPAs, people who are blind may be able to have more efficient interactions to accomplish more productivity-focused tasks they seek with their personal assistants.

Minho Heo
Hyeri Jung
Byungchan Kim
Joonhan Park

Project Title: Exploring the Conversational Importance of Software Engineering Chatbots

Mentor: Andre W. van der Hoek

Abstract:
Open-source bug reporting systems are special because they allow for everyone's contributions. However, a large number of bug reports are not of good quality. The quality of bug reports is important since it influences the time and effort needed to solve problems. Due to availability of large numbers of bug reports, especially for open-source software, there is considerable research on bug report quality. This paper introduces an experiment to improve the quality of bug reports using a chatbot. By leveraging the characteristics of chatbots, which can give immediate feedback and recommendations to users' reports, we anticipate improving the quality of bug reports. This paper presents the conversation flow of the chatbot, the methods to understand users' intents, and heuristics to give feedback. Finally, this paper summarizes the results for our research based on interviews with developers.

Seunghwan Hong
Hyunji Kim
SangHoon Kim
Nayoung Lee

Project Title: Lightweight, Voice-Based Knowledge Capture and Delivery in Software Design Meetings

Mentor: Andre W. van der Hoek

Abstract:
For the most important kinds of software design work (e.g., shaping the architecture, designing a protocol, laying out a database schema), developers usually turn to a whiteboard to create and modify sketches that support their discussion about a given design task. This is commonly the way design meetings take place. During these meetings, there are moments of importance that shape the eventual design of the software as well as its potential future evolution. A long-standing problem for this kind of meeting is capturing the information produced during those important moments. In this study, we introduce "Knocap Board," a tool able to capture the context of important design moments. Knocap Board allows developers to capture both drawings and the associated conversation just right after an important moment takes place. We use this tool as an instrument to explore the benefits of documenting design work 'at the moment' in a lightweight, semi-automatic fashion. We hypothesize that capturing design information while the meeting is taking place, rather than once it has concluded is a more efficient way to document software designers' work. We plan to evaluate our approach conducting a small laboratory experiment, where designers', supported by the tool, will work on a given design task. Our evaluation will consider three important criteria: effectiveness, usability, and intrusiveness. We will use these criteria as a framework to compare our approach to other tools that have also attempted to improve developers' documentation of their design work during software design meetings.

YiJi Bae
Joohee Kwon

Project Title: Improving Computational Tools for Analyzing Health-Related Social Media Data

Mentor: Kai Zheng

Abstract:
Topics related to health, healthcare, and public health are commonly discussed on social media platforms such as Twitter and Facebook. Such data provide an invaluable source of information for researchers and policy makers to better understand the public's opinions toward important issues such as health policies (e.g., the Affordable Care Act) and controversial health interventions (e.g., HPV vaccination). Sentiment analysis, a technique rooted in natural language processing, is a commonly used tool for deriving

insights from social media data, by identifying positive, neutral, or negative emotions from user-generated text. While there have been many sentiment analysis tools available, most of them were developed outside of the healthcare domain, e.g., based on movie reviews. Consequently, their performance is suboptimal, and varies to a great extent when applied to health data on social media. This project aims to develop an integrated tool to help researchers and policy makers evaluate the performance of competing sentiment analysis algorithms to make informed decisions on which algorithm might perform best based on the characteristics of the dataset being analyzed. To achieve this goal, we developed a web-based application using Python and Django framework that integrates four commonly used sentiment analysis tools: Vader, Textblob, Stanford NLP, and the sentiWordNet Dictionary. Once the user uploads a dataset, the web application will automatically compute the precision, recall, and confusion matrix using each of these sentiment analysis tools and display the results in a visual presentation conducive to easy assessment of their comparative performance. The results can be then downloaded for further analysis. Our web application also provides additional features that many of the existing sentiment analysis tools do not support, such as analyzing the text at the sentence level rather than at the post/tweet level. We believe that our project will make a valuable contribution to improving the utility and appropriateness of use of sentiment analysis tools to better understand user-generated health text on social media.

Suin Lee

Project Title: Predicting Frequent Visitors of the Emergency Department

Mentor: Kai Zheng

Abstract:

Emergency Department (ED) overcrowding has been a challenge worldwide. This issue is attributable in part to a small number of patients who visit the ED much more often than the average patient population. In this project, we aim to characterize such patients, referred to as "frequent visitors," through big data analysis. The ultimate objective is to create a prediction model that can reliably predict the likelihood of whether a patient will become a frequent ED visitor in order to inform interventional strategies to reduce unnecessary ED use. To achieve this objective, I used Python and R to analyze a large, five-year dataset collected from the ED at the UC Irvine Health. During initial phase of the project, I developed a preliminary prediction model using machine learning. However, the performance of the model was not ideal due to lack of apparent features that could robustly differentiate frequent visitors from average patients. Therefore, I subsequently focused on characterizing these two different patient populations using statistical approaches. The results show that several features indeed have different statistical distributions between frequent visitors and non-frequent visitors. These features not only include the patients' demographics, but also their medical conditions and their health behaviors. This finding suggests that it is possible to build effective predictive models using the data, which will be pursued in my next phase of research.