

IEOR

INDUSTRIAL ENGINEERING & OPERATIONS RESEARCH ALUMNI NEWSLETTER

SPRING 2020



Chair's Announcement



Dear alumni, students, faculty and friends of IEOR:

Greetings from Berkeley! We hope that this newsletter finds you and your family safe and well in these challenging times of global pandemic. We have been inspired by how the Berkeley community has responded to help (<https://bit.ly/coe-covid-response>), and we encourage alumni to reach out to us to collaborate, as this is a time when our field can truly make a difference.

We have a lot to share about our growing and thriving IEOR community. With 453 students, we are again educating the largest Berkeley IEOR community in history this year. Meanwhile, the skills our students and alumni are learning are becoming more relevant in today's modern economy, and we have seen diversification in the types of jobs and industries that alumni are working in. Inside this newsletter, you will see numbers about where alumni are working, popular job titles, and profiles of alumni making an impact in academia and many sectors of the economy.

We also want to give you a glimpse of the important research being conducted in the Department, from Professor Xin Guo using a machine learning algorithm to help improve diagnosis of diabetic blindness, to Professor Lee Fleming showing the importance of scientific research for fueling innovation in our economy. Also presented is some of my own research on how regulations can affect the ridesharing industry. In our Research Roundup, we provide abstracts of some of the most cutting-edge investigations being conducted in our field anywhere in the world in areas as dynamic as power systems, online learning, and artificial intelligence to track global wildfires.

Additionally, in this newsletter, we strive to showcase the breadth of activity and ingenuity being demonstrated by our entire community, such as our master of engineering students using machine learning to fight alarm fatigue in hospitals in their innovative capstone project, or our distinguished board members, Terry Duryea and Bob Cliff, reflecting on their careers in IEOR.

As always, please do not hesitate to reach out to me if you have any ideas on how we can continue to strive for excellence in the IEOR department.

Go Bears!

A handwritten signature in black ink, appearing to read 'Max Shen', written in a cursive style.

Max Shen
Professor & Chair
Berkeley IEOR



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Cover Photo: Thomas Galeon, Xudan Luo, Oskar Radermecker, Clement Ruin, Yixun Tan, Wei Tan, Jidapa Thanabhusest, Sruthi Thomas, and Jessica Wu at the Master of Engineering (MEng) Capstone Showcase (Photo by Golnaz Shahmirzadi)

IEOR BY THE NUMBERS

18

PROFESSORS

7

EMERITI

6

FULL-TIME STAFF



NATIONAL ACADEMY OF ENGINEERING FACULTY

SHMUEL OREN
(PROFESSOR OF GRADUATE SCHOOL)

BOB OLIVER
(EMERITUS)



EARLY CAREER AWARD FOR SCIENTISTS AND ENGINEERS FACULTY MEMBERS

BARNA SAHA
JAVAD LAVAEI
KEN GOLDBERG

MAX SHEN
ANIL ASWANI
PHILIP KAMINSKY



INFORMS FELLOWS

ALPER ATAMTURK
SHMUEL OREN
DORIT HOCHBAUM
CANDACE YANO
MAX SHEN
BOB OLIVER
LEE SCHRUBEN

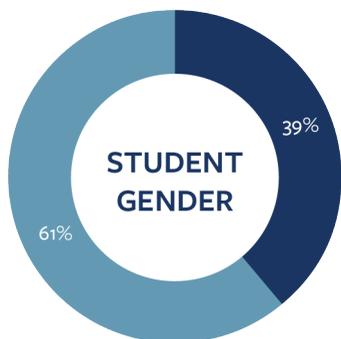
22 STUDENTS PER TENURE-TRACK FACULTY

(425 IEOR / 19 FACULTY)



236

UNDERGRADUATES



■ FEMALE
■ MALE



217

GRADUATE STUDENTS

140 MASTER OF ENGINEERING

12 MASTER OF SCIENCE

69 Ph.D.



4,297
ALUMNI

\$77K

AVERAGE STARTING SALARY
(UNDERGRADUATE)

\$117K

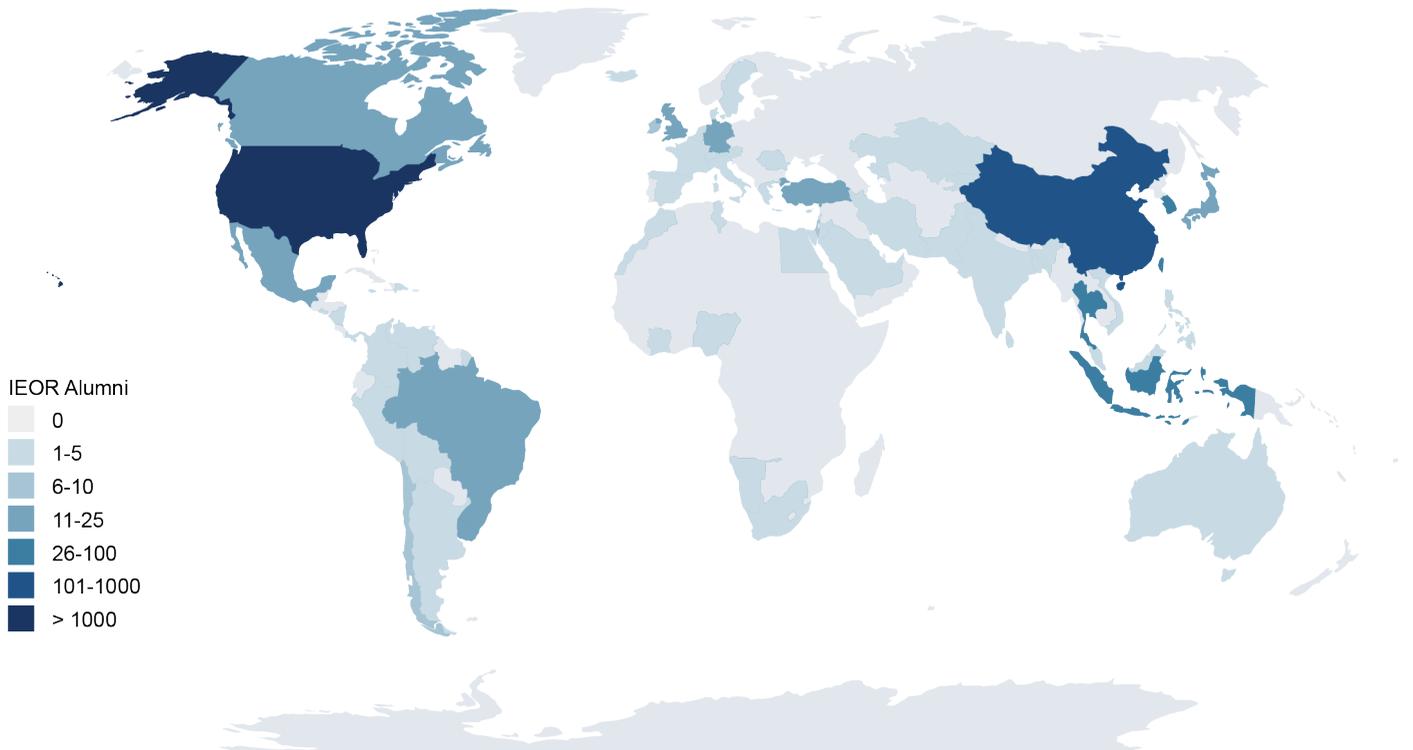
AVERAGE STARTING SALARY
(M.ENG)

POPULAR JOB TITLES

- | | |
|----------------------------------|-------------------------------|
| 1. DATA ENGINEER | 6. CONSULTANT |
| 2. DATA SCIENTIST | 7. INDUSTRIAL ENGINEER |
| 3. PRODUCT MANAGER | 8. COMPOSITE PROCESS ENGINEER |
| 4. BUSINESS ANALYST | 9. CEO / CO-FOUNDER |
| 5. BUSINESS INTELLIGENCE ANALYST | 10. ASSOCIATE CONSULTANT |



WHERE DO ALUMNI LIVE?



COMMUNITY HIGHLIGHTS



IEOR Fall Picnic

The Department of Industrial Engineering & Operations Research hosted its annual fall picnic on Sept. 26 to welcome new and returning students to the department at UC Berkeley. Students enjoyed games, conversation, and great food!

IEOR Holiday Party

The IEOR department hosted its annual holiday party at the Wozniak Lounge in Soda Hall in December 2019. Around 100 faculty, students, and staff showed up to celebrate the (near) end of the semester with live music, games and delicious food



Fung Fellows Present on Loneliness

On Tuesday, December 10, 2019, first year Fung Fellows presented their team's recommendations for combating social isolation on the UC Berkeley campus and beyond. This challenge is a partnership with Hopelab, a San Francisco-based social innovation lab that designs science-based technologies to improve the health and well-being of teens and young adults.



COMMUNITY HIGHLIGHTS



SCET Wins Excellence in Entrepreneurship Teaching and Pedagogical Innovation Award

In October 2019, The Sutardja Center for Entrepreneurship & Technology (SCET) at the University of California, Berkeley was awarded the Excellence in Entrepreneurship Teaching and Pedagogical Innovation Award at the 2019 Global Consortium of Entrepreneurship Centers (GCEC) conference.

MEng Picnic

On October 18, 2019, MEng social representatives organized a Fung Institute community picnic on Memorial Glade which included fun games, tasty snacks and drinks, and of course a little networking with students.



MEng Alumni Brunch

On September 8, 2019, the Fung Institute held the 8th annual MEng alumni brunch. With our growing network, this was our first year hosting the brunch in the University Club at the California Memorial Stadium. Our 400+ alumni and students were able to enjoy the delicious food alongside a spectacular view, aided by unusually clear skies.



COMMUNITY HIGHLIGHTS



MEng Capstone Showcase

On Friday, May 10, 2019, Master of Engineering capstone teams shared their final deliverables created over the course of the academic year. Attendees were able to access to the latest in dynamic and collaborative engineering for a truly unique, one-of-a-kind experience.

Collider Cup

More than 100 UC Berkeley students and community members gathered on Friday, December 13th in Sutardja Dai Hall to watch SCET's top students and startups compete at the end-of-semester Collider Cup V, presenting their innovative and mission-driven mindsets.



Tech Firm Leadership students win 'paperclip challenge,' snag photo with Chancellor Carol Christ

5 students from the Technology Firm Leadership course, IEOR 171, proved their entrepreneurial prowess by "trading up" and exchanging paper clips for something priceless: A group photo with UC Berkeley Chancellor Christ.

Q&A with Intellicare, winners of the 2019 Fung Institute Mission Award

Edited by Ashley Villanueva



Thomas Galeon, Xudan Luo, Oskar Radermecker, Clement Ruin, Yixun Tan, Wei Tan, Jidapa Thanabhusest, Sruthi Thomas, and Jessica Wu are awarded for their Capstone Project that limits erroneous heart rate monitor alarms at hospitals.

Each year, the Fung Institute Mission Award is awarded to the Capstone team that best exemplifies the mission of the institute: “transforming scientists into leaders who can take risks and develop technical, social and economic innovations.” Finalists are nominated by Fung Instructors; winners are chosen by Fung Institute staff based on the project brief. This year, the recognition goes to the IntelliCare: Machine Learning to Fight Alarm Fatigue in Hospitals Capstone team, advised by Prof. Gabriel Gomes, Prof. Xiao Hu, and Prof. Michelle Pelter.

IntelliCare: Machine Learning to Fight Alarm Fatigue in Hospitals

Eight out of ten bedside hospital alarms are false alarms. This costs the US healthcare system more than \$2.5 billion annually and limits the effectiveness of nurses in real situations of urgency. Machine learning algorithms could help improve monitors but they require large annotated datasets. However, manual annotation of ECG records is a time-consuming process for cardiologists. In collaboration with UCSF, our team has developed a semi-automatic annotation tool focussing human resources

on only the most informative ECG records. This will ultimately lead to the creation of a dataset 100 times larger than any other available resource.

We developed a proof of concept by focusing on Premature Ventricular Contraction, the most frequent cardiac arrhythmia. Our team designed a variety of machine learning pipelines, including feature-based models and deep learning on time series data, to recognize irregular beats. These models were then incorporated into an active learning framework requiring minimal human input to classify unannotated data. The resulting annotated dataset will help improve existing hospital monitors and allow nurses to focus on patients most in need.

We had a chance to speak with the Capstone team (Thomas Galeon, Xudan Luo, Oskar Radermecker, Clement Ruin, Yixun Tan, Wei Tan, Jidapa Thanabhusest, Sruthi Thomas, and Jessica Wu) about their experience.

How did you define the scope of the Capstone project?

If you’ve ever been to a hospital ICU or Emergency care department you’ll have noticed that heart rate monitor alarms go off all the time. In 80% of cases these are false alarms due to patient movement and scratching. This wastes valuable time and resources for hospitals. False alarms also put patient’s lives at risk since nurses become desensitized to the urgency and no longer respond to alarms. We also came to understand that excessive alarms induce stress and anxiety among patients. These were the motivations behind our project. Our Capstone project was suggested by University of California San Francisco’s

(UCSF) hospital which, like hundreds of other hospitals across the country, has been facing a high number of false alarms. They asked us to develop a method to limit erroneous alarms in their monitors. Our team focused on the most common type of cardiac arrhythmia, premature ventricular contraction (PVC), which accounts for a third of all alarms. We developed a proof of concept for filtering PVC false alarms. In the future, we hope to extend our work to other types of cardiac arrhythmias.

What was your most significant technical challenge & how did you tackle it?

Working with UCSF’s hospital was an incredible opportunity. The hospital gave us access to a billion electrocardiogram records which had triggered an alarm for PVC. This dataset is 2 orders of magnitude larger than any other publicly available dataset. However the data came unannotated: we had to determine whether or not each record was a false alarm. Manually annotating the records was unfeasible and would have required million of hours of annotation by trained cardiologists. To tackle this issue we used active learning, a machine learning technique which focuses manual annotation efforts on only the most informative records. Instead of randomly annotating samples, our algorithm identifies the most informative records to annotate. The other records are annotated automatically.

See tinyurl.com/intellicarecapstone for the complete interview with the Fung team

2020 Advisory Board



Raaid Alireza



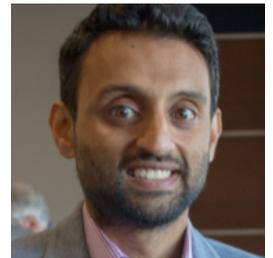
John Birge



Bob Bixby



Nancy Blachman



Sujit Chakravarthy



Tim Chen



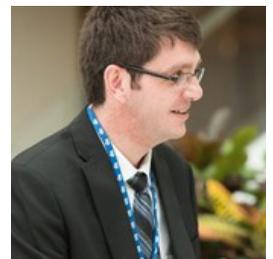
John Chendo



Judy Chou



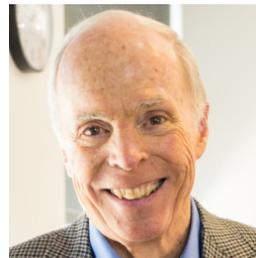
Bob Cliff



Terry Duryea



Michelle Fisher



Bill Floyd



Coleman Fung



Charles Huang



Shailendra Jain



Judith Kulich



Andrew Laffoon



Bob Oliver



Richard Passov



Robert Phillips



Andrew Rudd



Aram Sogomonian



Todd Strauss

2020 Faculty Members



Ilan Adler
*Professor,
Head M.Eng Advisor*



Anil Aswani
Associate Professor



Alper Atamturk
*Professor, Graduate
Admissions Chair*



Lee Fleming
Professor



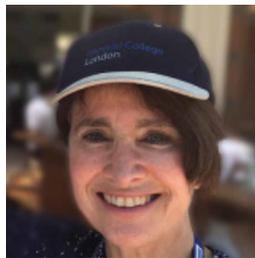
Ken Goldberg
Professor



Paul Grigas
*Assistant Professor,
Equity Advisor*



Xin Guo
Professor



Dorit Hochbaum
*Professor,
Head Graduate Advisor*



Philip M. Kaminsky
Professor



Javad Lavaei
Associate Professor



Robert Leachman
*Professor, Head
Undergraduate Advisor*



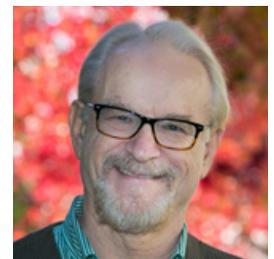
Shmuel Oren
*Professor of the
Graduate School*



Rhonda Righter
*Professor,
ORMS Advisor*



Barna Saha
Assistant Professor



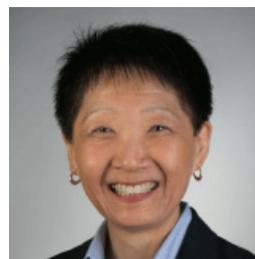
Lee Schruben
*Professor of the
Graduate School*



Zuo-Jun "Max" Shen
*Professor,
Department Chair*



Ikhtlaq Sidhu
*Adjunct Professor,
Chief Scientist,
Sutardja Center*



Candace Yano
*Professor,
M.S. Advisor*



Zeyu Zheng
Assistant Professor



Saving Sight with Machine Learning

By Keith McAleer

Diabetic retinopathy (DR) is the most common cause of vision loss among people with diabetes and a leading cause of blindness. Right now, there are an estimated 415 million people suffering from diabetes worldwide, and this number is projected to grow to 642 million by 2040.

Approximately one-third of diabetic patients have DR. While blindness caused by DR is mostly preventable with early detection and treatment, it is difficult to diagnose, and many patients do not get screened due to the disease's slow progression, the lack of access to eye specialists, or simple unawareness.

Thanks to cutting-edge machine learning techniques developed

by IEO's Risk Analytics and Data Analysis Research (RADAR) Lab at the

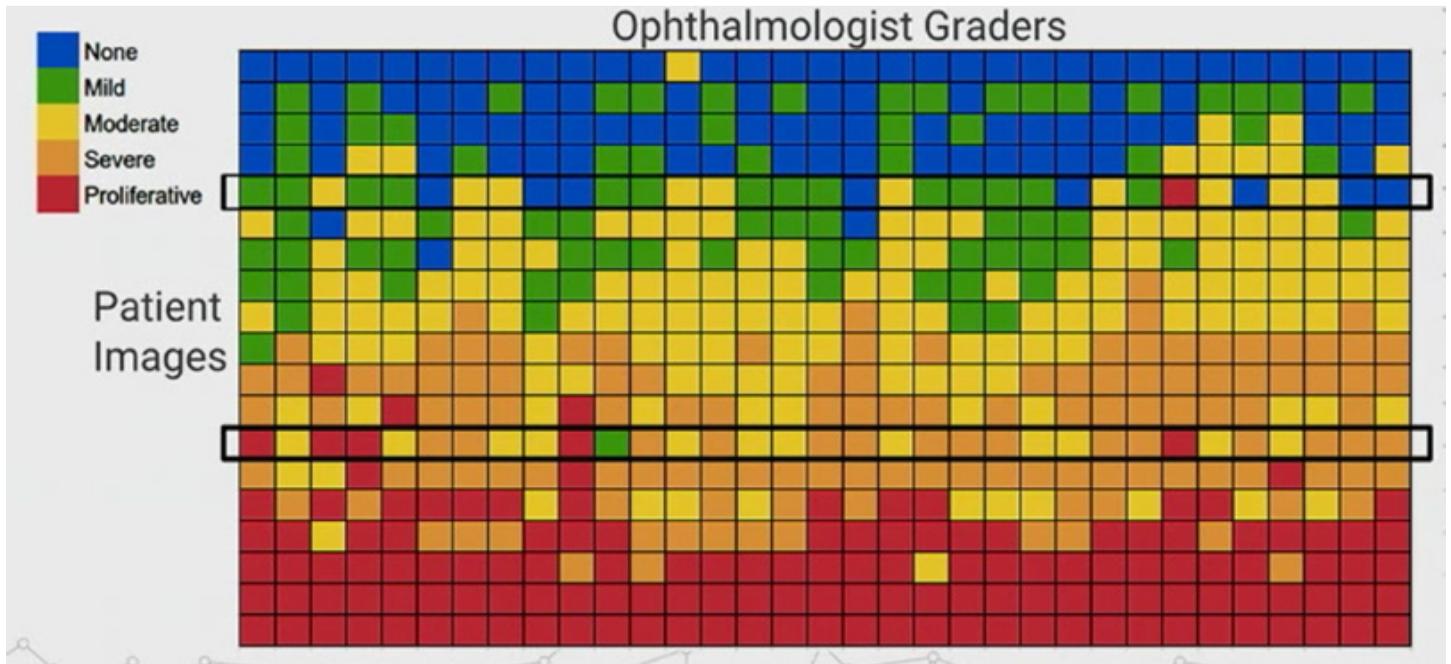
and if you remove the obvious cases, it is closer to 50 percent. Now what

“Guo and her research team from RADAR lab, thought that perhaps they could develop algorithms using machine learning techniques to assist with diagnoses...”

University of California, Berkeley, led by Professor Xin Guo, millions of diabetic patients now have a cheaper and more accurate way to screen for eye disease. “What is really needed if you are thinking about prevention, is to diagnose the cases in-between,” said Guo. “The average consistency of eye specialists to detect a DR is 65 percent,

do you get with 50 percent? You flip a coin.”

Guo and her research team from RADAR lab, (including her PhD student Guan Wang and research associate Cheng-ju Wu), thought that perhaps they could develop algorithms using machine learning techniques to assist with diagnoses and help eye specialists



Correctly diagnosing eye disease is difficult, even for trained eye specialists. Eye doctors are good at detecting very healthy, and very unhealthy tissue, but have difficulty consistently diagnosing tissue that is in between.

improve their consistency. She and her collaborators developed a deep neural network to detect features in retinal images.

But in order to train their algorithm, they would need data that was labeled by expert doctors. They found hospitals in China that were able to provide retinal image data and recruited a team of volunteer doctors to help label the the images as healthy

or diseased. Through this network of doctors, each labeling 20-30 images per night, the researchers were able to collect over 100,000 patient cases for their algorithm. And by tracking which patients ultimately got eye disease, they eventually achieved more consistent results than the average eye specialist.

While they have had some success at detecting all seventeen major eye

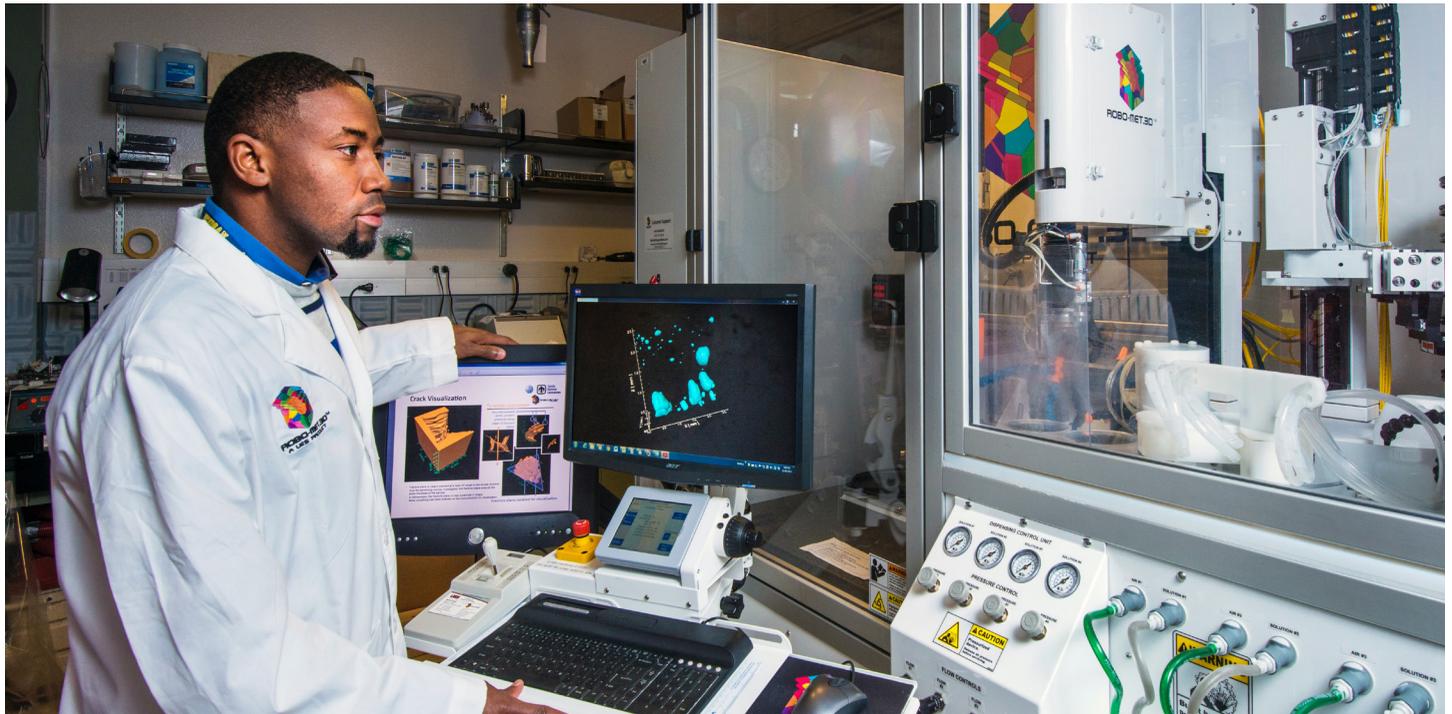
diseases, Guo and her colleagues have been most successful at detecting DR, which the system can now accurately detect about 97 percent of the time. Guo hopes that using the same techniques, she will soon be able to achieve more consistent results with other major eye diseases. Since their discovery, Guo and her collaborators have installed close to 100 systems in some of the poorest rural areas in China. The villages where the system is implemented do not have consistent access to the internet, and Guo's algorithm lives on a computer connected to a camera, which gives the doctor the probability that the patient has eye disease, such as 90 percent or 95 percent. So far, Guo estimates that 3 to 5 million people have used these systems since they began their efforts in 2016.

(pictured left) The system is deployed in over 100 districts in the rural places in Jiangxi Province where villagers do not have access to regular medical care. It has served between 3 millions to 5 million users.



Kill Science Funding and You Kill the Future Tech Economy

By Lee Fleming and Matt Marx



When you hear the word innovation, you might think of Silicon Valley: a place where inventors, engineers, and scientists — funded by deep-pocketed venture capitalists and led by plucky entrepreneurs — build new products and industries from thin air. There’s an increasing sense that the private sector is leading the charge; budget director Mick Mulvaney has even mused that we may not need government-funded research at all.

Nothing could be further from the truth.

In the first comprehensive analysis of all U.S. patents going back to 1926, we and our co-authors found that the private sector’s reliance on government support has recently risen dramatically and is now close to

one-third of all U.S. patents. And it’s more than a third for venture-backed startups, especially for the high fliers that fuel job growth — for example, Google’s patent on its PageRank search algorithm acknowledges an NSF grant in library science.

“...the private sector’s reliance on government support has recently risen dramatically and is now close to one-third of all U.S. patents.”

After analyzing linkages between tens of millions of patents and science papers, exhaustive accounting shows that federal research increasingly fuels the innovation that ultimately leads to jobs, industrial competitiveness, and

entrepreneurial success. Smartphones are a case in point (sorry, Apple): They employ liquid-crystal displays (NIH, NSF, DoD), GPS (DoD), Lithium-Ion batteries (DoE), and DRAM (DARPA).

Patents that rely on federally-funded

science are more important: They are more novel, more likely to be cited by future patents, and more often renewed. Groundbreaking technologies in all industries — from textiles and paper (approximately 20 percent of all patents in the field) to

materials and chemistry (almost 60 percent, and growing) rely on federally-funded science. And U.S. inventors are increasing their reliance on federal funding at a faster rate than foreign inventors, indicating that American research is not wasted overseas.

It may not be a surprise that corporations are primarily responsible for this trend. Yet these commercial firms aren't simply free riding on government investments in basic science: Corporations continue to invest heavily in research (though they are publishing less in the scientific literature). Furthermore, firms have to do science to understand science — corporations must invest merely to

“Groundbreaking technologies in all industries — from textiles and paper to materials and chemistry rely on federally-funded science.”

understand the benefit and accomplish the challenge of development — they simply don't pull down ready-to-build products from a government-subsidized shelf. Federal science creates a delightfully wonderful public good — everyone can use it, for a very long time (it never gets “used up” — we can see recent references to very old government-backed science in our data), and incorporate it into a wide variety of products.

We're not accountants or tax economists, but it would surely be a very good investment to take a small portion of the corporate tax revenue and keep funding public science. We made no claims in our research on the financial value of federally supported patents, but when we applied one

recently developed method from our finance colleagues, the yearly value of corporate patents which rely on federal science was at least on par with (and sometimes much greater than) the yearly federal research budget. This implies that corporate innovation alone justifies the entire federal science budget.

And that was just patents — we ignored even more important benefits of basic research, such as the training of our technical work force, improved health (in drugs, devices, and better medical practices), unpatented trade secrets, higher productivity of our farms and factories, better weapons for soldiers, and a much higher chance

that the industries of the future will be based in the United States. We ignored these other benefits simply because we don't trust our methods yet to make a comprehensive claim. When we can quantify such benefits accurately, it's likely we'll see ROI in the many hundreds of percent.

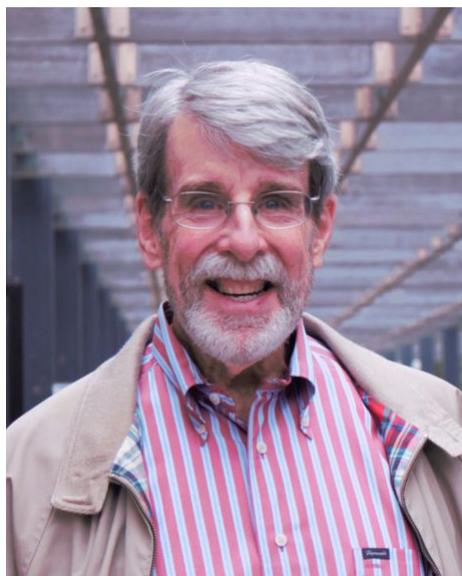
Basic science doesn't prop up the stock market today, but it is the goose that lays a variety of golden eggs for many years to come. In the face of slowing economic growth and probable recession, pulling back on funding for scientific research will ultimately gut our capacity for innovation and long-term economic competitiveness. It's clear that America's biggest rival gets this: China has dramatically

and rapidly ramped up its spending on science. It's not unlike the space race — only now it's the global economy, everyone's health, high-paying tech jobs, and the future of our environment that's at stake.



Lee Fleming (pictured above) is the Faculty Director of the Fung Institute for Engineering Leadership in UC Berkeley's College of Engineering and Professor in the Industrial Engineering and Operations Research department. Matt Marx is Dean's Research Scholar and Associate Professor in Strategy and Innovation at Boston University. Both have worked in Silicon Valley and hold patents in a variety of fields. Their three co-authors on the original article are Guan Cheng Li from UC Berkeley, Hilary Greene from the University of Connecticut Law School, and Dennis Yao from the Harvard Business School. All five have received funding from the National Science Foundation; Fleming and Li have a patent pending that was a research product of an NSF grant.

Board member Terry Duryea's mantra for a rewarding career — maintain flexibility and stay on a steep learning curve



IEOR advisory board member and alumnus, Terry Duryea, is reputed for his trailblazing contributions and mentorship in the fintech industry.

In a conversation with the department, ex-CFO of McAfee and IEOR Advisory Board member Terry Duryea shared his experiences of a career in business modeling and financial decision making.

An alumnus of Berkeley IEOR, Terry reasoned his choice of major by stating “The only subject I got a C in, the highest grade of my high school freshman year, was math. Fortunately, my grades improved each year.” Admission criteria might have been different in the time, but to opt for IEOR was a natural choice for Terry.

From his undergraduate experience of a co-op student with US Steel in Pittsburg, CA, Terry realized that he did not want to work in manufacturing,

a historical focus of industrial engineering. He instead realized that all his lessons from industrial engineering could be used in modeling real-world systems, and diverted his interests to that domain.

After a bachelor’s degree in IEOR, Terry attended Stanford Business School. Recalling his experiences, Terry states how graduating from business school allowed him to value the integration of people and processes and not overlook the non-engineering elements of large scale systems.

On graduating, and after a three-month-long Europe trip, Terry accepted his first job at Deloitte. With no domain emphasis yet, Terry believed being at Deloitte would train him with skills in accounting and help him maintain a steep learning curve; one that saw him become a CPA and eventually a partner. Following his role at Deloitte, Terry served as a VP of Finance and CFO at three medium-scale technology firms and was eventually appointed CFO at McAfee Associates in 1995.

Terry joined McAfee on realizing the potential internet security could have in the future. When he joined, McAfee had revenue of \$100 million and was a shareware company offering premium paid services. As CFO, he was tasked with ensuring the smooth financial transitions, as the company expanded

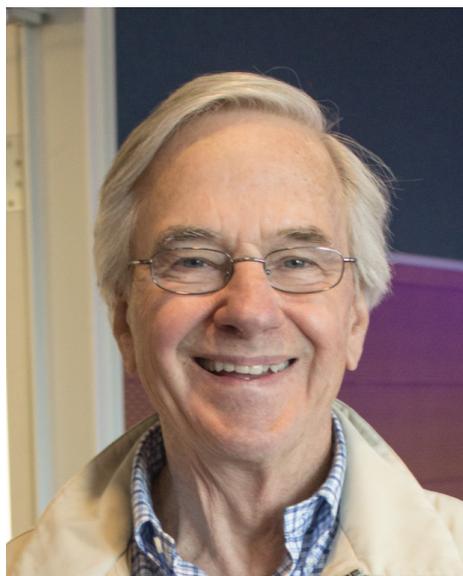
to large scale internet services and grew at a remarkable 75% annually. Given McAfee’s high web traffic, he was also responsible for monetizing it. To work with growth numbers and monetary concepts unheard of during the time made his role fulfilling.

Realizing that he wanted to focus more on his family, Terry later quit full-time work and defined the role of ‘Non-employee Founder’ for himself, wherein he drew on his financial and accounting expertise to help start companies in return for founder stocks. While his roles remained diverse — acting CEO to industry mentor to hiring manager — the crux of them all was expounding on the relationships and reputations he had built with investors and founders.

Terry now invests his time in community services including the Los Gatos Town Financial Committee and working alongside several non-profits focussing on housing and healthcare for seniors. As an alumnus of Cal and Stanford, Terry also actively serves both schools.

When asked to advise current students, Terry emphasized the importance of curiosity and willingness to explore throughout one’s career. He says “... you can’t predict where the world is going... [success] comes down to expanding your knowledge and broadly maintaining flexibility.”

Conventionalizing the Unconventional — **Board Member Bob Cliff** shares his experiences as a consultant with skills in IEO



Bob Cliff, IEO advisor and CEO of Cliff Consulting, was the first to integrate industrial engineering in service areas such as banking and insurance companies

In conversation with the department, Bob Cliff, founder and ex-director of Cliff Consulting and now a member of the IEO Advisory Board, shared his experiences of successfully applying his IEO skillset to fields deemed unconventional in his time.

Bob graduated in 1970 with an IEO PhD, M.S. and B.S. from Cal. Although he began his academic journey at the University of Southern California, set for a degree in electrical engineering, Bob wasn't very pleased with the academic environment and soon transferred to Berkeley. Enrolled in Berkeley for electrical engineering, Bob realized after his first class that Kirchoff's rules weren't for him.

Wishing to study something similar to his experience from working at a steel factory in the summer, he switched to IEO.

"I loved it here! It was just incredible," claimed Bob as he spoke about how flowchart and algorithm heavy the curriculum back then was. As a student, Bob got involved with research in human factors engineering, which continued through graduate school, and worked on a human-machine interface particularly related to loss of attention when driving cars.

Proficiency in research meant that Bob began receiving offers for joining faculties — including one by a visiting lecturer from the Massachusetts Institute of Technology. Bob, however, was unsure about entering academia.

Eventually accepting Dr. Ted Crossman's offer for assistant professorship at Cal, Bob taught classes on human factors engineering and stochastic modelling for two years. His true interests, however, lay in uncharted territory for IEs. "At that time industrial engineering was aimed at manufacturing — building cars, refrigerators — it was not used in the space of services like banks and insurance companies," claimed Bob, who hoped to change this through the launch of his new company, Cliff Consulting.

Bob's first consulting project was

with the Bank of California, who were processing the accounts for 'Shell Credit Card' — one of the many credit cards issued by gas companies at the time. The process they followed was time-intensive and lowered workers' morale. Bob identified this as an industrial engineering problem and suggested sorting checks based on bank locations and applying worker standards as a bare minimum to provide incentives for exceeding performance. Overall, Bob's work helped increase productivity by 20%.

Bob's portfolio grew through his career — he helped five major banks establish Master Charge (now MasterCard) and assisted Kaiser Permanente develop a healthcare database system for treating medical emergencies. Bob headed his small-scale firm for over 40 years, and eventually decided to move on in 2013. Since then, he has volunteered as a foundation board member at the Lake Tahoe Community College, through which he helps all low-income students get full ride scholarships and access to learning materials.

When it was unheard of, Bob decided to use IEO as an "idea of applying engineering methodology to business problems that works out in all sorts of soft fields." Sharing advice to current students, he emphasized how industries today realize IEO's need and versatility, and why it is imperative to assess one's interests and fit.

Reducing Fallout from Rideshare Companies

Municipalities address increased traffic, pollution, taxi company bankruptcies and driver poverty



The Rapidly Expanding Rideshare Industry

600+ cities in 65 countries



Uber

400+ cities in China, Australia, Latin America, and Japan



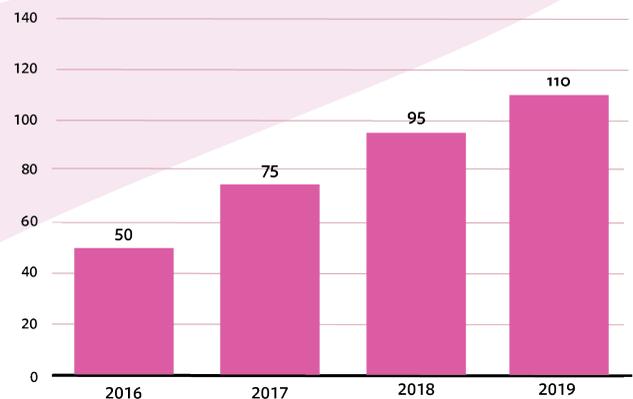
DiDi

350+ cities in US and Canada



lyft

Monthly number of Uber's active users worldwide from 2016 to 2019 (in millions)



The Negative Effects



Increasing traffic congestion & pollution



Inflicting unfair treatment on ride-share drivers



Contributing to bankruptcies and suicides among taxi operators

These consequences will only worsen if rideshare companies are left unregulated and unchecked.

What Have Local/State Governments Done So Far?

 **NEW YORK**

- Requires detailed data about every ride-share trip
- Charges a congestion fee to finance public transit
- Placed a cap on new vehicle licenses

 **BEIJING**

- Regulate prices and has set emissions standards

 **LOS ANGELES**
SAN FRANCISCO

- Charge fees and collect data for airport access

Putting Regulations to the Test

Researchers in China and the U.S., including **UC Berkeley, Industrial Engineering and Operations Research professor, Zuojun ‘Max’ Shen**, modeled the effect of rules that limit the number of ride-share drivers on the road and considered what would happen to incumbent taxi operators if the new rivals were left to grow unchecked.

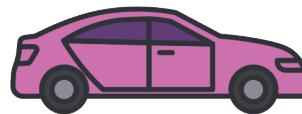
The model was based off of data collected by DiDi, a popular rideshare service in China, in Hangzhou where the local government has authorized regulations that limit the number of ride-share drivers.



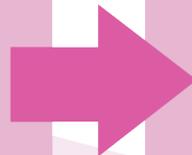
Hangzhou regulations on rideshare services (2017)

- Require ride-share drivers to pass special driving tests and have at least three years of driving experience
- Cars have to be registered locally and have been on the road for fewer than five years

Findings & Conclusion



The research findings showed that the average ride-share price was significantly higher than before the rules were adopted (even higher than taxi fees)!



The taxi industry can survive and compete with rideshare services in the market!

SUMMER EXPERIENCES

IEOR 2019

What were IEOR students up to this summer? We asked our undergraduate and Ph.D. students to share their summer experiences, whether it was in research or industry to show the breadth of opportunities for IEOR students.



Michelle Liu (B.S. '20)
IE Intern at The Walt Disney Company

"As an IE intern for The Walt Disney Company this summer, I got to work on many projects for Disneyland Resort revolving around guest arrival, merchandise, attractions/entertainment, and food & beverage. One of the most exciting parts of my experience was getting to be a part of the opening team for Star Wars: Galaxy's Edge. My first project was

on Savi's workshop (the lightsaber-building experience at Star Wars Land) and it was focused on finding ways to reduce the show and replenishment cycle times without compromising the guest experience. I ended up making difference recommendations with the way cast members were handling replenishment and interacting with guests during the build process to minimize show time and allow the Park to schedule more of the high-demand shows each day.

Some of my other favorite projects were a Mickey's House Operational Efficiency Study and a Disneyland Drop-Off/Pick-Up Area Utilization Study. The Mickey's House project looked at how to streamline the ToonTown Mickey meet-and-greet process, and the Disneyland Drop-Off study was looking at how to avoid/alleviate the extreme vehicle congestion that takes place in the area during peak arrival and departure times. It was really cool to get to present my findings to GMs of the resort and see the impact of my work on guests right before my eyes. I got to learn so much from my coach, coworkers, managers, and other Cast Members there and had a really fun time with the other interns! The best part was definitely seeing how much happiness and excitement Guests received from the magical experiences that my team worked on enhancing!"



Justin Gerwien (B.S. '21)
Operations Summer Intern at HARMAN International

"This summer, I interned in the operations department at Harman International, a consumer electronics company which designs and manufactures JBL, Harman/Kardon, AKG, and multiple other brands of speakers, headphones, and audio equipment and peripherals. I worked for six weeks in the logistics team which focuses on getting products from China to the US, then distributing those products around the country. I participated in the ocean carrier selection process and helped develop a plan for improving warehousing practices. The last 6 weeks I worked in the sales and order processing team which focuses on forecasting demand and ensuring that supply meets that demand. I created daily supply reports

of Harman's best-selling products and spent considerable time in SAP helping the team decide whether or not to expedite a product shipment through air or truck diversion.

I worked on two larger projects over the course of the internship. The first was a group project in which me and several other Harman interns developed a business proposal to help Harman attract and retain young talent in the currently tight and competitive labor market. Out of ten teams of interns, our team placed third for our proposal which advocated more modern workspaces, improved employee benefits and perks, greater flexibility, a superior applicant portal, and more diverse university recruitment and sponsorship. The second project was my personal project in which I investigated the physical and financial feasibility of tracking Harman's products through the entire supply chain from the production plants in China to Harman's customers around the world. I researched different tracking systems, wrote and presented a business proposal to my managers, and worked with a GPS tracker manufacturer to set up a live demonstration of their GPS trackers and tracking portal for Harman. While I wasn't able to see the GPS trackers fully implemented into Harman's supply chain, I helped get the ball rolling towards improving Harman's understanding and visibility of their supply chain.

Georgios Patsakis

(Ph.D. candidate)

Research Scientist at Amazon

"I spent my summer working as a Research Scientist for the Middle Mile Planning, Routing and Optimization

Science (MMPROS) team at Amazon, in Palo Alto. The whole internship was a very fulfilling and creative experience. The team has many interesting problems that can be directly addressed using Operations Research, with the main concern being scalability. My main project was focused on optimizing cross-border transportation. I got the chance to devise and implement algorithmic solutions that involved decomposition methods, heuristics, stronger formulations for mixed integer programs, as well as enrich my technical skills by diving in more depth on the use and implementation of specialized optimization software. The team I joined was very welcoming and consisted exclusively of kind, interesting, and talented people. The managers were very supportive, and clearly defined the goals of each project. Through common activities, the team came even closer together. Traveling to other Amazon facilities and offices, and meeting people who are working on different branches of the company, was also an exciting part of the job. Overall, I would definitely recommend this experience to people who want to see their expertise used in real world applications, while still retaining the element of research."

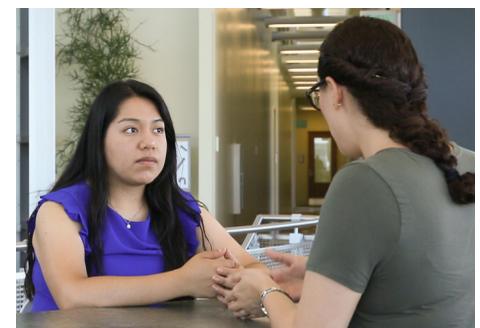
Emily Garcia (B.S. '20)

Undergraduate Research Fellow at Purdue University

Over the summer, as a Purdue Summer Undergraduate Research Fellow (SURF), I worked with Dr. Paul Griffin, Dr. Ping Huang, Dr. Zachary Hass and Dr. Yuehwen Yih at the Regrenstrief Center for Healthcare Engineering to determine the risk factors associated with potentially avoidable hospital re-admissions for long-term care.

According to a long-term care scorecard measure performed by the AARP, Indiana currently ranks as the worst state to provide long-term care, however re-hospitalizations, especially those under 30-days, are a nationwide problem accounting for over a trillion dollars of expenditures for Medicare and Medicaid.

Using the Centers for Medicaid and Medicare Indiana Minimum Data Set Version 3.0, which contained over 2 million patient assessments, I analyzed a list of compiled candidate risk factors using statistical analysis and programming. I identified 31 key risk factors that included medications, patient characteristics, health and mental health conditions that influence the probability of a patient experiencing a hospital re-admission within 30-days. In addition, I built a prediction risk model to help identify patients at risk of a re-hospitalization. Thanks to the support of my team, I have been selected to present at the INFORMS Annual Meeting 2019.



MEET THE CLASS OF 2019:
SENIOR SPOTLIGHTS



Nicholas Lofgren

Major: B.S. IEOR

What is your favorite IEOR class and why?

IEOR 115. Not only was the class taught in a very engaging manner by Professor Goldberg, but through the 10 person project team I was able to meet many amazing people in other disciplines.

Is there anything else you would like to add?

The IEOR department and its students have given me a second home in Berkeley, and I am so thankful to have found myself in this major.



Smita Balaji

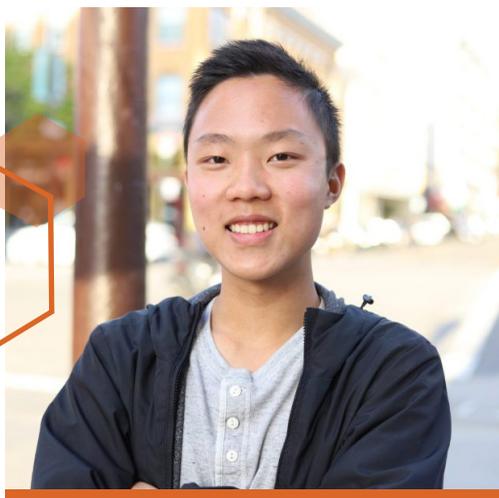
Major: B.S. IEOR

What are your post-graduation plans?

Industry Consulting

What is your advice to younger IEOR students?

Get to know people in your major! One of the huge advantages of IEOR is it's a small community within this giant public university so take advantage of it. Get to know your peers, form study groups, hang out on the weekends – they may become your best friends.



Jim Xu

Major: B.A. ORMS & Public Policy Minor

What are your post-graduation plans?

I will begin working at PwC in San Francisco but planning to pursue a PhD!

What is your favorite IEOR class and why?

IEOR 173. I have absolutely hated probability ever since taking Stat 134, but IEOR 173 places probability concepts under a new light and in applicable ways.

What is your advice to younger IEOR students?

Do not ever be afraid of reaching out to professors; they can offer some pretty cool insights into their fields that you might want to engage more with.

MEET THE CLASS OF 2019: SENIOR SPOTLIGHTS



Ebru Kasikaralar

Major: B.S. IEOR

What are your post-graduation plans?

I will be doing PhD in Management Science and Operations Management at Chicago Booth.

What is your advice to younger IEOR students?

I would recommend to be aware of the opportunities that are out there and to start looking for them early. If they want to go to grad school, they should have research experience or if they want to go into industry, they should have work experience. Going to IISE events to get to know other IEOR majors can be very useful for future collaboration in upper division IEOR classes.



Aditya Tyagi

Major: B.S. IEOR, minor in EECS

What are your post-graduation plans?

MS in Analytics at Northwestern University in the Fall.

What is your favorite IEOR class and why?

My favorite IEOR class was IEOR142 – Machine Learning & Data Analytics by Prof. Grigas. I worked on a solo analytics project that received acclaim from the Professor. He also later invited me to join the class's course staff. IEOR142 also played a key role in convincing me to pursue a graduate degree in analytics.

At a larger level, IEOR142 teaches a set of skills that will become fundamental to the way IEOR is practiced in the future.



Aimee Largier

Major: B.S. IEOR

What is your favorite Cal memory?

I was sitting in Bechtel one day and a guy came up behind me and tapped me on the shoulder – I didn't even slightly recognize him. He then told me that I was his tour guide when he was a prospective student touring Cal and that my tour had made him choose IEOR as his major and been a major part of him deciding Cal was the right school for him. I have never felt so proud.

Is there anything else you would like to add?

IEOR self-selects amazing people and if you can make connections with those people it will change your college experience in ways you can't even imagine.



Berkeley 150W: Celebrating the Women of IEOR

Berkeley Engineering has always been at the forefront of breaking barriers for women in the field. With several thousand women graduating from Cal with an education in engineering, Berkeley Engineering takes great pride in shaping women engineers who shape the world through their immeasurable contributions.

As Berkeley celebrates 150 years of women on campus, **Berkeley IEOR** recognizes some of the finest women affiliated with the department and hopes to inspire a new generation of Industrial Engineers and Operations Researchers.



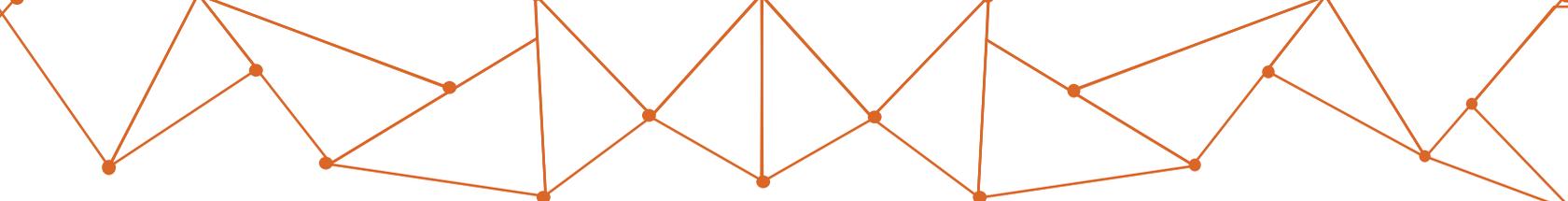
Dorit Hochbaum – Berkeley IEOR’s first woman faculty member

The first woman appointed to the Berkeley IEOR faculty, Dorit Hochbaum is a maestro in discrete optimization, network flows and integer programming. Having received a PhD from Wharton School of Business in mathematical programming, Dorit was appointed as an IEOR professor at Berkeley in 1981. Since then, she has authored over 160 papers appearing in operations research, management science and theoretical computer science literature sources. Currently the head graduate faculty advisor in the department, Dorit has supervised several PhD theses and in the process, helped shape several successful careers in academia.



Dashi Singham – IEOR alumna at the Naval Postgraduate School

A research-track associate professor in operations research at the Naval Postgraduate School, Dashi Singham received her Ph.D. in operations research from UC Berkeley in 2010. Dashi focuses on developing the methodology for analyzing data from experimental or simulation results and her areas of interest include finding optimal stopping rules to determine sample sizes, time series modeling, and uncertainty quantification. While being at the Naval Postgraduate School, Dashi has worked on the areas of healthcare and military applications, and plans to move into the energy industry. She also teaches courses in simulation and statistics and has advised over 17 Ph.D. theses.



Candace Yano – Berkeley IEOR’s first woman department chair

Serving as the IEOR chair from 1995 to 2003, Candace “Candi” Yano was the first woman to head the department. An MS and PhD recipient from Stanford University in operations research and industrial engineering, Candi held a position at Bell Telephone Laboratories before being appointed to Berkeley IEOR in 1993. Now serving a dual academic role as the Gary & Sherron Kalbach Chair in Business Administration at Haas, and as a professor in the IEOR Department, Candi was also the Associate Dean of Academic Affairs and Chair of the Faculty at Haas from 2016 to 2019.



Gah-Yi Ban – IEOR alumna in the limelight at London Business School

Gah-Yi Ban completed her MSc and PhD in Industrial Engineering and Operations Research and MA in Statistics from UC Berkeley in 2012 before obtaining a BSc in Physics and Mathematics from University of Sydney. Following her education, Gah-Yi entered academia as an assistant professor of management science and operations at London Business School, where she teaches core courses across several programs at London Business School, while having co-developed the Global Business Assignment on Digital Disruption and Innovation in San Francisco. Having completed over nine years in the role, Gah-Yi’s work has gained a lot of recognition.



Rhonda Righter – Berkeley IEOR Professor and former Department Chair

A professor, and department chair from 2008-2011, at the Department of Industrial Engineering and Operations Research, Rhonda Righter is a renowned academic. Having received a Master’s and Ph.D. in IEOR from Berkeley, Rhonda went on to carve an identity as an award-winning professor in the IEOR department where she has furthered research in the general area of stochastic modeling and optimization. Additionally, Rhonda serves as an assistant editor for the Journal of Scheduling, and the INFORMS Service Science Journal. Rhonda is actively involved with INFORMS and has also been the founding chair of the Applied Probability Society at INFORMS.

ALUMNI PROFILE

Sarina Chen and Wesley Jin: Sweetgreen



Q: What is it like to work at Sweetgreen? Can you tell us a bit about the company and the culture there?

A: Wesley:

It's exciting to be a part of a company that is at the digital frontier of the restaurant industry with no shortage of interesting problems to solve. Together we're on a mission "to inspire healthier communities by connecting people to real food"! I feel very lucky to work with and befriend such smart and passionate people who share a common goal.

Sarina:

Since Sweetgreen has a strong food and wellness ethos, the company promotes a healthy and sustainable lifestyle for its employees. Some perks include fresh fruit + unlimited PTO, and I would also say an office full of foodies!

Q: What do you do there? Which skills from IEOB are you using the most?

A: Wesley:

I work as a data engineer in Sweetgreen's technology org, developing and maintaining data pipelines, APIs, and ML tools used by the rest of the business. The most relevant courses are data systems (IEOB 115), optimization (IEOB 160, 162), and statistics (IEOB 165, 172). One project I want to highlight is the Oven Schedule iPad application used by stores to determine what to cook throughout the day. I wrote a mixed-integer scheduling program to minimize unmet customer demand while considering waste and cost trade-offs.

A: Sarina:

As a data analyst, my main responsibilities include building reports (SQL, Tableau) and creating ad-hoc analyses (Python) for internal stakeholders. I like to add the “sweettouch” by applying my graphic design skills to my products. That being said, the most relevant classes to my role are database design (IEOR 115) and industrial design (IEOR 170), both taught by Professor Goldberg.

Q: Can you give us an inside view about what a day in the life looks like for you?

A: Wesley:

My team follows the agile software development approach, so my days are loosely structured to get tasks done on a two week cadence. The majority of my day is spent writing code, monitoring software deployments, and reviewing code and design. The best part of everyday is usually lunch time, when we shoot the breeze outside on the patio with our sweetgreen meals.

Sarina:

My day varies depending on the current state of my projects. To start, I dedicate a few days to scoping, which includes meeting with different teams, sketching out ideas, exploring the data, then finally putting together a proposal. Then I enter the coding grind, bouncing ideas with peers and learning best practice. The work is very rewarding at Sweetgreen because our projects continue to get a lot of company-wide recognition.

Q: What advice do you have for current IEOR students?

A: Wesley:

Learn a programming language to bridge theory with application. I recommend Python, which is the most popular programming language with one of the most supportive communities. It opens up a whole world of automating tasks for you, and coding skills are very relevant and transferable in the current job market.

Sarina:

Manage your time well so you can plan and accomplish everything you want to do! It’s definitely tough during undergrad, but I’m glad I was able to balance my classes, student organizations, wellbeing, and time with friends. I still manage my calendar the same way I did in school.





IEOR RESEARCH ROUNDUP

Hypothesis Testing Approach to Detecting Collusion in Competitive Environments

Pedro Hespanhol, Anil Aswani

There is growing concern about the possibility for tacit collusion using algorithmic pricing, and regulators need tools to help detect the possibility of such collusion. This paper studies how to design a hypothesis testing framework in order to decide whether agents are behaving competitively or not. In our setting, agents are utility maximizing and compete over prices of items. A regulator, with no knowledge of the agent's utility function, has access only to the agents' strategies (i.e., pricing decisions) and external shock values in order to decide if agents are behaving in competition according to some equilibrium problem. We leverage the formulation of such a problem as an inverse variational inequality and design a hypothesis test under a minimal set of assumptions. We demonstrate our method with computational experiments of the famous Bertrand competition game (with and without collusion) and show how our method performs in this environment.

Vulcano - Understanding global wildfire through AI

Cristobal Pais, Max Shen, Pelagie Elimbi, Marta Gonzalez

The destructive potential of wildfires has been exacerbated by climate change, causing their frequencies and intensities to continuously increase globally. Generating fire-resistant terrains via efficient and calculated fuel-treatment plans is critical to protecting native forests, agricultural resources, biodiversity, and human populations. To tackle this challenge, we propose a framework that integrates fire spread, optimization, simulation, and AI models. We are currently developing a novel and more accurate online worldwide fire risk index system based on historical data of fire events, using this valuable information as an input of our framework to assist decision-makers to prevent or minimize the impact of these catastrophic events, anywhere in the planet.

Rank-one Convexification for Sparse Regression

Alper Atamturk and Andres Gomez

Sparse regression models are increasingly prevalent due to their ease of interpretability and superior out-of-sample performance. However, the exact model of sparse regression with an L_0 constraint restricting the support of the estimators is a challenging non-convex optimization problem. In this paper, we derive new strong convex relaxations for sparse regression. These relaxations are based on the ideal (convex-hull) formulations for rank-one quadratic terms with indicator variables. The new relaxations can be formulated as semidefinite optimization problems in an extended space and are stronger and more general than the state-of-the-art formulations, including the perspective reformulation and formulations with the reverse Huber penalty and the minimax concave penalty functions. Furthermore, the proposed rank-one strengthening can be interpreted as a non-separable, non-convex sparsity-inducing regularizer, which dynamically adjusts its penalty according to the shape of the error function. In our computational experiments with benchmark data sets, the proposed conic formulations are solved within seconds and result in near-optimal solutions (with 0.4% optimality gap) for non-convex L_0 problems. Moreover, the resulting estimators also outperform alternative convex approaches from a statistical viewpoint, achieving high prediction accuracy and good interpretability.

Online learning in a non-stationary and volatile business environment

Zeyu Zheng

Online learning or the so-called online decision making problems rest in the domain that the decision maker needs to make a sequence of decisions without complete knowledge of the business environment in the beginning. After making each decision, the decision maker gets to know the business environment better through the instantaneous outcome from her current decision, and then uses that to guide her next decision. Past literature typically studies the contexts where the past observations are representative for the future, and assumes that the business environment remains steady. Our recent works, alternatively, develop optimal sequential decision making strategies when the future business environment may change in scale and/or may evolve more volatile than before.

Homotopy Method for Finding the Global Solution of Post-contingency Optimal Power Flow

SangWoo Park, Elizabeth Glista, Javad Lavaei, Somayeh Sojoudi

The goal of optimal power flow (OPF) is to find a minimum cost production of committed generating units while satisfying technical constraints of the power system. To ensure robustness of the network, the system must be able to find new operating points within the technical limits in the event of component failures such as line and generator outages. However, finding an optimal, or even a feasible, preventive/corrective action may be difficult due to the innate nonconvexity of the problem. With the goal of finding a global solution to the post-contingency OPF problem of a stressed network, e.g. a network with a line outage, we apply a homotopy method to the problem. By parametrizing the constraint set, we define a series of optimization problems to represent a gradual outage and iteratively solve these problems using local search. Under the condition that the global minimum of the OPF problem for the base-case is attainable, we find theoretical guarantees to ensure that the OPF problem for the contingency scenario will also converge to its global minimum. We show that this convergence is dependent on the geometry of the homotopy path. The effectiveness of the proposed approach is demonstrated on Polish networks.

IEOR Awards



Cal Cybersecurity Fellowship to Matt Olfat

Nominated by professor Aswani, Matt Olfat, an IEOR Ph.D. candidate, was awarded the inaugural Cal Cybersecurity Fellowship. He will develop a research initiative entitled “Cybersecurity for Cyber-Physical Infrastructure Interacting with 5G Networks,” which aims to design mechanisms for detecting attacks on cyber-physical systems.



Professor Alper Atamturk Elected Chair of the INFORMS Optimization Society

Professor Alper Atamturk is set to chair the INFORMS Optimization Society, which aims to promote the development and application of optimization methods and software to solve Operations Research/ Management Science problems, and to encourage the exchange of information among practitioners and scholars in the optimization area.



Alper Atamturk named INFORMS Fellow

In the annual INFORMS meeting in Seattle, Professor Alper Atamturk was named an INFORMS Fellow for demonstrating exceptional accomplishments and making significant contributions to the advancement of Operations Research/ Management Science through his career as a professor.



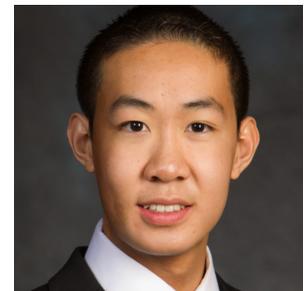
IEOR undergraduates selected as finalists for INFORMS Operations Research Prize

Advised by Professor Aswani, three former IEOR students — Liangyuan Na, Cong Yang and Chi-Cheng Lo — were selected as finalists in the INFORMS Undergraduate Operations Research Prize Competition. Their work investigated machine learning algorithms identifying individuals whose information had been removed from aggregate datasets of physical activity data.



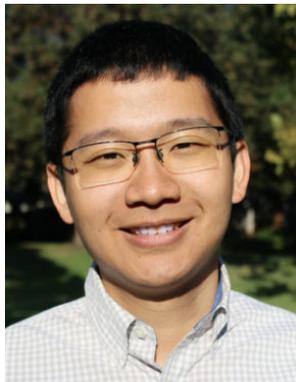
Katta Murty Best Paper Prize awarded to Junyu Cao

Junyu Cao, for her outstanding paper “Sequential Choice Bandits: Learning with Marketing Fatigue”, was awarded The Katta G. Murty Best Paper Prize. The prize, established in 2006 as a gift from IEOR alum Katta Murty (’68 PhD IEOR), is an annual competition among IEOR graduate students for exceptional papers focused on optimization.



Evan Gong announced as winner of Jengyee Prize

Evan Gong, a Political Economy and German undergraduate student was awarded the 2019 Jengyee Prize. The prize recognizes well-rounded undergraduate students at UC Berkeley with exceptional leadership for a better future and is awarded in honor and memory of Jengyee Liang, who received her B.S. IEOR in 2005.

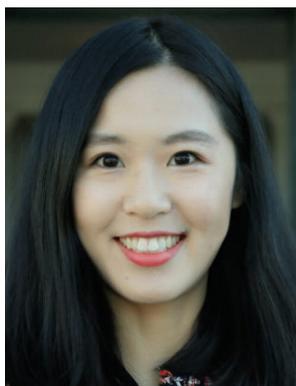


Sheng Liu

Graduating with a Ph.D. in Spring 2019, Sheng Liu has accepted a faculty position at University of Toronto's Rotman School of Management. At Berkeley, Liu worked on problems from innovative business models and smart city operations with Professor Max Shen.

Cedric Josz

A postdoctoral scholar at Berkeley IEOR, Cédric Josz has now accepted a faculty position at Columbia University. At Berkeley, Josz was designing tractable algorithms for optimization problems on Professor Lavaei and Professor Sojoudi's teams.

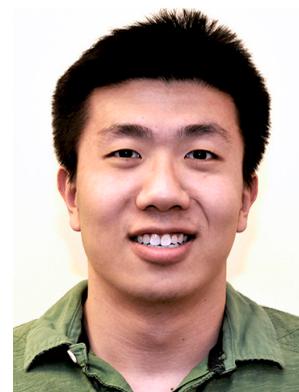


Renyuan Xu

Graduating with a Ph.D. in Spring 2019, Renyuan Xu is now pursuing her postdoctoral studies at Oxford University through an no-teaching fellowship, following which she will begin her faculty position at University of Southern California.

Richard Zhang

A postdoctoral scholar at Berkeley IEOR, Richard Zhang has now accepted a faculty position at University of Illinois, Urbana-Champaign. At Berkeley, Zhang worked on numerical algorithms for computational problems in energy and transportation industries with Professor Lavaei.



Kevin Li

Graduating with a Ph.D. in Fall 2018, Kevin Li is now working with Uber as a data scientist, focusing on marketplace optimization and spatial temporal pricing. At Berkeley, in addition to research projects, Kevin was on the course staff of many courses including Data X.



Zeyu Zheng joins IEOR

On completing his Ph.D. in management science and engineering from Stanford, Dr. Zeyu Zheng joined Berkeley IEOR as an assistant professor in Fall 2018. Excited to bridge operations research and data science, Dr. Zheng's research interests include stochastic modeling, statistical inference, and financial technologies.



Barna Saha joins IEOR

Moving from the University of Massachusetts Amherst, Dr. Barna Saha joined Berkeley IEOR as an assistant professor in Fall 2019. With a Ph.D. in computer science and experience as a research scientist at AT&T Shannon Labs, Dr. Saha's research includes probabilistic methods and randomized algorithms, and data analytics.



Anayancy Paz Retires

After successfully completing 23 years of service at UC Berkeley, and 11 years with Berkeley IEOR, the IEOR faculty, students and staff bid farewell to Anayancy Paz and wished her a happy retirement in Summer 2019.

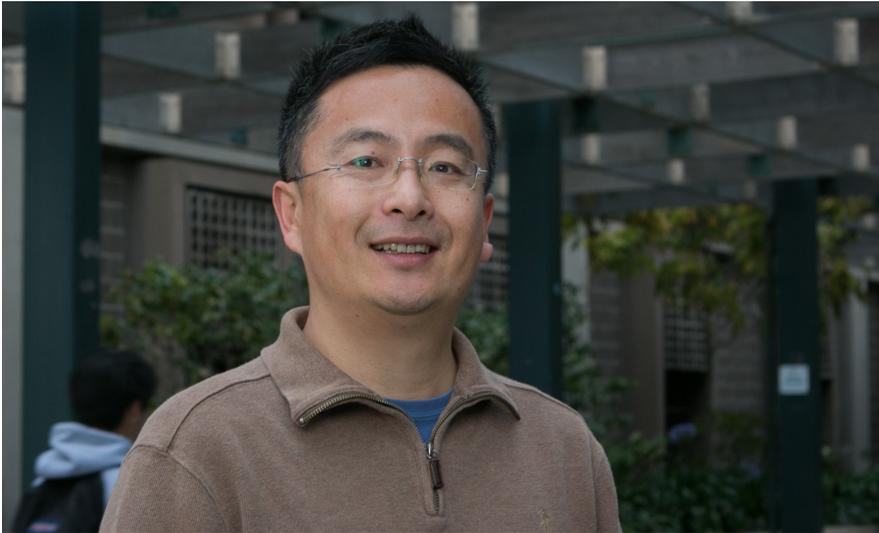


Former students celebrate Professor Oren

In Spring 2019, the Energy and Market Engineering Symposium in Honor of Shmuel Oren was held at UC Berkeley. Organized by three of Professor Oren's former Ph.D. students, over 70 people attended the symposium and highlighted Professor Oren's seminal contributions in diverse fields.

STAY CONNECTED

Professor Max Shen comments on supply chain disruption caused by COVID-19 & how operations research can help in Berkeley Conversation



“Some of the challenges we are facing right now can actually be addressed by designing and optimizing a resilient and fast response supply chain. So, the supply chains will be less vulnerable to disruptions and demand surge.”

See the full video here:

<https://tinyurl.com/leorcovid19>

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CLASS OF 2019 GRADUATES



Undergraduate Program

B.S. IEOR

Aplin, Chase Palmer	Kuo, Ethan Song-En	Nassef, Saeed
Balaji, Smita	Kurniawan, William	Oner, Alper
Bao, Xing	Largier, Aimee	Petikyan, Nelli
Braude, Omer	Ledesma, Francesca Inez	Stuczynski, Camille Daley
Davar, Neel Jay	Lee, Dao Ming	Tan, Yong Yi
Gurel, Elif	Li, Shixuan	Tang, Jason Low
Hsu, Emma	Li, Victor Henry	Torbett, Irvan Arvenzia
Hugo, Dominic Pacheco	Lofgren, Nicholas Dean	Tyagi, Aditya Anuj
Itkis, Alexandra Michelle	Lorio, Nicholas Quinn	Yang, Samuel Eallan
Janakiram, Ajay	Lu, Charles Michael	Yoo, Brian
Johng, Kenny	Marlina, Astrid	Yu, Yue
Kasikaralar, Ebru	Mukaled, Ali	Zhu, Yuting
Kresl, Luscie Alena	Mulchandani, Gaurav	
Krishnamurthy, Susheel	Naranjo Brambila, Ilse Paola	

B.A. ORMS

Chen, Arthur Ulysses Lapcing	Mao, Cinyi	Xu, Shijie
Chen, Qiuyi	Papadopoulos, George	Xu, Zijing
Cheng, Emmy Karen	Pham, Kevin Minh	Zhang, Jun
Dong, Lillian Fu	Radhakrishnam, Diksha	
Hwang, Daniel Sung-Jae	Wu, Kevin	

Graduate Program

Ph.D.

Cao, Ying	Lee, Ji Ung	Xu, Renyuan
Grosbard, Dean Israel	Liu, Sheng	Yang, Nan
Gurek, Tugce	Spaen, Quico Pepijn	

M.S.

Bansal, Vanshika	Lee, Yoon	Ong, Jonathan Li Qun
Cho, Jehum	Li, Xinyi	Vermeersch, Nathan
Ding, Andrew Shi	Manasawala, Aummal Baneesn	Yang, Cong
Fraboni, Yann	Meng, Ran	

Amour, Myriam	Li, Yiran	Thanabhusest, Jidapa
Bachlaus, Kshiti	Li, Zipei	Thomas, Sruthi
Bal, Yu	Li, Ziyu	Tiloy, Louis
Betman, Gregory	Li, Zuheng	Tiong, Edward Kwong Yi
Bidesi, Arjun Singh	Lim, Clara Shu Qi	Troncoso Rubin, Joaquin Jose
Britto, D. Carl Mario Joseph	Lim, Kenneth	Vigner, Hugues Pier Guy
Chang, Lih Yun	Lo, Yu-Chun	Wang, Jing
Chatty, Anirudh	Lu, Jie	Wang, Lu
Chen, Mengjie	Luo, Xudan	Wang, Weilin
Chen, Qi	Mao, Mao	Wang, Yinghao
Chen. Shuxiao	Marinaki, Maria	Wang, Titong
Chen, Yanxiu	Max, Muriel	Wang, Ziyang
Chen, Yishuang	Mezerreg, Ines	Wei, Lan
Corley, Ryan Clifford	Mistry, Shivam Darshan	Wu, Donglin
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