



Chair's Announcement



**Dear alumni,
students,
colleagues,
and friends:**

Greetings from Berkeley where another productive year is winding down for the department. We have had many successes this year, including improving our ranking to a tie for the #2 ranked program in the country, seeing Professor Shmuel Oren be inducted into the National Academy

of Engineering, hiring a very promising new Assistant Professor Paul Grigas (who you will find a profile of in this newsletter), and seeing our alums continue to lead and succeed in nearly every industry.

The department also completed a once-a-decade academic program review, where a team of colleagues from the (other) top IEOR departments in the country visited Berkeley IEOR to give their assessment. The committee praised the department for our accomplished and dedicated veteran faculty, spectacular young faculty, our ever-improving graduate programs, bright and interested undergraduate students, and for the significant improvements that came with our recent renovations to our home at Etcheverry Hall.

Going forward, the committee also recognized the challenges that the department will face in the future — challenges most departments at Cal are currently facing — with regard to resource constraints. We hope to overcome these challenges by embarking on a long-term strategic plan to drive efficiencies in our programs and offerings as well as leverage our networks to ensure that the department will continue to be a world-class place for students to learn. On the last page of this newsletter, you will see that we are asking alums to contribute to our campaign to renovate our only department classroom in this spirit. We're already well on the way to meeting our fundraising goals thanks to contributions from generous alums.

I would also like to announce with mixed emotions that this will be my final semester as the chair of the IEOR department. It has been tremendously gratifying, and a great honor, to lead the IEOR department for the past five and a half years. I'm thankful to have had the support and encouragement of the best staff, students, and faculty in world! It has been wonderful getting to know so many accomplished alumni — thanks to all of you who have reached out to me either electronically or

in person at one of our many alumni events. We couldn't have accomplished nearly as much without your support.

Besides focusing on my research, I will be taking a new position at the College of Engineering as the Associate Dean for Planning & Development, and I am excited to announce that I will be succeeded by one of our most distinguished faculty members, Professor Ken Goldberg.

Ken joined the Berkeley faculty in 1995, and is described on Wikipedia as an “artist, writer, inventor, and researcher in the field of robotics and automation.” Ken's primary appointment is in IEOR, but he is held in high esteem throughout campus, as reflected in his secondary appointments in EECS, Art Practice, the School of Information and Radiation Oncology at UCSF's Medical School. Ken currently serves as Director of CITRIS's People and Robots Initiative and UC Berkeley's AUTOLAB where he and his students pursue research in geometric algorithms and machine learning for robotics and automation in surgery, manufacturing, and service applications. Ken has several hundred peer-reviewed publications and eight U.S. patents, and his artwork has appeared in 70 exhibits including the Whitney Biennial. He was awarded the NSF Presidential Faculty Fellowship by President Bill Clinton in 1995 and the IEEE Robotics and Automation Society George Saridis Leadership Award in 2016.

With Ken at the helm, I am more than confident that the department will continue to rise in prominence as our students, faculty, and alums continue to break new barriers in our field.

As always, feel free to reach out to me at kaminsky@berkeley.edu if you have any comments.

Go Bears!

A handwritten signature in black ink that reads "Phil".

Phil Kaminsky, Professor & Outgoing Chair, IEOR

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HOCHBAUM BREAKS NEW BARRIER IN IMAGE SEGMENTATION

In the U.S. in 2016, it is estimated that more than 23,000 people will be diagnosed with a malignant brain or spinal cord tumor, and over 16,000 people will die from brain cancer. Brain imaging with CT or fMRI machines is a critical part of the diagnosis process for doctors working to detect tumors in patients. While these brain scanners can produce useful images almost instantaneously, the process of interpreting them can be quite slow — it can take hours for a specialist to process the images manually.

However, with IEO Professor Dorit Hochbaum's new algorithm for segmenting images, the process of identifying worrisome regions of brain scan images could be significantly quicker in the future. The algorithm uses image segmentation, an approach where an image is automatically divided between its salient features and the background. Her new algorithm can quickly and precisely identify prominent features in almost any kind of image — which means in the case of brain scans that it can automatically identify possible tumors which can then be referred to a physician for further analysis.

Image segmentation itself is not a new concept. Currently, the most popular algorithm to segment an image is called normalized cut (NC), an approach developed by Jianbo Shi and Jitendra Malik in



This figure shows the original image (left), the image segmented using NC (middle), and the image segmented using Hochbaum's new algorithm (right). In this case, Hochbaum's algorithm is 86 times more accurate.

2001. The NC algorithm identifies the salient features in an image by looking for groups of pixels that are similar to each other and dissimilar to the surrounding pixels. The NC approach can have good results for identifying features within an image, but overall the problem of image segmentation is still intractable in this form — meaning engineers using the algorithm must be satisfied with approximate and unreliable results.

Hochbaum realized that it isn't necessary to take into account whether the pixels in the background surrounding each feature are similar to each other — something that the NC algorithm does factor in — rather it only matters that the pixels within each feature are similar. This insight helped Hochbaum simplify the problem such that a new algorithm could solve the problem in real time, meaning her new algorithm — which she calls NC' or HNC — can be used in applications without using approximation. NC' is also much more precise and speedier computationally — so much so that it can be used to track features in live video, a feature not possible with NC.

This new ability to segment images precisely and quickly is already being used

for ground-breaking research. Hochbaum has recently begun working with the Harvard Decision Science Laboratory to help them interpret how neurons in the brain interact with each other. Researchers there have recently gained the

This insight helped Hochbaum simplify the problem such that a new algorithm could solve the problem in real time, meaning her new algorithm — which she calls NC' or HNC — can be used in applications without using approximation.

capability to create videos that show tens of thousands of neurons firing over time. By combining this new ability to capture neurons on video with Hochbaum's algorithm to interpret what the neurons are doing, the Harvard lab hopes to gain a more complete understanding of what is happening in the brain during human decision-making. ■

BERKELEY HYPERLOOP TEAM HEADS TO FINALS

Imagine being whisked from SF to LA in 30 minutes. That is the promise of the Hyperloop, a concept proposed by SpaceX/Tesla founder Elon Musk in 2013. The idea is to solve the problem of medium distance travel by mounting a long tube on earthquake-resistant pylons through which a pod would be propelled at over 700 miles per hour. The pod will use magnets to levitate in a nearly-airless tube in what Musk believes to be the fastest and most efficient way to travel a few hundred miles.



Emily Ma



Tyler Chen

Since its introduction, the audacity of the Hyperloop concept has inspired many engineers including the more than 40 members of Berkeley Hyperloop (or bLoop), a UC Berkeley student team composed primarily of engineers that is competing in SpaceX's Hyperloop Competition. BLoop has twelve team leads including Logistics Lead Emily Ma (IEOR '17) and Project Manager Tyler Chen (MSE/BioE '19). For Chen, being on the Hyperloop team is a dream, "When I first came to Berkeley, all I wanted was to join a Hyperloop team."



The Berkeley Hyperloop team

The Berkeley Hyperloop team has already built a prototype and competed at SpaceX's Hyperloop Pod Competition Design Weekend in Texas last January. The bLoop team was one of 22 teams selected (out of 115) to advance to the Hyperloop Competition I finals taking place next January 2017. The winner of the competition will win "literally the world's coolest trophy" according to SpaceX, which is a promise not to be underestimated from a company that has plans to colonize Mars in the next decade.

BLoop is taking a realistic approach to compete against the other teams in the finals which include the likes of MIT, Wisconsin, and Delft from the Netherlands. "We are focusing on the human-centric aspects that other people aren't," said Chen, "Some teams are like 'let's go as fast as you can' and that's cool, you can go fast, but do you maintain pressure in your cabin? Do you have

multiple seals to ensure that people can breathe inside? A lot of our sub-systems, in terms of how they operate are a little more scalable than other teams. For example, we are using electro-magnets for braking and other teams are using

"Berkeley breeds a very specific kind of student, which is one that is self-starting, independent, and self-reliant."

permanent magnets. Permanent magnets are kind of an on-off switch. You have to move them close to the rail to slow down. We are using electro-magnets that allow you to super easily control the brake force with voltage. You don't have to wait for things to move for it to work. (continued on Page 16)

IEOR ALUMNI PROFILES – *Check out what alumni are currently up to***Animesh Garg***Ph.D. IEOB 2016**Postdoctoral Researcher at
Stanford University****What was your first job ever?***

Postdoc at Stanford is the first full time job I have taken up. Prior to this, I have interned at JK Tyre Manufacturing and National Thermal Power Corporation in India during my undergraduate years.

What are you currently working on?

I am working on making robots smarter. Specifically, I work on deep reinforcement learning algorithms to enable robots perform complex and dynamic tasks in everyday environment.

Do you have any advice for current IEOB students?

IEOB is a great program at the intersection of analytics, machine learning and operations research. Spend time taking hard and fundamental classes, and find industry internships close to your expertise to build a strong portfolio for a career after graduation.

What do you miss about being a student at Cal?

The collegial atmosphere on Campus, not living in Berkeley and the Berkeley food culture.

**Theresa Roeder***Ph.D. IEOB 2004**Associate Professor at
San Francisco State University****What are you currently working on?***

I do two types of research. The more practical side consists of often smaller projects that address a specific issue in my classes (e.g., assigning students to groups) or with student learning (e.g., the effectiveness of different types of peer evaluation feedback). More theoretical projects harken back to more to my student days, where I look at simulation enrichment or predicting how long to run Integer Programming problems in order to get “good enough” solutions.

What do you miss about being a student at Cal?

The constant intellectual stimulation, and hanging out with my friends!

Do you have any advice for current IEOB students?

Try to take as much advantage as you can of all the amazing opportunities a campus such as yours affords you!

**Thomas Boeck***B.S. IEOB 2016**Currently: Supply Chain Analyst at
Levi Strauss & Co.****What was your first job ever?***

House painting! My dad owns a small residential house painting company, so painted, caulked and sanded away some high school summers.

What are you currently working on?

Well, I have a job these days, so a lot of my time goes into that. Also brewing a nut brown ale. I'm trying to lead a dynamic life. Reach out to me if you think of any good hobbies (thomas.p.boeck@gmail.com)!

What do you miss about being a student at Cal?

Midday naps, haphazard schedules, offbeat classes.

Do you have any advice for current IEOB students?

Floss!



Christopher Au

B.S. IEOB 2014

Currently: *Data Engineer at Autodesk, Inc.*

What are you currently working on?

Aside from working as a Data Engineer at Autodesk, I am also working with a non-profit organization called Foodies Without Borders as a pro bono consultant. Foodies Without Borders is a non-profit organization focusing on empowering young generations and under-privileged communities in Kenya through culinary arts and sustainable farming, enabling them to be self-reliant. Our mission is to teach local communities aspects of commercial cooking: sanitation techniques, meal preparations, and culinary arts derived from sustainable farming, through a series of pop-up kitchens around the country.

What do you miss most about being a student at Cal?

What I miss most about being a student at Cal is 1) the diverse environment that allows me to constantly learn and grow into a more mindful person, and 2) the proximity of friends and other brilliant students that bring the best out of me.

Do you have any advice for current IEOB students?

Don't be limited to what you studied.
Get comfortable with being uncomfortable.
Develop your network and invest in your relationships.



Cynthia Tran Tillo

B.S. IEOB 1997

Currently: *Principal Product Manager at Adobe*

What did you do after graduation?

I actually started my career at Hewlett Packard's semiconductor facility as a full-fledged Industrial Engineer. This involved conducting manufacturing process cycle time studies, implementing Kanban, and modeling queues. The one noteworthy thing I remember: we hired IEOB Professor Rob Leachman as a consultant for our fab and I got to approve his timecards!

What are you currently working on?

I have the fortune to product manage a portfolio of amazing solutions within Adobe's Marketing Cloud. Chances are when you online shop and need to zoom into or customize a product, it is powered by my solution. Being a product manager leverages everything we learn in Industrial Engineering around optimization techniques. A good product manager is a master at optimization - balancing the often complex and competing demands of Quality, Scope, and Time. Optimizing feedback from a variety of sources - customers, sales, competitors, market - and being able to synthesize into something meaningful.

What do you miss about being a student at Cal?

The diverse, intellectual discussions on a wide range of topics, as well as the ability to pursue divergent projects on a whim. Thinking back, having the freedom and bandwidth to think, challenge, and learn is truly amazing!

Do you have any advice for current IEOB students?

One mentor gave me this advice that I found apt in our 20's: "take the time to figure out what you are meant to do in your 20's, and you will have the next 30 years in your career to do it well." I take that as optimizing for learning and growth whenever possible.

AMBER RICHTER JOINS GOOGLE'S OPERATIONS DECISION SUPPORT TEAM

Amber received her PhD at Berkeley IEOB in spring 2016. We sat down to ask Amber about her new job at Google.

You've just finished your PhD at Berkeley IEOB. Can you tell us briefly about your research here?

My research was with Professor Shen in disaster relief supply chain management. My main research project involved dynamic relocation and inventory management of prepositioned disaster relief supplies.

Tell us about your new position. What are you most excited about? What is your role? Who else is on your team?

I recently started as a Quantitative Analyst at Google. I am on the Operations Decision Support (ODS) team - we are a team of about 20, most with OR PhDs, who use OR and advanced analytics tools to support decision making within Google's technical infrastructure. We help support all aspects of the infrastructure from hardware inventory management and compute and storage resource utilization within data centers to capacity planning in Google's wide-area network. If you want to learn more about how OR and advanced analytics are used on the ODS team and throughout Google, look out for our up-coming article in the December issue of INFORMS' OR/MS Today magazine.

There is so much to be excited about

when working at Google, for example, Google's fun and inspiring work environment, extensive offering of professional and personal enriching courses, and free and delicious food. I am most excited, however, to work closely with and learn from my incredibly intelligent and skilled colleagues. I am surrounded by technically oriented and inspiring people who are excited about the work that they do and Google provides a fantastic environment and community for collaboration and information and skill sharing.

Which of the skills that you learned at Berkeley IEOB do you anticipate using most in your new position?

One of the most valuable skills I gained is the ability to approach and solve unstructured and often ambiguous problems. I suspect I will use this often in this job as well as in all my future jobs.

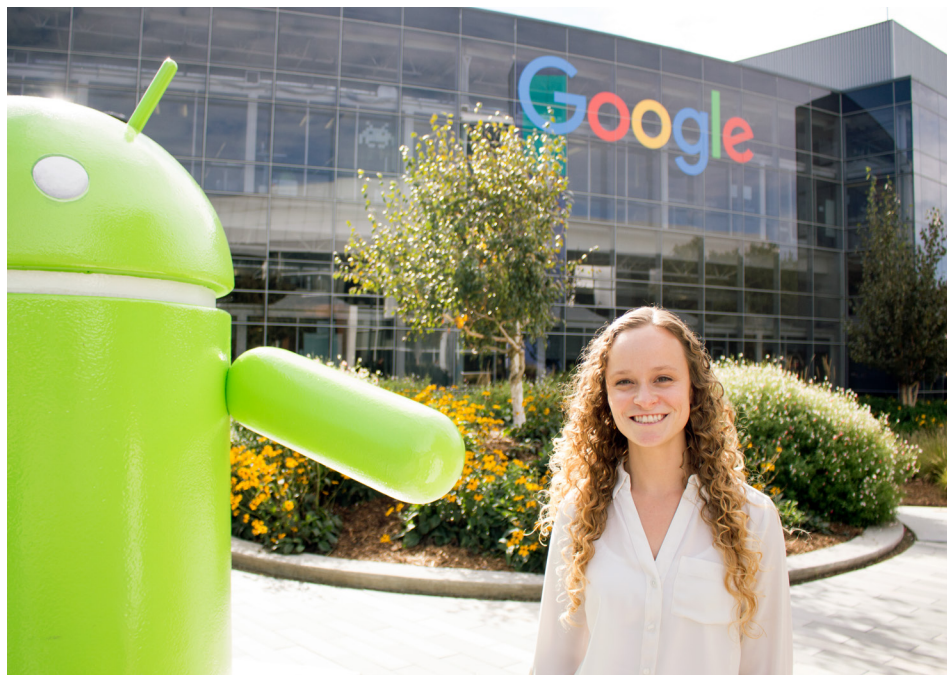
I will also frequently use many of the mathematical skills I learned like modeling, forecasting, optimization, simulation, and supply chain management.

What will you miss about being on campus?

Seeing my many great friends within the department every day. The campus' many quiet nature spots, especially along Strawberry Creek, and its great ceramics studio.

Do you have any advice for current graduate students?

Foster community within the department. Do internships. Negotiate time off between finishing your degree and starting a job. Take breaks, do the things that make you happy, and take advantage of the flexible student lifestyle as much as you can.



Amber in front of Google Headquarters in Mountain View, CA

CAN FITNESS APPS MAKE US FIT?

Right now if you have a smartphone and an interest in living a more active lifestyle there are literally tens of thousands of fitness apps available that can help you track every step, set activity goals, and even play (or compete) with a friend. Surprisingly, despite the popularity and wide range of fitness apps — there isn't a whole lot of scientific research out there showing that they actually work.

"My experience is that someday I feel like I should exercise, and then I will download one of those apps in the hope that they will help me," said Mo Zhou, a third-year IEO graduate student who has just launched a new study to research fitness apps, "And then after a week, I never check the app again."

"We want to look at this problem on the scientific spectrum to see if [fitness apps] really work."

Zhou's experience is not uncommon. Research shows that most people have a hard time sustaining any type of long-term behavior change. The hope of mobile health applications is that they can help people change their behavior for the long-term without (costly) clinical intervention.

So, to investigate the effectiveness of fitness apps, Zhou (under the guidance



Ph.D. student Mo Zhou is investigating how mobile health apps can change our exercise behavior.

of Assistant Professor Anil Aswani and Professor Ken Goldberg, and as part of a larger research team with Professor Phil Kaminsky; Graduate Student Yonatan Mintz; Undergraduate Students Jessica Lin, Smita Jain, Emily Ma; UCSF Associate Professor Yoshimi Fukuoka; and UCSF Assistant Professor Elena Flowers) has built her own mobile health application and launched an on-campus study with UC Berkeley staff and students as subjects. Zhou is not only interested to see if fitness apps can make a difference, but also interested in understanding which app features may be most effective in motivating physical activity, "No one has really looked at how these different features can motivate people to exercise more. We want to look at this problem on the scientific spectrum to see if they really work."

In the first of three studies which launched with sixty-five UC Berkeley staff in September, Zhou is investigating

whether or not dynamic goal setting will improve subjects' daily steps. Her app sends a notification in the morning to subjects to set their goal and another in the evening to notify subjects whether or not their goal has been reached.

While this may sound pretty standard to the fitness app connoisseur, Zhou will go beyond most fitness apps out there by setting goals using an algorithm that accounts for the subject's baseline activity level, reaction to previous notifications, and most novel — the subject's self-efficacy or confidence in their ability to meet a goal. For some of us, meeting goals is more motivating than it is for others. Zhou believes understanding the psychological factor is an important (and understudied) element.

After the first study is completed, Zhou will launch two more studies with UC Berkeley students as subjects. In the second study, she will compare her dynamic goal setting algorithm with a simple version and investigate push notifications further to see how frequency, context, timing, and other factors affect behavior.

Zhou is excited about the third study which investigates the social factor of fitness apps. For this phase, she will again ask UC Berkeley students to participate and will split them into groups to try to understand how competition and cooperation may work to change behavior.

In one group, individuals will compete against each other. Each individual will be able to see how they rank on a leaderboard compared with others. For another group, she will randomly assign two-person teams to compete against each other. For a third group, she will use an algo

(continued on page 16)

SYSTEMS THINKING

by Jessica Lin

On October 27-29, I had the opportunity to attend the Society of Women Engineers (SWE) National Conference in Philadelphia with over 11,000 attendees from across the world. There, we listened to speaker sessions and lightning talks, networked with over 350 companies at the career fair, and met inspiring women from all engineering backgrounds. At the conference, I attended a speaker session “Systems Thinking” by Bianca McCartt and Erin Schilling of GE Aviation, which I particularly enjoyed.

Systems thinking is a particular mindset that allows you to understand how different elements within a system influence one another. It requires both an open mind and an awareness of your own thought process, which will allow you to challenge assumptions, look at different perspectives, and see your own understanding with respect to others’ understandings.

When using systems thinking, a system is defined as a bounded space comprised of components that interact with one another. It is generally always a part of a super-system, and also contains within itself, many sub-systems. For example, if I define an engine as a system, the super-system could be a car and a sub-system could be a particular filter. When evaluating system effects, a systems thinker must understand that results are generated by the interactions between



IEOR undergraduates Jessica Lin (1st from left) and Waverly Runion (4th from left) meet new friends at the Society for Women Engineers' WE16 Conference in Philadelphia

components, and not the components themselves. If you don't understand the interactions within a system, then sometimes, a solution may cause more problems in other areas of the system.

An interesting example of a solution causing more problems is the story of The Cats of Borneo. In the 1950's on the island of Borneo, there was a malaria outbreak. To solve the problem, the World Health Organization sprayed the island with large amounts of DDT to kill the mosquitoes. However, this ultimately generated more problems for the islanders. The DDT killed many other insects, which were eaten by the geckos, which then were eaten by cats. The

cats couldn't survive the DDT like the geckos, and thus their population greatly declined. This then resulted in a large increase in the population of rats on the island, causing a rodent infestation and generating another issue for the World Health Organization. Thus, you can see that it is important to create a balanced design when creating a solution to a system.

The key to creating a balanced design is to optimize outcomes of the system as a whole, and not just outcomes of component interactions. In other words, create solutions for the bigger picture, not the small details. For example, consider a professional soccer team. If a

coach offers his offense players a bonus proportional to the number of goals they scored, then logically these athletes would rather lose a game 4-5 than win a game 2-1. Additionally, the coach offers his defense players a bonus that is inversely proportional to the number of goals scored by the opponent. Similarly, these athletes would prefer to lose a game 1-2 than win a game 5-4. However, if you look at the overarching goal which is to win the game, then this is contradictory, as both the offense and defense players would rather lose in order to obtain their bonuses. Thus, rather than trying to optimize the team at these sub-levels, the coach should optimize the team as a whole.

“Systems thinking is not just an important discipline for process or systems engineers; it can be used as a structured method for efficient problem-solving in many different types of scenarios.”

Systems thinking is not just an important discipline for process or systems engineers; it can be used as a structured method for efficient problem-solving in many different types of scenarios. As an IEOR major, I find it extremely applicable to what I have learned in school and complementary to potential career interests as well. If you’d like to learn more about systems thinking, you can check out the book *The Fifth Discipline* by Peter Senge. ■

YOUR CONSTANT

by Waverly Runion

Life’s a variable, SWE is your constant. That is the message that Jessica Rannow, the National President of the Society of Women Engineers, iterated to us over and over throughout the four days of the Society of Women Engineers (SWE) National Conference. Sitting at the welcome ceremony, surrounded by lights and music and the hundreds of other women dressed to impress future employers, I pondered Jessica’s mantra.

Coming into Berkeley, I had an idea of how much SWE had already impacted my life. If not for their overnight host program, I never would have made the all-important decision to attend Berkeley as an undergrad. Asking the girls questions, completing engineering challenges, and having the opportunity to get to know all of the incredibly driven and inspiring women in UC Berkeley’s SWE section was what ultimately led me to this amazing university.

Through the conference, workshops, information sessions, career fair, and thousand or so networking opportunities, it was easy to see how SWE was affecting my life in real time. In that moment, I was a collegiate, learning from all the lessons SWE provided to its collegiate members, but it wasn’t easy to see how the benefits might continue once college was over.

On the last day of the conference, the UC Berkeley SWE section attended the

Celebrate SWE banquet dinner. Filling the room were hundreds of women in evening finery, clinking glasses and celebrating another year with SWE. Once again Jessica Rannow gave the opening and closing speeches, and once again, she repeated her message: Life’s a variable, SWE is your constant. I watched as the names of SWE’s life members flashed on her presentation behind her and as women all around the room rose for recognition. These women, ranging across all ages, stood, showing their solidarity with the organization – showing that even after all their years, they stood by SWE. In them, I could see myself – one day standing at the Celebrate SWE banquet with a whole new generation of SWE collegiate members.

I’m over two years into my undergraduate studies now, and I can say with confidence that SWE has had a big hand in molding me into the person I am today. I have learned valuable leadership skills and I’ve gained some of the skills necessary to navigate the business world. I’ve found irreplaceable role models to mentor me, and I have mentored underclassmen of my own. Most notably, I’ve met some of my best friends – girls who I know will be there with me through it all, to the end.

It’s true that life is a variable. It is always changing, always throwing new challenges my way and putting obstacles in my path. There are twists and turns, ups and downs. You never know what life has in store for you. I wouldn’t say that I could expect what SWE would bring to my life, nor can I say that it hasn’t challenged me, but I will say that the support system SWE offers is invaluable. ■

IEOR GRADUATE STUDENT PROJECT SHOWCASE

See what our graduate students are currently working on with faculty

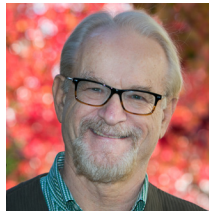
World Health Organization Global Mobility Study



Michael Suey



Zachary Mulder



Prof. Schruben

This project was designed in conjunction with the World Health Organization to analyze a proposed mobility system in which professionals would move between posts after serving a limited number of terms. The team designed simulation models in Sigma and Excel as well as created a number of performance metrics to help understand what it would take to make the system successful and the sensitivity of the parameters in the process of matching professionals to their next post.

A study of discrete second-order conic optimization



Andrés Gómez



Prof. Atamturk

Decision-making problems with logical choices and uncertainty can often be modeled as mixed-integer second order conic optimization problems. We do a systematic study of such problems, analyzing their mathematical structure and devising new algorithmic tools to tackle them. The insights gained from our research can be used to solve problems arising in finance, project management, reinforcement learning and facility location problems.

Efficient algorithms for finding near-global solutions of non-convex problems: from power systems to optimal control theory



Salar Fattahi



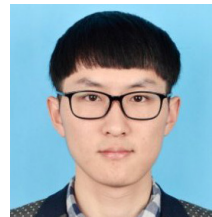
Prof. Lavaei

This research focuses on designing and analyzing algorithms for solving complex, nonlinear, and large-scale optimization problems in decentralized control systems, power systems, and generalized network flows. Fattahi is interested in developing efficient methods to find optimal or near-optimal solutions of non-convex and discrete optimization problems with several local solutions.

Machine learning in patent similarity clustering



Titouan Jehl



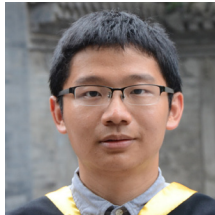
Tu Ni



Prof. Fleming

This project uses natural language processing algorithms (such as doc2vec) on patent files (abstract, claims and description) to find relevant prior art for given patents with similarity clustering, and thus reduce the probability of potential patent invalidation, litigation and blocks.

Adjacency-Clustering and its Application for Yield Prediction in Integrated Circuit Manufacturing



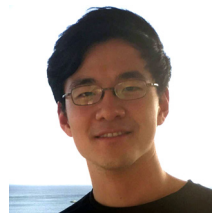
Sheng Liu



Prof. Hochbaum

We devise a new technique called adjacency-clustering to find clusters of objects that are affected by other objects of close proximity. We use this model for accurate yield prediction in integrated circuit manufacturing. The adjacency-clustering model is based on the Markov random field minimum energy model that is solved efficiently with combinatorial algorithms utilizing the parametric cuts approach. The adjacency clustering model captures the neighborhood effect and delivers superior accuracy as compared with the state-of-the-art models. Moreover, adjacency-clustering is flexible and can be adjusted for a wide range of applications where a neighborhood effect is present.

Multiproduct Dynamic Pricing



Kevin Li



Prof. Yano

Dynamic pricing is a relatively new but growing practice in the retail sector. The problem is challenging as the impact on retailer's bottom line is heavily influenced by consumers who are both behavioral and strategic. Without insights derived from historical data, firms which blindly and continuously adjust prices are bound to find dynamic pricing ineffective. In our project, we address a retailer's problem of setting prices over a multi-period horizon for substitutable products, considering the effects of reference prices on customers' strategic buying behavior, including stockpiling. Following a 2-stage approach, we first derive the consumer's optimal purchase policy, and use the derived demand information to reformulate and solve for the retailer's optimal pricing policy.

BERKELEY IEO TO HELP EDUCATE THE NEXT GENERATION OF TECH LEADERS AND ENTREPRENEURS

Industrial Engineering & Operations Research will be one of two core engineering majors offered in a new program launched by UC Berkeley to help educate future technology leaders

and entrepreneurs. Undergraduates applying for admission for Fall 2017 can now apply to the **Management, Entrepreneurship, & Technology** program, a dual-degree program in which graduates will earn B.S. degrees from both the top-ranked Berkeley College of Engineering and Berkeley Haas School of Business.

To lead in the 21st century innovation economy, business leaders will not only need to have a comprehensive understanding of concepts in communications and management, but there is an increasing demand for managers with

a solid technical foundation as well. As tech continues to be the primary industry leading innovation, there is a shortage of managers with the expertise to truly understand how to drive their companies forward. The M.E.T. program will help meet this industry need and educate more workers qualified to lead and start innovative companies.

The first M.E.T. cohort will be just 30 students to allow for increased mentorship and encourage collaboration for students. ■

More info at met.berkeley.edu

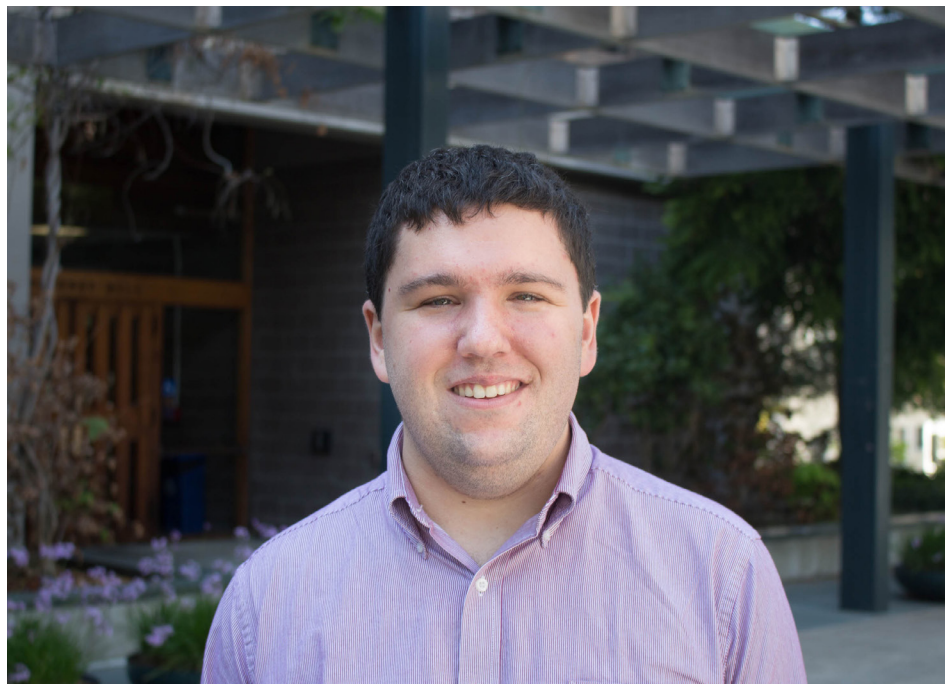
PAUL GRIGAS JOINS IEOR FACULTY AS NEW ASSISTANT PROFESSOR

The Department of Industrial Engineering and Operations Research at UC Berkeley is proud to welcome Paul Grigas as a new Assistant Professor this fall. Paul received his Ph.D. in Operations Research from MIT in 2016. Previously, he earned a B.S. in Operations Research and Information Engineering (ORIE) from Cornell University.

As an undergraduate at Cornell, Paul was drawn to operations research because he appreciated its mathematical rigor compared with other engineering disciplines and the fact that an education in OR offers a broad set of tools that can be applied in many different contexts. After being involved in research and taking graduate level courses, Paul decided to pursue a Ph.D. at MIT.

At MIT, Paul's research and interests focused on the interface between optimization methodology and algorithms, machine learning, and data-driven decision making. For part of his research, Paul developed a new algorithm for the "matrix completion" problem — a prototypical machine learning problem that is often applied in recommender systems — by using state-of-the-art techniques in optimization and numerical linear algebra to greatly improve computation speed — a useful improvement to help tackle large scale matrix completion problems.

Paul's research also focused on investigating new connections between opti-



mization and boosting algorithms for statistical learning, where the goal is to analyze a large set of simple classification models to determine which are most relevant in order to produce a highly accurate model. For example, there might be thousands of simple models used to predict whether a user will click on an online sports advertisement (e.g. one simple model might be "users aged 25-40 are most likely to click"). Boosting methods are utilized to combine a select few simple models into a more powerful "committee," which can then be used to make the best informed decision about who is most likely to click the sports ad.

Paul is excited to teach his first courses at Cal next semester. He will teach IEOR 290, which is a new graduate-level course where he will cover recent advances in optimization, machine learning, and

data-driven decision-making at a deep technical level. He will also teach IEOR 242, which will focus more on how to apply statistical machine learning methods in the context of real problems.

Paul is very excited to be a part of the IEOR department at Cal, "By definition IEOR is on the interface between all these areas that excite me: optimization methodology, statistics, and machine learning — with the emphasis on decision-making which I really like."

Currently, Paul's research is focusing on bridging the gap between statistical learning and traditional optimization based models (e.g. for problems such as inventory management) by designing loss functions (which describe the accuracy of a statistical model's prediction) that better account for the structure of the underlying optimization model. ■

SHMUEL OREN INDUCTED INTO NATIONAL ACADEMY OF ENGINEERING

IEOR Professor Shmuel Oren was recently elected to the National Academy of Engineering (NAE). On Oct. 14, 2016, Shmuel was officially inducted to the NAE for his contributions 'to the integration of decisions and cooperative market mechanisms for adaptive multisource electrical power systems.'

Shmuel is the second IEO professor to join the academy after Emeritus Profesor Robert M. Oliver. In total there are now 81 engineers from UC Berkeley in the NAE including Dean Shankar S. Sastry and IEO joint faculty Richard M. Karp and Christos Papadimitriou. ■



Professor Shmuel Oren officially joins the
National Academy of Engineering

COMING
SPRING 2017!

IEOR Alumni Social

Connect with other IEO alumni, catch up with old friends, and enjoy delicious food and drink

Look for an invitation
coming soon!

If you would like to host the event or have an idea for a venue, please contact Keith McAleer at kmcaleer@berkeley.edu

WHAT DO IEO ALUMNI DO?

IEOR alums work in a broad array of industries and fill a wide range of roles within companies, non-profit, and government. We looked at the job titles for over 400 alums to create the word cloud below. The bigger the word, the more often it appears in alumni job titles.



(“HYPERLOOP” CONTINUED FROM PAGE 5)

So, I think we are really emphasizing scalability and safety.”

“I also think the people on the team make it pretty exceptional, because well — Berkeley rocks,” added Ma, “Berkeley breeds a very specific kind of student, which is one that is self-starting, independent, and self-reliant.”

Despite their strong team (which has recently grown stronger by consolidating with other Berkeley Hyperloop teams) and success so far, there are still challenges for the upcoming competition in January. For one, building a Hyperloop pod is not cheap.

“Over the summer, one of our lead engineers Ray Chen who is the chassis lead realized that our current build is going to be too heavy to be feasible to compete with,” said Ma, “So, he said we are going to build a second complete prototype — and it’s going to be built entirely out of carbon fiber. So, that sounded like a lot of money.”

The team is currently working on sourcing money and carbon fiber for the second prototype. Once they have it built, there is the additional logistical and financial challenge of transporting the team — and the 350 pound pod — to Hawthorne for testing.

“When push comes to shove, the pod, the competition and the engineering comes first. The people on the team are very dedicated,” said Ma, “They will find a way to fund their own tickets — that is exactly what they did for the Texas competition.”

While the first Hyperloop competition finals are in January, that won’t be the end of Hyperloop for SpaceX or the bLoop team. SpaceX plans to hold more competitions in the future, and Berkeley Hyperloop hopes to continue to inspire engineers to propose unconventional solutions to big problems.

For their part, Ma and Chen are currently working to organize a class where they will teach students how the Hyperloop works and use it as an example of an atypical solution to a massive problem to help students get used to solving problems in innovative ways.

“One thing we are trying to do is push the spirit of what we are doing to the larger Berkeley campus community,” said Chen. ■

You can find more information about the Berkeley Hyperloop team by visiting <http://www.berkeley-hyperloop.com>

(“FITNESS APPS” CONTINUED FROM PAGE 9)

rithm to assign two-person teams based on their baseline activity levels with the goal of forming teams in a way to make it as competitive as possible. The last group may be the most interesting — Zhou will recruit students in pairs to join the study as friends who will compete against other two-person teams.

“In terms of cooperation in physical activity intervention, there is not a lot in the literature,” said Zhou, “So, it will be interesting to see how people actually will behave. I would think that if I am cooperating with a friend and we are competing in something, I would feel bad if I am not doing well and she is doing most of the work.”

While mobile applications have the potential to make a big difference (consider the extra calories burned by the Pokémon Go craze earlier this year), it is still unclear which features are most sticky and best for changing long-term behavior. With Zhou’s research, we will hopefully be able to shed more light on best strategies fitness apps can employ to help us all get moving. ■

**JAVAD LAVAEI AWARDED
\$1M GRANT FROM OFFICE
OF NAVAL RESEARCH**

IEOR Assistant Professor Javad Lavaei has just been awarded a \$1 million grant to support his work on nonlinear optimization from the Office of Naval Research (ONR).

The Director of Research Early Career Grant is extremely selective and will help cover research expenses up to \$200k per year for 5 years. According to the ONR, Javad was awarded the grant for his “innovative research at the frontiers of science and technology that is relevant to the mission of ONR” and for “community service demonstrated through scientific leadership and community outreach.”

This is Javad’s fourth career award from the Young Investigator Program. He previously won a separate award from the ONR, one from the Air Force Office of Scientific Research, and another from the Defense Advanced Projects Research Agency (DARPA). ■

SUTARDJA CENTER FOR ENTREPRENEURSHIP & TECHNOLOGY: A GRAND OPENING

by Carlos Ramos de la Vega

The Sutardja Center for Entrepreneurship and Technology officially opened its doors at its new space at California Memorial Stadium on Friday, August 26th. Students, faculty, and a wide range of contributors and executives gathered to celebrate the long-awaited inauguration of the Center.

Special guests included long-standing supporters and friends of the SCET, Pantas Sutardja and Ting Chuk, the Dean of the College of Engineering, Shankar Sastry, and the international academics, researchers, and entrepreneurs on the Berkeley faculty that represent the success of the Center's Global Partners Program.

Dean Sastry was the first one to take the podium. "The risks to innovate to change people's lives, and take the necessary risks for doing so is at the heart of what it means to be an engineer". Sastry spoke of a vision shared by many in the audience who believe in the power building a bridge between in-classroom learning and pragmatic applications.

Appropriately, the development of the Berkeley Method of Entrepreneurship was the underlying theme guiding the conversation at the event. According to Founding Director Ikhlaz Sidhu, entrepreneurs must hold the right combination of theoretical foundations,



The Sutardja Center for Entrepreneurship & Technology officially opened its doors on a new space at California Memorial Stadium this past August

From left to right: IEOB Professor & Chair, Phil Kaminsky; Sutardja Center Chief Scientist & Founding Director, Ikhlaz Sidhu; Benefactors Ting Chuk and Pantas Sutardja; student Vruti Desai; Sutardja Center Managing Director Ken Singer; and Dean Shankar S. Sastry

real-world experience, and mindset in order to be able to make a tangible and sustainable impact.

This is the vision that the Sutardja Center for Entrepreneurship & Technology embodies and has built since Dean Richard Newton and Ikhlaz Sidhu laid the foundation for the center eleven years ago.

It all started with one course for engineering undergraduates; now, students not only have the ability to learn and practice entrepreneurship by enrolling in classes that range from product management to data analytics, but are also given the opportunity to shape the vision and purpose of the Center itself by joining its rapidly growing team.

This is the global technology powerhouse that overlooks the Berkeley campus from its new location at Cal's Memorial Stadium while keeping innovation close to its core at the College of Engineering.

The SCET is now at the center stage of a period of renewed potential. This made its Grand Opening feel like a two-fold celebration: the welcoming of a brand new chapter, and the reward for the talent and effort of everyone that has brought it this far. ■

You can find more information about the Sutardja Center for Entrepreneurship & Technology, its courses, programs, and who is involved by visiting scet.berkeley.edu.

Our Graduates

B.A. Operations Research & Management Science

Spring 2016

Michele Gleit
Jai Ho Jung
Anirudh Srinivas Kilambi
Andrea Kwan
Jong Yoon Lee
Kevin Chia-Hau Lee
Tiffany Soebijantoro
Cong Wang
Cynthia Wu

B.S. Industrial Engineering & Operations Research

Spring 2016

Thomas P Boeck
Alejandro Castillejo
Cheuk Him Desmond Chan
Albert G Chandra
Burt J Chen
Courtney Zhi-Jia Chow
Ryan Clifford Corley
Catherine C. Darmawan
Yirong Fan
Oliviero Felice F. Figus
Cheyanne Isha Galinato
Calvin Gozali
Li Gu
Chunchun Huang

Farzad Kargaran
Rajit Kinra
Sooyoun Kwon
Jinzhou Li
Nanavati Mei Yi Low
Hing-Man Mak
Riley John Murray
Bowen Ni
Sasha Mehul Patel
Dylan Labatt Randle
Raymond Rudianto
Jerome T. Rufin
Kunal S. Shalia
Jonathan Sumarto
Sirisha P. Varigonda
Jessica A. Wijaya
Hiromichi Yamamoto
Yikun Yang

Master of Engineering

Spring 2016

Marie-Camille Achard
Utsav Akhoury
Ana Sofia Aramayo Car-
rasco
Xabier Azagirre
Omar Bentahar
Yin Bian
Yacine Brini
Arthur Laurent Cahen
Guillaume Candeli
Anis Chagar
Baihan Chen
Rebecca Chew Min Ting
Kevin John Danser
Marie Douriez

Boran Fu

Martin Gouy
Xiaoyu Gu
Shaoting Han
Ziang Hu
Akshee Jain
Daqian Jiang
Jason Kam
Hyeji Kim
Kar Fu Kong
Camille Lehujeur
Juanyan Li
Lujia Li
Xiang Li
Yifang Liu
Zhenhang Liu
Tian Luan
Thibault Martin
Armelle Patault
Nihit Prakash
Neng Qiao
Honghao Qiu
Elana Rosen
Karl Paul Sahyoun
Kilian Schindler
Lydia Marie Smith
Nick Stauss
Xilin Sun
Shishir Sura
Mihir Subodh Tamhankar
Chong Wee Tan
Ludovic Thea
Xuedong Tian
Cedric Roch Vallee
Joel Prince Varghese
Chaitanya Pradeep Wadi
Tingting Wang
Xueqi Wang
Sio Fong Wong
Yiteng Xu

Xuanqi Yang
Yiheng Yang
Bing Lin Yeo
Wendi Zhao
Zirui Zhong
Chuanhai Zhu

Master of Science

Spring 2016

Huseyn Abdulla
Aaron Warner Atton
Agrima Bahl
Deepa Dilip Kalelkar
Mengyu Li
Nishant Yash Lokhandwala
Shir Nehama
Aurelien Amiyao Ouattara
Yiwen Tang
Kevin Maxwell Vale
Ji Wang
Haoyun Wu
Xijia Wu
Qi Xu
Dimin Xu

Ph.D.

Spring 2016

Qiaochu He
Amber Richter
Peng Yi
Qi Zhang

Etcheverry Classroom Renovation Campaign

Donate now to help us upgrade our aging basement classroom for the next generation of students



While we know that alums may have fond memories of learning in **room 1174** on the first floor of **Etcheverry Hall**, this room is in dire need of renovations.

Broken furniture, stained carpets, loud fan noises — this windowless room is currently not a favorite place for faculty to teach or students to learn. While we can't fix the lack of windows, we think that implementing a state-of-the-art design **will make a big difference for the next generation of students.**

STAY CONNECTED

Website: ieor.berkeley.edu

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Help us reach our \$125,000 fundraising goal by contributing to our classroom renovations fund.

You can donate directly to the renovation of this classroom by visiting <https://give.berkeley.edu/browse/?u=325> and selecting “Etcheverry Hall Classroom Renovations Fund”

QUESTIONS OR COMMENTS?

Please feel free to contact Keith McAleer at kmcaleer@berkeley.edu with questions, comments, ideas, suggestions, partnership opportunities or any other inquiry for the department.

University of California, Berkeley

Industrial Engineering &
Operations Research

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