



shell

The **RISE** OF CS

A New Era for Students



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Editor at Large
Neil Spring

Managing Editor
Todd Holden

Lead Designer
Gabby Larios

Photographers
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Patrick Jenkins
Anna Blue Keleher
Gabby Larios
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Staff Writers
Alex BenDebba
Kelly Bilodeau
Marcus Fedarko
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Letter from the Chair

Dear Alumni and Friends,

In the 19 months since the University of Maryland made the announcement that the Brendan Iribe Center for Computer Science and Innovation would be the new home to our department, so many wonderful things have happened. I have had the pleasure of traveling several times to Seattle, the Bay Area, San Diego, and New York City to meet with some of you, and it has been delightful to host others of you in College Park for various events.

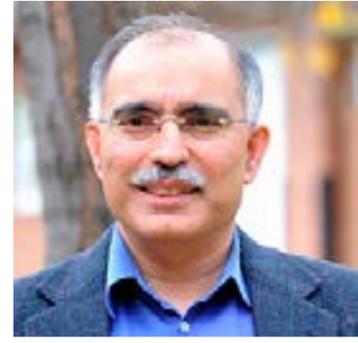
The support that so many of you have shown in terms of gifts to the building, scholarship support, and volunteering has been overwhelming, and for that, I am truly grateful. Our work is not finished, as we are continuing to build a strong foundation for the future of computer science here in College Park.

At the groundbreaking on April 30th, everyone there will celebrate all of you. You were the inspiration for this project, and I hope that we'll be able to make this building a place where scholarship, research, and teaching will thrive for decades to come.

This issue of shell is one in which we begin to address the growth and changes that we are experiencing, and show you the ways that we are working to make this department the best in country. You will also learn about some of the exciting research taking place here, new programs that we are offering, and well-deserved awards that students and professors have earned. We want you to be as proud of us as we are of you.

Together, we can ensure the rise of Computer Science at the University of Maryland.

Best wishes,



Samir Khuller
Professor and Elizabeth Stevinson Iribe Chair of Computer Science

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shell is a publication of the Department of Computer Science at the University of Maryland

contact us
editors@cs.umd.edu
@umdcs
www.cs.umd.edu

BEFORE GROUNDBREAKING

By: Alex Bendebba

In January of 2015, the state board of Public Works approved a contract for HDR Architects to begin designing the Brendan Iribe Center for Computer Science and Innovation. The \$150 million project has been allotted fourteen months for design and twenty-two months for construction. Ceremonial groundbreaking takes place on April 30, 2016, and demolition is set to begin in June 2016.

The University has released plans for the exterior and interior of the building. The Iribe Center will have an interior similar to the offices at Facebook, Oculus VR, and other tech companies. Unlike AV Williams and the Computer Science Instructional Center (CSIC), the computer science department's new building will have abundant open space for students to interact. There will be several dedicated research labs, including ones dedicated to virtual reality and robotics.

The Iribe Center will have large windows, to let in a great deal of natural light, a design that reduces the cost of artificial lighting while improving the work environment especially for the department's graduate students. There will also be informal study spaces, dedicated tutoring centers, and a large cafe on the ground floor. All of these features are in addition to well-designed classrooms, meeting rooms, and office spaces. The goals for the building are not only to bring a west coast startup atmosphere to the University, but also to encourage more student-initiated projects and collaborative learning and research.

"The design and architecture of the Iribe Center will bring people together to discuss new ideas and to collaborate meaningfully," said Professor Samir Khuller, Elizabeth Stevinson Iribe Chair of Computer Science. There will be two large lecture halls in the building to educate greater numbers of computer science undergraduates. The larger of these spaces will be the Michael Antonov Auditorium,

AN UPDATE

which will be host to countless speakers and events. Although these spaces will hold hundreds of students, these classrooms have been designed specifically to encourage small group collaboration and to give students the opportunity to get to know their classmates. Each level of the lecture hall will have two rows of tables, allowing for students to turn around, face each other, and quickly form groups during class time. The classrooms are modeled after those being constructed in the Edward St. John Teaching and Learning Center, which is located on the mall and set to open in 2017.

Smaller classes in the department comprise 50-60 students, and the design of the Iribe Center allows for courses of this size to seem much more intimate. The classrooms will allow for peer instruction, alongside more traditional styles of learning, in the hopes that students will feel enabled to ask questions of their instructors and each other. The rooms will have round tables to facilitate group discussions and problem solving. Instructors will find it easier to pose questions to their class and encourage students to work together to find solutions.

While CSIC is currently being outfitted with its first makerspace (a place for students to gather, share ideas, and build hardware and software projects), the Iribe Center will have 5,300 square feet of makerspace. These fun and collaborative spaces will also be open for students from all over the university to work with computer scientists to find solutions to problems together. The space will also allow students full access to hardware normally only available during large hackathons. The Co-director of Bitcamp (the largest hackathon at the University of Maryland), Anthony Castrio, hopes that the new building and makerspaces "will enable people to continue working on the projects they start at hackathons as much as it encourages them to attend more [events]."

The building will have 20,000 square feet dedicated to students in the form of meeting rooms, tutoring centers, and



open-seated areas for students to meet and work together. Although the Iribe Center is mainly for computer science students, the building will draw in other majors to the space and encourage interdisciplinary collaboration. While students will be learning and doing research, they may also decide to start a company, and the Iribe Center will accommodate that as well. "We want to prepare students before they go out and build businesses," Emeritus Professor Bill Pugh explained. "We want to give them a chance to come up with ideas, create teams, manage their time, and work with the new technologies without fear of failure. "

Collaboration and collaborative working spaces are at the heart of the Iribe Center. The connections that students make with each other and with faculty are vital to the building. Although Brendan Iribe has stated that he hopes virtual reality will eventually remove the need for physical proximity in collaboration, he understands the needs for students to be with each other and faculty and researchers in person. "You do need to get that [interaction] here on campus," he has said. "There's going to be a reason for [this] physical space for a very long time."



WE WANT TO PREPARE STUDENTS BEFORE THEY GO OUT AND BUILD BUSINESSES

-Emeritus Professor Bill Pugh



ALUMNUS OF THE YEAR AND ALUMNI HALL OF FAME

SUMAN BANERJEE

(PhD, '03) has been named the Alumnus of the Year for 2016.

Banerjee is currently a Professor in the Department of Computer Sciences at the University of Wisconsin-Madison, where he is the Director of Wisconsin Wireless NetworkinG Systems (WiNGS) Laboratory. The lab focuses its research on networking and distributed systems with a primary focus on wireless and mobile networking. He began his academic career in 2003 as an Assistant Professor in the same department.

He has recently received a Vilas Mid-Career Award from the University of Wisconsin, and in 2013, Banerjee was awarded the Rockstar Award of ACM SIGMOBILE of which he now serves as chair. In 2011, his paper for ACM MobiCom, "FLUID: Improving Throughputs in Enterprise Wireless LANs through Flexible Channelization" was fast-tracked to Transactions of Mobile Computing. That same year, he won the Wisconsin Governor's Business Plan Competition. In 2009, he won a Best Paper Award for ACM MobiCom for "CENTAUR: Realizing the full potential of Centralized WLANs using a Hybrid Data Path." He received a National Science Foundation Career Award in 2008, has over 75 peer-reviewed publications, and has sat on several committees, including serving as Program Chair for IEEE SECON and ACM MobiCon.

Banerjee graduated from the Indian Institute of Technology in Kanpur, India in 1996, where he earned a B.Tech in Computer Science and Engineering. He completed his M.S. in Computer Science at the University of Maryland of 1999, and he completed his Ph.D. in Computer Science in 2003. His dissertation is entitled A Cooperative Peer-to-peer Framework to Scale Multi-party Applications. His advisors were Bobby Bhattacharjee and Ashok Agrawala.

Michael Antonov, Brendan Iribe, and Andrew Risse are the newest inductees to the Alumni Hall of Fame. Each year, the Department of Computer Science celebrates the contributions that alumni have made to the field of computing and the impact that their work has on society.

MICHAEL ANTONOV

(B.S., Computer Science, 2003)

currently serves as Chief Software Architect at Oculus VR (he is also a co-founder of the company), where he leads the development of virtual reality software including game integrations, sensor-based tracking, and system software. Antonov is recognized for his expertise in complex software architectures, computing graphics, and his interest in programming language design. He is responsible for technical contributions that made Scaleform (a company that he, Brendan Iribe, and Andrew Risse worked on) a well-respected company in the video game market.

ANDREW REISSE

(B.S., Computer Science, 2001)

was a software developer and co-founder of Oculus VR who passed away in 2013. Andrew was a talented computer graphics engineer and gifted developer whose code is embedded in thousands of games played by millions of people around the world. His work was integral in the early years at Oculus VR, where he helped introduce tens of thousands of people to virtual reality through early prototypes of Oculus hardware.

BRENDAN IRIBE

(attended, 1997-8)

currently serves as the CEO of Oculus VR (he is also a co-founder of the company). Iribe's ambition, perseverance and forward-thinking vision has brought virtual reality to diverse consumers, which is changing how people understand the world. Iribe's leadership in other companies, including Scaleform (a company that he, Michael Antonov, and Andrew Risse worked on), is impressive and he has been an extremely successful serial entrepreneur in the video game industry.

PROJECT: SIDEWALK COMPUTING ACCESSIBILITY

with Kotaro Hara and Professor Jon Froehlich

By: Marcus Fedarko

In the modern age of Google Maps and other geographical technologies, finding directions is—for most people—an easily solvable problem. A user can input both a starting point and a destination, and within moments, a map will return a path between the two locations. For some people, however, this set path is not always an acceptable solution.

Users with mobility impairments may find some of the directions returned by current mapping technologies to be riddled with obstacles. Walking paths that might be slightly problematic for people *without* mobility impairments can become downright dangerous for people in need of accessibility accommodations. An unsafe walking path for a person with mobility impairments might include a lack of curb ramps, or a problem with a sidewalk or a crosswalk surface. For wheelchair users, unsafe travel may include obstacles blocking their paths, the disappearance of a sidewalk altogether, or any number of issues. Data about deficiencies in everyday travel environments are not always readily available to users before they visit a certain area.

Kotaro Hara's work focuses on solving this problem. A PhD candidate in the Human-Computer Interaction Lab (HCIL), Hara has developed software to help people with mobility impairments ensure that they are able to set safe, clear paths when they use geographical technologies. Hara works with his advisor, Jon Froehlich, who is an assistant professor in computer science, and a member of HCIL. In order to facilitate this safe

travel, Hara has collected street-level accessibility data and created a technology—named Project Sidewalk—that uses imagery from Google Street View to let users easily label accessibility features or problems of a street.



Without a large amount of training, Project Sidewalk users can label curb ramps (or missing curb ramps), path obstacles, surface problems, or other accessibility information at the street level. Through crowdsourcing—receiving many small contributions from many people—Hara is able to garner a significant amount of accessibility data, which can be used to create tools that provide vital information to people with mobility impairments.

“We were thinking about a lot of applications,” Hara said, “like navigation that takes into account accessibility information”. For instance, they thought of a version of Google Maps that helps me get to Starbucks—but instead of showing the shortest paths, it shows accessible paths for wheelchair users, and it could show the path that doesn't have much of an incline or that has curb ramps.” Hara also mentioned heat map visualizations of neighborhoods that could “help people assess neighborhood quality for people with mobility impairments.”

Pictured left to right: PhD Student, Kotaro Hara, Professor Jon Froehlich, and MS Student, Majeed Kazemitabar.

Project Sidewalk has a good deal of potential, Froehlich and Hara explained. Though the tool's current focus is on obtaining accessibility data, it is possible to generalize it to finding other information. The two researchers list vegetation, urban morphology (the aesthetics of cities and other human environments), and fashion as just a few of the subjects that would be possible to study using a generalized version of the tool.

Froehlich understands that people might argue that mobile phone problem-reporting services render Project Sidewalk redundant. However, one of the noteworthy features of this technology is that users are able to survey places thoroughly from the comfort of their chairs before they venture outside. “Our argument has always been, that [the problem reporting service] is far more scalable than the last 150 years of citizen reporting, but for our tool, you don't even have to get out of your chair. You can survey many places in the world and I think that is hard to argue with in terms of scalability potential.”

The inspiration for the project came from Froehlich's experience as a graduate student at the University of Washington as he was looking for projects that had social relevance. When he met Hara, they decided to embark on this project together. “The big data movement had just begun, [using] these massive data sources, and I [thought] Google Street View is actually just another big data source. But people are just treating it like a map. But what could we learn from it?”

When asked how he might work on this project in the Iribe Center, Froehlich mentioned that he would like to use drone-based urban surveying for accessibility. “For that,” he says, “you'd need a space that provides not only the physical space to perform internal tests of your flying drones but you also need a place—and a mechanism, the resources, the equipment—to build things. Like attachments for cameras, to build the sensors necessary to make these drones and robots.”

“Google Street View is actually just another big data source. But people are just treating it like a map. But what could we learn from it?”

Hara and Froehlich want to make life easier and more inclusive for people around them. “Our goal [is] just to inspire and encourage people who would directly benefit from this data—both the person who has the impairment as well as the care network around them,” said Froehlich. “I don't think [the user base] has to be a ton of people, because Kotaro's interfaces are so efficient for every city we think we can survey. That's the goal: collect accessibility data in every city.”

Project Sidewalk is now available to the general public at sidewalk.umiacs.umd.edu, for anyone who would like to contribute.

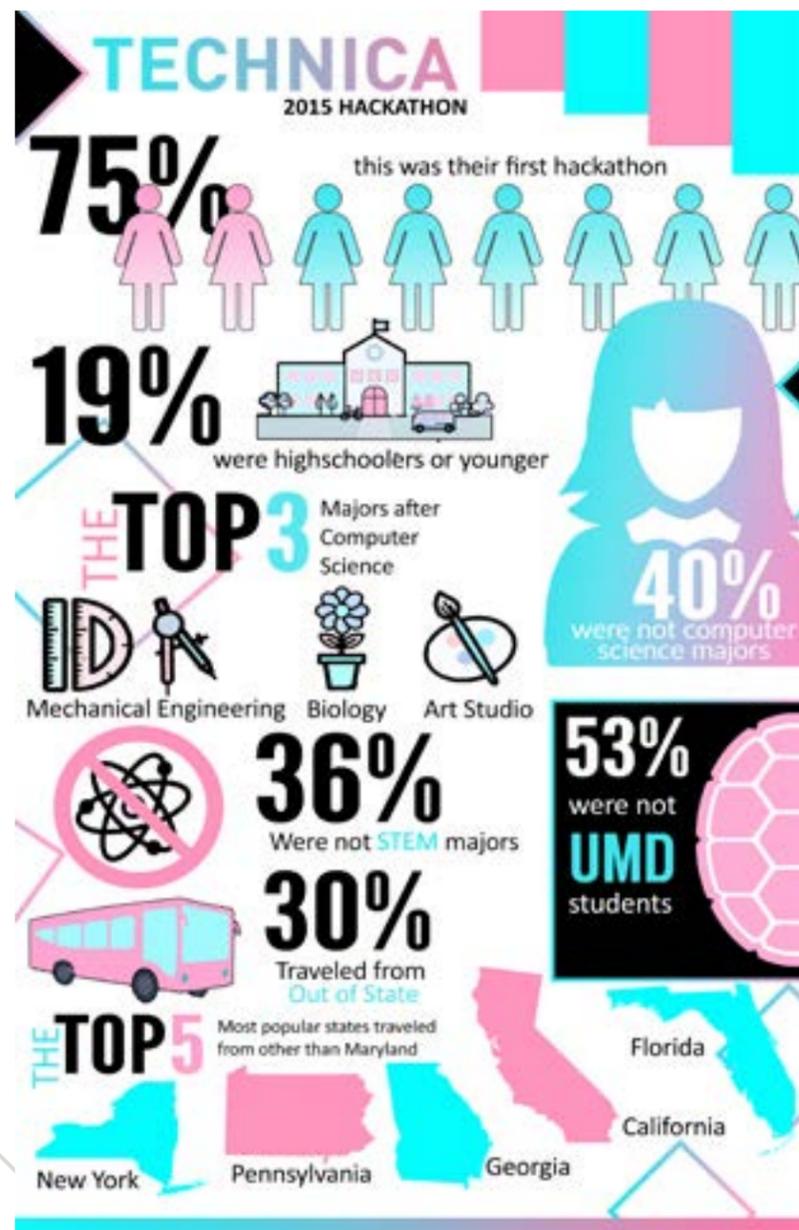


WOMEN IN COMPUTER SCIENCE

OUTSIDE THE CLASSROOM

This last year has been an exciting one for women in computer science at the University, particularly those who are involved with the Association for Women in Computing (AWC). During the fall semester, many of its members were involved in founding Technica—the first all ladies’ hackathon at UMD. Hundreds of women took buses or drove from universities all over the country to participate in the hackathon. The organizers of Technica also invited high-school students who were interested in learning how university hackathons work in a very open and welcoming environment.

Sophomore computer engineering major Amritha Jayanti, is the director of the hackathon, and several members of the AWC, as well as women and men from a host of majors, including computer science, were instrumental in ensuring this event’s success. Jayanti and the team are now planning Technica 2016.



Infographic by Gabby Larios

On April 7th, 2016, the AWC hosted its ninth annual Casino Night at the College Park Marriott Hotel & Conference Center. Over 200 students, graduate students, faculty, staff, and special guests gathered together for an evening of casino games and prizes. Participants played with ‘funny money’ to win chips and compete for prizes. It is always a time to unwind before increased workload in the final weeks of the semester. This year, the theme was ‘Red Carpet’ and many students dressed the part (everyone was welcome to dress in what made them comfortable).

Faculty, staff, and teaching assistants served as dealers for poker, blackjack, roulette, craps, and a money wheel. This year’s Casino Night was sponsored by Accenture, Appian, Booz Allen Hamilton, Capital One, Cipher Tech Solutions, Lockheed Martin, Laboratory for Telecommunication Services, Northrop Grumman, Palantir, AOL., Microsoft, and the Department of Computer Science.





FOUR PROMOTIONS

On to the next stage:

Amol Deshpande has been promoted to the rank of Professor of Computer Science. He has a joint appointment in the University of Maryland Institute for Advanced Computer Studies (UMIACS).

In his research, Deshpande works on several topics in big data, including database query optimization, adaptive query processing, cloud computing, sensor network data management, uncertain data management, and graph databases. He has received an NSF Career Award, and he currently sits on the editorial boards of ACM Transactions on Database Systems (TODS) and Distributed and Parallel Databases. He has over 50 publications in refereed conferences and journals.

Deshpande teaches courses in Databases and Data Science and is the director of the graduate certificate in data science. For the last few years he has directed the annual High School Programming Contest.

Deshpande began his career in the Department of Computer Science in 2005. He earned a Ph.D. from University of California at Berkeley, and his B.Tech. degree from Indian Institute of Technology, Bombay.

Mihai Pop has been promoted to the rank of Professor. Pop also has appointments in the Center for Bioinformatics and Computational Biology (CBCB) and in University of Maryland Institute for Advanced Computer Studies (UMIACS)

Pop develops novel approaches for genome assembly and analysis, and is an expert in metagenomic data analysis. Recent developments in high-throughput experimental technologies and the existence of meaningful information from the wealth of data being generated propel his research. He develops computational infrastructure for biological research to understand the computational structure of the problems he solves. He has over 100 publications in the fields of bioinformatics and computational biology.

Pop teaches and researches bioinformatics, and databases, and he has begun restructuring the first year sequence for computer science majors. He was awarded an excellence in teaching award in 2015.

Pop joined the department of Computer Science in 2005. He earned a PhD in Computer Science from The Johns Hopkins University.

Héctor Corrada Bravo has been promoted to the rank of Associate Professor of Computer Science. Corrada Bravo also has appointments in the Center for Bioinformatics and Computational Biology (CBCB), as well as in University of Maryland Institute for Advanced Computer Studies (UMIACS)

Corrada Bravo's research focuses on statistical and machine learning methods for high-throughput genomic data analysis. This includes pre-processing of measurements from high-throughput assays, disease risk models that integrate high-throughput genomic and other data, and cancer epigenetics and biomarker discovery. He also works on the development of new methods and tools from multiple areas in the computational and statistical sciences: basic bioinformatics/biostatistics, statistical and machine learning, data management, and numerical optimization.

He teaches undergraduate courses in data science and bioinformatics.

Corrada Bravo joined the Department in July of 2010 after a postdoctoral fellowship at The Johns Hopkins University Bloomberg School of Public Health. He earned a PhD in Computer Science from the University of Wisconsin at Madison, and he also holds degrees in music from The Peabody Institute and the Indiana School of Music.

Mohammad Taghi Hajiaghayi has been promoted to the rank of Professor of Computer Science. Hajiaghayi is currently the Jack and Rita G. Minker Professor of Computer Science. He also has an appointment in University of Maryland Institute for Advanced Computer Studies (UMIACS).

Hajiaghayi's research focuses on algorithms, game theory, social networks, network design, graph theory, and big data. He has designed numerous algorithms in approximation algorithms, fixed-parameter algorithms, algorithmic game theory, algorithmic graph theory, online algorithms, and streaming algorithms. He has over 200 publications with over 185 collaborators and ten issued patents. He is also a recipient of an NSF Career Grant, and serves as Editor of *Algorithmica*, *Algorithms*, and the *Encyclopedia of Algorithms*.

Hajiaghayi teaches courses in algorithms and game theory. He conducts research with students in approximation algorithms, fixed-parameter algorithms, algorithmic game theory, algorithmic graph theory, online algorithms, and streaming algorithms.

Hajiaghayi earned a PhD in Computer Science from MIT, an MS in Computer Science from University of Waterloo, and a B.Sc. from the Computer Engineering Department of Sharif University of Technology. He joined the Computer Science Department in 2010.

THE RISE

OF CS

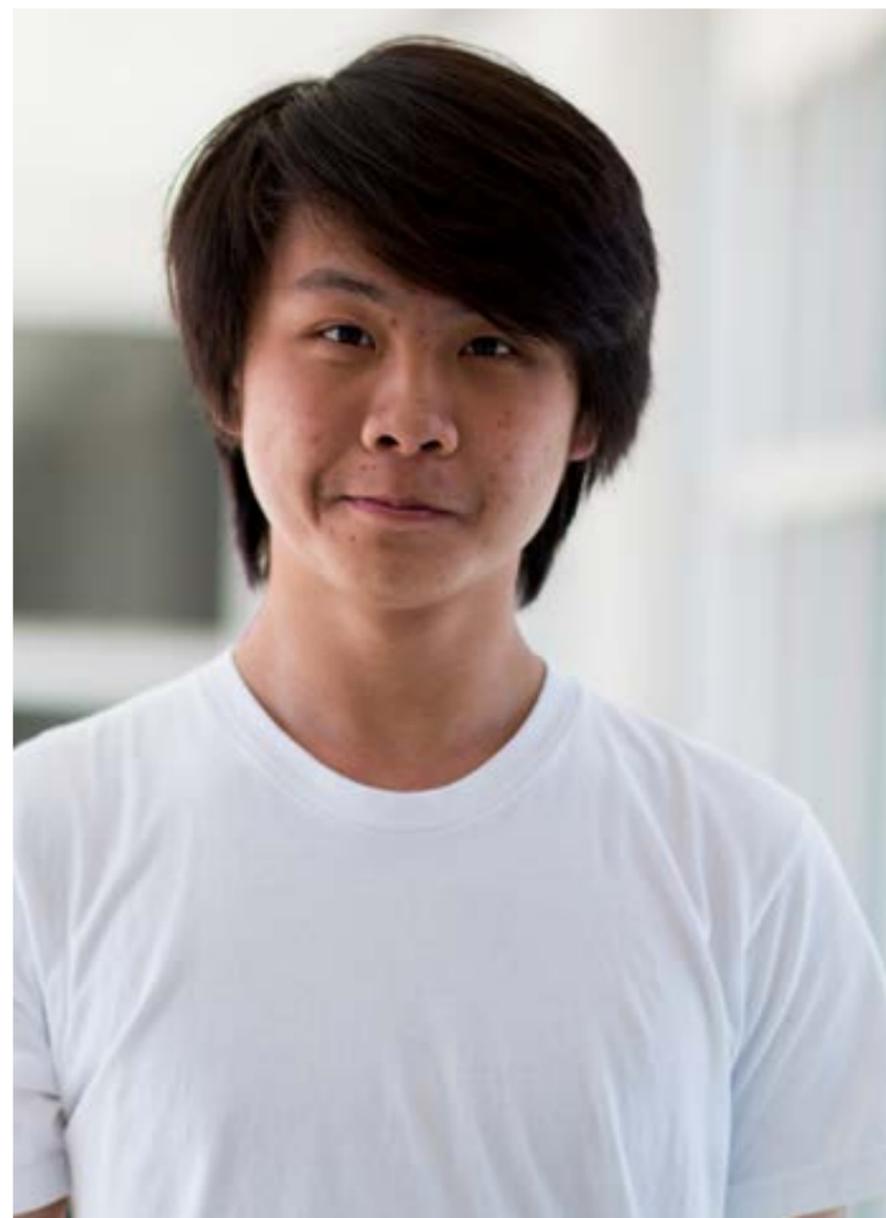
By Alex BenDebba & William Woodruff

Few fields can claim the allure and potential of computer science. From an explosion in cross-disciplinary research to the meteoric rise of America's startup culture, CS has firmly established itself in the public eye. It is often the subject of news and popular culture and is at the center of many educational initiatives for future generations of students. "Being a computer science major gives you opportunities to be a part of whatever area you're interested in," said Jacqueline Chen, a junior who is interning at Google this

summer. "From gaming to politics to virtual reality, it's amazing being at the intersection of so many different fields." Unlike the tech boom and bust of the early 2000s, new interest and growth in the field seems very different from before. This rise in computer science is less ephemeral; it will become a permanent part of our educational and daily landscape. Our dependence upon technology, from shopping to medicine to education, and our need to keep information associated with those activities secure, ensure the need

for computer scientists for decades to come.

In his final State of the Union address, President Barack Obama highlighted the importance of computer science education. He noted the increase in numbers of students graduating with degrees in computer science and engineering when he said, "We should build on that progress, by ... offering every student the hands-on computer science and math classes that make them job-ready on day one."





After this address, news organizations including NPR and Education Week ran stories on the feasibility of introducing computer science courses nationwide to elementary, middle, and high school students. These articles also addressed what an initiative of this type would mean for the future of the field.

The Computer Science Department is already experiencing an increased number of new students interested in learning programming languages and how to construct optimal algorithms. Much like the rise in the number of students during the tech bubble of the early 2000s, the Computer Science Department is seeing record enrollments, which have nearly doubled over the last five years. The number of graduate students has risen as well. With well over 2,300 students enrolled, the department now makes up nearly 10% of the undergraduate population at the University of Maryland.

This makes computer science larger than many programs at the University including biology and economics. “Many factors draw students to computer science,” said Professor Alan Sussman, Associate Chair for Undergraduate Studies. “And it doesn’t look like it’s slowing down.”

One of these new, eager computer science majors is Kat Golladay, a sophomore lacrosse player who has recently transferred into the department. “As the world moves toward a place where computers and technology play such a monumental role in everyday life,” she said. “I find it very exciting that through computer science, I can be at the center of that development and be so close to a changing world.” The excitement surrounding the major, its popularity, and growth have created a host of exciting new opportunities as well as new challenges.

A WEALTH OF OPPORTUNITIES

Looking at the sheer amount of available job opportunities with lucrative salaries, it is not surprising why computer science has grown so quickly in popularity.

In 2015, *Forbes* named computer science as the college major with the highest starting salaries in the United States: the average starting salary of \$66.8K, is quite high when compared to an average of \$45.5K for all other bachelor degrees. ‘Software developer’ was named the best job in 2014 in US News and World Report. Major tech companies like Google, Intuit, Intel, Adobe, and Microsoft are consistently top-ranked on Fortune’s list of best companies for tech workers.

While many new graduates worry about finding employment in their field, computer science graduates boast some of the lowest

unemployment rates in the country.

“Our majors have unparalleled access to employers,” said Andrew Nolan, Assistant Director of Undergraduate Studies in computer science. Nolan noted that the department hosts two internship and career fairs yearly for students. During the fall semester, he and a team of undergraduate advisors organize a large fair for over 120 companies who are looking to hire interns and graduating students. The same team gathers to hold a smaller 87-company internship and career fair at the Riggs Alumni Center at the start of the spring semester. “We try to ensure that all of our undergraduates—and it’s nearly 2400 of them—get all of the opportunities that we can give them,” Nolan said.

Despite the sizeable population of computer science majors, undergraduates have worked hard to meet their professors and each other. “Though there are more CS students than ever, it has remained easy to get to know my professors,” said Eric Jeney, a computer science major and graduating senior, who will be joining Palantir in Washington, DC after graduation. “The growth of the CS program encourages new companies to attend our career fair each year,” he said. Graduating senior Brendan Rowan also encouraged students to be independent. “Despite the large number of CS majors, you’ll never run out of opportunities to make your CS experience at UMD more intimate. Visiting your professors in office hours is a good way to get involved in research,” he said. In conversations and interviews, several students mentioned the excitement inherent to the work





of computer science and the talents and abilities of faculty members as reasons for their satisfaction with the department. For many students, including junior Alex McKay, the subject and the people teaching it open doors to the world: “No other major teaches concepts and ideas that are so relevant to the modern world. Everyone at this school uses apps, websites, databases, and programs, but we can create and improve on them.” she said. She highlighted the tangibility of her learning and is excited about what the future holds. “With such an incredible faculty and so many options within the major, we are empowered to literally do anything we can imagine.”

Sharing their interests in technical subjects and participating in a host of activities and clubs help most students to find friends in the major. Students have many groups to choose from including the Association for Women in Computing (AWC), the student chapter of the Association for Computing Machinery (ACM), the CS Latino Group, the CS African-American Organization, Terrapin Hackers, and the Virtual Reality Club. For many students, clubs and organizations help them gain confidence in the field, which at first can seem daunting.



A second year computer science major, Nadine Perez, counts herself as a student who started the program nervous about her abilities, but as she has continued taking courses and joined organizations, she has found her confidence. “I used to be ashamed to raise my hand. I failed tests out of fear of asking questions,” she explained. “I am now an active member of Terrapin Hackers, the AWC, and the Computer Science Latino Group, and am in the front row of all my lectures.” Perez now co-directs a hackathon on the west coast, and plans on eventually founding her own. She said that the professors, graduate students, fellow students, and staff have worked hard to create a space where she can learn. “I feel my goals are achievable and that I am competent,” Perez said. “The CS Department has helped me overcome what was once an ingrained fear of the field into a giddy ambition, and I truly believe that is extraordinary.”

Alexa Chittams, a third-year student, was also new to programming and she too found a warm and welcoming environment. “There are a lot of clubs and friendly people to study with. The professors are very nice and approachable. They genuinely care about the students want to help them succeed,” she said. She also finds that her classes are well-designed. “I found it challenging to come into CS with no prior experience in coding. However, because of the numerous office hours, helpful TAs and professors, I was able to learn a lot and really enjoy my first experience with programming.”

POPULARITY OF HACKATHONS

Interest in computer science has also been spurred on by the popularity of hackathons, events in which students spend 24-36 hours developing (or hacking) a piece of software or hardware. Students from the University host several hackathons including Daemon Dash (CS Department Hackathon), Technica (an all women’s hackathon), JHacks (Maryland’s Hillel National Collegiate Hackathon), and Bitcamp (UMD’s general hackathon).

Student-led hackathons not only provide participants with tools and technology they might not otherwise have access to, but they also allow student organizers at UMD to engage with several university departments to create an inclusive event for anyone interested in tech. Hackathons give students an introduction—albeit a frenetic one—to rapid prototyping and creating new hardware and software. “The community at Bitcamp in general is very open as well and everyone is willing to lend a hand to their neighbors,” Anthony Castrio, co-director of Bitcamp, explained. “This makes it a lot easier for people to join in without feeling that they need to be studying computer science or already be an expert.”

One example in which Bitcamp makes hackathons more inclusive is its COLORWAR, a design competition that takes place on the second day of the hackathon. Students interested in design compete by quickly coming up with designs around themes, including Bitcamp’s own theme, Explore New Grounds.

The competition is fast-paced and draws a crowd. It also seems to draw more women into participating in the event, which is one of Bitcamp’s major goals. Bitcamp’s media team posted to Twitter during the hackathon that 25% of their participants were women, and that they were looking to increase that number.



Hackathons and tutorials run by the Terrapin Hackers, aptly called “hacktorials,” have also generated more student interest in the field. President of the Terrapin Hackers and first-year student Ishaan Parikh credits this group, his participation in startup shell—an entrepreneurial space for undergraduates interested in exploring ideas for tech companies—and his professors for not getting lost in the crowd of students who are interested in computer science. “Personally, I have never felt like ‘just another student,’” he said. “The faculty make you feel like they care—because they do! Even though there are so many students to worry about, the department wants to help any undergrad that demonstrates initiative.”



PAST CHALLENGES, CURRENT AND FUTURE IMPROVEMENTS

One of the biggest challenges facing the department is finding enough space to house all of its students, graduate students, staff, and faculty. Just as the Computer Science Instructional Center (CSIC) was built in the last boom, a new building is on the horizon. Fortunately, the construction of the Iribe Center will be the start of bringing the community closer together through architecture. With its groundbreaking on Maryland Day 2016, the Iribe Center answers a call to reexamine how thoughtful design can positively affect how faculty teach and interact with students, and how students can have an inspiring place to learn by themselves and from each other. There will soon be more tutoring spaces, larger, better-designed classrooms, and access to materials student wouldn't otherwise be able to use.

Even with the thousands of square feet in classrooms added by the the Iribe Center, the department has so many students that all of the classrooms in CSIC will still be in use. "The population of Computer Science majors is large enough that we will be using both buildings once the Iribe Center is completed," explained Professor Samir Khuller, Elizabeth Stevenson Iribe Chair of Computer Science. The department is doubling its space just to meet current student enrollment.

Furthermore, with the attention surrounding the economic potential of technology, the explosion of CS at Maryland is not entirely surprising. It is also not entirely unprecedented. Graduates who matriculated during the dot-com

bubble may recall a similar atmosphere of excitement around Computer Science and technology as a whole. With the addition of the Computer Science Instructional Center in 2002, "[t]here was a general sense of improvement and prosperity," said Dr. Randy Baden, who began his undergraduate career at the University in 2001. "We went from having our classes in temporary buildings to having them in CSIC and that definitely felt like it added legitimacy to the subject." There is a similar excitement now surrounding the Iribe Center.

Even as Brendan Iribe, a host of other donors, the State of Maryland, and the University are able to help address the problems of space for computer science students, the fear of problems from the last surge in majors drives the department to make the experiences of all undergraduates as meaningful as possible. Such a dramatic growth in the popularity of computer science is cause for celebration, but it has also become a source of frustration for students in increasingly large classes. These complaints are eerily familiar to faculty and staff who were present during the last surge of enrollment.

A major challenge during the dot-com bubble, according to the students at the time, was how impersonal the department became. Alum Mike Smorul, who graduated in December of 2002, mentioned how "there really wasn't a CS community or much support for undergrads beyond basic class scheduling." With so many students appearing so quickly, the department had a difficult time adjusting. At the time, there were two staff

members in the undergraduate office for 2,000 majors. The department has made a commitment to its students by increasing the numbers of undergraduate staff members. There are four full-time academic advisors, a director of the honors program and student enrichment, and an Assistant Director of Undergraduate Studies.

While the student to staff ratio for undergraduates is very much improved, there remains a higher ratio of students to professors. As of spring semester 2015, the student to professor ratio was far higher than any other department at the University of Maryland. These numbers mean that student time with professors is more limited, which is frustrating for everyone. Recently, students have voiced concerns on UMD's subreddit (a website for students to discuss goings-on) about class scheduling. Many lower level courses are larger than ever, and some are even being taught in other buildings including Marie Mount Hall in order to have a large enough space.

Students have expressed a desire for the University to hire more tenure-track professors to teach them—particularly in senior level courses. They realize how important it is to be taught by experts in a variety of fields. "I hope that in the future our department can hire more professors to teach a wider variety of classes, especially at the 400-level," said Amber Mirza, a junior computer science major and president of the Association for Women in Computing. "Because Computer Science is an ever-changing subject, and it seems like every day there is a new topic within technology, it would be useful to



learn from more experts we graduate."

By learning from past mistakes, the Computer Science department can avoid the same pitfalls from the early 2000s. "It appears the department has made quite a leap in making Computer Science much more supportive and welcoming place than it was when I was there," Mike Smorul said.

In order to help fellow students get a better handle on the subject matter, computer science students have taken on responsibilities and started new programs to ensure that other students can adjust to the demands of a program of this size. For two semesters, graduating Senior Matthew Bender held a series of lectures called "The Command Line," in which he helped students to understand the common pitfalls that they would encounter while learning to program in C for the Introduction to Systems course. Several students attended the course and thanked Bender for helping them to understand what their professors or

teaching assistants didn't have the extra time to explain in class or in office hours.

The majority of the clubs and programs that make Computer Science at Maryland so popular are student run, and the students in these organizations encourage one another to keep programming, learning, and becoming the best computer scientists possible. Many undergraduates serve as teaching assistants for courses and work tirelessly to ensure that students with less experience are able to learn how to code, construct algorithms, and not to be afraid of compilers and operating systems. Until new faculty in computer science begin arriving on campus, some gaps that arise from having a high student to professor ratio can be filled in with increased student involvement.

As the the field of computer science continues to rise in popularity, importance, and relevance to our everyday lives, so will the department--in terms of its reputation, and in the estimation of its students and alumni. While all of

the challenges from the tech bubble of the early 2000s have not been completely solved, there is a clearer understanding and awareness of the past, which will help those teaching, researching, and learning in the Iribe Center to move thoughtfully forward into the future.



DROWSY POWER MANAGEMENT

SAVING ENERGY ON ANDROID

Mobile phones consume energy even when in your pocket. While part of the phone is always awake, keeping the cell connection ready, the main processor works just like a laptop's: waking up when there's data to process or user input to handle, and lying in a "sleep" state at all other times. To handle incoming push notifications, keep bluetooth devices connected, and periodically check email, the processor often has to switch between being "awake" and "sleeping."

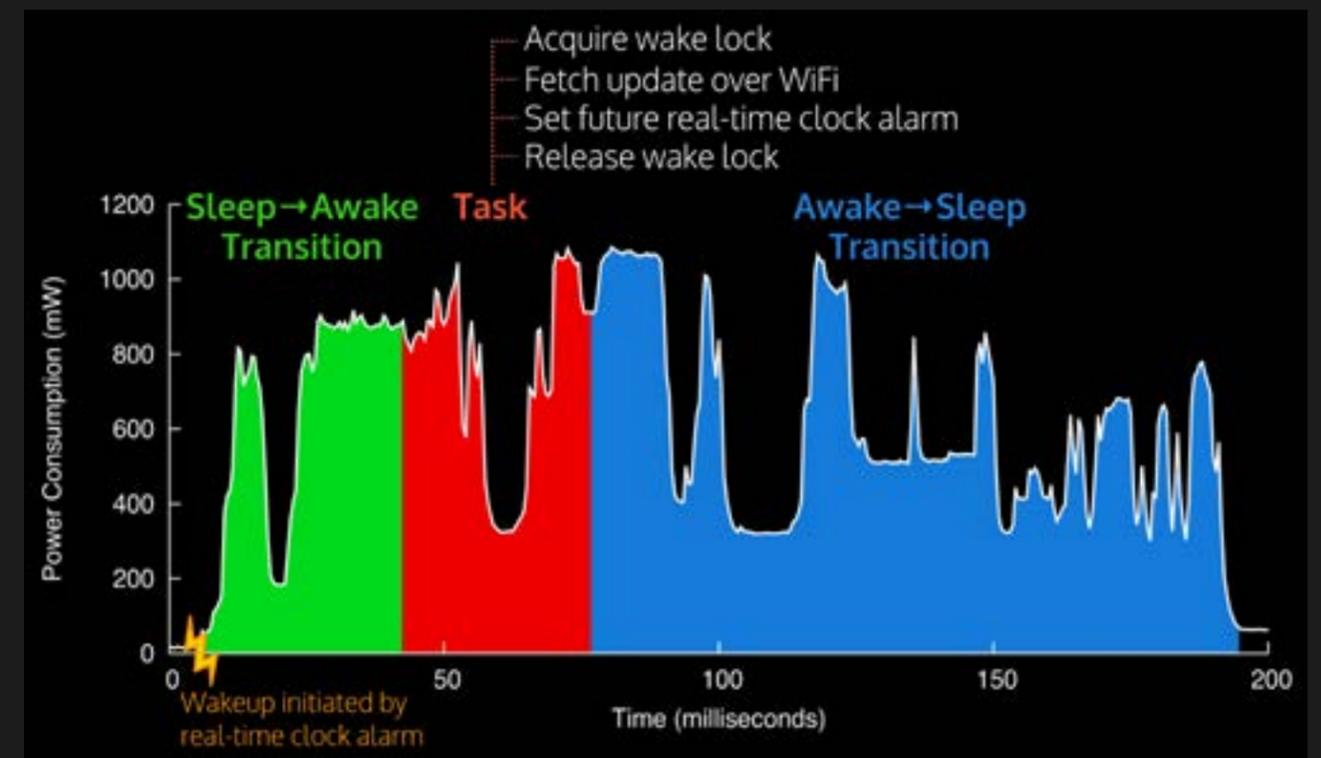
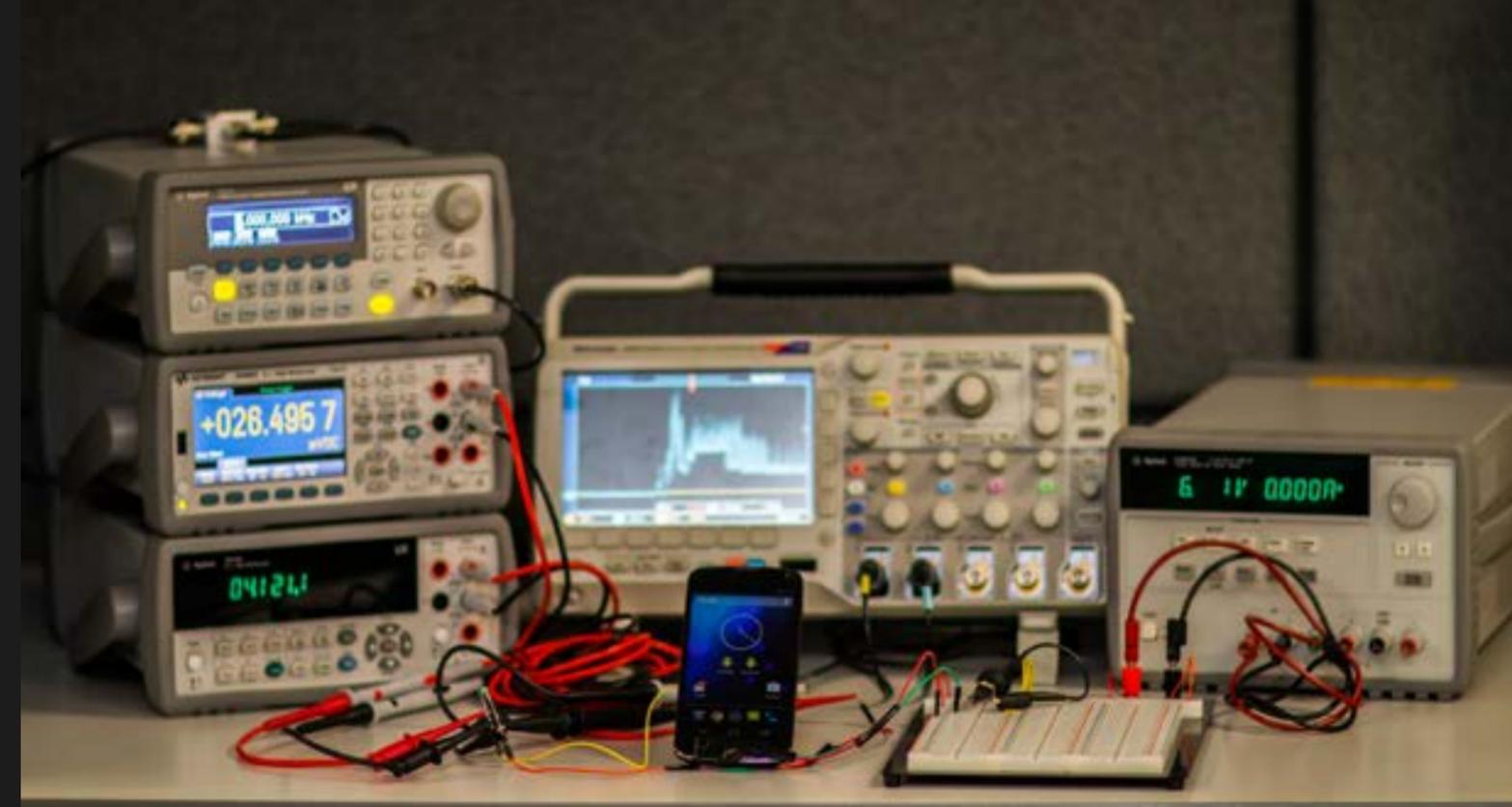
To perform these intermittent background tasks, the mobile phone must wake up from its "sleep" state and transition into its "awake" state; after completing the task, the phone can then transition back into "sleep." Although the time to transition the processor to "awake" and back is very small when compared to the duration of even the shortest interaction with the user, and the power consumed during the transition is very small compared to turning on a power-hungry display, in the context of very short background tasks that don't use the display, the transition can be 4-5 times longer than actually processing the event. Considering how often the phone awakens to check for incoming messages, the power consumed adds up.

PhD students Matthew Lentz and James Litton, along with their advisor Professor Bobby Bhattacharjee, found a way to reduce the energy that mobile applications expend

while completing this sleep-wake-sleep cycle. These three researchers have concluded that the phone does not need to be completely awake in the same way that it would have to be for longer, human-driven tasks.

Lentz, Litton, and Bhattacharjee have created a new intermediate power management state called Drowsy, which sits between the sleep and wake states. In the Drowsy state, not all processes and devices (i.e., the hardware components of a tablet or phone) are woken up; instead, only the minimal set of processes and devices are awoken in order to handle any work performed prior to returning to the sleep state. In other words, a mobile phone is raised from sleep just enough to receive a push notification or to communicate with another system before settling back into its sleep, energy saving mode.

They designed Drowsy to determine the minimal set of processes and devices needed by determining which ones are interdependent within an operating system. This design choice enables developers to use Drowsy without affecting the current version of their mobile applications. The researchers implemented Drowsy within the Android kernel and observed energy-efficiency improvements of up to 5x for common, short-lived tasks.



To read a copy of the paper visit:
http://www.cs.umd.edu/~mlentz/papers/drowsy_sosp2015.pdf

The project:
<http://www.cs.umd.edu/projects/drowsy>

GRAD SCHOOL OVER STARTUPS:

Andrea Bajcsy & Frank Cangialosi

On December 17, 2015, The Computing Research Association (CRA) announced the 2016 Outstanding Undergraduate Research award winners. Computer Science seniors Andrea Bajcsy and Frank Cangialosi both received honorable mentions for their research. Bajcsy, a Brendan Iribe Scholarship recipient, works with Professor Yiannis Aloimonos in computer vision and robotics, and Cangialosi, a Gannon-Della Torre Scholarship recipient, works with Research Scientist Dave Levin in computer networks, security, and network measurement.



In a time when most of their peers are headed to industry to work for large companies or startups around the country, Andrea Bajcsy and Frank Cangialosi are moving counter to that trend and will be starting PhD programs in computer science in the fall semester of 2016. Bajcsy is primarily interested in computer vision and robotics, and she will be attending the University of California at Berkeley starting in September. She is also a 2016 recipient of a National Science Foundation Graduate Research Fellowship. Cangialosi is interested in networks and network measurement and will be attending the Massachusetts Institute of Technology starting in September as well.

The two outstanding students agreed to sit down for an interview to talk about their research, their research advisors, the experiences that they have had at the University of Maryland in the Computer Science Department, and what they've learned while they have been here.

Both students are extremely clever, determined, and intellectually

curious. They each clearly articulate their interests and goals with excitement and ease, and look forward to the day when they can be professors themselves. When asked to give a summary of the work that they accomplished for the CRA research awards, they spoke about outside collaborators and the joys they each found by working on open problems. Even though she came from a family of computer scientists,

Andrea Bajcsy didn't want to major in the field. "When I came to UMD, I was an undecided major. I was interested in so many things, so I took classes in a bunch of different areas. It was hard for me to decide [on a major] because I liked it all," she said. Then she discovered that computer science would allow her to work on problems across several different fields, and she ultimately decided to focus on robotic perception. She does research with computer science Professor Yiannis Aloimonos, who is also the Director of the Computer Vision Laboratory. Bajcsy also credits her continuing interest in robotics to her time spent in the summer of 2015 conducting research with Professor Ronald Fearing at

University of California Berkeley in the Biomimetic Millisystems lab. Bajcsy said that working with both these professors helped her to understand how to translate specific data. "The major goals of the field are to look at sensory data and to bring meaning to it and bring it into action of the world," she said. For Bajcsy, research is exciting because, "there are problems that are open-ended and not google-able."

Frank Cangialosi, on the other hand, knew that he wanted to be a computer science major, but he was not terribly interested in research until he registered for Professor Neil Spring's CMSC 396H course, a requirement for the computer science honors program. During that course, he chose group led by Dr. Dave Levin, an Assistant Research Scientist with UMIACS. "When my group and I found that we couldn't solve our problem (detecting censorship in Tor) because we didn't have the proper tool to measure latency between Tor nodes, I approached Dave

about working on this problem more," he said. From that point forward, Cangialosi began working with Levin on this project, eventually presenting it at the ACM Internet Measurement Conference (IMC) Tokyo 2015. While working with Levin, Cangialosi has also had the opportunity to work with other networks researchers including Professor Alan Mislove of Northeastern University. The work that he did with Levin also convinced Cangialosi that research was anything but boring, and that a career in academia could be an interesting one with a variety of problems to solve. "I am someone who likes learning. A lot," he said.

When asked about what they enjoyed about working with their research advisors, Andrea Bajcsy said, "The coolest thing about working with [Aloimonos] is ideas." She praised her advisor for his openness and willing to discuss a variety of challenges in the field. "The crux of a good research problem is the problem itself," she

continued. "The hardest part is finding what is new interesting and worth spending time on. I really appreciate the insight and the discussions that I have with him because we get to think about not only what is useful for us tomorrow, but what will be useful in 20 years down the road."

For Frank Cangialosi, working with Levin also involves the constant flow of ideas. "That's the best part of working with Dave. I don't know where all of these ideas come from, but they don't stop," he said. Cangialosi praised Levin's understanding of several different subfields of computer science, and credited Levin with teaching him new things. "He always has insightful things to stay about any kind of problem and I constantly learn from him—even in an hour-long meeting," he said, meeting with him opens my mind to a bunch of different possibilities. It is impressive how he brings in that knowledge and has so many ideas."

Bajcsy and Cangialosi are the latest in a line of students from the University of Maryland to be recognized by the CRA for their research abilities, and like the winners before them, are likely to go on to illustrious careers in computer science.

LIST OF CRA WINNERS

2015: Andrea Bajcsy, Honorable Mention (advisor: Yiannis Aloimonos)

Frank Cangialosi, Honorable Mention (advisor: Dave Levin)

2013: Victoria Lai, Finalist (advisor: Dave Levin)

2012: Elissa Redmiles, Honorable Mention (advisor: Samir Khuller)

2010: Matt McCutchen, Awardee
Allison (Hoch) Janoch, Honorable Mention
John Silberholz, Honorable Mention

2008: Katrina LaCurts, Honorable Mention

2007: Jessica Chang, Honorable Mention

RAMANI DURAISWAMI

Wins University System of Maryland Award

On April 15, 2016, Professor Ramani Duraiswami (also of UMIACS) was presented with a University System of Maryland Board of Regents' Faculty Award for Scholarship, Research or Creative Activity. Each year, the UMD Board of Regents recognizes faculty in this category for their "exceptional scholarship or research that extend or deepen the bounds of knowledge or of creative activities that are recognized as innovations in the nominee's discipline."

Professor Samir Khuller, Elizabeth Stevinson Iribe Chair of Computer Science, and a faculty committee nominated Duraiswami for his creative work with Virtual Reality in sound. Khuller cited the software and hardware that Duraiswami has developed, as well as the work that he has done on hearing, the human ear, computer audition, and sound to make the virtual reality experience all the more real for users of this new and innovative technology. In his nomination letter, Khuller also mentioned that Oculus VR has licensed the software that Duraiswami's company, VisiSonics, has created.

Duraiswami and his company have been highlighted in many online publications, most recently in the Baltimore Business Journal, DCInno, and Engaget.

Duraiswami joined the Computer Science Department in 2004 and he directs research at the Perceptual Interfaces and Reality Laboratory. His primary interests include computer audition, computer vision, machine learning, and scientific computing. He joined the faculty in 2004 as an Assistant Professor after having been a Research Scientist at the University of Maryland Institute for Advanced Computer Studies. He earned his PhD from Johns Hopkins, and his B.Tech from Indian Institute of Technology Bombay.

DAN SUGARMAN:

Why I gave to the Iribe Center

When Dan Sugarman graduated with a degree in computer science in 2010, he was confident that the right place for him was the PhD program in computer science at Stony Brook University. During his time as an undergraduate, he did research projects with Professor Amitabh Varshney in graphics, and with Professor Mihai Pop in bioinformatics.

The Computer Science Department and the University gave him many opportunities. He double majored in mathematics, joined a social fraternity, and did internships including one at the Department of Commerce. He was interested in starting a company, but at the time, there were not many opportunities for students interested in tech entrepreneurship. He did find however, that the department mentored and supported many students who were interested in research and graduate school, so he decided to focus on that. He really enjoyed working with this research mentors, and decided that graduate school was the next logical step.

In the middle of his PhD program, he realized that more than anything, he wanted to start a company. A friend of his from his University of Maryland days approached him with an idea for a project that makes trade with China easier, and Zentail was born. "We got into Y-combinator, and changed our ideas a few times and then settled on efficient ways to connect buyers and sellers of products," he said. Zentail is an all-in-one ecommerce technology platform for product information, inventory, and order management. Sugarman has been very supportive of entrepreneurship in the Computer Science Department. He was instrumental in bringing Y-combinator partners to give a presentation to student entrepreneurs during the fall semester of 2015.

It was this continued connection to the Department and the University that encouraged Sugarman to give to the Iribe Center. "I really enjoyed my time at Maryland," he said, "[and] I have always wanted to give back. I want to make sure that other students, who are interested in entrepreneurship like me, have a chance to learn and to try this while they are in college." Sugarman also mentioned that this building will do a lot for the community of computer science students who are interested in technology and entrepreneurship. "The timing wasn't fantastic," said Sugarman. He thought it would be easier to give when if and when he exits Zentail. "But it didn't work out that way. And opportunity doesn't come around like this very often. My time is as important as a donation, but it's important to put your money where your mouth is and show your support."

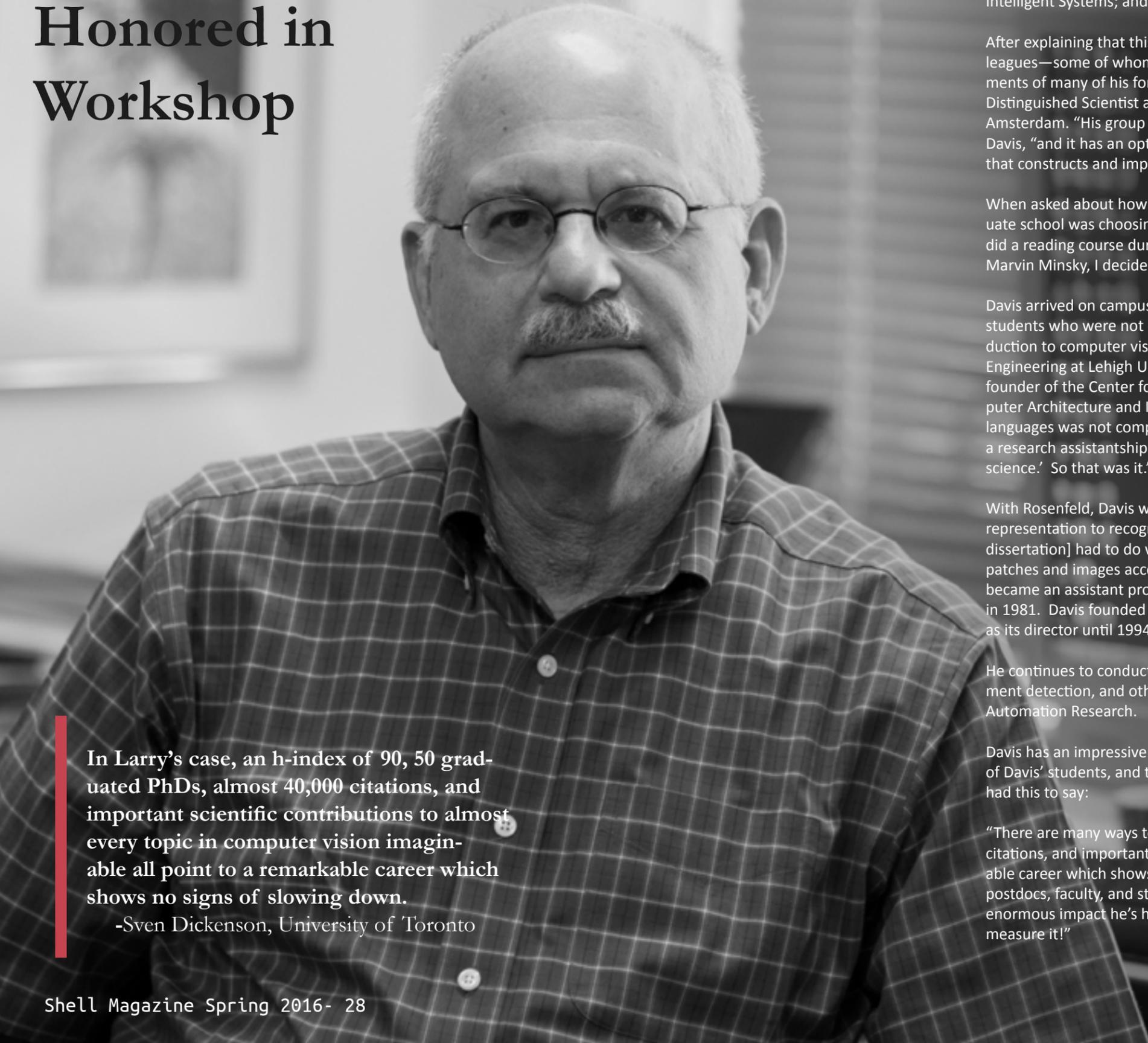
I really enjoyed my time at Maryland, and I have always wanted to give back.

Dan Sugarman ('10), CEO, Zentail



Larry Davis

Honored in Workshop



In Larry's case, an h-index of 90, 50 graduated PhDs, almost 40,000 citations, and important scientific contributions to almost every topic in computer vision imaginable all point to a remarkable career which shows no signs of slowing down.

-Sven Dickenson, University of Toronto

From June 10-12, 2015, Professor Larry Davis was honored at a workshop named after him, which was held in Cape Cod, Massachusetts. Taking place after the Computer Vision and Pattern Recognition (CVPR) Conference in Boston, attendees gave papers and presentations in Davis' honor. Many of the presenters at the conference were Davis' long time colleagues, collaborators, and friends, several of whom are also former students and post-docs. Computer Science Affiliate Professor and Chair of the Department of Electrical and Computer Engineering Rama Chellappa co-organized the conference with Yaser Yacoob, Associate Research Scientist for UMIACS; Michael Black, Director of the Max Planck Institute for Intelligent Systems; and Sven Dickinson, Professor of Computer Science at the University of Toronto.

After explaining that this conference in no way heralds retirement, Davis said that it was nice to see so many of his colleagues—some of whom had come from as far away as China—to give a paper in his honor. He recalled the accomplishments of many of his former students who were in attendance. He mentioned Professor Darius Gavrila (PhD '96) who is a Distinguished Scientist at Daimler R&D in Ulm, Germany, and is also a Professor of Computer Science at the University of Amsterdam. "His group is responsible for a lot of the computer vision-based safety aids in the new Mercedes Benz," said Davis, "and it has an option that will avoid pedestrians." He also mentioned another of his students who leads a group that constructs and implements decorative LED-lighting for opera houses, cityscapes, and the Empire State Building.

When asked about how he started working in computer vision, Davis recounted that his first major decision about graduate school was choosing between a PhD in math at NYU or a PhD in computer science at the University of Maryland. "I did a reading course during my senior year in college [at Colgate University]. Because I liked and understood the books by Marvin Minsky, I decided to go into the field," he said.

Davis arrived on campus as students were being drafted into the Vietnam War, and he counted himself fortunate among students who were not chosen to fight in the conflict, and who could complete graduate degrees. He attributed his introduction to computer vision to Roger Nagel (PhD '76) who is now the Harvey Wagner Professor of Computer Science and Engineering at Lehigh University. Through Nagel, Davis met world-renowned researcher in computer image analysis and founder of the Center for Automation Research, Professor Azriel Rosenfeld. "I was a TA, and I had done research in Computer Architecture and I really didn't like that," he said. He recounted that his master's thesis in software programming languages was not compelling to him either. "[T]hen Roger introduced me to his advisor, Azriel Rosenfeld, who offered me a research assistantship on the spot. So I thought, 'What do I have to lose? He's the brightest light on campus in computer science.' So that was it."

With Rosenfeld, Davis wrote a thesis on low-level recognition problems representing the shape of objects and using that representation to recognize instances of objects in pictures. "It is very simple by modern standards," he said. "Also, it [the dissertation] had to do with how you represent the texture of a surface with a texture model and then classify surface patches and images according to the kind of material they represent based upon textural appearance." From there, Davis became an assistant professor at the University of Texas in 1977 until returning to the University of Maryland as a professor in 1981. Davis founded the University of Maryland Institute for Advanced Computer Studies (UMIACS) in 1985 and served as its director until 1994. He also served as the Chair of Computer Science from 1999-2012.

He continues to conduct research in computer vision, and artificial intelligence, with a host of work in recognition, movement detection, and other topics. And now, many years after being a PhD student, he is now the director of the Center for Automation Research.

Davis has an impressive research and teaching career so far, and it is only bound to continue. When asked about being one of Davis' students, and then becoming his friend and collaborator, Professor Sven Dickinson of the University of Toronto had this to say:

"There are many ways to measure a research career. In Larry's case, an h-index of 90, 50 graduated PhDs, almost 40,000 citations, and important scientific contributions to almost every topic in computer vision imaginable all point to a remarkable career which shows no signs of slowing down. An equally impressive indicator of success is the number of students, postdocs, faculty, and staff he's mentored in his career. In our celebration on the Cape, it was really inspiring to see the enormous impact he's had on the careers and lives of so many people -- a fantastically rich career any way you want to measure it!"

Letter from Abroad

Dear UMD CS,

My time at University of Edinburgh is almost finished. I have one more week of classes, two weeks of spring break, one week of revision, and a month of exams. I feel homesick, but I also feel sad about leaving. It's weird because at the beginning of the semester I wasn't the happiest, but now, even while still being here, I feel nostalgic.

The start was a bit rough because I had a preconceived notion of what studying abroad would be like. I thought I'd make really close friends quickly. The only reason I thought this was because of my older sister's study abroad experience in Australia. It turns out I didn't even know everything about her experience before coming here.

I guess that's the big thing to realize, you don't know everything about another person's experience, so you shouldn't necessarily base your ideas on what they say. What actually happens in the moment may be entirely different than the ideas you have in your head; I know they were for me. My experience has been different because it's mine. It's based off of what I do, not based off of what I thought I would be doing. Another big thing I learned is just go do things. Be a bit spontaneous. Why wait for people? Why plan everything? Sure it's more fun with friends and I am someone who likes having a plan, but if it's something you really want to do and the opportunity arises, you're going to regret it if you wait. Maybe have an idea of what's going to happen, but go ahead and jump in. I did when I signed up for the hillwalking club by myself. I didn't really know what I was getting myself into; hiking in the Highlands is nothing like hiking in the United States. It ended up being one of the hardest things I've ever done, but it was also one of the most amazing and memorable experiences I will probably ever have.

I know it's sort of cliché, but to make memories and have a full experience, it really is up to you. Don't get stuck because of ideas in your head, instead take action.

See you in a few months,
Angela Kuriacose



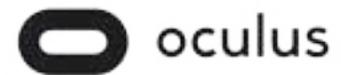
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