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ODYSSEY

COLLEGE OF
COMPUTER, MATHEMATICAL,
AND NATURAL SCIENCES

NOW YOU SEE IT

WHAT HAS RESEARCHERS LOOKING AND SEEING IN NEW DIMENSIONS?
DISCOVER THE ANSWER IN THE PATTERN ABOVE.



UNIVERSITY OF
MARYLAND



ODYSSEY

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Department of Biology (formerly Zoology)
Department of Cell Biology and Molecular Genetics (formerly Microbiology)
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Odyssey is published twice a year for alumni, friends, faculty, staff and students of the College of Computer, Mathematical, and Natural Sciences. Your comments and feedback are welcome. Please send them to abbyr@umd.edu.

Dear Friends,

As you read this letter, another exciting and highly productive semester has come to a close. This spring, the College of Computer, Mathematical, and Natural Sciences launched a number of new initiatives, received national recognition for its students and programs, and awarded more than 1,100 degrees to future scientific leaders. I am proud that our graduate programs were once again highly ranked by U.S. News & World Report—with six specialties ranked in the top 10, and 13 programs and specialties included in the top 25. You can read more about our rankings and other college activities beginning on page 16.

One of our newest programs, Terrapin Teachers, was introduced in February and promises to add to the ranks of qualified science, technology, engineering and mathematics (STEM) teachers throughout the region. The joint program with the College of Education enables undergraduate students in STEM fields to receive both a subject-matter degree and teaching certification in four years. The program replicates the national UTeach program, which was created by UMD Senior Vice President and Provost Mary Ann Rankin in 1997 when she was at The University of Texas at Austin.

Another exciting initiative was announced in March. In partnership with longtime corporate supporter Lockheed Martin, we launched the new Quantum Engineering Center, where researchers in our college plan to develop a quantum computing platform that has the potential to transform research in areas ranging from drug discovery and communications to logistics. The Quantum Engineering Center will be located in the

new Physical Sciences Complex. In April, we celebrated the grand opening of the building, one of the nation's premier research facilities and one of the largest construction projects in university history.

We also celebrated the achievements of our students who earned nationally competitive awards this spring: three juniors received Goldwater Scholarships; another junior, who was a 2013 Goldwater Scholarship winner, was selected as a Truman Scholar; two undergraduates received Hollings Scholarships from the National Oceanic and Atmospheric Administration; and a total of 16 students and alumni received National Science Foundation Graduate Research Fellowships.

"Big data" is changing the discovery process across a wide range of disciplines. In this issue, we present a snapshot of big data research throughout the college and highlight alumni who are making their mark in the big data field. We also report on a professor's unique trip this winter to Guam to gather data on our atmosphere.

As always, we thank you—our alumni and friends—for your collective support, which moves us ahead and ensures that our college remains at the forefront of research and education.

A handwritten signature in blue ink that reads "Jayanth R. Banavar".

Jayanth Banavar
Dean
College of Computer, Mathematical,
and Natural Sciences

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ON THE COVER

A 3D STEREOGRAM, MADE FROM A REPEATING PATTERN OF *ARABIDOPSIS*, A SMALL FLOWERING PLANT, REVEALS THE THEME OF THIS ISSUE OF ODYSSEY. READ ABOUT BIG DATA RESEARCH IN THE FEATURE, STARTING ON PAGE 4. *ARABIDOPSIS* PHOTO BY CAREN CHANG.

TIPS ON VIEWING STEREOGRAMS: BRING THE IMAGE CLOSE TO YOUR EYES, UNTIL YOU TOUCH IT WITH YOUR NOSE. NEXT, WHILE STARING AT THE END OF YOUR NOSE, SLOWLY PULL THE IMAGE AWAY FROM YOUR FACE. AT SOME POINT, YOU WILL SEE THE HIDDEN WORDS.

BRENDAN IRIBE (FRONT RIGHT) GIVES ADVICE TO BITCAMP ORGANIZERS AT UMD'S FIRST HACKATHON.

NOW YOU SEE IT



AMITABH VARSHNEY (RIGHT) SHOWS GRADUATE STUDENTS SUJAL BISTA (FAR LEFT) AND PATRICIA SAZAMA BRAIN IMAGES THAT COULD IMPROVE DIAGNOSIS OF MILD TRAUMATIC BRAIN INJURY. IN COLLABORATION WITH RAO GULLAPALLI AND JIACHEN ZHUO AT THE UNIVERSITY OF MARYLAND SCHOOL OF MEDICINE, THE TEAM IS USING NEW METHODS FOR BIG DATA ANALYSIS AND VISUALIZATION, COMBINED WITH ADVANCED IMAGING TECHNIQUES, TO MAP SUBTLE CHANGES IN GRAY- AND WHITE-MATTER BRAIN FIBERS NOT VISIBLE IN TYPICAL MRI SCANS.



Unexpected Patterns and Connections Fuel Data-driven Discoveries

*By Nancy Grund
Photo by John T. Consoli*

Just as the invention of the microscope opened new worlds, big data is unveiling the next frontiers for scientific discoveries. “Drawing from multiple sources of information, data can be fused to provide a big picture through the ‘macroscope,’ and researchers can zoom in on different levels of detail,” says Amitabh Varshney, UMIACS director and computer science professor.

Within and across their areas of expertise, CMNS researchers are making order out of big data chaos as their research pinpoints meaningful patterns that could move them closer to the next big breakthrough.

The Potential to Improve Lives

The potential of big data to improve and save lives is most evident in health care and the biological sciences. The amount of health-related data is expanding exponentially, and the latest data collection and analysis techniques are allowing researchers to make unanticipated connections that could translate into new ways to treat and cure disease.

Varshney is developing visualization techniques to illustrate stem cell division, in collaboration with Antonio Cardone, UMIACS assistant research scientist; Peter Bajcsy, National Institute of Standards and Technology (NIST) computer scientist; and Carl Simon, NIST biologist. “Visualization can turn complex sets of data that are too big, too small or too scattered into infographics or diagrams that often reveal unexpected patterns and connections,” Varshney explains.

The NIST researchers are documenting the entire stem cell division process, with each imaging experiment generating some 700 gigapixels of data. Varshney is creating software to display the images and differentiate by color the various textures of different parts of the cell, a process called texture-driven recolorization. “The visualization tool allows researchers to characterize individual cell properties and interactions with other stem cells,” says Varshney. If conditions and patterns that promote cell growth can be identified, those conditions could be replicated in the laboratory to create new cells. “Those new cells could ultimately replace dying cells to restore tissue or organ function. That is a key goal of regenerative medicine,” adds Varshney.

If Varshney has his way, physicians could one day make treatment decisions in an augmented reality setting surrounded by wall-size images of MRIs, X-rays and other medical data. Varshney, who began his career designing three-dimensional simulations for military applications, plans to create an augmentarium, a virtual-reality research environment that combines high-performance computing with advanced visualization techniques. The augmentarium is the latest technology enhancement proposed for UMIACS, which currently houses an 11-foot by 7-foot display wall consisting of 25 separate tiles that can project images with 25 times more detail than the average photograph.

Mihai Pop is using big data to accelerate discovery in the field of metagenomics—a discipline that involves studying the genetic material of microorganisms. His recent research focuses on the thousands of microbial communities that live in our bodies. As part of the National Institutes of Health-funded Human Microbiome Project—a study of some 10,000 species of microbes that collectively have more than 8 million genes—a lack of patterns caught researchers’ attention. “We were surprised we could not identify a core human microbiome that was universal in all patients,” relates Pop. “Big data has revealed the tremendous diversity among people, which confounds any simplistic



A computer scientist and his team of students at the University of Maryland analyze hundreds of thousands of gene sequences as part of the largest, most comprehensive study of childhood diarrheal diseases ever conducted in developing countries.

The study, which is a collaboration with the University of Maryland School of Medicine’s Center for Vaccine Development, includes 22,000 children in regions of Asia and Africa. The researchers hope to detect a pattern that holds clues to lifesaving medical treatments for diarrhea, the second-leading killer of children worldwide.

“The beauty of big data is that it could help us identify new bacteria or existing bacteria that we never suspected were associated with diarrheal disease,” says Mihai Pop, associate professor of computer science with an appointment in UMD’s Center for Bioinformatics and Computational Biology. “As you continue to work with the data and patterns emerge, one set of findings can lead to another, such as the discovery of completely new pathogens.”

Pop is just one of many researchers in the College of Computer, Mathematical, and Natural Sciences (CMNS) who is harnessing the power of “big data”—a popular term used to describe the massive amount of information that is acquired, stored, searched, shared, analyzed and visualized—in the quest for answers to some of the world’s most complex problems. Using the latest computational tools to extract the most important pieces of information from these huge data sets and applying sophisticated analytic techniques, researchers are discovering patterns and making unexpected connections in virtually every scientific discipline.

Pop’s work is one example of how big data is turning research on its head—revealing patterns before hypotheses are made. “In the past, researchers had a theory or hypothesis and suspected certain patterns or trends. We used data to confirm those hypotheses. Today, we may not know exactly what we are looking for, but we can use data to make new discoveries as theories and patterns emerge,” says Joseph JaJa, professor of electrical and computer engineering with an appointment in the University of Maryland Institute for Advanced Computer Studies (UMIACS). JaJa also serves as director of cyberinfrastructure for the National Socio-Environmental Synthesis Center (SESYNC), which is funded through a National Science Foundation (NSF) grant to UMD.

approaches aimed at understanding the differences between healthy and sick people.” This finding is changing how studies are organized, with a focus on tracking individuals across time to eliminate some of the variability in observations and make it easier to uncover new insights, according to Pop.

When it comes to exploring complex biological questions, sometimes the smallest scientific systems can hold important clues. “Insects are great model hosts for understanding the evolution of pathogens and pathogenesis,” says Distinguished University Professor of Entomology Raymond St. Leger, who is sequencing 13 different genomes—each providing 30 million base pairs—of *Metarhizium*, tiny fungi that can penetrate directly into insects. St. Leger is studying the genomic structure of these fungi to identify genetic differences and how novel pathogens emerge. “The more genomes you include, the more geometrically difficult it is to analyze and compare as you mix and match,” explains St. Leger. His laboratory is also interested in re-engineering these fungi to produce antimalarial proteins that could be transferred to a mosquito, thereby restricting its ability to carry and spread malaria. “We need lots of comparative data to find specific patterns in gene expression and determine when and where we can tweak the pathogens so they permanently suppress the malaria-carrying mosquito.”

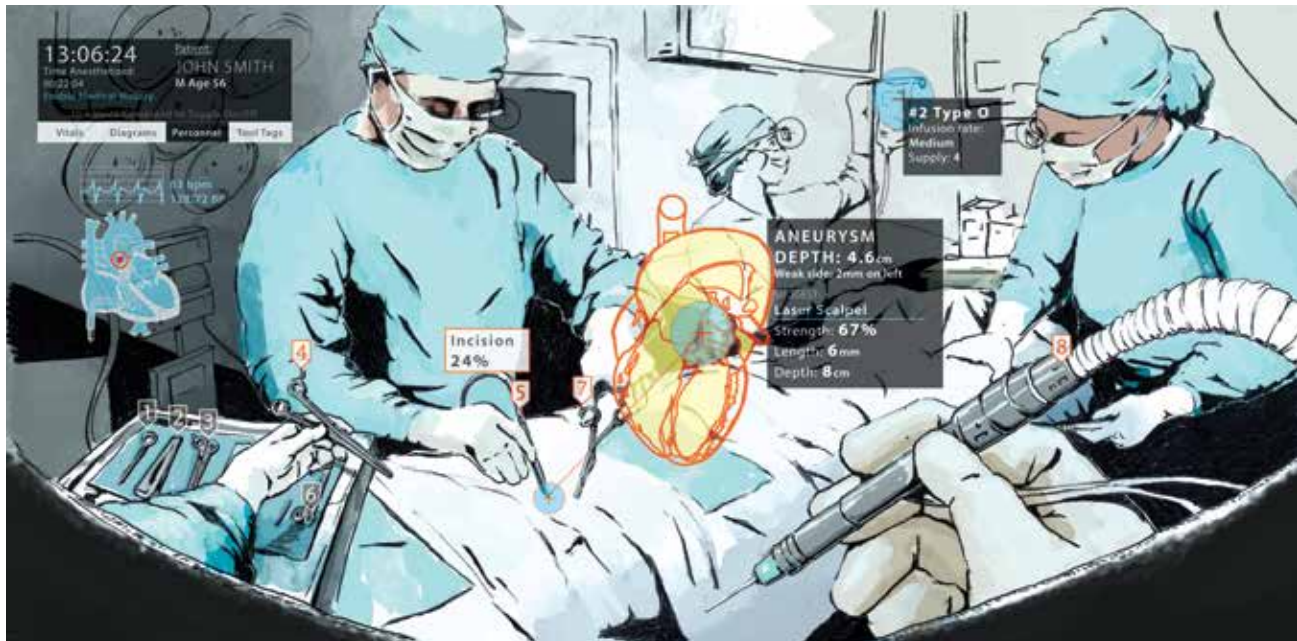
In her work on plant signaling, Caren Chang, professor of cell biology and molecular genetics, has turned to another small system that has generated large amounts of data and been cited in thousands of research papers worldwide: the plant model *Arabidopsis thaliana*, the first complete plant genome

to be sequenced. “I am trying to understand the hundreds of genes and proteins that signal ethylene, the fruit-ripening hormone that also plays a role in many aspects of plant growth and development, including protection of plants from environmental stresses, such as drought and insect attack,” says Chang.

To advance her work and leverage prior research, she is collaborating with Louisa Raschid, professor in the Smith School of Business with appointments in UMIACS and computer science, who applied a data retrieval tool she developed with collaborators at the University of Iowa to thousands of published works on *Arabidopsis* to extract gene-related sentences and terms. The team experienced an “aha” moment when Raschid called Chang to verify patterns about certain genes. “Caren was surprised at my level of knowledge. I was simply looking at the patterns in the data that made it easy to review the literature without the genetic expertise,” says Raschid. Because *Arabidopsis*

“Today, we may not know exactly what we are looking for, but we can use data to make new discoveries as theories and patterns emerge.”

—JOSEPH JAJA



AN AUGMENTED REALITY SETTING COULD HELP PHYSICIANS MAKE REAL-TIME DECISIONS IN THE OPERATING ROOM, AS DEPICTED IN THIS ARTIST'S RENDERING. SUCH SETTINGS COULD PROVIDE NOVEL SIMULATION AND TRAINING ENVIRONMENTS FOR FUTURE DOCTORS AND SURGEONS.

contains numerous genes implicated in human diseases—such as cancer and Alzheimer’s disease—understanding its genes offers clues to other living organisms.

Across all disciplines, big data techniques can help researchers quickly review reams of published research in their fields and determine how their work adds to accepted knowledge. Computer Science Associate Professor Hal Daumé III is developing advanced data analysis tools to process the written word and make basic search decisions on language quickly, using higher-level linguistic analysis only when needed—a technique called learned dynamic prioritization.

The tools can be used to identify future trends in science and technology, by coupling the way scientists discuss ideas with analyses of patterns in standard sources, such as academic citations.

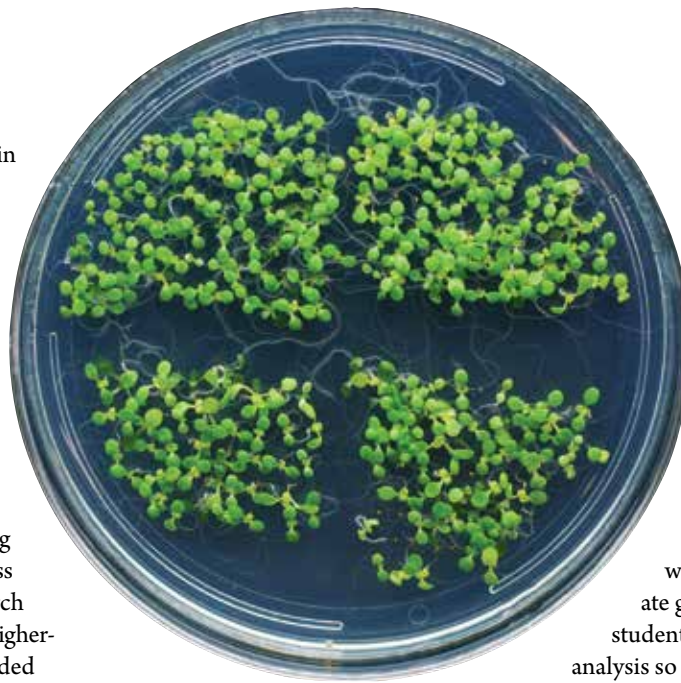
Daumé adds, “We are developing models that can dynamically decide how much information a user needs and when to look further. Our technique is as accurate as previous approaches but up to 10 times faster because less time is spent on the more obvious analyses, freeing up time for the difficult cases.”

Big Data Changes the Panorama of Land, Sea and Sky

Exciting new facilities and greater access to national and international experimental data sets are providing researchers in the physical and environmental sciences more resources to inform their work.

NSF’s largest investment in studying the solid-earth sciences has already yielded some 65 terabytes of data—or more than 26 billion single-spaced typewritten pages of information—and adds another terabyte, on average, every six weeks. The EarthScope Facility network of 1,600 seismometers is generating voluminous amounts of data as it measures ground vibrations from stations in all 48 contiguous states, Alaska and Puerto Rico, covering 3.8 million square miles.

“There is not a seismologist in the world who has not used this data,” says Geology Assistant Professor Ved Lekic. “It has revolutionized our ability to detect and image structures in the earth’s interior and has increased data availability a hundred-fold.” Lekic and his students are using recordings of ground vibrations to detect the scattering of



ARABIDOPSIS THALIANA WAS THE FIRST PLANT GENOME TO BE COMPLETELY SEQUENCED AND IS CITED IN TENS OF THOUSANDS OF RESEARCH ARTICLES.

seismic waves across the base of the North American tectonic plate.

They also develop methods to more accurately and cost-effectively analyze those recordings to determine the shapes of seismic waves as they pass through structures below the earth’s surface.

Lekic’s research is funded in part by a recent NSF Early Career Faculty Development Program award, which will also support an undergraduate geology program. “We want to give students experience with data collection and analysis so they can take full advantage of the wealth of massive data sets gathered around the world,” notes Lekic.

Data drawn from satellite observations are the basis for much of Atmospheric and Oceanic Science Professor Rachel Pinker’s work on radiative fluxes, the electromagnetic radiation received from the sun or emitted from the atmosphere and/or the earth’s surface. Pinker’s work explores the variability in these fluxes, which could dramatically affect the climate system and the water cycle.

In collaboration with a team of hydrologists at Princeton University and the University of Washington, Pinker is using her expertise to help build Earth System Data Records for the global terrestrial water cycle, a task that requires storing and analyzing information from all available geostationary and polar-orbiting satellites from the early 1980s to the present, representing some 100 terabytes of information. In another joint effort, this one with U.S. and French scientists, Pinker is using extensive satellite data to study radiative fluxes and turbulent (sea-air) fluxes over the oceans, focusing on the impact of aerosols. “This information can improve estimates of the amount of heat stored in the oceans and can add to the body of knowledge on weather patterns, including hurricanes and droughts,” says Pinker.

Astronomy Professor Lee Mundy is eager to tap into a new source of big data based in Chile. In a project funded by the National Radio Astronomy Observatory and the NSF, Mundy will have access to a flood of data from the new Atacama Large Millimeter/submillimeter Array (ALMA). “The primary output will be large data cubes—images with thousands or tens of thousands of planes of information about the structure, movement and chemical composition of the material that

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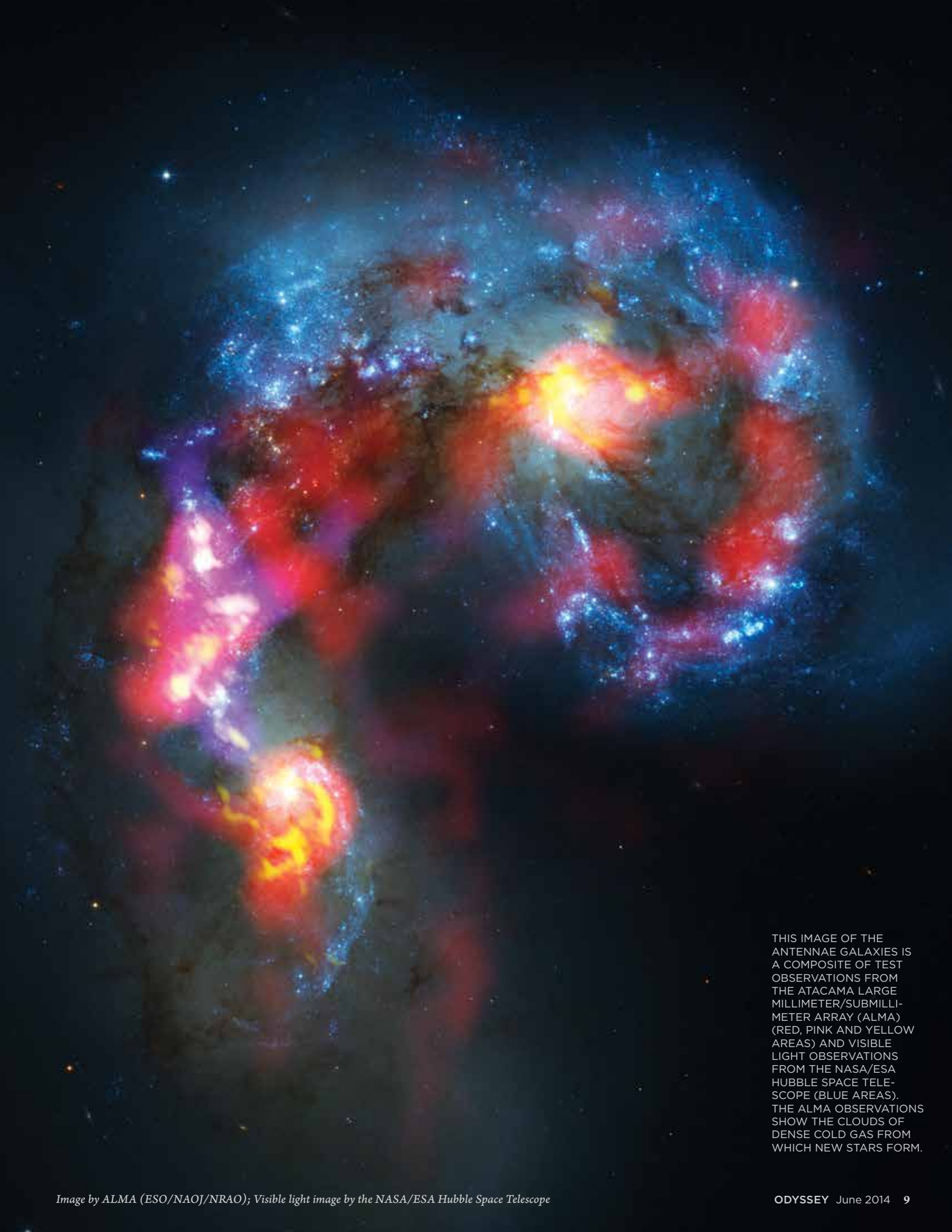
EYTAN RUPPIN

Computational Biology Expert Joins CMNS

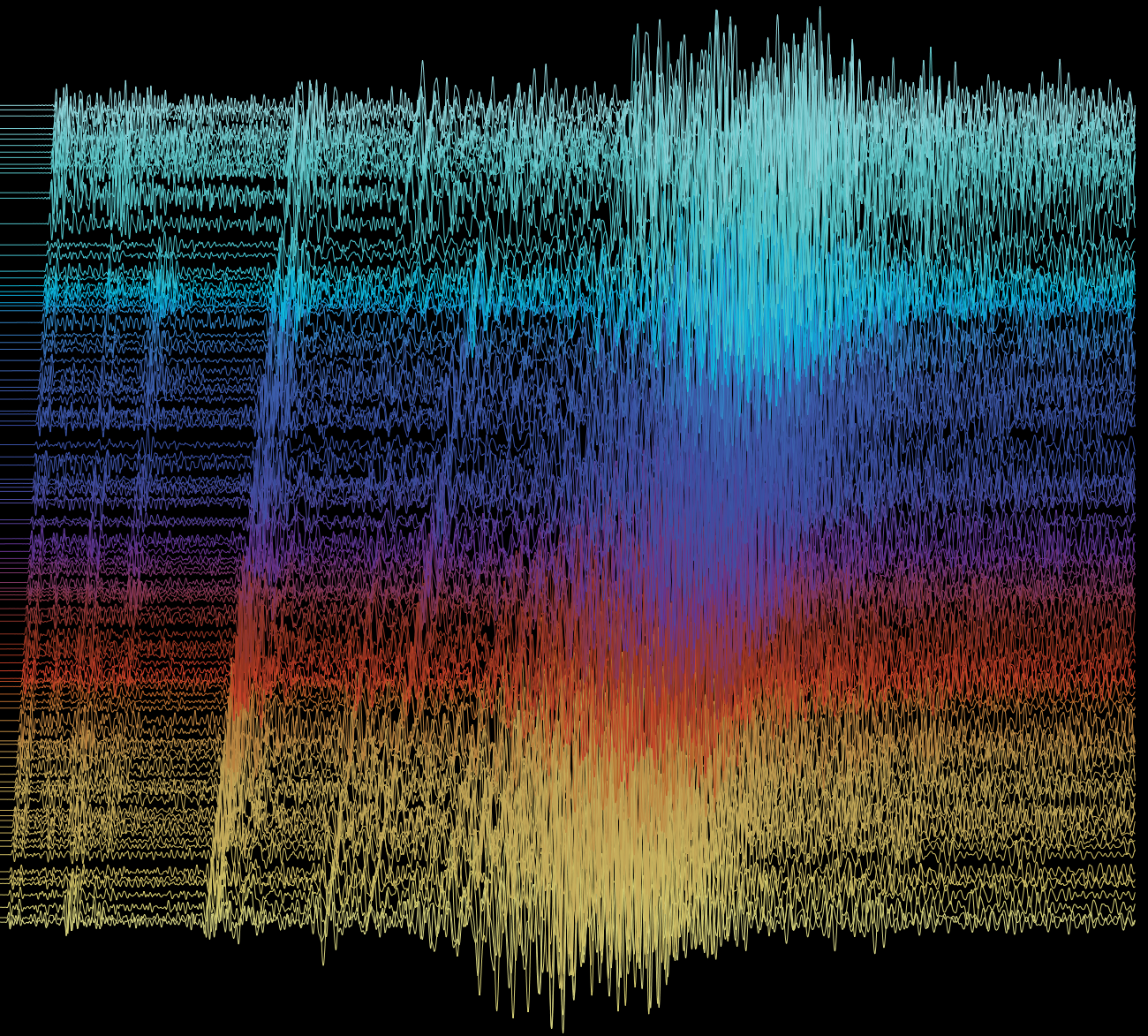
Eytan Ruppin will join CMNS this summer as director of the UMIACS-based Center for Bioinformatics and Computational Biology (CBCB). “The CBCB is a unique multidisciplinary center of excellence in computational biology,” says Ruppin, who is currently a professor in computer science and medicine at Tel Aviv University. “I look forward to enhancing the interactions and collaborations between the center and systems biology experimental groups across the UMD campus and the National

Institutes of Health to maximize the impact of our research.”

Ruppin earned an M.D./Ph.D. from Tel Aviv University in 1993 before joining UMD’s Department of Computer Science as a postdoc. He is widely recognized for his research in neural modeling of brain disorders and computational systems biology. His current work focuses on the construction and analysis of computational models of metabolic alterations on a genome-wide scale that occur during the aging and cancer processes.



THIS IMAGE OF THE ANTENNAE GALAXIES IS A COMPOSITE OF TEST OBSERVATIONS FROM THE ATACAMA LARGE MILLIMETER/SUBMILLIMETER ARRAY (ALMA) (RED, PINK AND YELLOW AREAS) AND VISIBLE LIGHT OBSERVATIONS FROM THE NASA/ESA HUBBLE SPACE TELESCOPE (BLUE AREAS). THE ALMA OBSERVATIONS SHOW THE CLOUDS OF DENSE COLD GAS FROM WHICH NEW STARS FORM.



Big Data Game Changers



STEVE ARMENTROUT

Steve Armentrout, Ph.D. '94, computer science, has been a leader in big data for nearly two decades. "The world has caught up with our company. We have always been ahead of the curve in terms of modeling and data analytics," says Armentrout, who is founder and CEO of Parabon Computation. "We began designing solutions to solve data-heavy and computer-intensive problems 15 years ago." Along the way, Parabon generated two patents for grid computing technologies, which harness

computers' unused processing cycles in a network to solve problems too intensive for a stand-alone computer. With spinoff company Parabon NanoLabs, Armentrout has spent time building high-performance computing solutions for problems involving DNA. "We are developing a new class of nanopharmaceuticals and advanced forensic tools made possible by recent advances in DNA sequencing, processing and manufacturing technologies," says Armentrout. Parabon's latest initiative, ComputeAgainstAlzheimers.org, uses crowdsourced computing capacity to understand the genetic underpinnings of Alzheimer's disease.



FATMA OZCAN

Since graduating from UMD, Fatma Ozcan, Ph.D. '01, computer science, has worked as a research staff member at the world-renowned IBM Almaden Research Center, which boasts a rich history of data breakthroughs that include the distributed relational database, the first data mining algorithms and innovations in data storage technology. She is working on integrating the data warehouse and Hadoop systems. Hadoop is open-source software that

stores enormous data sets across distributed clusters of servers and runs analysis applications in each cluster. "I am exploring ways to leverage the best of both of those worlds," explains Ozcan, who is also working on a project that could transform IBM's big data portfolio. "The XAP (eXtreme Analytics Platform) project explores and extends Hadoop as an enterprise platform for large-scale enterprise analytics," says Ozcan. "We are exploring ways for more efficient structured and semi-structured data processing."

contributes to the formation and evolution of galaxies, stars and planetary systems,” says Mundy. “In the old days, we would get a few cubes with a few hundred planes that we could examine by eye. It is just impossible for the human brain to process the terabytes of information coming from ALMA.”

Mundy is working with Amitabh Varshney to apply computer science techniques to this astronomy data. “For instance, using an established computing technique, researchers can analyze the data cubes according to a specific set of criteria, then focus on the most important features. Next, the computer can be directed to find these features in a large set of data cubes, display the results and further refine the features selected,” explains Mundy.

Back on the ground, SESYNC postdoctoral fellow Mary Collins is using big data sets to determine whether the country’s major industrial polluters are contributing to pollution disproportionately in poor and minority communities. In a cross-disciplinary collaboration, Collins is working with Joseph Jaja and Ian Muñoz, scientific programmer at SESYNC, to cross-reference many years of data from the Environmental Protection Agency’s Toxic Release Inventory with U.S. Census Bureau data. The team is examining the inventory’s records of nearly one billion chemical releases from industrial facilities across the continental U.S. and data on population characteristics—primarily race, income and education—from some 8 million U.S. census blocks.

“Computer science techniques from machine learning, statistics and visualization enable researchers to explore many ideas at once and interact with large-scale, spatio-temporal data—over a period of time in various locations—while testing different hypotheses,” reports Jaja. The next step: substantially enlarge the current study and analyze up to 30 years of data to gain deeper insight into the relationship between toxic releases from industrial plants and demographics.

“Big data, in and of itself, is not really of any value at all. In the end, discovery comes from finding the small nugget of information that is most important to the user.”

—LOUIQA RASCHID

FULL SEISMIC WAVEFORMS CONTAIN A WEALTH OF INFORMATION THAT CAN BE ANALYZED TO INFER PROPERTIES AND STRUCTURES BENEATH THE SURFACE OF THE EARTH.



DJ PATIL

Data can be used to solve the world’s big problems and also some of life’s more mundane problems, according to DJ Patil, Ph.D. ‘01, applied mathematics. Patil is vice president of product at RelateIQ, a big-data startup company that uses data to automate relationship tracking. “People have underestimated the impact of data, and we want individuals to use big data as a weapon to solve many of the problems associated with managing professional relationships,” says Patil, who is the

former head of data products and chief data scientist at LinkedIn. Using data and algorithms, RelateIQ automatically tracks and analyzes the day-to-day interactions that drive business relationships, such as contact reports, sales calls and daily meetings, and generates real-time insight into workflow patterns. “This application will help people work together more efficiently and can revolutionize sales team management,” says Patil, who was selected as a 2014 World Economic Forum Young Global Leader.



DAVID BADER

Recognized as a “rock star” of high performance computing by *InsidePC* in 2012 and one of *HPCwire*’s People to Watch in 2012 and 2014, David Bader, Ph.D. ‘96, electrical engineering, was recently selected to chair the School of Computational Science and Engineering at the Georgia Institute of Technology. His big data experience rests in the design and analysis of parallel and multicore algorithms for real-world applications, including computational

biology and genomics, and massive-scale data analytics for government and industry projects. Bader attributes much of his success to the mentoring he received from his doctoral adviser Joseph Jaja, a professor in electrical and computer engineering, UMIACS and SESYNC. “Professor Jaja directed me to interesting real-world problems and encouraged me to think about the significance of my role in the world,” recalls Bader.

Higgs Boson Data Moves to UMD's New Cyberinfrastructure Center



BIG DATA GENERATED BY THE COMPACT MUON SOLENOID PARTICLE DETECTOR, SHOWN HERE, IS STORED AND PROCESSED IN THE NEW UMD CYBERINFRASTRUCTURE CENTER.

There are few data sets bigger than those collected by the Large Hadron Collider (LHC), the world's largest and most powerful particle accelerator housed at CERN near Geneva, Switzerland. Some 50 researchers at UMD, including graduate and undergraduate students led by Physics Professors Drew Baden, Sarah Eno, Nicholas Hadley and Andris Skuja, worked with the CMS (Compact Muon Solenoid) particle detector as part of the project that eventually led to the discovery of the Higgs boson particle, the elusive subatomic particle that helps to explain how particles acquire mass.

The UMD team, along with thousands of scientists worldwide, analyzed massive amounts of data generated by the experiment—data that far exceeds the contents of all the books in the Library of Congress. “It took about two years for us to capture the data on the Higgs boson from the LHC and two years to confirm it,” explains Hadley. “Our next steps will be to collect new data and look for any additional properties the particles may demonstrate. Any subtle deviations from our predictions of particle behavior will point the way to new scientific breakthroughs.”

Big data generated by the LHC included 40 million collisions per second with each one generating one megabyte of data. Every second some 200 of these events were stored, generating about 20 petabytes of data per year. Data is stored at CERN, but sent to computing centers worldwide for analysis, including the UMD CMS Tier 3 Computing Cluster. “We currently have three management nodes, 152 cores (or processors), two interactive nodes and 75 terabytes of usable storage disk space,” says Hadley, who notes how the computing cluster's location on campus has given undergraduates unprecedented research opportunities.

The CMS Computing Cluster is one of the first systems to move into the new 9,000-square-foot UMD Cyberinfrastructure Center located in the Rivertech Building in the university's M Square Research Park. The center also will provide power and space for Deepthought2, a new high-performance computing cluster that supports the needs of the entire university research community, offering central processing units for computation, graphics processing units for specialized computational processing and large memory nodes. The cluster provides one petabyte of storage and is connected by an InfiniBand high-speed network, which is 50 times faster than the average home broadband network. Deepthought2 is expected to be one of the top 500 clusters in the world and one of the top 10 clusters among U.S. universities.

Mining Social Networks and User-generated Data

With the proliferation of social media, individuals are now generating an unprecedented volume of personal data. Today, more than 1 billion people use Facebook each month, individuals share more than 400 million photos each day on Snapchat and 1 billion “likes” are posted on Instagram daily, making social networks fertile ground for analyzing user behavior patterns and constructing new operational tools.

Computer Science and UMIACS Professor Ben Shneiderman recently took part in a first-of-its-kind study that analyzed patterns in tens of thousands of Twitter conversations to provide a topographical “map” of Twitter users, visually identifying six distinct structures in discussions. Sponsored by the Pew Research Center, the study relied heavily on open-source software called NodeXL, which was tested extensively by Shneiderman and many of his graduate students in the UMD Human-Computer Interaction Lab. The software helps translate large data sets into networked visualizations of tweets, retweets and the social networks of Twitter users. “Visualization helps identify patterns and makes data clear, actionable and understandable,” says Shneiderman.

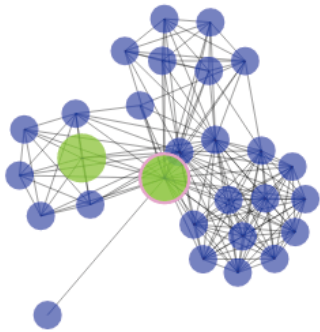
Jimmy Lin, associate professor in the iSchool, computer science and UMIACS, spent an extended sabbatical at Twitter from 2010 to 2012, where he worked on services designed to identify relevant content for users and on analysis tools to support data science. His research at Twitter contributed to the “Who to Follow” service, which automatically suggests accounts to follow, and to expert search, a product to help users find accounts that match their interests.

Lin has long been interested in building tools to support data mining and analysis at a massive scale. “Today, companies ranging from Twitter to Walmart to Bank of America gather vast amounts of data about their customers, which they analyze to learn more about customers and improve their business,” says Lin. “This is what data science is all about—extracting insights from data to better inform decisions.” Lin is now focused on building algorithms and distributed systems to analyze such data in real time.

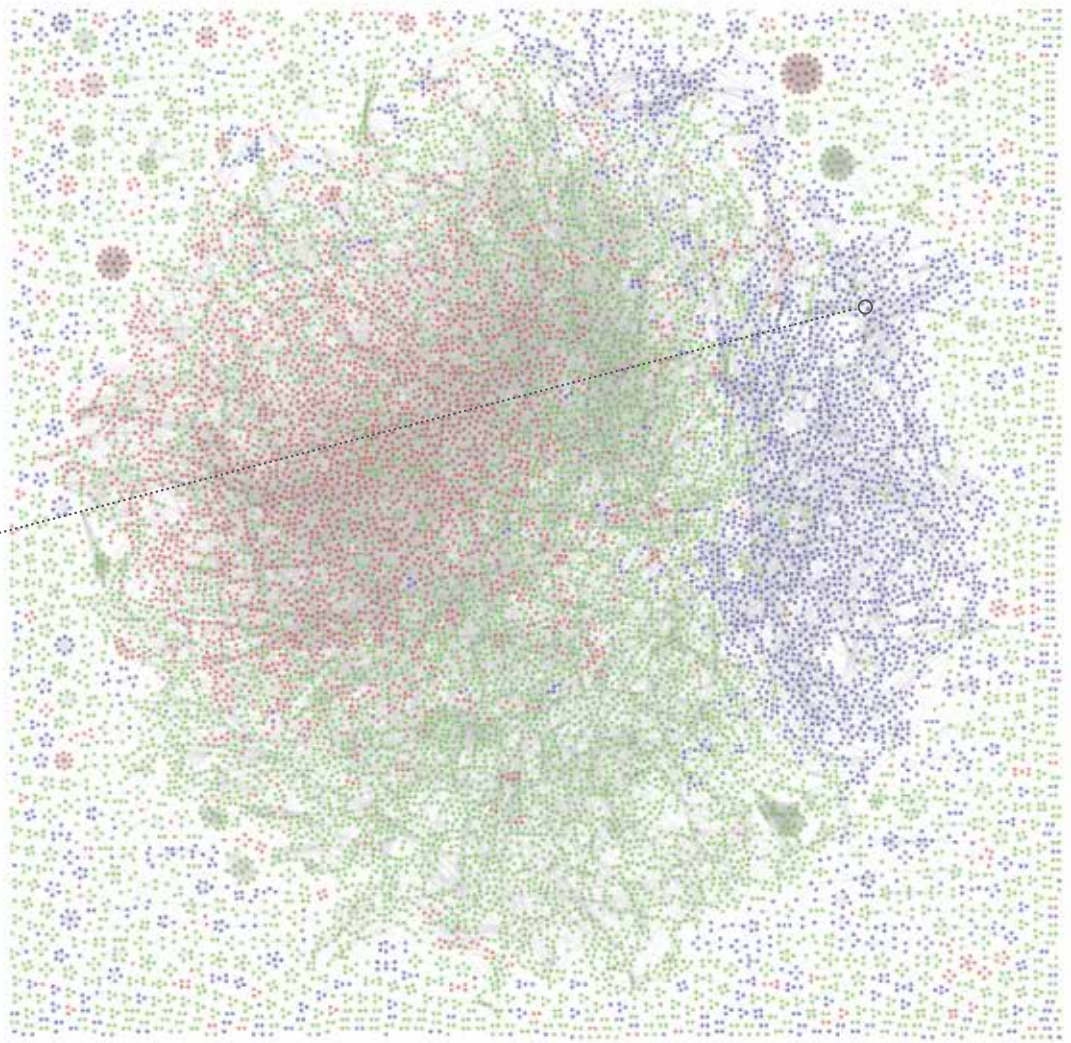
According to Amol Deshpande, associate professor of computer science and UMIACS, data from all types of networks—from social to communication to financial transaction—are most naturally represented as graphs of entities and the connections between them. For this reason, Deshpande has set his sights on creating a general-purpose, graph data management system that enables users to store, process and analyze very large volumes of data in an easy-to-use intuitive manner, which no data management system can do today.

He is designing tools to help users extract insights and knowledge from large-scale network data, such as determining if multiple names in a network belong to the same entity (entity resolution) or identifying the most important entities in a network (centrality analysis). “In a social network, centrality analysis could mean identifying an influential person based on how many other influential people he or she is connected with,” explains Deshpande. He is also interested in creating ways to handle streaming and continuously evolving dynamic data. “There are millions of tweets hourly,” says Deshpande. “We want to develop a streaming system that continuously updates new events and analyzes them immediately.”

As the volume of multimedia data explodes across all platforms, including social networks, Computer Science Department Chair Samir



AN EXAMPLE OF ENTITY RESOLUTION: GrDB, A NETWORK ANALYSIS TOOL, ENABLES SCIENTISTS TO INTERACTIVELY EXPLORE A LARGE, NOISY INFORMATION NETWORK (RIGHT) AND IDENTIFY THAT THE TWO GREEN NODES (ABOVE) REFER TO THE SAME PERSON.



Khuller is focusing on the storage and movement of data over local-area and wide-area networks. Long before Netflix was streaming video to millions of users worldwide, Khuller was grappling with the need to meet rapidly changing multimedia demand: How do you predict popularity and shifting demand? How many copies of each data item must be stored? How can servers be designed to accommodate changing access requirements? “Systems must be capable of dynamic reorganization, which requires a more robust mapping of data items and greater versatility in data layout,” says Khuller, who estimates that more than 90 percent of Internet traffic today involves multimedia.

He is creating algorithmic techniques that can improve the performance of large multimedia data storage systems. “We want to build systems that can cope more gracefully under unreasonable demand situations,” explains Khuller, whose primary collaborator is Leana Golubchik, former computer science associate professor at UMD now at the University of Southern California.

Across every network and every computing platform, from mobile to cloud technologies, data protection remains a critical concern. “The biggest challenges for security and privacy are distributed networks, the scale of systems and the massive amounts of data,” says Computer Science Assistant Professor Elaine Shi. “When many operating systems, such as those in mobile phones, were developed, few imagined how the systems would be used to collect data of every kind. Usage has gone beyond the capacities of many current models.” This contributes to what Shi calls privacy diffusion—the scattering of personal and sensitive information within and across systems.

The accelerated growth of the cloud computing market brings even more security challenges. Shi was recently awarded a Sloan Fellowship for her work in securing data in the cloud against physical attacks. “Our goal is to build a cloud platform that can automatically protect user data, whether from a malicious insider at a large company or an intruder,” Shi explains. Her team has created a secure processor that prohibits an attacker from accessing any sensitive information stored on the system by probing memory or system buses, the high-speed communication channels used to transfer information between components.

The Ultimate Challenge

The big data revolution is here, blurring the lines between the traditional disciplines of computer science, mathematics, the physical sciences and the life sciences. As the revolution unfolds, the ultimate challenge remains finding those unexpected connections and teasing out the related patterns in data. “We are just beginning to get a full glimpse of what lies ahead in this promised land,” says Amitabh Varshney.

No matter the size of the data set, the information ultimately must have value and add knowledge—whether improving health, predicting global climate change or advancing the understanding of social behavior. Louiqa Raschid, whose work on database and data management projects spans health care, financial and social media applications, explains, “Big data, in and of itself, is not really of any value at all. In the end, discovery comes from finding the small nugget of information that is most important to the user.” ■

UP, UP AND AWAY

CONTRAST Team
Takes to the Skies

As North America experienced one of the coldest winters in recent history, University of Maryland researchers were surveying the skies above the tropical western Pacific, collecting data that will yield clues about the effects of human activity and ocean biology on the composition of the atmosphere. The research team included two graduate students and Professor Ross Salawitch, who holds appointments in atmospheric and oceanic science, chemistry and biochemistry, and the Earth System Science Interdisciplinary Center.

The researchers traveled to Guam, an island in the Pacific Ocean 3,300 miles west of Hawaii, where the world's warmest sea surface temperatures lead to the most active cloud systems on Earth. During the winter months in the Northern Hemisphere, the combination of heat and moisture in the region causes warm air to rise from the ocean's surface, creating a chimney effect and feeding into huge clusters of thunderstorms. The storms lift gases and particles through the low levels of the atmosphere and into the stratosphere, where they can spread over the entire planet, linger for long periods of time, and influence atmospheric climate and composition worldwide.

As co-principal investigator of the CONTRAST (CONvective TRansport of Active Species in the Tropics) field project, Salawitch helped lead a series of intensive data-gathering flights by three aircraft, the most comprehensive data collection effort of its kind in the region.

"One of our goals was to define the chemicals in the air, with special emphasis on chemicals introduced or altered by humans," explains Salawitch. "There have been measurements from long-ago aircraft campaigns, but nothing nearly as comprehensive. This project will give us a strong fingerprint of human activity on the region."

Salawitch served as mission scientist aboard the HIAPER (High-performance Instrumented Airborne Platform for Environmental Research) aircraft, a Gulfstream V jet sponsored by the National Science Foundation (NSF) and the National Center for Atmospheric Research (NCAR) and modified for advanced research. HIAPER flew at altitudes between 500 and 48,000 feet, along with NASA's Global Hawk, a robotic air vehicle that studied upper-atmospheric composition primarily between 45,000 and 60,000 feet. The British Facility for Airborne Atmospheric Measurements' (FAAM) BAe-146 research aircraft conducted extensive sampling near the ocean's surface. Taken together, the data collected by the three aircraft will give research collaborators a detailed view of air masses spanning tens of thousands of feet from the ocean surface to the stratosphere.

The CONTRAST mission provided a novel way of examining the transformation of the halogen group of elements—bromine, chlorine and iodine—from their origins in the ocean to the stratosphere. The researchers focused on halogen family elements because they remove atmospheric ozone. Classic chemical measurement techniques, including gas chromatography, mass spectrometry and absorption spectroscopy, required small, autonomous hardware packages designed specifically for the HIAPER platform. Two instruments onboard HIAPER measured organic halogens (chemical compounds with the carbon-bromine bond intact) and two other instruments measured inorganic halogens (chemicals produced once the carbon-bromine bond has been broken). "We can map the transformation of these chemicals to quantify how ocean biology affects the stratosphere," says Salawitch.



THREE AIRCRAFT PARTICIPATED IN DATA COLLECTION TO
FLEW IN THE HIAPER AIRCRAFT.

Julie Nicely, a graduate student in chemistry, served as mission coordinator on one of the flights and played a critical role in charting the plane's course to optimize the collection of samples. "As we were flying and seeing firsthand the change in air quality, we were able to perform real-time analysis to help us better understand the chemical features of the atmosphere," says Nicely, who also assisted with chemical forecasts and analysis for the entire campaign.

Making and Breaking the Models

Though data analyses are far from complete, Salawitch reports a major surprise. "There was a significant amount of pollution in the atmosphere over Guam. We know this pollution is



NASA Global Hawk
45,000-60,000 FT.
LOWER STRATOSPHERE

NSF/NCAR HIAPER
500-48,000 FT.
TROPOSPHERE

FAAM BAe-146
100-24,000 FT.

TO ASSESS THE CHEMICAL COMPOSITION OF THE ATMOSPHERE IN THE PACIFIC OCEAN. UMD RESEARCHERS

not coming from Guam and that a pervasive amount is coming from upwind areas. We will be building trajectory models to study the type of pollution and determine where these air masses originated," he explains.

Dan Anderson, a graduate student in atmospheric and oceanic science and

CONTRAST team member, also reports an unexpected finding. Anderson, who measured the abundance of formaldehyde in the air using an instrument developed at NASA's Goddard Space Flight Center, notes, "We discovered that the middle of the remote, marine atmosphere holds higher concentrations of formaldehyde than we anticipated, which raises a lot of new questions."

Project findings will result in a new data set for evaluation of climate-chemistry models for a previously untested region of the world. "Our data will feed into the work of the air quality community, the climate community and a whole body of chemists eager to see what we have found," says Salawitch. ■

—NANCY GRUND



CHEMISTRY GRADUATE STUDENT JULIE NICELY PROVIDES REAL-TIME ANALYSIS OF DATA COLLECTED OFF THE COAST OF GUAM.

Big Data on Board

- 16 FLIGHTS**
- 138 HOURS**
- 24 INSTRUMENTS**
measured the physical and chemical state of the atmosphere
- 31 VARIABLES**
related to meteorological conditions, clouds and aerosol particles along the flight track
- 127 CHEMICAL CONSTITUENTS**
- DATA COLLECTION OF SOME OF THE CHEMICALS OCCURRED ONCE PER SECOND**
- OZONE LEVELS MEASURED HALF A MILLION TIMES**
- SEVERAL TERABYTES OF DATA CONDENSED FOR SHARING AND ANALYSIS**



(L-R) WILLIAM PHILLIPS, ELIZABETH NUSS, WILLIAM KIRWAN, WALLACE LOH, NANCY KOPP, MIKE MILLER, PATRICK GALLAGHER AND JAYANTH BANAVAR CUT THE RIBBON TO OFFICIALLY OPEN THE PHYSICAL SCIENCES COMPLEX.

University Celebrates Grand Opening of New Physical Sciences Complex

On April 23, the University of Maryland celebrated the grand opening of its new Physical Sciences Complex. The state-of-the-art research building is an instant architectural landmark with its shimmering elliptical atrium. The facility—filled with researchers from physics, astronomy and the interdisciplinary Institute for Physical Science and Technology—is poised to generate world-changing scientific advancements. Constructed with a \$115.7 million contribution from the state of Maryland and \$10.3 million from the federal government’s National Institute of Standards and Technology (NIST), the 160,000-square-foot building houses nearly 50 laboratories, more than half of which were constructed to the most stringent technical standards.

More than 300 people attended the grand opening celebration, which featured a ribbon-cutting ceremony. Program speakers included Maryland State Treasurer Nancy Kopp; Maryland Senate President Mike Miller; University System of Maryland Chancellor William Kirwan; UMD President Wallace Loh; NIST Director Patrick Gallagher; UMD College of Computer, Mathematical, and Natural Sciences Dean Jayanth Banavar; and UMD Physics Professor and NIST Physicist William Phillips.

During the ceremony, the Gluckstern Garden, located at the base of the ellipse, was dedicated in memory of Robert L. Gluckstern, who was a UMD chancellor (now called president) and physics professor. Elizabeth Nuss, Gluckstern’s wife, spoke about her husband at the event.

Four days after the celebration, the building starred in an episode of “Veep,” the Emmy-award-winning HBO comedy starring Julia Louis-Dreyfus. ■

▶ [Watch a video about the grand opening at ter.ps/pscopening](http://ter.ps/pscopening)



U.S. NEWS & WORLD REPORT GRADUATE SCHOOL RANKINGS

- 14TH Physics**
SPECIALTIES
3rd Plasma
6th Atomic/molecular/optical
8th Quantum
10th Condensed matter
13th Cosmology
- 15TH Computer science**
SPECIALTIES
13th Systems
13th Programming language
16th Artificial intelligence
- 17TH Mathematics**
SPECIALTIES
10th Applied math
- 32ND Earth sciences**
SPECIALTIES
7th Geochemistry
- 41ST Chemistry**
- 55TH Biological sciences**

Lockheed Martin, UMD Partner to Develop Next Generation Quantum Computer

Building on more than 60 years of collaboration, Lockheed Martin and the University of Maryland are partnering to develop an integrated quantum computing platform that has the potential to revolutionize research in areas ranging from drug discovery and communications to logistics. The parties signed a memorandum of understanding on March 5 establishing the Quantum Engineering Center at the University of Maryland.

“Classical computing can only take us so far,” said Ray Johnson, Lockheed Martin senior vice president and chief technology officer. “In the future, critical systems will become so complex that problems will take too long or become too expensive to solve using even our most powerful supercomputers. We believe the next computational revolution will stem from applied quantum science—a discipline that connects physics, information science and engineering.”

The initial goal of the Quantum Engineering Center is to demonstrate a quantum platform that features reliable, well-characterized operation without requiring a user to have a deep understanding of the internal workings of the system—just like conventional computers work today. This research will require close cooperation between scientists and engineers.



(L-R) PATRICK O'SHEA, RAY JOHNSON AND MARY ANN RANKIN ESTABLISH THE QUANTUM ENGINEERING CENTER.

“We are talking about unusual systems—specially tuned laser and microwave fields trained with exquisite precision onto individual atoms suspended with electrical fields and immersed in a vacuum chamber a million times less dense than outer space,” said Chris Monroe, Bice Zorn Professor of Physics at the University of Maryland. “Our focus now is integrating these systems to consistently and reliably work in harmony, much like engineering a complex aircraft, so that the device is more than just a sum of its parts.” ■

National UTeach Program Expands to UMD

In early February, the University of Maryland launched a program called Terrapin Teachers to increase the number of high-quality secondary science, technology, engineering and mathematics (STEM) teachers. The university received a five-year, \$1.45 million grant from the National Math and Science Initiative to replicate the nationally recognized UTeach program and expand the university's offerings that enable undergraduate students in STEM fields to receive both a subject-matter degree and teaching certification.

Terrapin Teachers is a joint initiative between the university's College of Education and College of Computer, Mathematical, and Natural Sciences. The program is co-directed by Arthur N. Popper, a professor in the Department of Biology, and Daniel I. Chazan, a professor in the Department of Teaching and Learning, Policy and Leadership.

“Tomorrow's leaders, innovators and entrepreneurs are shaped by dynamic teachers,” said UMD President Wallace Loh. “This is



(L-R) MICHAEL MARDER, RHONDA RANDON, DONNA WISEMAN, ART POPPER, WALLACE LOH, LILLIAN LOWERY, WILLIAM KIRWAN, MARY ANN RANKIN, DAN CHAZAN AND JAYANTH BANAVAR CELEBRATE THE LAUNCH OF TERRAPIN TEACHERS.

why we are so pleased to join forces with the transformative teacher preparation program UTeach, which grows the pipeline of cutting-edge STEM leaders who make a difference in the classroom.”

Mary Ann Rankin, UMD senior vice president and provost, created the UTeach program in 1997 when she was dean of the College of Natural Sciences at The University

of Texas at Austin. The program has been replicated at 35 universities. Projections indicate that, by 2020, UTeach programs will have produced more than 9,000 math and science teachers—nearly 10 percent of the White House's 100Kin10 national goal of producing 100,000 new STEM teachers by 2021. ■

▶ Watch a recording of the event at ter.ps/teach

Brendan Iribe Kicks Off First UMD Hackathon

Nearly 700 college students from across the country attended the University of Maryland's first hackathon in early April. The College of Computer, Mathematical, and Natural Sciences and the Clark School of Engineering jointly sponsored Bitcamp, a 36-hour hackathon held in Cole Field House, where student teams created new apps, games and programs.

Bitcamp was one of 37 official Major League Hacking events held this spring. Last fall, UMD's

Terrapin Hackers team was named champion of the Major League Hacking Season.

Bitcamp's opening ceremony featured keynote speaker Brendan Iribe, former UMD student and CEO of Oculus VR, the

company that created the Oculus Rift virtual reality headset for immersive gaming. Iribe spoke to Bitcamp participants—and a campus audience of 300 earlier in the day—about his journey from College Park to Irvine, Calif., and he described the excitement of learning that Facebook would acquire Oculus VR for \$2 billion.

At Bitcamp, Oculus VR co-founder and chief software architect Michael Antonov, B.S. '03, computer science, joined Iribe to judge two dozen hacks that used the Oculus Rift. They selected their favorite entries, including

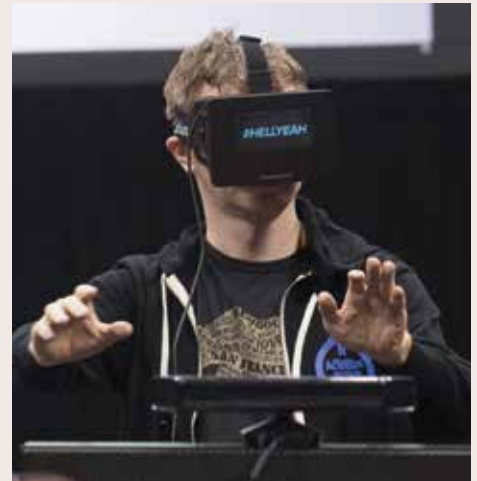


BRENDAN IRIBE (FRONT ROW, BLACK SHIRT) CELEBRATES THE CONCLUSION OF BITCAMP WITH ITS STUDENT ORGANIZERS.

an interactive Iron Man game that integrated Xbox Kinect motion detection and the Rift headset to allow users to shoot rays out of their hands at targets. Teams that created hacks with the headsets kept them following the event, thanks to Iribe, who also promised next generation headsets to team members who created the entrepreneurs' favorite hacks.

While on campus, Iribe and Antonov also visited the labs of Computer Science Professors Ramani Duraiswami and Amitabh Varshney; met with other computer science faculty members and reminisced about their late co-founder Andrew Reisse, B.S. '01, computer science, in whose memory Oculus VR established a computer science scholarship; and gave a headset demonstration to UMD President Wallace Loh. ■

▶ [Watch a video at ter.ps/bitcamp2014](http://ter.ps/bitcamp2014)



(ABOVE) AT BITCAMP, MICHAEL ANTONOV JUDGES ONE OF THE STUDENT HACKS THAT USED THE OCULUS RIFT HEADSET. (LEFT INSET) AN OCULUS RIFT HACK DESIGNED BY STUDENTS AT BITCAMP.



IN MARCH, THE COLLEGE HOSTED ASTRONAUTS KAREN NYBERG AND LUCA PARMITANO, WHO WERE FLIGHT ENGINEERS DURING A RECENT EXPEDITION ABOARD THE INTERNATIONAL SPACE STATION. THEY TOLD A CROWD OF MORE THAN 350 PEOPLE ABOUT THE 166 DAYS THEY SPENT IN SPACE, WHICH INCLUDED 2,656 ORBITS OF THE EARTH WHILE TRAVELING MORE THAN 70 MILLION MILES.





Matchmaker TO THE WORLD

What began as an idea for the University of Maryland business plan competition more than a decade ago has evolved into Zoosk, one of the world's most successful online dating platforms that now boasts 25 million members from 80 different countries. At its helm is co-founder and CEO Shayan Zadeh, M.S. '02, computer science, who attributes much of the company's success to a more sophisticated use of the data mining and data optimization techniques he studied at UMD.

"We are the only dating company that can look at massive amounts of data from the consumer and use that information to help individuals find the best romantic partner," describes Zadeh, who created the company with his UMD business plan competition partner Alex Mehr, Ph.D. '03, mechanical engineering.

Both business partners had used online dating services and saw a great opportunity. "Building on our personal experiences with online dating services, we felt strongly that we could bring a big data approach to online dating. We wanted to apply our know-how to an industry that would have lots of impact on people in their daily lives," explains Zadeh.

"When I entered UMD, my career trajectory was very different from where I am sitting now," recalls Zadeh. "Computer Science

Professor V.S. Subrahmanian's work in big data and Professor Samir Khuller's expertise in solving complex problems were foundational in my work." Following graduation, Zadeh spent nearly four years at Microsoft in Seattle before heading south to San Francisco, where his 180-person company is based. He advises budding entrepreneurs, "Find the intersection between your skill set and what you really like to do. Any successful career involves hard work, but it becomes much easier if your heart is really in it."

For now, Zadeh remains focused on growing Zoosk, improving the product and providing employees with opportunities to advance in their careers. "While we now have the tools to process vast amounts of information, we look to universities like UMD to help train the workforce that is needed to use the tools to turn data into knowledge," says Zadeh.

No matter what the future holds, Zadeh attests, "I will always be a Terp, and I am happy to give back to the university in return for all that it has given me." ■ —NANCY GRUND

In March, Zadeh spoke at the College of Computer, Mathematical, and Natural Sciences' third annual Bay Area Alumni Networking Reception at the Museum of Computer History in Mountain View, Calif.

CREATING A Financial Cushion

When Ruchi Mehta, Ph.D. '00, molecular and cellular biology, arrived on the College Park campus from India to begin her graduate studies in 1995, she had \$300 in savings. "It was not a huge financial cushion to fall back on," recalls Ruchi, who joined her future husband, Amit Mehta, MBA '96, business and management, in pursuing an advanced degree from University of Maryland.

While pursuing her Ph.D., Ruchi worked as a resident advisor and as a teaching assistant for Biochemistry Professor Jason Kahn, her doctoral adviser, to support herself. She soon realized that while she loved science, she wanted to explore other ways to use her knowledge. With a few business electives under her belt and in-depth research of the health care investing world, Ruchi looked to Wall Street when she completed her degree and was soon hired by what would become one of the largest hedge funds in the world. "It was a risky choice, but a fascinating one. With my science background, I knew how to read and interpret data and use that information to make investment decisions," describes Ruchi, who eventually managed the health care segment of the firm, analyzing biotechnology, pharmaceutical and medical device companies, among others.

Today, Ruchi spends much of her time volunteering at the school her two young children attend, but Amit remains committed to the hedge fund industry, co-managing his own firm. The Mehtas are quick to acknowledge the role UMD has played in their success. "The skill sets we acquired and the motivation to work hard and do well was, in part, learned at the University of Maryland," notes Ruchi.

Now, the Mehtas are giving others the opportunity to learn those important lessons. The Mehta Graduate Research Award supports graduate students in the College of Computer, Mathematical, and Natural



YUE ZHENG, THE FIRST RECIPIENT OF THE MEHTA GRADUATE RESEARCH AWARD, IS INTERESTED IN DISCOVERING NEW ANTIBIOTICS TO COMBAT DISEASE.

Sciences with international experience who want to serve the broader global community when they graduate. "We want to provide a safeguard for international students if other means of funding fall through the cracks," explains Ruchi.

Biochemistry graduate student Yue Zheng, who left China to continue her education at UMD, is thrilled to be the first recipient of the award. "The award is gratifying because it recognizes my hard work during the past few years," says Zheng, who is interested in discovering new antibiotics to combat disease.

The Mehtas are looking to create a wider circle of philanthropy through their award. "We hope the recipients of our award will want to give back when they are able. We would love for other alumni and friends to find ways they can give back as well. UMD deserves it," says Ruchi. ■ —NANCY GRUND

"We want to provide a safeguard for international students if other means of funding fall through the cracks."

—RUCHI MEHTA

INSPIRED BY THE MEHTAS?

JOIN THE MEHTAS IN MAKING A DIFFERENCE IN THE LIFE OF A STUDENT. CONTACT ANDREA MORRIS AT 301.405.8296 OR AEMORRIS@UMD.EDU FOR MORE INFORMATION.

FACULTY & STAFF HIGHLIGHTS

Millard Alexander, chemistry and biochemistry, will receive the Herschbach Medal (Theory) at the 2015 Dynamics of Molecular Collisions Conference. The award, named after 1986 Nobel Laureate in Chemistry Dudley R. Herschbach, recognizes outstanding contributions to the field of molecular dynamics.

Gretchen Campbell, Joint Quantum Institute and National Institute of Standards and Technology, received a 2013 Presidential Early Career Award for Scientists and Engineers in recognition of her research on ultracold atoms.

Rama Chellappa, computer science and electrical and computer engineering, and **Dana Nau**, computer science, were elected fellows of the Association for Computing Machinery. Chellappa was honored for his work in image processing and computer vision, and Nau was recognized for his contributions to automated search and planning.

Rita Colwell, Institute for Advanced Computer Studies, received the Prize Medal from the Society for General Microbiology. "As a global leader in her field this award has been given to recognize the outstanding contribution she has made to microbiology, in particular the control of cholera and the far-reaching impact this has had."

David Doermann, computer science, was elected fellow of IEEE for contributions to the research and development of automatic analysis and processing of document page imaging.

Michael Doyle, chemistry and biochemistry, received the Hillebrand Prize from the Chemical Society of Washington (CSW). The most prestigious honor given by CSW, the prize recognizes significant accomplishments in chemistry.

James Farquhar, geology, received the 2014 Science Innovation Award from the European Association of Geochemistry.

Dale Fixsen, astronomy, received NASA Goddard's Robert H. Goddard Honor Award for individual outstanding scientific achievement.

Sylvester James "Jim" Gates, Jr., physics, was chosen by the students and faculty of the Harvard Foundation to receive the 2014 Scientist of the Year Award. The award recognizes internationally noted scientists for their remarkable achievements and for promoting initiatives that increase diversity in all areas of science, engineering and mathematics.

David Inouye, biology, published a paper in the Proceedings of the National Academy of Sciences showing that more than two-thirds of alpine flowers have changed their blooming pattern in response to climate change. Major media outlets covering the work included The Christian Science Monitor, Daily Mail, LiveScience, Los Angeles Times, Mother Jones, NBC News, Salon, The New York Times and Time magazine.

Lyle Isaacs, chemistry and biochemistry, and **Ross Salawitch**, atmospheric and oceanic science and chemistry and biochemistry, were elected fellows of the American Association for the Advancement of Science. Isaacs was honored for "distinguished contributions to supramolecular chemistry, particularly the development of cucurbit[n]uril molecular containers and self-sorting systems." Salawitch was recognized for "advancing our understanding of ozone chemistry and Earth's climate through harmonized measurements and models."

Patrick Kanold, biology, published a paper in the journal *Neuron* showing that the brains of adult mice can be rewired to compensate for a temporary vision loss by improving their hearing. The findings were reported by the BBC, Daily Mail, EarthSky, Fox News, NPR, StarTribune (Minneapolis), The Telegraph (London), The Washington Post and Voice of America.

Sydney Levitus and **Rachel Pinker**, atmospheric and oceanic science, were elected fellows of the American Meteorological Society.

Doron Levy, mathematics, and **Sylvain Veilleux**, astronomy, have been named fellows of the John Simon Guggenheim Memorial Foundation.

Karen Lips, biology, published a paper in the journal *Global Change Biology* showing that wild salamanders are getting smaller as their surroundings get warmer and drier. Media outlets that covered the work included the BBC, The Christian Science Monitor, The Huffington Post, Mother Nature Network, National Geographic, NBC News, Science News, Scientific American, The New York Times, Weather Channel and Yahoo.

Jandelyn Plane, computer science, received the 2014 Women in Technology Social Impact IT Leadership Award for her work in improving computing education, her leadership as associate director of the Advanced Cybersecurity Experience for Students program and her efforts in advocating for underrepresented populations in computing. Plane is director of the Maryland Center for Women in Computing.

Hanan Samet, computer science, received the 2014 W. Wallace McDowell Award, the highest technical honor given by the IEEE Computer Society. Samet was also elected fellow of the University Consortium for Geographic Information Science in recognition of being an "international eminent scholar in the theory and development of spatial data structures."

Elaine Shi, computer science, was awarded a 2014 Sloan Research Fellowship. Granted by the Alfred P. Sloan Foundation, fellowships were awarded to 126 early-career scientists based on their potential to contribute fundamentally significant research to a wider academic community.

Anne Simon, cell biology and molecular genetics, was elected fellow of the American Academy of Microbiology.

Genevieve Spanjer Wright and **Gerald Wilkinson**, biology, published a paper in the journal *Current Biology* showing that male big brown bats can produce a special sound that tells other bats to keep away from their prey. The findings were reported by ABC News, Chicago Tribune, LiveScience, Mother Nature Network, MSNBC, Orlando Sentinel, Reuters, Scientific American, The Globe and Mail, The Guardian (London) and Yahoo. ■

Three alumni were awarded 2014 Sloan Research Fellowships.

- **Kristopher Karnauskas**, Ph.D. '07, atmospheric and oceanic science, is an associate scientist in geology and geophysics at Woods Hole Oceanographic Institution.
- **Benjamin Langmead**, Ph.D. '12, computer science, is an assistant professor of computer science at The Johns Hopkins University.
- **Jared Speck**, B.S. '02, mathematics, is an assistant professor of mathematics at the Massachusetts Institute of Technology.

Bradford Hill, M.S. '01, physics, received the 2014 Paul Zitzewitz Excellence in Pre-College Physics Teaching Award from the American Association of Physics Teachers in recognition of extraordinary accomplishments in communicating the excitement of physics to students.

Veena Katikineni, B.S. '12, biological sciences, with partner Alejandra Leyton of Tulane University, won a \$10,000 "Scientists Without Borders" Open Innovation Mental Health Awareness Challenge. Their concept, MHealth for Mental Health, proposes using text messaging services to directly supply relevant information to depressed/anxious individuals, their friends and family, and the community, with the hope that users will refer one another to the service. Katikineni is currently attending the University of Maryland School of Medicine.

Lura Powell, B.S. '72, Ph.D. '78, chemistry, was appointed to the Washington State University Board of Regents. Powell was director of the Pacific Northwest National Laboratory before serving as president and CEO of Advanced Imaging Technologies. Previously she directed the Advanced Technology Program at the National Institute of Standards and Technology. She is a fellow of the American Association for the Advancement of Science.

Ana Maria Rey, Ph.D. '04, physics, and **Scott Weaver**, Ph.D. '07, atmospheric and oceanic science, were each awarded a 2013 Presidential Early Career Award for Scientists and Engineers.

In recognition of their many accomplishments, the 2014 Distinguished Alumni awardees were honored on April 10.

- **Eliot Atekwana**, B.S. '84, geology, is a professor of geology at Oklahoma State University.
- **Charles Bennett**, B.S. '78, astronomy and physics, is a professor of physics and astronomy at The Johns Hopkins University.
- **Robert Brammer**, M.A. '70, Ph.D. '72, mathematics, is president and CEO of Brammer Technologies.
- **Terry Gaasterland**, M.S. '88, Ph.D. '92, computer science, is professor and director of the Scripps Genome Center at the University of California, San Diego.
- **Richard Isaacson**, Ph.D. '67, physics, is program director (retired) of gravitational physics at the National Science Foundation.
- **Rachel Pinker**, Ph.D. '78, meteorology, is a professor of atmospheric and oceanic science at UMD.
- **Michael Raupp**, Ph.D. '82, entomology, is a professor of entomology at UMD.
- **Michael Rudolph**, M.S. '80, microbiology, is a dentist with East Warsaw Dental Group.
- **Phil Schneider**, B.S. '79, biochemistry, is director of the Spine Center and orthopedic surgeon at Holy Cross Hospital.
- **Allan Will**, B.S. '76, zoology, is president and CEO of EBR Systems.
- **James Yorke**, Ph.D. '66, mathematics, is Distinguished University Research Professor Emeritus of Mathematics at UMD. ■

ALUMNI NOTES ARE WELCOME.

PLEASE SEND THEM TO ODYSSEY, CMNS DEAN'S OFFICE, UNIVERSITY OF MARYLAND, 2300 SYMONS HALL, COLLEGE PARK, MD 20742. SEND INFORMATION BY FAX TO 301.314.9949 OR BY EMAIL TO MKEARNEY@UMD.EDU.

Ledleys are Leaders in Science Education

Tamara Ann Shapiro

Ledley, B.S. '76, astronomy; Ph.D. '83, MIT, was conducting climate change research long before scientists agreed that climate-warming trends are likely due to human activities. **Dr. Fred Ledley**, B.S. '74, physical sciences; M.D. '78, Georgetown University, who met his future wife as a student at the University of Maryland, is also an innovator, drawing on his medical background to lead two successful biotechnology companies. More recently, both have made substantial contributions to science education.



TAMARA LEDLEY

A senior scientist and director of the Center for STEM Teaching and Learning at TERC, Tamara led the development of the award-winning Earth Exploration Toolbook and the Climate Literacy and Energy Awareness Network's Collection of reviewed educational resources. Her work in climate literacy and science education was recognized in 2013



FRED LEDLEY

when she received the American Geophysical Union's Excellence in Geophysical Education Award. Fred's expertise in biological research and business ultimately led him to create and direct the Center for Integration of Science and Industry at Bentley University, where he is advancing the translation of scientific discoveries for public benefit. In 2013, he was elected fellow of the American Association for the Advancement of Science for his contributions to the integration of molecular genetics and genomics into medicine, industry and education. ■

STUDENT HIGHLIGHTS

Three CMNS students were among the 283 Barry Goldwater Scholars selected from 1,166 students nominated nationally this year. A fourth CMNS student received an honorable mention. The students, who are all members of the UMD Honors College, plan to pursue doctoral degrees in their areas of study and to become university professors.

- **Geoffrey Ji**, physics, mathematics, economics and computer science
- **Michael Mandler**, chemistry and biological sciences
- **Rafael Setra**, mathematics and electrical engineering
- Honorable mention: **Daniel Farias**, computer science, mathematics and electrical engineering

Biological sciences and computer science double major **Fang Cao** has been awarded a 2014 Truman Scholarship, which is awarded to undergraduates who demonstrate exceptional leadership potential and a commitment to careers in government, the nonprofit or advocacy sectors, education or elsewhere in public service. Cao is the first UMD student to be awarded both Goldwater and Truman scholarships.

Computer science graduate students **Snigdha Chaturvedi** and **Kotaro Hara** were awarded 2014 IBM Ph.D. Fellowships. These fellowships honor exceptional students worldwide interested in solving problems that are important to IBM and fundamental to innovation. Chaturvedi's research interests focus on

machine learning, data mining and information abstraction, while Hara's research focuses on human-computer interaction and using crowdsourcing to solve accessibility issues.

Biology undergraduate student **Andre DeSouza** received a 2014 Howard Hughes Medical Institute Exceptional Research Opportunities Program award. DeSouza will spend the summer conducting research with Columbia University's Richard Axel, who received the Nobel Prize for Physiology or Medicine in 2004.

Computer science undergraduate student **Vicky Lai** was a finalist for the Computing Research Association's 2014 Outstanding Undergraduate Research Awards. The awards recognize undergraduate students in North American colleges and universities with outstanding potential in an area of computing research.

A Fulbright student grant was awarded to biology and psychology senior **Stephanie Lighter** to teach English in India during the 2014-2015 academic year. She will serve as a Fulbright English Teaching Assistant at the Vinay Nagar Bengali Senior Secondary School in New Delhi.

Two CMNS students were awarded National Oceanic and Atmospheric Administration Ernest F. Hollings Scholarships: **Robert Lukin**, chemistry, and **Michael Natoli**, atmospheric and oceanic science, and mathematics.

The scholarship is designed to increase undergraduate training in oceanic and atmospheric science research, technology and education.

Physics senior **Noah Mandell** is the recipient of the University Medal, awarded by the University of Maryland in recognition of his academic distinction, extraordinary character, and extracurricular contributions to the university and the larger public.

Marine-estuarine-environmental sciences graduate student **Brittany West Marsden** received the Ecological Society of America's 2014 Graduate Student Policy Award. She participated in policy training sessions and meetings with decision-makers on Capitol Hill in April.

Biological sciences graduate student **Daniel Serrano** was awarded a Mass Media Science & Engineering Fellowship from the American Association for the Advancement of Science. Serrano, a native Colombian, will spend the summer as a Spanish-language science reporter at Nuestra Tele Noticias.

Biology graduate student **Richard Smith** is one of only 10 U.S. graduate students selected to attend the 64th Lindau Nobel Laureate Meeting in Germany in June. Some 30 to 40 Nobel Laureates are expected to meet with 600 young researchers. ■

IN MEMORIAM

Marshall Ginter, emeritus professor in the Institute for Physical Science and Technology (IPST), passed away Dec. 9, 2013. Ginter, who joined the Institute for Molecular Physics in 1966, was an energetic and productive scientist. He made important contributions to the understanding of highly excited Rydberg states in small molecules. He welcomed new ideas and mentored many students and colleagues. Ginter continued to actively conduct research at UMD until 2012.

Deborah Morrin-Nordlund, M.S. '92, marine-estuarine-environmental sciences (MEES), and assistant director of the MEES graduate program, passed away April 28, 2014. Morrin-Nordlund worked at MEES for

over 17 years, helping thousands of students achieve their educational goals.

Vejay Singh, undergraduate student in biological sciences, passed away in March 2014. His mother accepted a posthumous degree on his behalf at the May graduation ceremony.

E-an Zen spent 30 years as a geologist with the U.S. Geological Survey before serving as a geology professor at UMD from 1989 to 2004. Zen passed away March 29, 2014 in Reston, Va. As a geologist, Zen focused on northern Appalachian geology, the composition of granites and the origins of the Potomac River gorge. He was a member of the National Academy of Sciences and past president of the

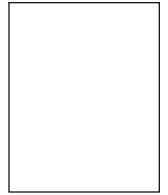
Mineralogical Society of America, the Geological Society of America and the Geological Society of Washington.

Robert Zwanzig, Distinguished University Professor and Professor Emeritus in IPST, passed away May 15, 2014. A theoretical physicist and chemist, Zwanzig joined the faculty at UMD in 1968 and retired in 1988, after which he joined the Laboratory of Chemical Physics of the National Institutes of Health. He was elected to the National Academy of Sciences in 1972. Zwanzig's deep insights into equilibrium and non-equilibrium statistical mechanics influenced these fields profoundly. He was also a great teacher of graduate students and mentor to younger scientists. ■



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