What's the big deal with big data? Take a look in your basement or attic for a quick reminder. You probably have boxes full of personal belongings that you have forgotten long since packing them away. Why do we collect and store so many things? Wouldn't it be great if there were an expeditious way to sort through all of your belongings for the precious things you'd truly like to keep?

A decade ago megabytes of memory meant something. We now take gigabytes and even terabytes for granted, with high-capacity storage drives readily available and affordable. In a recent 2011 report by the McKinsey Global Institute, it was noted that $600 would purchase a hard drive capable of storing all of the world's music! When storage is inexpensive, it is much easier to simply save data than to sort, filter, and delete. Sorting through massive data sets can lead to significant insight, but it is time consuming unless automated (remember your attic . . . ).

Compounding this issue, we, as a society, are creating more data than one might ever have conceived possible. Consider the continually growing storage capacity displayed by Google every time you enter your account (10288.42 megabytes at the time of writing this letter) or the amount of detailed information, “digital breadcrumbs,” people choose to post on Facebook or leave at sites like Amazon or Google when searching for products or information. The same McKinsey report cited earlier noted that 30 billion pieces of content are shared on Facebook alone every month. This data has value in marketing and sales—but in aggregate, not just individually. (I won’t address personal privacy issues here, which is another topic unto itself.) However, to mine this data for kernels of knowledge and insight, one must use algorithms derived from computational science, mathematics, and statistics. This data isn’t neatly structured or organized; it ranges in form from numbers to text, images, and audio/video clips.

The analysis is far from limited to data found on social networks and other websites. Engineers and scientists are generating massive data sets from advanced imaging systems used in medicine from the molecular to the anatomical level, from images of the Earth to that of our universe, from detailed study of genomics and proteomics, and other domains far too numerous to list here. Faculty and students here in the Hajim School, in collaboration with faculty from our School of Medicine and Dentistry, recently published a paper on predicting infectious disease transmission based upon geo-tagged micro-blog data (Twitter). Adam Sadilek and Henry Kautz (Hajim School), and Vincent Silenzio (School of Medicine) developed a scalable probabilistic model to infer the health of a person from location and social interactions observed by monitoring social media.

Our commitment to the future of big data was perhaps best underscored by the Rochester Big Data Forum 2012 (Oct. 4–6), featuring leading researchers, corporate executives, and faculty from across the country.

The University of Rochester formally launched our initiative in big data this past year, thanks to the help and support of alumni like Nomi Bergman ’85 and husband Neal. Numerous faculty lines will be created in support of this initiative to address the ever-growing research demands and to train undergraduate and graduate students for future high-demand career opportunities.

The fall newsletter serves to focus on big data in recognition of our University efforts and the Hajim School’s role in the initiative, and we think that is a Big Deal!

Sincerely

Rob Clark
Professor and Dean, Hajim School of Engineering and Applied Sciences
It is no coincidence that the University hosted Big Data Forum 2012, which attracted some of the leading thinkers and players in the field for presentations, discussions, and networking from October 4 to 6.

The University is quickly becoming a major player in the efficient analysis of vast quantities of data, as demonstrated by the recent acquisition of the IBM Blue Gene/Q supercomputer for the Health Sciences Center for Computational Innovation (HSCCI). The Blue Gene/Q, which can make 209 trillion calculations a second, significantly broadens the data processing power of Rochester.

University researchers may be able to use big data to speed production of vaccines, for example. But the possible applications extend to many other types of data: meteorological measurements, retail transactions, even social media postings. In the Hajim School, Henry Kautz, chairman of the Department of Computer Science, and Adam Sadilek, a post-doctoral fellow in computer science, have been attracting a great deal of media attention for studying messages from the social networking service Twitter. (See the following article, “Can Twitter Really Predict the Spread of Flu?”)

Topics at Big Data Forum 2012 ranged from predictive analytics and machine learning to the semantic web and data mining—the techniques used to obtain, explore, and analyze vast amounts of digital information.

“It’s a bit like prospecting in the old days of mining, because you’re looking for nuggets of gold, represented through novel insights gained from the analysis of very large and complex data sets,” says Rob Clark, dean of the Hajim School and interim senior vice president for research.

Kautz says that with the supercomputing hardware now in hand, the focus should be on the need for people who can use it in creative ways. He believes computer scientists will become increasingly involved in solving research problems in other fields.
Adam Sadilek is a postdoctoral fellow in the Department of Computer Science, working with Professor Henry Kautz and Vincent Silenzio, associate professor of psychology. Sadilek and his colleagues have been using Twitter to predict the spread of infectious illnesses like the flu. Not surprisingly, his research has been getting much media attention in recent months, including coverage in *New Scientist* and *Discover* magazines and on NPR. We asked him to tell us a bit more about what they have found.

**Adam, what does your model predict?**

Our automated model predicts when any given Twitter user gets ill, up to eight days into the future. However, not all cases of an onset of an illness can be foreseen from social media alone.

**How can you do this?**

We collect Twitter data in real time—the content of the tweets as well as current user location (many tweets are annotated with precise GPS information). We have then taught the computer to look at the tweets and determine if someone is ill. Our experiments have shown that our model is nearly as accurate as humans who manually analyze the text and much, much quicker! We can then use the information about the location of the person tweeting and their social ties to quantify the spread of an infectious disease.

**Tweets are only 140 characters—is this enough to understand if someone is ill?**

It is hard but not impossible. There is a limit on the level of detail you can mine from short snippets of text. Rather than doing simple keyword search, we have developed a complex language model that looks at each tweet within a larger context. The model considers more than two million language features when “thinking about” each tweet.
Can this method be used for predicting other things?
So far we have discussed the impact of physical encounters and social ties on one’s health. For infectious diseases, these are the dominant channels for contagion. However, there are other factors as well that affect our well-being, like eating habits, exposure to pollution, exercise, weather, and many others. Leveraging social media, we can begin to quantify and predict their impact on our health in real time and at a population scale, something that was impossible until now.

How do you think we could use this knowledge that we can get from social media?
Our research empowers individuals to make better-informed decisions. For example, when deciding which restaurant to go to, people can readily see which places could be risky based on how many of yesterday’s patrons became ill. The government and other organizations can use insights we mine to refine their policies and base their decision on fine-grained data that is timely and inexpensive to obtain.

And it has led to a start-up company?
Yes, we have founded fount.in (http://fount.in), a social analytics company that helps people and businesses understand what is happening around them in real time. In the health care domain, we focus on questions such as “Will Jane catch a cold next week? How can we intervene to prevent an epidemic?” We answer such questions for specific people, in real time, and at a population scale. This was impossible until now.

If you want to find out more about Sadilek’s research, you can visit his website at www.cs.rochester.edu/~sadilek/research/.

To explore the health of New Yorkers with the web application, go to http://fount.it.
At the start of Yellowjacket Weekend 2012, the Ronald Rettner Hall for Media Arts and Innovation was little more than a fenced-off scrape in the ground, bare dirt occupied by pieces of heavy equipment.

What a difference a year should make. Come Yellowjacket Weekend 2013, if all goes according to schedule, Rettner Hall will be ready for students.

The three-story, 18,900-square-foot structure is designed to be a welcoming, collaborative space. It will be a place “for student-initiated innovation,” notes Hajim Dean Robert Clark, “a playground for students of arts, sciences, and engineering. Offering opportunities to ‘design and build’ for curricular projects or to explore individual curiosity, the building will be a hub for creativity.”

And it will be open 24 hours a day. This is where students will pursue two majors being offered for the first time this fall: digital media studies and audio and music engineering.

Both are designed to give students opportunities to explore the evolving fields of digital technology through multidisciplinary research and learning, through a synthesis of science, technology, art, and the humanities.

“Whether students are designing and building assistive technologies or rendering the latest audio recording,” Clark adds “the Rettner building will be equipped with the tools necessary to accomplish the task.”

The first floor will include a fabrication center filled with electromechanical tools and materials, prototyping tools, and other equipment for students to design and build physical products.

The second floor will feature high-end hardware and software for graphics, animation, 3-D printers, and other computer processing-intensive tasks. Flexible spaces will allow small groups of students to work together.

A third floor “casual room,” next to a multipurpose learning studio, is where students will be able to brainstorm ideas, map out plans, and discuss projects. The floor will also feature state-of-the-art audio and video recording studios, editing rooms, and equipment.

Located between Wilson Commons and Morey Hall, the new building is named for University Trustee Ronald Rettner, a real estate and investment company president and philanthropist, who provided the lead gift, which enabled construction to begin.

Though Rettner’s gift helped make this project a reality, additional support is needed for various programs and capital efforts within Rettner Hall.

Construction benchmarks
Here are some key benchmarks in the construction process, says Jose Fernandez, executive director of Campus Planning, Design, and Construction Management.

- Foundations were laid starting in September; more than 1.5 million pounds of concrete will be placed.
- About 450,000 pounds of steel will be installed starting in late November.
- The building shell is expected to be completed in spring, with occupancy in fall 2013.
Mechanical engineering student Nelson Lee was hoping for an interesting internship this past summer. He got that and more, working at the National Institute of Standards and Technology (NIST), one of the nation’s oldest physical science laboratories. The “more” was the setting at the foothills of the Rocky Mountains in Boulder, Colo.

Lee, now beginning his junior year at the Hajim School, was attracted to the internship because it involved alternative fuels. His research topic specifically dealt with the problem of hydrogen embrittlement—the process by which metals, including steel, become brittle from exposure to hydrogen.

“If this problem can be solved,” says Lee, “the transition to solar and wind power will be much easier.”

The idea is to use existing natural gas pipelines to store and transport the electricity generated by solar and wind systems. The electricity would be in the form of hydrogen, the very substance that can corrode the steel that makes up the pipelines.

Lee helped run some of the tests for metal fatigue and tension, which involved saturating steels in high-pressure hydrogen. He also worked on the precharging of steel, placing the metal samples in a hydrogen environment, then immediately coating the samples with molten tin to prevent the hydrogen from escaping traps inside a metal lattice.

“We made a great deal of headway during my time at NIST,” says Lee. “I worked with a state-of-the-art device capable of simultaneously performing fatigue testing on 10 specimens of different size and material. As a result, we were able to generate a large amount of data during my 10 weeks there.”

Lee, who comes from Manhattan (average elevation 97 feet), not only made the most of his internship at NIST, he took full advantage of his surroundings—once he got accustomed to the reduced oxygen levels—climbing Lookout Mountain (elevation 7,581 feet), mountain biking, and visiting area attractions.
Nearly 100 years after the Optical Society of America (OSA) was founded in Rochester, the annual meeting is back in town.

From October 14 to 18, more than 1,500 researchers from around the world will attend “Frontiers in Optics,” OSA’s 96th annual meeting at the Riverside Convention Center. That’s a far cry from the 100 participants who gathered for the first annual meeting at Columbia University in 1916 to discuss the cutting-edge advancements of the time. This year’s meeting will feature innovative optics and photonics, from adaptive optics and medical imaging to holographic optics and optical sensing.

During the plenary session, Alfred T. Goshaw of Duke University will give a presentation on the “History of the Higgs boson and recent discoveries at the CERN Large Hadron Collider.” Joseph H. Eberly, the University of Rochester’s Andrew Carnegie Professor of Physics and professor of optics, will receive the society’s 2012 Distinguished Service Award. Xi-Cheng Zhang, director of the Institute of Optics and M. Parker Givens Professor of Optics, will receive OSA’s 2012 William F. Meggers Award in celebration of outstanding work in spectroscopy.

It will be the 21st time the meeting has been held in Rochester.

From the beginning, the OSA and the Institute of Optics at the University have been closely related. The Optical Society was founded in 1916 after several individuals met at the Physics Library of the University of Rochester and founded the Rochester Association for Advancement of Applied Optics. That led to the birth of OSA one month later.

This was during World War I, which demonstrated that it was not practical to depend on Europe and Germany, in particular, for optical supplies for the growing optical-related industries.

There also was widespread sentiment in the United States that a school was needed to supply trained optical scientists and engineers to industry and to perform basic research. This led to discussions about starting the Institute of Optics at the University. Many of the founders of the OSA were part of the advisory committee that led to the institute’s creation in 1929.

The close relationship between the OSA and the institute continues. For example, 18 of the 76 past OSA presidents were alumni of the Institute of Optics or were on its faculty at the time of their election.
Govind Agrawal, professor of optics and of physics, received the IEEE Photonics Society’s prestigious Quantum Electronics Award during the group’s annual conference in September in San Francisco.

Joseph H. Eberly, Andrew Carnegie Professor of Physics and professor of optics was selected to receive the 2012 Distinguished Service Award from the Optical Society.

David Foster, assistant professor of chemical engineering, was named a University Professor of the Year, a Students’ Association honor that celebrates a faculty member for his or her achievement purely as an undergraduate professor.

Lane Hemaspaandra, professor of computer science, was chosen as this year’s sole recipient of the prestigious Edward Peck Curtis Award for Excellence in Undergraduate Teaching.

Jennifer Kruschwitz, adjunct professor in the Institute of Optics, was named 2012 Technology Woman of the Year by Digital Rochester, a networking group.

Duncan Moore, vice provost for entrepreneurship, the Rudolf and Hilda Kingslake Professor of Optical Engineering Science and professor of optics and of biomedical engineering and professor of business administration in Simon School, was recognized for his outstanding record of research, teaching, and leadership with the Hajim School’s 2012 Lifetime Achievement Award.

Brian Thompson, provost emeritus and professor emeritus of optics, was named 2011 Engineer of the Year by the Rochester Engineering Society at its 110th annual gala held April 28.

David Williams, William G. Allyn Professor of Medical Optics and professor of optics, of brain and cognitive sciences, of ophthalmology, of biomedical engineering; and director of the Center for Visual Science, has received the Antonio Champalimaud Vision Award at a ceremony chaired by the president of Portugal in Lisbon. The award recognizes Williams’s work on adaptive optics technologies.

Xi-Cheng Zhang, director of the Institute of Optics and M. Parker Givens Professor of Optics, was selected to receive the Optical Society’s 2012 William F. Meggers Award in celebration of outstanding work in spectroscopy.
Twice a year they gather, from Tucson and Boston, from LaJolla and Long Island, from Washington, D.C., and upstate New York. Fifteen of the best and brightest in their fields.

Their expertise covers a broad range, from precision optics to investment banking, from aerospace engineering to intellectual property law. Nine have headed, founded, or helped launch companies. One was secretary of the Navy.

This is the Dean’s Advisory Committee of the Hajim School.

“Every major organization is served by an advisory group that provides perspective on opportunities and challenges,” says Robert Clark, who picked the DAC’s members after becoming dean of the school in 2008.

They advise and counsel Clark on key aspects of the school’s management, offering insight and guidance on curricular initiatives, capital needs, trends in admissions and retention, career and internship services, and networking skills for students, as well as providing leadership in garnering financial support for the Hajim School, explains Eric Brandt, the school’s senior director of development.

They also advise on the “critical issues facing engineering,” Clark adds. “For example, a recent focus of the group has been communication and networking. Many participants from the DAC and other alumni have volunteered their time to provide workshops for students outlining the importance of professional networking and communication.”

This initiative is leading to a new course for undergraduates that will formally address verbal and written communication as a way to improve their professional networking skills and enhance their career opportunities, Clark adds.

All DAC members are also members of the George Eastman Circle, an influential group of University donors. All but one of them are University of Rochester alumni.

And that member, Chairman John Bruning—who has strong ties to the University of Rochester as a member of its Board of Trustees and having served on the Institute of Optics’ Strategic Planning Committee.
Bruning says he was flattered when Clark asked him to serve on the Dean’s Advisory Committee. Even before serving on the board, Bruning had been impressed by Clark’s willingness to seek advice. “He is such a quick study and such a good leader,” says Bruning. “I thought that whatever time I might invest in an advisory committee for him would be worthwhile. A lot of deans are forced into this kind of thing and don’t want it. It was quite clear that Rob did want it and would benefit.”

DAC meetings are held in places like Chicago, New York, or California that are convenient for its far-flung members to reach.

“It’s a very action-, results-oriented group,” says Bruning, “consisting for the most part of business people, so it has that kind of flavor to it.”

“I would say there’s probably dialogue by at least half of the group that occurs outside the meetings.”

That dialogue, in meetings and outside of meetings, can bear fruit in many ways. For example, a conversation among DAC members led to the coining of “Full Spectrum,” the school tagline that graces the cover of this newsletter. That’s an appropriate description of the Hajim School’s offerings—and a pretty fair approximation of the breadth of advice DAC members bring to its dean.

Wyant Gift

James C. Wyant, a member of the Dean’s Advisory Committee, is remembering his alma mater with a most generous donation. Wyant’s gift will create an endowed professorship in the Institute of Optics, where he got his academic start more than four decades ago.

“At a formative time in my professional life, Rochester grounded me in the sound principles of optics,” says Wyant. “This gift is not only an expression of gratitude for what Rochester did for me, but also a vote of support for the increasingly global optics community.”

Wyant earned both his master’s degree and his PhD in optics from the University of Rochester.

Visit meliora.rochester.edu

Bob Klimasewski

’66 (engineering), ’67 (M5 optics). Chairman, Virtualscopics Inc., medical imaging analysis tools that assist in accelerating drug development.

Previously president, CEO of Transcat Inc., and cofounder, vice chairman, Burleigh Instruments, Inc. Recipient, Armstrong Alumni Service Award (2006) and Hajim School Distinguished Alumni Award (1993). Member, University of Rochester Athletic Hall of Fame (baseball, football). Served as a member of the Trustees Alumni Council of the College.

Michael Lax

’75 (chemical and mechanical engineering). President, CEO of Au tronic Plastics Inc. and subsidiaries, Westbury, N.Y., plastic product design, mold construction and manufacturing of industrial and precision components. Founder, Clear-Vu Media (entertainment-packaging), and (with son Daniel) Clear-Vu Lighting (high-powered LED Luminaries and jobsite lighting for subways, construction industry). Member, New York City Regional Cabinet.

John Major

’67 (mechanical and aerospace engineering). Founder/president, MTSG (Major Technologies Solutions Group), Rancho Santa Fe, Calif., investment, consulting, operations, and governance practice focused on the telecommunications industry. Considered a pioneer of the wireless industry. Recipient, Hajim School Distinguished Alumnus Award (2010). Served as a member of the Trustees Alumni Council of the College.

Rob Milne


Howdy Pratt

’60, ’62 (MS geological sciences), ’66 (PhD geological sciences). More than 20 years’ experience with SAIC as senior vice president. Founder, first employee of Terra Tek; founder, director, Pioneer Oil and Gas Company. Member University of Rochester Athletic Hall of Fame (tennis). Member, San Diego Regional Cabinet; has also served as a member of the Trustees Alumni Council of the College.

Don Winter

’69 (physics). Former Secretary of the Navy, currently consultant to the Navy and other organizations. Led NRC study and report on Deepwater Horizon Oil Rig Blowout. Former VP, divisional president, Northrup Grumman. Recipient, Arts, Sciences, and Engineering Distinguished Alumnus Award (2009). Member, Washington, D.C., Metro Regional Cabinet.

Jim Wyant

’67 (MS optics), ’69 (PhD optics). Professor of optical sciences, and of electrical and computer engineering, University of Arizona. Former dean there.

Visiting professor, the Institute of Optics. Recipient, Hajim School Distinguished Alumnus Award (1994). Serves as a Trustee for the University of Rochester.
FAST FACTS

- Home to the Institute of Optics: founded as the first optics education program in the United States in 1929 through a grant from Kodak and Bausch & Lomb

- Laboratory for Laser Energetics, a national resource for research in inertial confinement fusion, is led by Robert McCrory, a mechanical engineering faculty member.

- Advantageous undergraduate student to faculty ratio of approximately 10:1

- Percentage of bachelor’s degrees awarded to women by school: Ranked 19th @ 31.3%

- The percentage of Hajim students studying abroad has increased from 10.1 percent in 2007 to 16.0 percent in 2012.