

AT A GLANCE

DISCIPLINES

Computer Science
Mathematics
Statistics

RESEARCH STRENGTHS

Mathematics:

*Algebra
Applied Mathematics
Combinatorics
Geometry
Number Theory
Topology*

Computer Science:

*Artificial Intelligence
Computer Systems
Database & Knowledge Management
Scientific Computing
Theoretical Computer Science*

Statistics:

*Bayesian Statistics
Probability*

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Think:
Solutions

**Computer &
Mathematical
Sciences**

CGMS



The Department of Computer and Mathematical Sciences (CMS) is the University of Toronto Scarborough's home for mathematics, statistics and computer science – three disciplines at the core of advances in science and technology. The University of Toronto is at the elite level of research in these fields – a distinguished reputation in which the faculty of the CMS Department at UTSC plays an important role.

In Mathematics, UTSC is the de facto hub within the three University of Toronto campuses for work in probabilistic combinatorics. Faculty also work in number theory, algebra, geometry, topology and applied mathematics. In Statistics, the focus of research is Bayesian statistics. Computer Science faculty work in database and knowledge management, artificial intelligence, computer systems, scientific computing and theoretical computer science.

The CMS Department's 16 tenure-stream faculty are active in graduate-student supervision as well as research, publishing 45 articles in prestigious refereed journals and conference proceedings in 2007-08. Collectively, the department's researchers bring to UTSC close to \$1 million in research funding each year. With 14 other members in the teaching stream, CMS faculty total 31. Two recent hires in the department are Balazs Szegedy in Mathematics and Bianca Schroeder in Computer Science.

CMS offers about 80 courses and 90 lecture sections every year to some 7,000 students, with more than 500 of these students enrolled in the department's four specialist and three major programs. All CMS programs have a co-op option. Programs are also provided in conjunction with other departments such as Management and IT, Natural Sciences and Physical and Mathematical Sciences.

In 2007-08, the department introduced the Quantitative Analysis program, in which students apply mathematical tools to discover patterns in data. This highly interdisciplinary program brings together mathematics, statistics and computer science, combining them with knowledge in other subjects. It prepares students for careers as data analysts in numerous fields, including biological and life sciences, physical sciences, finance and economics, and social and health sciences. To enhance the ability of UTSC students to pursue interdisciplinary studies, the department will also offer two new minor programs in Computer Science and Statistics.

The superior quality of the faculty and programs at CMS is evidenced by its outstanding students. Wojciech Gryc, a graduate of UTSC's International Development Studies (IDS) and Mathematics programs, was named a Rhodes Scholar for 2008; he now pursues a master's degree in mathematical modelling and scientific computing at the University of Oxford. (Read more about Gryc's story on page 45.) Thuy Vu, an undergraduate in the Computer Science co-op program, was a finalist for the Google Anita Borg Scholarship in 2008, which honours women who excel in computer science. •

Elites among the elites of mathematics

The “University Professor” designation, which recognizes pre-eminence among the many distinguished professors at the University of Toronto, is held by only 35 – barely 2 percent of the total number of professors across the three University of Toronto campuses.

Renowned number theorist John Friedlander is UTSC's only faculty with the distinction, which was awarded to him in 2002.

Before joining U of T in 1977 and serving as Chair of the Mathematics Department in 1987-91, Friedlander has held appointments at Massachusetts Institute of Technology, University of California, Berkeley, and Princeton University, where he has been a

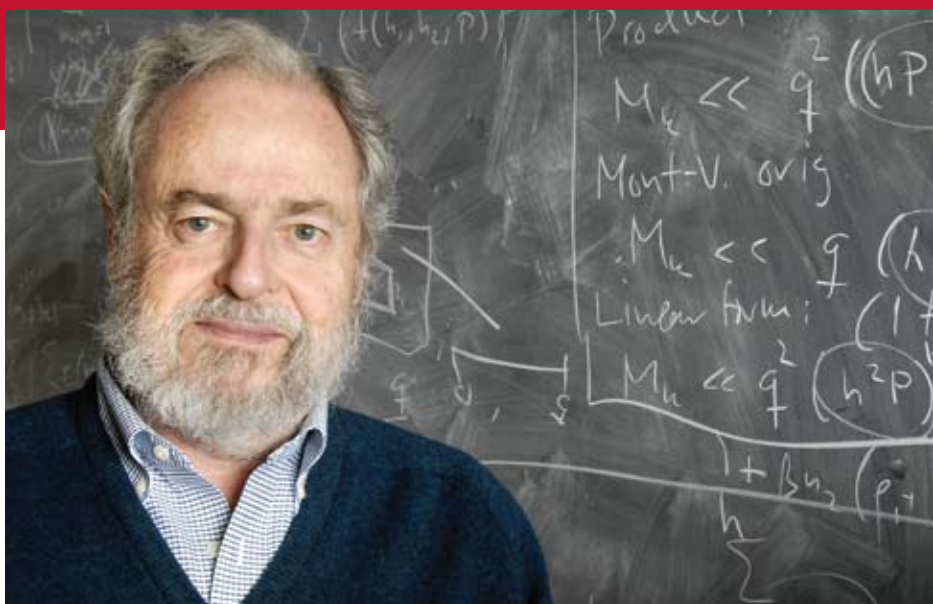
member of the Institute for Advanced Study.

The importance of any mathematical advance relates to its close connection to other fields of knowledge such as physics or computer science. Once seen as unconnected to anything outside the realm of pure math, number theory has arrived in the everyday world via high-speed computation and cryptography in applications such as online security.

Friedlander's contribution to this field has been highly lauded. In 1988 he was named a Fellow of the Royal Society of Canada. In 2002 he received the CRM-Fields prize, Canada's premier award for mathematics, and the Killam Research Fellowship from the Canada Council for the Arts for 2003-05.

Another accolade garnered by the Computer and Mathematical Sciences faculty is the appointment of Professor Lisa Jeffrey in 2007 to the Royal Society of Canada. She was also selected in 2005 as a Fields Institute Fellow, a distinction conferred to those with outstanding contributions to mathematics in the country. An expert in symplectic geometry, an area of mathematics linked to theoretical physics, Jeffrey applies pure mathematics to prove results predicted by physicists in quantum field theory. She excels at making abstract principles relevant in her second- and third-year mathematics classes at UTSC.

Among the notable early-career scholars in the department is Mathematics Professor and Canada Research Chair Bálint Virág. In August 2008, Virág received – jointly with University of Colorado's Brian Rider – the Rollo Davidson Prize, presented by the University of Cambridge to young, promising researchers in probability theory. The international award recognizes Virág and Rider's work in random walks and matrix theory with practical applications ranging from the evaluation of search engine effectiveness to representing properties of physical systems and nature.



The Computer and Mathematical Sciences Department boasts many distinguished faculty who are recognized for making groundbreaking contributions to their respective fields. Among them are (from top), Professor Bálint Virág, Professor Lisa Jeffrey and University Professor John Friedlander.

Visualizing new directions in computing

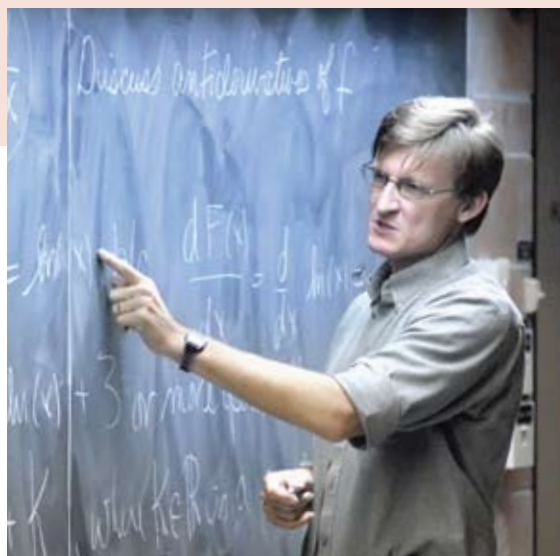
Award-winning UTSC Computer Science Professor David Fleet is researching how to enable computers to see. Computers do see but in limited ways – vision chips in cars, for example, can detect obstacles – but Fleet is more involved in the fundamental problems of computational perception rather than in the applications.

His interdisciplinary research spans problems in computational visual perception and neuroscience, as well as computer vision, an area of interest to numerous fields, such as aerospace and medicine. He foresees the addition of a machine learning course to his teaching portfolio which includes computer graphics and computer vision.

In one of his research projects, computers are programmed to estimate the shape and movement of people from digital video. With this information, he can synthesize animated characters from new perspectives, or recognize a person's activity. With research projects like this, Fleet's work will help future computers perceive and process images and video of the three-dimensional world in ways similar to humans.



Professor David Fleet is pictured here with images depicting results from the physics-based people-tracking project, produced in collaboration with PhD student Marcus Brubaker.



Senior Lecturer Ray Grinnell teaches students the value of mathematics in getting to the heart of matters.

Teaching the value of math

UTSC Mathematics Senior Lecturer Ray Grinnell is recognized as an excellent teacher. He won the Scarborough Campus Students' Union Teaching Award in 2005 and was nominated for two consecutive years for TVO's *Best Lecturer Competition*.

Grinnell's view of his job – *teaching* mathematics, not *lecturing* on it – benefits the wide range of students who take courses in the Department of Computer and Mathematical Sciences, as the vast majority of them are not math specialists or majors. The secret, according to Grinnell, is in instilling in students the value of mathematics to other applications. Math skills – such as numeracy, critical thinking, analytic and logic – help students in any program get to the heart of matters. Frequently applying context – and humour – Grinnell is able to bring on board students from a diversity of academic programs and math skills.

"One popular theme is money. Money almost always gets the attention of management students," says Grinnell. "I tell them, 'Drink one less medium cup of coffee a day. Take the \$500 annual saving and invest that each year at 7 percent. Then, when you're my age, you'll have \$40,000 – all because you bought one less cup of coffee. However, do it now, because the key factor is time.'"

"When I arrived at university, I found math much tougher than I expected. Professor Grinnell was extremely approachable and gave me extra help every week through a summer make-up program. This became a turning point for me and now I'm pursuing teaching as my career path."

**– Anna Fan, fourth-year student,
Mathematics and Chemistry Major**