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2005 CARLETON UNIVERSITY CONVOCATION

Researcher keeps eye on the big picture

Gabriel Wainer hopes to develop computer systems that can react in real-time to real-life situations, writes
PAULINE TAM.

Technicians bearing new computers come and go from Gabriel Wainer's office, adjusting the equipment that links him to a lab down the hall. If Mr. Wainer has his way, the 64 extremely fast computer chips in the lab will eventually work together, performing complex tasks at dizzying speeds.

One of Mr. Wainer's ideas is to use this automated system to control a mock factory built entirely of Lego pieces. An even better idea would be to run the factory remotely from his office, where he could control the whole operation on a computer.

This is one of the ways Mr. Wainer plans to spend a $15,000 prize from Carleton University, which recently named him one of its top researchers of the year.

The experiment may sound like child's play, but there's a deeper purpose behind the setup. Mr. Wainer, a computer scientist, is trying to solve a problem that has long eluded specialists in the field: How to simplify the design of large, intricate computer systems, while improving the efficiency and accuracy of the software that controls them.

To engineers, this is the challenge of real-time computing — the ability of machines to simulate real-life situations, and react instantaneously to their surroundings.

In the future, Mr. Wainer's work may even lead to what's known as predictive computing — the ability of machines to perceive, reason and make decisions ahead of when they're needed, ushering in a new age of "intelligent" technologies.

It's not the type of cuttingedge work Mr. Wainer was able to do in his native Argentina, which is what led him to Carleton five years ago.

"When I was interviewed, people asked me, 'Why are you coming to Carleton?' And I said, 'Because when I see who teaches here and what is being taught, this is what I would have loved to study as a student.'"

At 39, Mr. Wainer is a mathematician by training, but he has become an expert on complex physical systems after creating a software toolkit that can be used to study everything from forest fires to traffic jams and Internet user patterns.

At the heart of Mr. Wainer's work is the idea that intricate math governs almost all of the seemingly chaotic and complex events of life.

When he first started as a graduate student, the abstract world of numbers and formulas was what interested him. But over the years, he has learned that the knowledge gained from his work can be used to solve real-life problems.

"We do a lot of work on methodology, but people want the application," observes Mr. Wainer. "They want to see what this is useful for."

In the case of gridlock, his tools can simulate swaths of urban geography, as well as the behaviour of every driver in it, allowing traffic lights to be reprogrammed to ease congestion.

The same tool can simulate the landscape and winds that affect how a forest fire spreads, as well as how firefighters react to the blaze. The resulting information can be used to plan effective firefighting techniques or predict whether a town is in the path of a fire.

Mr. Wainer has a website of more than 150 different models, all of which use advanced math to simulate complex systems. The models are widely available to researchers and private industry free of charge. As an example, a University of Ottawa graduate student is currently using one of the models to study chemical reactions in human cells.

"I have models of ants moving in the field, and I have models of bacteria spreading on the surface of raw fish. And the mathematics that we use for those things are exactly the same," says Mr. Wainer.

The son of a well-to-do family in Buenos Aires, Mr. Wainer spent his childhood steeped in numbers. His grandfather was the country's auditor general, and his father, who trained as an industrial engineer, ran a consulting business.

As a teenager, Mr. Wainer helped his father with the accounting books, and assumed responsibility for the office computer, which he learned to program. At a time when personal computers were still a novelty, he quickly got hooked and decided to pursue computer science in university.

Because the field of real-time computing was still new, Mr. Wainer taught himself much of what he knows by reading whatever textbooks he could find in Argentina.

While doing his master's degree at the University of Buenos Aires, he was recruited by a visiting scholar to the Université d'Aix-Marseille in France, where he completed a PhD. It was there that he expanded his research to include the related field of computer simulations.

But despite finishing his PhD at the top of his class, Mr. Wainer returned to Argentina with few prospects for the kind of research he wanted to do. Beginning in 1997, he taught part-time at a number of universities around the country, and accepted invitations — from the U.S., Japan, Korea — to work as a visiting scholar. But he always returned to his native country wishing advanced research opportunities were available closer to home.

Disillusionment started to set in when he noticed that some of his former students, working in Argentina's private sector, made five times the salary he did.

"They would say to me, 'You have a PhD, you're brilliant, why don't you go to industry?'" recalls Mr. Wainer. "And I would say, 'Because I love this. Why do I have to change and go to industry? I love teaching and researching.' I was happy with what I was doing but deep down, I felt there was a lack of respect for what I did."

It wasn't that Mr. Wainer wanted to get rich; he simply wanted to feel his work was valued. As it was, he was teaching at three different universities just to make ends meet.

"If my salary was half the money that my students were making in industry, I wouldn't feel so bad. And that was the general feeling of many people who were in my situation. We didn't want to get super salaries if we got to stay in Argentina with our family and friends, doing academic work that we love."

In 1999, near the height of Ottawa's tech boom, he picked up a trade magazine and noticed in an ad that Carleton was hiring computer-science professors. He didn't hesitate to apply.

Once hired, he arrived to find a vibrant climate for eager young computer jockeys — a mood that quickly turned sour with the sudden downturn of the city's tech economy. But Mr. Wainer wasn't deterred.

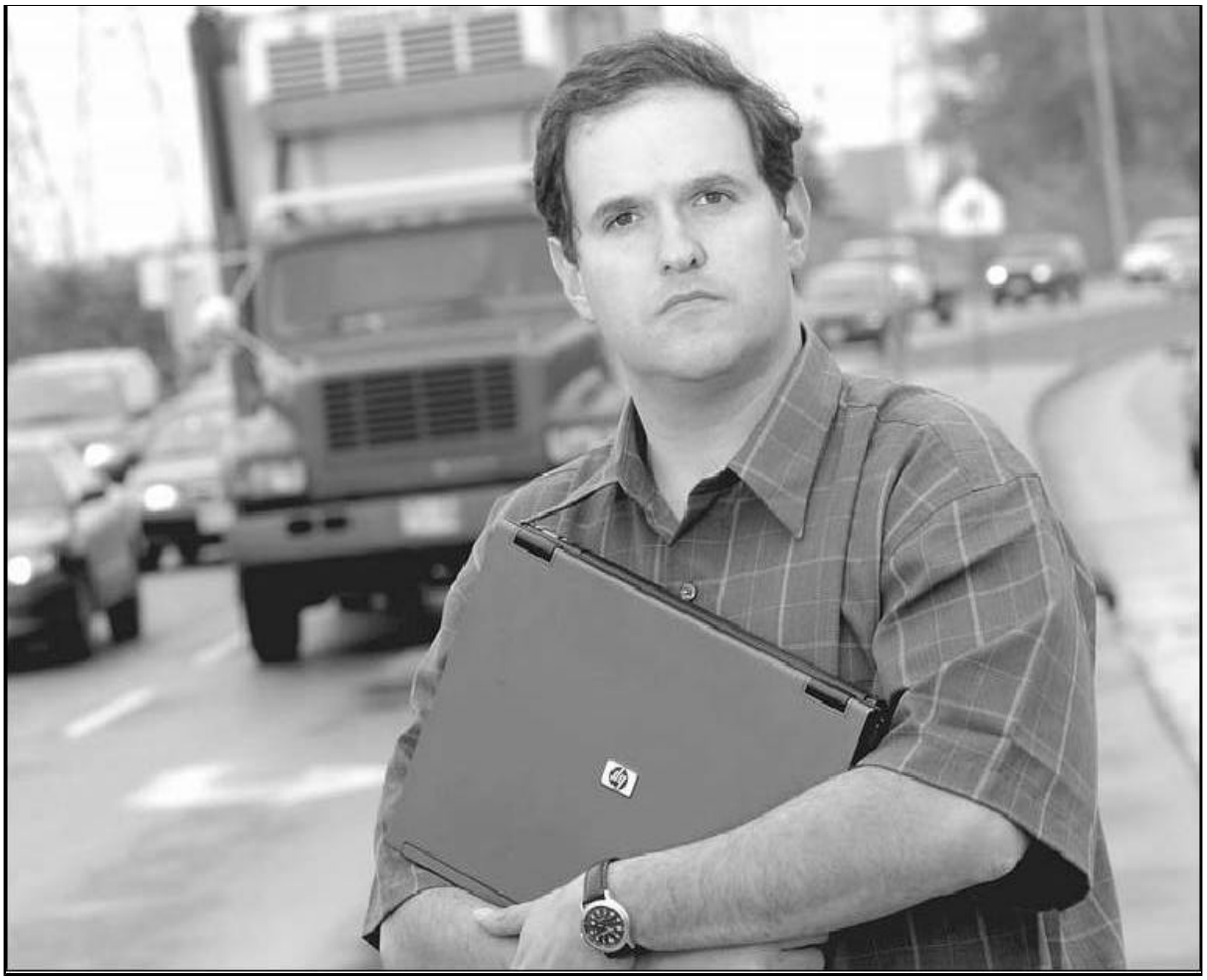
"I didn't have any research support from industry when I came because I was pretty new, and then I didn't have any industrial funding after that because everything went downhill."

Things have definitely changed these days.

Mr. Wainer's research is being funded over the next five years with a $125,000 federal grant, and his lab is being outfitted with more than $500,000 from government and industry, including contributions from Hewlett Packard, IBM and Intel.

For a guy who likes nothing better than to crunch numbers, life is good. "I like the focus of what we're doing here," says Mr. Wainer. "This is where I've always wanted to be."

CARLETON UNIVERSITY AT A GLANCE
Full-time students: 18,720 Part-time students: 4,865 Faculty: 776 full-time, 424 part-time
English-speaking students:
16,985
French-speaking students:
533 Other: 4,728 Not reported: 1,339 Geographic origins: 21,153 Canadian, 2,433 foreign
Leading origins of Canadian students: Ontario, Quebec, British Columbia
Leading origins of foreign students: China, Iran, India, U.S. President: Richard Van Loon
Operating budget:
$240 million Research budget: $86 million



BRUNO SCHLUMBERGER, THE OTTAWA CITIZEN Gabriel Wainer, a computer scientist at Carleton University, is trying to solve a problem that has long eluded his peers: How to simplify the design of large, intricate computer systems while improving the efficiency and accuracy of the software that controls them.