Campus Profile
McGill UniversityÐTeaching, research, and new network technology

McGill University of Montreal has a full-time student enrollment of 18,000 and its faculty number approximately 3,000. Recognized for research, McGill also has more than 4,000 graduate students. The university offers a three-year undergraduate program leading to a bachelor's degree, and graduate studies leading to master's and doctorate degrees.

Until last year, McGill offered programs leading to M.S. and Ph.D. degrees but undergraduate courses only in conjunction with engineering and mathematics major programs. In 1990 the Quebec government gave McGill permission to add a computer science major, and provided funds for the university to purchase computer equipment. After evaluating several computer systems, McGill selected NeXT computers and purchased 53 NeXTstations and 8 NeXTcubes in addition to the four NeXTcubes the school already owned. The School of Computer Science plans to use the NeXT computers for teaching, computer architecture research, database research, software engineering, computational robotics, computational geometry, and artificial intelligence.

Selected for operating system and interoperability

"When we evaluated computer systems, our requirements were a multitasking operating system that could run a large body of existing UNIX-based software, an object-oriented environment for fast prototyping and developing, high-speed networking capability, and the ability to co-exist with our existing workstations, which include Sun, MIPS, IBM, Hewlett-Packard, and Solbourne," says Peter Deutsch, systems manager for the School of Computer Science. The school also had stringent requirements for the operating system. "We wanted a friendly interface because many students are taking our courses as electives and we see no reason to inflict raw UNIX upon them," says Deutsch. "At the same time, our computer science students need to be able to `lift the lid' on any conventional graphical user interface

and access the raw operating system." To evaluate operating systems, Deutsch tried compiling and running a number of third-party UNIX utilities not included in the NeXT system software. "We were able to compile every tool but one without error. Underneath the NeXTstep graphical user interface is a stable implementation of Mach, which does a great job of looking like Berkeley UNIX."

Computer science teaching laboratory

The NeXT teaching lab will have 60 NeXTstations: 50 for students and 10 for staff or for use as laser printer drivers and network information servers. The classes slated to use the lab include Files and Databases, Topics in Artificial Intelligence, Automated Reasoning, High-performance Computer Architecture, and Computer Networks. "Initially, we've selected courses that need to have access to loosely coupled parallel processing capabilities, which a network of NeXT computers provides," says Deutsch. "As we get a feel for the lab load, we may extend use of the lab to students in first-year courses, such as Comparative Languages, Compilers, and the undergraduate Computer Architecture course."

Research in parallel computation

The teaching lab will also support research in parallel computation applications. Renato de Mori, director of the School of Computer Science, plans to use the NeXTstation network to apply speech recognition algorithms to large voice samples, which he collects using Ariel dual-channel stereo microphones for NeXT computers. "Speech recognition is a compute-intensive job, that is well suited to parallel computation," says Deutsch.

To distribute computation tasks to individual NeXT computers, de Mori's team will use Zilla, a program bundled with NeXTstep 2.0 that allows one master server machine to remotely execute processes on slave machines (see ªTales of zilla: Adventures in distributed computation,º *NeXT on Campus*, June, 1990). As a particular computer completes a task, it sends the result to the server and requests more work. The research won't interfere with students' computer time because Zilla assigns a task to a particular NeXT computer only when it is not being used.

Students develop standalone sound editors

De Mori also uses NeXT computers to teach a course in Person-Machine Communication. ªIn the course, students develop interfaces using icons, menus, windows, speech, speech recognition, and speech

playback,º says de Mori. Last year, de Mori asked students to develop a standalone sound editor for the NeXT computer, based on the Lip Service panel in NeXTmail. Sound editors are used to edit speech waveforms and build messages from a basic set of spoken sentences without repeating voice acquisition. de Mori explains, ªTo make an announcement in an airport, for example, you need the phrase `flight number,' followed by the digits, then the destination, then the phrase `gate number' followed by the digits. Using a sound editor, you can create whatever sentences you need without doing voice acquisition for every possible message. There are a lot of little tricksÐif you build up a message by isolated words, it doesn't sound natural.º

When the School of Computer Science was evaluating NeXT computers, de Mori asked an on-staff programmer if developing a stand alone sound editor for the NeXT computer was a reasonable eight-week project. The programmer studied the problem during weekend, and came back Monday not only with a "yes," but with a complete solution. He developed a sound editor that could record, display, edit, and save a messageÐin 30 lines of code. ªWhile we could have developed the sound editor using X Windows instead of NeXTstep, it would have required substantially more code,º says de Mori. The speed of programming in the NeXTstep environment allowed de Mori to expand the assignment, asking students to customize the base sound editor for specific applications, such as making bank transactions by phone. ªOur students really like the machine because it allows them to concentrate on the programming work instead of the tedium of manipulating bits,º he says.

Using speech and icons in telerobotics

In another application of speech technology, de Mori is using a NeXT computer to study the use of speech and icons in telerobotics applications. ªOn the MegaPixel Display we simulate a robot that would assist physicians performing eye surgery,º says de Mori. ªWe also simulate an eye and two microscopic needles. The physician, who presumably has his or her hands busy, gives voice commands to the robot, who manipulates the needles with more precision than a human could.º

McGill's biomedical engineering department intends to build a working prototype of the simulated robot for actual use in microsurgery.

Database application development

Faculty member Tim Merrett is using a NeXT computer to develop a new database programming

language that integrates any database and an application. Called Aldat, for Algebraic Data Language, Merrett's language is unique because it operates on any data in secondary storage (on disk), including maps and pictures as well as text. ªThe watchword of our concept is integration,º says Merrett. ªBy integrating a database into a programming language, we can provide the flexible operations for data in secondary storage that programs such as Pascal, Objective-C®, and ADA provide for data in main memory. This makes it easier for a programmer to write programs that involve database applications.º

Potential applications for Aldat include Hypertext programs that find a given word in all its contexts, indexing, and analyzing maps and picturesÐfor example, determining what state contains a given city. ªAlgorithms for this kind of data manipulation in main memory are well known,º says Merrett. ªTo have them run in a database programming language is new. Programmers who work on databases generally have to add special constructs to deal with pictures and maps. With Aldat, programmers don't need to add anything special for maps, texts, or expert systems, because the language is based on general concepts. Aldat works at the same level with files as FORTRAN does with numbers. Where you can add numbers in FORTRAN, you can merge filesÐor relationsÐwith Aldat.º

Besides integration, Aldat's other primary advantage is the flexibility it gives the programmer. "Aldat is a flexible development language," says Merrett. "It enables you to build a program incrementally, working from what you understand now, to what you need to build. That's usually a no-no in software engineering. We've made concepts as few and broad as possible. Therefore, the language has relatively few syntactic constructs."

The value of Aldat's spare syntactic constructs was validated by Merrett's experiment with artificial intelligence programming, for which the language is not specifically designed. "We rewrote an existing expert system shell using Aldat in just one man-month, compared to the several man-years it might have taken using another language." Merrett attributes the faster development time to Aldat's high-level language and its built-in editors. ªBecause Aldat is such a high-level language, the shell occupies 170 lines of code. That's an advantage in itself, because if the code is short, there's less likelihood that bugs can creep in. Once you've done your editing, the data is absorbed into the relational system." The built-in editors include a Prolog language editorÐuseful for artificial intelligence application developmentÐa picture editor, and a text editor. The programmer can turn them on to do a specific function, then turn

them off to return to the relational database.

In putting Aldat in perspective, Merrett states that the advance it represents is not in providing new programming capabilities, but rather in wrapping existing technology in a neater package. "We view Aldat as ordering the field of database application programming languages so it can become the next stepping stone."

Merrett plans to develop a NeXTstep interface for Aldat. "NeXT is the most favorable target machine because it comes with useful software and data that we want to integrate into AldatÐfor example, the Digital Librarian text database, its object-oriented interface, and PostScript for drawing pictures and formatting documents," says Merrett. "These are all features we'll integrate into Aldat."

The School of Computer Science is currently using Aldat in the undergraduate Databases course as an example of a relational database system. In graduate courses, students investigate new applications and capabilities for Aldat, helping them prepare to do their own research on language concepts.

Port of X11 Release 4 of X Windows
McGill also required X Windows support because the systems staff uses X Windows to manage the School of Computer Science network and to display the output from their minicomputer debugger. X Windows was not commercially available for NeXT computers, so a staff member from the McGill Research Centre for Intelligent Machines was enlisted to port X11 Release 4 of X Windows. "We rebuilt the MIT Release 4 of X Windows, changing its 8-bit server for color screens into a 2-bit server for the monochrome NeXT," says Deutsch. "The initial port took just one month." The beta version runs in cooperation with NeXTstep version 1.0a. A release for NeXTstep version 2.0 is planned, and both versions will be submitted to MIT for inclusion in the standard X11 release.

Server for directory of Internet archive sites
The School of Computer Science has developed and manages a server that enables users to locate programs on the Internet, a collection of 300,000 computers at universities and research institutions around the world. Approximately 750 sites are archive servers, which make files available to other members of the Internet. These servers include software, mailing lists, bulletin boards archives, and digitized images of Hubble telescope photographs. "The archive site storage is in the gigabytes," says

Deutsch. "The biggest problem users face is finding the program you want." To simplify the task of locating files, a programmer at the School of Computer Science wrote software that lists and updates all files at archive sites. It proved so popular that McGill now makes the service available to anyone on the Internet. McGill calls its server Archie, the "server server."

Archie allows users to search for specific program names or strings and find which server contains the program, or to list all the software on the server at a particular site. Currently, Archie runs on UNIX workstations. "We plan to port the server code so it will run on a NeXT computer at McGill and also to develop a graphical user interface for NeXT computer owners who want to use Archie," says Deutsch. To use Archie, users with UNIX machines can telnet to quiche.cs.mcgill.ca. [132.206.2.3] as user archie.

Versatile programming environment
Some researchers, programmers, and other faculty at McGill use NeXTstep, others use raw UNIX, and still others plan to use X Windows when the port is complete. "The primary advantage of the NeXT development environment for our research is the object-oriented environment, which enables us to do fast prototyping and developing," explains Deutsch. "We consider it an enabling technology because it allows us to attack projects we couldn't have before."

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