

DIGITAL EQUIPMENT CORPORATION

pdp10

APPLICATION NOTE

The University of Western Ontario Expands Computing Centre



A flag atop a distant medieval castle...the moat-like Thames River...Big Ben sounding the hour over rolling countryside. The foregoing is not a scene from merry old England; it's a bit of the colorful atmosphere to be found on the lovely meadowed campus of The University of Western Ontario, London, Ontario, Canada.

In contrast to its setting, this university of over 13,000 students boasts one of the most modern and progressive university Computing Centres in the western hemisphere. To provide the best possible service, the Centre has developed a complex computer network, structuring the system around a PDP-10 time-sharing computer supplied by Digital Equipment Corporation. The result is a versatile system that allows many users to perform a large variety of computing tasks at the same time.

For example, several departments have remote batch processing terminals which permit programs in card form to be submitted to the PDP-10 or to a separate batch processing computer. Teletype terminals scattered throughout the university allow students and faculty to conversationally develop specialized programs or use the computer in instruction exercises. Another PDP-10 terminal—essentially a separate computer—ties the system to a display unit and drum plotting device so that program information can be graphically displayed.

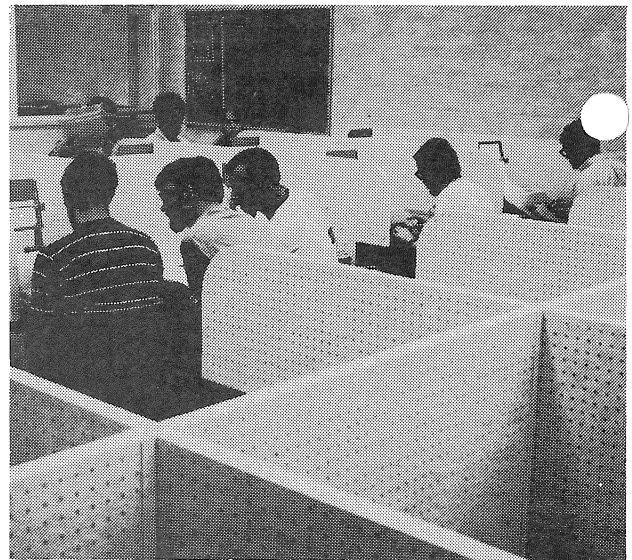
Since the PDP-10 was installed in the summer of 1968, demands on the Computing Centre have increased greatly. To provide needed service, the Centre staff and the operating budget have doubled. System capacity has also expanded with the recent addition of disk pack systems, providing 40 million words of on-line storage for user programs and data. Also, the Centre is acquiring more teletype terminals—so that a total of 42 terminals can simultaneously communicate with the PDP-10.

Whereas personnel turnover in programming is normally high, turnover at the Computing Centre is extremely low, due to interest in developing and expanding the complex computer network. But the challenge of equipment and operation is only part of the story. Staff interest is also held by the scope and diversity of projects being implemented: programs to classify Russian folklore, population genetics studies on fruit flies, fertility studies of East Coast fishermen to name a few.

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Learning FORTRAN via a keyboard CRT terminal and a slide projector.



The Computer Science Department presently uses 24 teletype terminals, four keyboard CRT devices, and slide projectors. In the near future, they will have a complete multi-media laboratory for undergraduate instruction with eight individual carrels, each of the carrels in view of a central TV monitor screen.

University of The North—A CAI Project

Even the Eskimos have used "Western's" PDP-10. In cooperation with the Federal (Canadian) Department of Communication, the Computer Science Department recently sponsored a student to perform CAI research with public and high school Eskimo natives. The experiments were held at Inuvik, a village on the MacKenzie River, 120 miles north of the Arctic Circle.

Primarily an information exchange, the studies employed a teletype terminal connected to the PDP-10 by a series of cable, microwave, and wire communication media. After the program was completed, the same teletype was demonstrated at a communications conference at Yellowknife, Northwest Territories, Canada, a meeting attended by computer users, electronic communications persons, sociologists, and senior government representatives.

Pioneering in CAI

Most CAI projects at Western are joint efforts, combining the skills of experts in a particular field, programmers, students, educators and psychologists. The lessons themselves are written in a language called ETL, designed specifically for writing CAI programs. ETL, short for Educational Technology Language, was originated by the Ontario Institute for Studies in Education and improved extensively by "Western" for use on the PDP-10.

Among the department's current accomplishments are eight 45-minute trigonometry lessons, a project which teaches the structure and machine language of a hypothetical decimal computer of the Von Neumann type, and a 1-1/2 hour FORTRAN lesson. The FORTRAN lesson uses an adaptive strategy to determine which of three levels of material the student should receive. At the end

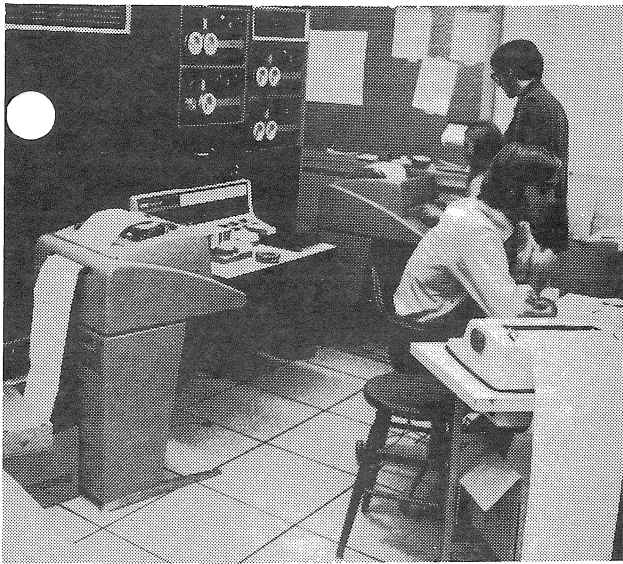
of each 12 blocks of material, the program compares the student's response with a cumulative record of the response of all students that have taken the lesson; the program selects the next level of material based on the results of the comparison.

Another CAI project is using students as primary developers for a course on the COBOL programming language. Like other CAI lessons, the COBOL course will be presented on a variety of media. The basic material will be presented via TV monitor with large amounts of text and graphics displayed on a slide projector. Questions relating to the material can appear on either the slide projector or on a keyboard display terminal which the student also uses to transmit his answers to the PDP-10. The course will also include written material which summarizes the course and leaves space for the students to write notes.

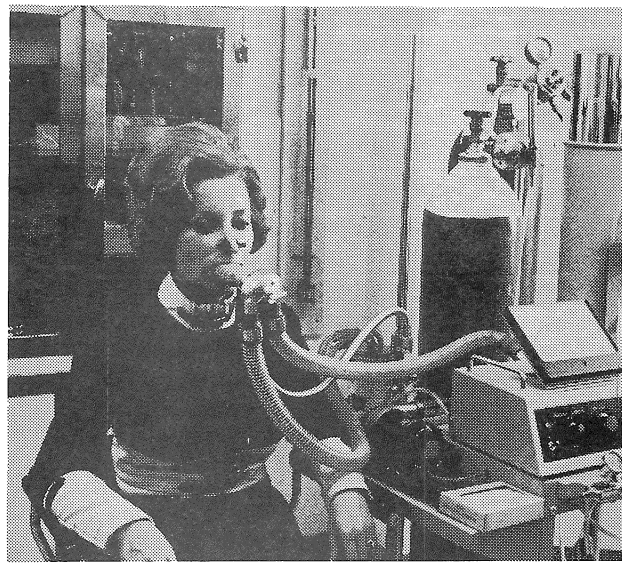
The 200 students taking the course will not be graded on their performance. However, the lessons will be designed for ease of use and understanding—one of the primary aims in using students as lesson developers. The course will be designed in sections, enabling the students to stop at any point for lunch or break, and return without having to start the lesson over again. Or they can request, via teletype, a particular section that they wish to review.

The lesson will be written in conversational form. For example, after Bill answers a question, the computer might "flash" the following on the graphics terminal, "Not quite right, Bill, try again."

Although a student can ask questions of the classroom consultant, by typing the word "HELP" after any question, he can obtain aid directly from the computer. In response, he might receive a simplified version of the



A glimpse of the PDP-10 console in the busy Computing Centre. Among the tasks of the Computing Centre staff are operations, software and systems development, applications programming for other departments, and engineering of interface equipment. The staff also works with a liaison group of users to plan future developments.



Part of an intensive pulmonary investigation at the St. Joseph's hospital. Here the helium lung volume circuit is used to measure the capacity and mixing efficiency of the lungs. Measurements are input via teletype to the PDP-10 and test results are available within seconds.

question, a reference to a slide or written material, or the computer might even give him the answer to the question.

The course will be designed so that it can be used with other computer systems. For easy modification, parts of the program that are peculiar to a particular computer are keyed so that they can be sorted and revised to fit another computer.

The PDP-10 and Russian Folklore

Even today, it's rare for a scientific or commercial tool, such as the computer, to be applied in the humanities. Western, however, boasts a professor of Russian studies who is using the computer to accomplish a job that would be difficult if not impossible by manual means. The task—a system for the classification of Russian folklore.

The classification is based on a theory expounded by a Russian academician at the turn of the century, stating that all literature is composed of building blocks or motifs. Applying this theory to fairy tales revealed 51 motifs, including for example, arrival of the villain, struggle with the villain, receipt of a magic gift, etc. With variants eliminated, the number of motifs was reduced to 31. Interestingly, the motifs always appear in the same sequence. That is, a particular tale will only contain some portion of the complete list; but of the ones that appear, motif C will not precede motif A or G will not precede D, etc.

So far, the theory has been applied to Russian folk tales, the tales of the North American Indian, and some mythology. And the same type of analysis could be used on lyrical themes and ballads.

The programming techniques developed for the study should prove extremely valuable in using the computer to solve other types of non-numeric problems. But the study has even greater import. An evaluation of folklore

is an evaluation of a people's attitude toward life. Therefore the study could ultimately reveal a greater understanding of the human mind and human needs.

The PDP-10 Examines Lungs

In another field of endeavor, the PDP-10 takes part in laboratory testing at the St. Joseph's Hospital, a mile or so from the Western campus. Data from pulmonary testing is input to the system via remote teletype while laboratory testing is proceeding. Results of the computer calculations are immediately returned on the teletype, so that the doctor can view the results and determine whether further tests are necessary before the patient has left the laboratory.

The detailed testing, using basal metabolism apparatus, includes measurements of maximum lung expansion, maximum exhalation rate, lung mixing efficiency, and lung diffusing capacity (the ability of the lungs to transfer oxygen to the blood). Results are compared against a norm based on the patient's age and height.

The tests reveal chronic bronchitis, emphysema, or any condition where the volume or structure of the lung is altered or destroyed. The measure of mixing efficiency, for example, can indicate obstructions caused by growths or polyps. Other measurements indicate whether the patient can tolerate removal of lung tissue and, if so, how much can be removed.

Even the simpler pulmonary tests reveal symptoms that are undetectable by stethoscope; thus St. Joseph's now gives each new hospital admission a "timed vital capacity test." The test, in essence, determines how big a breath the patient can take. If the reading is abnormal, other tests are made. Illustrating the importance of the testing is the fact that on the first day, only one of eight admissions—a teenager—received a passing grade.

Other Western Projects

Projects in other Western departments, often aided by Computing Centre personnel, are interesting and widely varied. In Zoology, for example, a number of projects involve the biology of animal population: reproductive behavior in the genus *Drosophila* or fruit fly, the ecology and growth of Canada and blue geese, hybridization in fish population.

The studies being performed in the Sociology department are almost endless. They include local studies in the London, Ontario, area on abortion, male sterilization, family planning, and suicides. Students have studied campus drug use, religiosity, and sex life. And the list even includes employment statistics on radio station journalism staffs, data on the educational aspirations of grade 12 students, and a fertility study of East Coast fishermen.

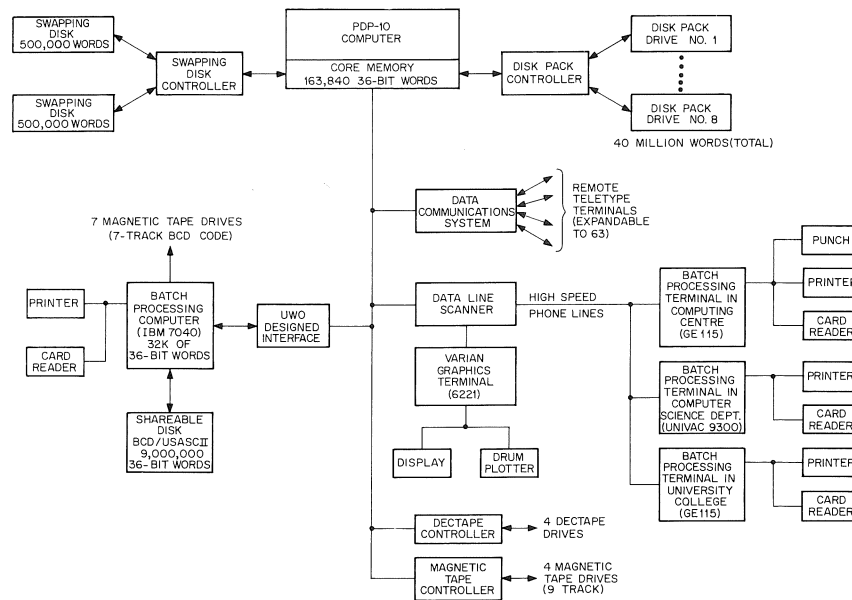
The Old and The New

Within the fortress-like walls of the University of Western Ontario lies a computing centre as bustling as the campus

setting is peaceful. Serving some 200 timesharing users and processing up to 450 batch programs per day is a busy full-time staff of 35. This group of innovators is responsible for:

- the PDP-10 coordinating processor
- 42 timesharing terminals
- computer graphics facilities
- a 32,000 word (200,000 character) batch processing computer
- 3 remote batch processing terminals
- 56 million characters of shareable disk storage
- 164,000 words (820,000 characters) of PDP-10 core memory
- 40 million words (200 million characters) of disk pack storage
- 15 magnetic tape drives

With these facilities and more to be added in the future, the Computing Centre continues to provide service to one of Canada's most prominent universities and to remain in the forefront of computer technology.



The complex network of computer systems and terminals built around a PDP-10. Input from the batch processing terminals can be processed by either the PDP-10 or by the batch processing computer. Input for the smaller computer is first stored on the PDP-10 disk, then transferred to a section of the shareable disk reserved for USASCII code. Information on the disk is finally converted to a BCD code and placed on magnetic tape, ready for processing.

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DIGITAL EQUIPMENT CORPORATION, Maynard, Massachusetts, Telephone: (617) 897-5111 • ALABAMA, Huntsville • ARIZONA, Phoenix • CALIFORNIA, Anaheim, Los Angeles, Oakland, Palo Alto • COLORADO, Denver • CONNECTICUT, Meriden • DISTRICT OF COLUMBIA, Washington (College Park, Md.) • FLORIDA, Orlando • GEORGIA, Atlanta • ILLINOIS, Chicago • INDIANA, Indianapolis • MASSACHUSETTS, Cambridge and Waltham • MICHIGAN, Ann Arbor • MINNESOTA, Minneapolis • MISSOURI, St. Louis • NEW JERSEY, Parsippany and Princeton • NEWMEXICO, Albuquerque • NEW YORK, Centereach (L.I.), New York City, (Englewood, N.J.), and Rochester • NORTH CAROLINA, Durham/Chapel Hill • OHIO, Cleveland and Dayton • PENNSYLVANIA, Philadelphia and Pittsburgh • TENNESSEE, Knoxville • TEXAS, Dallas and Houston • UTAH, Salt Lake City • WASHINGTON, Seattle • AUSTRALIA, Brisbane, Melbourne, Perth, and Sydney • CANADA, Edmonton, Alberta; Vancouver, British Columbia; Carleton Place, Ottawa, and Toronto, Ontario; and Montreal, Quebec • ENGLAND, London, Manchester, and Reading • FRANCE, Paris • GERMANY, Cologne, Hanover and Munich • HOLLAND, The Hague • ITALY, Milan • JAPAN, Tokyo • SWEDEN, Stockholm • SWITZERLAND, Geneva