The Personal Computer at Stevens Institute of Technology
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Stevens Institute of Technology began a program requiring every incoming student to own a Digital Equipment Corporation PC-350 in September 1983.

Stevens is largely a residential college of 1600 full-time undergraduates plus 1500 part and full-time graduate students located on a campus on the Hudson River overlooking midtown Manhattan. At present about 85% of the undergraduate students are in a unified engineering curriculum which allows some specialization in the junior and senior years in mechanical, electrical, chemical, and civil engineering. There is a science curriculum which has a mathematically oriented core followed by specialization in chemistry, chemical biology, physics, or mathematics. Next year there will be a new department in computer science drawing together separate programs already in existence for some time in the electrical engineering, mathematics, and system planning and management curricula. There are roughly 15 chemistry and chemical biology students in each graduating class. The chemistry program is approved by the A.C.S.

Stevens has historically had a strong emphasis on computer use starting with an IBM-1620 computer in the early 1960's and progressing through a UNIVAC 1105, IBM 360-Model 40, and since 1968, various models of the DEC System 10 and VAX computers. Four years ago, a separate Undergraduate Graphics Center was established with RAMTEK Color graphics terminals and a DEC 11/34 computer. In the Fall of 1982 all incoming Science and System Planning and Management students (80 in all) were required to own an Atari 800 computer. The introductory programming course focused on the development of numerical methods techniques, graphics, BASIC programming, and a collection of mathematical techniques in a personal library that could be used to assist in solving problems assigned in later courses. All the science students in this group took a course in computational physics in the sophomore year that expanded the concept of a library of useful routines. Experiments in data acquisition were also introduced. One limitation of the ATARI system was the lack of a FORTRAN compiler or interpreter and an Institute-wide curriculum requirement that all students learn and use FORTRAN. Uncertainty about the effect on student recruitment of an $800 increase in cost limited the choice of computers originally considered. (Tuition is currently $7400 per year.) However, student response was so positive that we decided to explore a system that would support FORTRAN, was disk based, and had graphics, an assembler, a 16 bit processor, and would allow for interfacing to laboratory experiments. After considering several different possibilities, a DEC Professional 325 was chosen with 256K core, two 400 Kbyte floppy disks drives, an interpretive FORTRAN and BASIC, a simple word processor and editor, graphics routines, and a monochrome graphics monitor. The processor was the 16 bit DEC 11/23 using the menu driven monitor called POS. The cost to students was $1800 (the list price was $4400) and included subsidies by Digital as well as Stevens. Students were charged the full $1800 on their first bill and had full title to the computer from the beginning. Additional financial aid, usually in the form of loans, was made available where necessary. The effect of this decision on recruitment seems positive. (There has been some drop in female applicants (normally 10% of the students) for undetermined reasons.)

During the summer of 1983 there was a flurry of developments including a decision that the interpretive FORTRAN was not acceptable. In order to support a compiler FORTRAN the system was upgraded to 512 Kbytes of memory, a 5 Mbyte Winchester drive was provided on loan, and a version of the DEC Tool-kit Software for the VAX was supplied. The Tool-Kit includes a FORTRAN compiler, BASIC, a sophisticated editor, a MACRO-11 assembler, and a library of FORTRAN callable graphics routines in addition to those included in BASIC. It uses VAX-like monitor commands in contrast to the menu drive POS system that comes normally with the Professional.

Our bowling alley was converted to a distribution center. Five hundred systems were purchased by freshmen. In addition, some 200 systems were ordered by other students, faculty and staff. After distribution, the same site was used as a repair center. Most problems were solved by switching boards. The more difficult cases were sent back to DEC.

Throughout the Fall term there were several major updates of system software and a decision was made to increase the 5 Mbyte disks to 10 Mbyte disks to make a more comfortable programming situation for FORTRAN and the Tool-Kit. None of these changes resulted in extra charges to the students. The standard student system for next year includes the 10 Mbyte disk (not on loan), Took-Kit software, 512-Kbyte memory, PC 350 rather than a PC 325, and the rest of the software mentioned above. The price will still be $1800 again involving substantial subsidies from Digital and Stevens. Over 1200 systems will be on campus by next fall. All systems will have the powerful WORD-11 word processing system. Although the student systems do not include printers, a laboratory containing several printers and PC-350's is available for making listings and for handing in assignments. Many students have acquired their own printers.

Most work with the PC's has been in a stand alone mode. With state aid we are acquiring a VAX 11/785 which can be used as a host for more efficient program development by faculty for distribution to students. Also, we are beginning exploratory work on networking a small group of PC-350's but that is very much in the initial phase. The 350 can be put in terminal mode and performs admirably as a graphics terminal for use in displaying views of molecules calculated on the host KL-10 by ORTEP or PLUTO. Hard copy pictures can be generated directly in raster form on the PC's printer or queued to the vector CALCOMP plotter interfaced to the main host computer. Although all students have accounts on the central campus computer, we have not encouraged students to use their systems as terminals as the congestion both of the phone system and of the central campus host would bring the whole operation to an abrupt halt. So far, few freshmen have ventured onto the central computer and we are naturally very curious how upperclass use of the KL-10 will change as the PC's percolate through the curriculum. The choice will be between a devoted powerful PC and a heavily loaded mainframe with a substantial research load.

One initially hidden cost of the personal computer plan was the necessity of rewiring all dormitories, designing a new furniture layout that would allow for adequate desk space for rooms containing two computers, and providing telephone wiring to each room which could be used for networking as those plans proceed. The networking could easily cost $4,000,000.

The development of computer use and applications throughout the curriculum has been procedding at a feverish pace. Because of the unified core taken by all students in both science and engineering programs, it has been possible to plan to make use of a hierarchy of commonly shared computer experiences. Both faculty and students are not enthusiastic about the use of computers for CAI. The emphasis has been to develop a user-friendly computer environment so that students and faculty will turn to the computer as the instrument of choice for solving appropriate problems. By having the computer easily at hand, it is hoped that the hostility that developed towards computers in batch oriented introductory programming courses and later unfortunate experiences with overloaded time-shared computer systems would not develop with the personal computers. Work is underway in over 25 courses throughout the curriculum to explore material and approaches that could make significant use of the 350. Initially, each student takes a programming course that includes BASIC, FORTRAN, graphics and the start of a collection of numerical techniques for use in later courses. Word processing use is encouraged. Work is in progress on developing a collection of IMSL-like subroutines that may be used for incorporation as subroutines in programs written to solve problems in a variety of courses. The mechanical engineering faculty is interested in the use of the 350 to prepare orthographic views of objects using raster and vector graphics. Work is in progress on software to make it possible to construct figures easily via computer.

In freshman chemistry we did not want to teach programming before the students had the introductory programming course. Our initial approach in August 1983 was to consider the NSF project SERAPHIM CAI software for the Apple II computer and to choose programs which could be converted to 350 BASIC, whose graphics could be adapted or duplicated, and which related to material in the general chemistry course. Eight programs were converted including RAST, ANIONS, DIPROTIC, HBA, THERMO, LOWREY, ABCKIN and WEAK. Several of Stan Smith's programs of potential interest could not be tried because they used ENBASIC which is a machine language specific (Apple II) course authoring language. A program which allows 2 and 3-D constructions of molecules from stencil elements was developed which could serve as a general slide making program. Dr. Malinowski is writing programs for simulating N.M.R. and mass spectral instrument response to be used in exploring use of some of the controls before students actually use the instruments. He is developing CAI introductions to the instruments in his laboratory. In addition, he has convereted his factor analysis programs from the Apple II to the PC-350.

Dr. Ermler's course in theoretical chemistry is taken by all science students in their junior year. He is working on adapting programs and a small data base for that course for use in some problem assignments particularly in chemical thermodynamics, statistical mechanics, quantum chemistry, and spectroscopy.

Several programs from Johnson's book, "Numerical Methods in Chemistry" have run successfully on the 350 using character graphics and I understand that Ken Jordan of the University of Pittsburgh has converted many of the programs to true graphics in color. These would mostly be useful in the junior and senior year.

Other applications in theoretical chemistry, kinetics, and especially in laboratory interfacing are being explored. A real time interface module for the PC-350 has just become available which will give access to RS232 and IEEE488 lines, as well as A/D and D/A channels.

We would be happy to share our experiences with the DEC Professional 350 and to learn of the efforts of others with this new machine. Also, we would like to share experiences with others who have, or are planning, a massive influx of small computers into the educational process.

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