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AUTHOR Edwards, Perry; Broadwell, Bruce
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ABSTRACT

Mini- and midi-computers have been introduced into the computer science program at Sierra College to afford students more direct contact with computers. The college's administration combined with the Science and Business departments to share the expense and utilization of the program. The National Cash Register Century 100 and the Data General Nova computers were acquired; the total hardware costs amounted to about $4600 per month. In addition to performing various administrative tasks, the Mini-Midi program is used in computer science courses to teach students how to work with computers, using logical problem solving methods. Student demand for these courses is high and their success rate in them is encouraging. Thus, the Mini-Midi combination is meeting the computing needs of the diverse programs at the college and is providing students with access to the hardware, all at a reasonable cost. (PB)

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BY

PERRY EDWARDS

BRUCE BROADWELL

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SIERRA COLLEGE
5000 ROCKLIN ROAD
ROCKLIN, CA 95677

916-624-3333 X200

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MINI, MIDI AND THE STUDENT

by
Perry Edwards
Bruce Broadwell
Sierra College
Rocklin, CA 95677
(916)-624-3333

ABSTRACT

The advent of the "Mini" computer has brought great changes to the computing community. These versatile lower cost systems have and are enabling many new users to enter the market place. The Mini when used in conjunction with the more traditional "Midi" computer, can provide an improved, broad based educational program. This paper deals with the current application of a "Mini" and "Midi" computing system in an ongoing instructional program.

C E D P A / C E C C J O I N T C O N F E R E N C E

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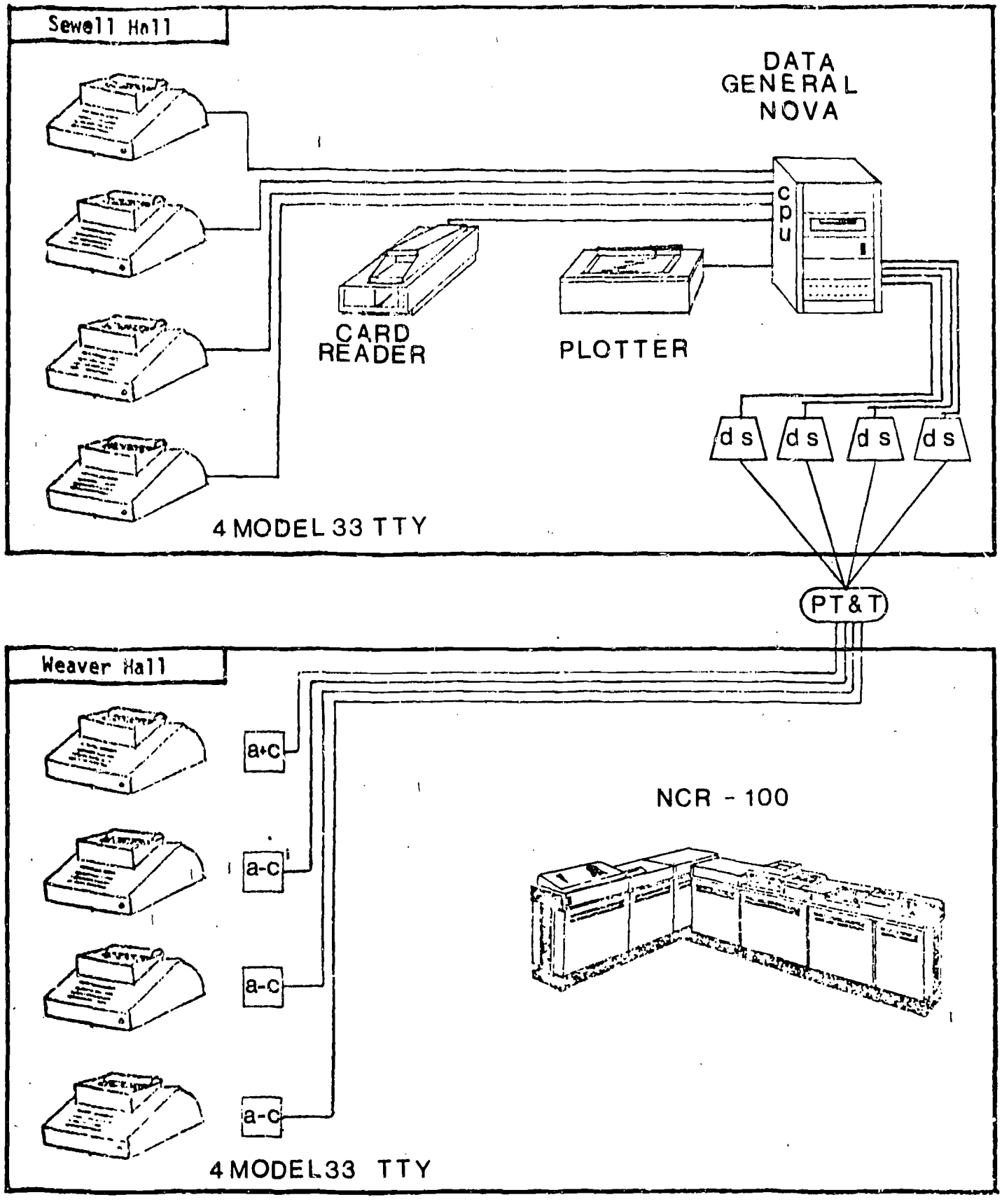

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I. BACKGROUND

Many two-year community colleges offer vocational and/or transfer courses in data processing. These courses typically consist of an introduction to data processing, programming and systems analysis. This paper is concerned with the content and approach used in the introductory course.

The introductory course usually covers the history of data processing, an overview of card machines, and an arm-chair look at computers and computing concepts. The student normally does a lot of listening to his instructor talk about the theory involved but has little opportunity to see and try it on his own. Perhaps he will have a chance to keypunch a few cards, take a tour of the computer center if time permits, or have a look at some slides of various pieces of equipment whose names will be numeric with no meaning. In general, little real appreciation or practical understanding of computers will have taken place during this first course. If he is a vocationally oriented student, the odds are that this course has done more to dissuade or antagonize him rather than to help him decide that this might be an interesting area for him to consider for a life-time career.

The second group of courses taken are those that involve programming. These courses revolve around the syntax rules of a particular language. Whether it is COBOL, FORTRAN, RPG, PL/1, or an Assembler language, it does not matter, syntax rules predominate. A student is given a problem statement and is supposed to write a program which does some calculations

instructions that solve the stated problem." These courses typically get more involved with the instructions, than the sequence. Grammar rules are studied in great detail with minor emphasis placed on how to put the instructions together to form a logically correct program. Students are expected to keypunch their source programs and in many cases leave them for batch compilation and execution during off, i.e. non-administrative, hours. The programs are typically returned within 6 to 24 hours with the various print-outs rubber-banded to the source deck. The student again has little contact with the computing system itself. In a few cases, an older second generation computer is available for the students to operate, but even these situations are rare, as older machines are usually phased out when the newer third generation machines are justified.

The last of the data processing classes is usually one titled Systems Analysis or Systems and Procedures. This course is generally an overview of information flow systems. Usually, it is taught with a project or case study approach and is perhaps the best course in an ongoing curriculum; providing, of course, the student makes it this far.

In many institutions computers have been too expensive to waste on the student (for whom the initial justification was made in the first place). Student programs can be more quickly processed by the skilled operator rather than the novice student. This relieves the computer for use in administrative data processing. However, as the number of students in these programs increases, more computer power

is deemed necessary and is obtained by adding on to the current system or going to yet a larger system, which is yet more expensive, and thus removes the student even more.

The answer to this dilemma has, in the past, been either to have a dual computer system or one large single system. In either "solution" neither the instructional nor the administrative staffs have been satisfied. A large system is too expensive for student use. Dual systems usually have not had enough power, either hardware, software, or both, to do the job. What is needed is equipment simple and inexpensive enough for an introductory group of students to operate--yet be complex enough to teach third generation programming and systems concepts and still be able to handle administrative tasks.

II. ENTER THE "MINI"

The recent introduction of the "Mini" computer in the marketplace may be a solution to the dilemma. An instructional program built around this type of computer system in conjunction with a third generation "Midi" computer would provide relatively inexpensive equipment for introductory students to operate and a more complex piece of hardware for the advanced students and for sophisticated administrative applications.

As can be seen by scanning any recent trade publication or newspaper, "Mini" computers are available from well over 50 manufacturers. They come in all types and configurations from the single-user teletypewriter version to those with line printers, disks, tape, and card readers.

In addition, some systems can be found that will time-share or can be interfaced to laboratory instrumentation. Prices obviously vary by particular configuration but typically run from $12,000 - $40,000 for purchase. Language capability is usually FORTRAN, BASIC, macro or an assembler. The hardware normally requires no special temperature or humidity controls and in some cases can use 110 volts wall current as the primary power source. "Mini" computers are small in size, being either table-top variety or those mounted in special racks. Memory is usually of the core or all monolithic variety (with memory cycle times of 300 nanoseconds in the case of the Data General Supernova SC) and can be found from minimums of 4K to maximums of 32K (12, 16, or 18 bit words).

III. MINI/MIDI HARDWARE ACQUISITION

The original concept of dual computers at Sierra College was developed out of the need for quick access to a computer for the physical and chemical science as well as the engineering drawing programs. Inter-departmental cooperation from the start was a must and has been achieved. Faculty members from the Mathematics, Chemistry, Physics, Engineering Drawing, and Business areas have worked together in putting together and developing the instructional program.

To more fully understand how the actual hardware was acquired and installed requires a brief look at the overall information processing requirements of the college. Prior to 1969, the only type of data processing equipment used at Sierra was tabulating equipment. Early

In 1968, the faculty and administration decided that it was financially feasible to implement computer operations, but only if all three groups (Science, Business, and Administration) would share in its expense and utilization. After discussions with many of the major vendors, accepting bids, and finally benchmark testing, the National Cash Register Century 100 was selected as the primary computer. The Data General Nova was picked for the mini system.

The primary consideration in vendor selection was hardware cost, software availability, and vendor assistance in administrative applications programming. NCR provides a disk operating system, COBOL, FORTRAN, NEAT/3, and a variety of utility routines. Data General provided a memory resident time-share BASIC (they now have disk resident version) and a single user non-conversational FORTRAN. The Century-100 was rented from NCR on a one-year contract. The rental cost for the computer is $2,110.00/mo. including maintenance and bundled software. This cost covers the following hardware devices:

16K Byte Memory and CPU
Dual Disk Drive (8.4 million bytes)
300 Card/Min. Reader
450 Line/Min. Printer
I/O Teletypewriter

The Century was installed in February of 1970.

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The Data General Nova is on a five-year lease purchase contract and costs $900/month which does not include maintenance but does include bundled software. This cost covers the following devices:

16K Word Memory and CPU
300 Card/Min. Hewlett Packard Reader
4 Model 33 ASR Teletypewriters
Houston Incremental Digital Plotter
High Speed Paper Tape Reader and Punch

Since the original installation of the Nova in February of 1971, the following pieces of hardware have been added to the system at an additional cost of $510/month.

4 Model 33 ASR Teletypewriters with Accoustical Couplers
8K Words of Additional Memory

These additions were made in October of 1971 in an effort to provide computing facilities to more beginning students.

The total cost for both systems is thus:

NCR Century-100	$2110/mo.
Data General Nova	1410/mo.
Maintenance on Nova	140/mo.
	$3660/mo.

In addition to the computer hardware costs, additional costs are encountered for keypunch rental, disk pack rental, telephone hand sets, miscellaneous tab equipment, and supplies. The additional costs amount to about $1,000/mo. The overall Data Processing costs at Sierra, exclusive of personnel, is therefore $4,660/month.

IV. MINI/MIDI IN USE

Thus, in order to meet a variety of instructional and administrative needs, a Mini/Midi program is currently in operation at Sierra College.

Administrative Data Processing uses the National Cash Register Century-100 solely. Applications programming is done in COBOL and in NCR's NEAT/3 macro/assembler language. Thus far, the Century 100 is processing the usual student personnel work, administrative report writing, and some simple financial accounting data (The major financial accounting, i.e., payroll and general ledger is being done by the Placer County Office of Education which coincidentally also has an NCR 100).

As originally conceived, the instructional program is designed to serve the following six differing types of students whose interests in the computing field vary from general to quite specific. These areas are:

a. General Education for 2-year or 4-year degrees
b. Two-year degree in Business Data Processing
c. Two-year degree in Engineering Drawing
d. First two years of B.S. Degree in Business Administration
e. First two years for B.S. Degree in Computer Science
f. First two years for B.S. Degree in Physical and Chemical Sciences

Course work to meet this variety of student needs is offered in many subject areas. There is one underlying premise, however, upon which all courses are based--Logical Problem Solving. By logical problem solving we mean the logical analysis of steps necessary to correctly solve an information or computing problem.

This ability to logically analyze the steps necessary to accomplish a desired computation is a developed technique we believe. Our students then must be provided with a framework within which to develop this technique. For example, in the Introduction to Data Processing and Computing course, the mini computer utilizing BASIC language in combination with a carefully planned series of student assignments enables the student to develop the technique of problem solving. With a spiral approach, the student begins by solving a very limited computing or information problem. This is limited in terms of length and complexity. Only a half dozen BASIC instructions are required. Subsequently the problems are expanded relative to complexity of logic and the number of BASIC commands required. Thus a student rather painlessly develops a logical approach to problem solving. The most potent tool utilized in the process is the mini computer with its interactive, straight-forward, people-oriented language.

The Data General Nova at Sierra College operates in a time-sharing mode with 4 hard-wired terminals and 4 remote terminals which use the campus telephone system. While operating in this mode, eight students can simultaneously be compiling and testing their programs using the BASIC Language. The primary advantages of BASIC are in its free flowing style and its interactive mode. Beginning students don't get bogged down in the syntax of the language and can thereby get to the terminals quickly and program more efficiently.

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So, the student's initial encounter with the campus computing systems is usually through the terminals and BASIC. If his major is in the Physical Sciences or the Engineering Drawing field, the Nova will usually be his only computing experience. However, students majoring the other areas will encounter both computers.

After writing many programs in BASIC, including a project program of his choosing, students in the Introduction to Data Processing and Computing course then switch to the Century. While this change, at the outset, may appear to be quite drastic, it is somewhat dampened by using a simple assembler language in their second computer experience. This simple assembler language, developed by one of our Business Data Processing students as his term project, introduces the novice to programming in quite a different form and makes him appreciate the powers of BASIC. The language itself has only 10 commands but allows the user to see the direct relationship between any programming language and the native (object) language of a computer, in a relatively straightforward manner.

Upon completion of the introductory course, students have many options open to them. If they are undertaking the two-year Business Data Processing Degree Program, they will probably take their second course in National Cash Register's NEAT/3 programming language.

However, they could take one of the other language courses: FORTRAN or COBOL. In any case the student becomes oriented toward the disk centered Century for all of his remaining official course work. In the language courses, students become familiar with the processing of programs through the Century 100 and will in fact operate the computer in a "hands-on" environment during their laboratory sessions. During non-laboratory hours, programs are batch processed and returned to the student in the more traditional method.

V. OBSERVATIONS AND TENTATIVE EVALUATIONS

Although it may be premature to make an extensive judgment of the Midi and Mini in cohabitation, as they have only been in operation together since March of 1971, there are a number of encouraging aspects that have and are developing. Student demand on the eight campus terminals is quite heavy. The terminals are quite busy from start-up time until late in the afternoon. The ease with which they can be operated, i.e. no sign-on procedure and relatively simple keyboard has also proved to be an added drawing power. The interactive BASIC language provides for rapid feedback and learning reinforcement.

Student holding power or retention is higher in most of our classes than has been the case in the past. If a drop does occur, it takes place early in the semester and not towards the middle or end.

It is also of interest to note that the advanced students, who did not have an experience with time sharing and BASIC, are asking for special instruction so that they too can become familiar with this

type of processing. We have found COBOL and NEAT/3 students using the terminals to prove their program's logic and its output's accuracy. Once they have utilized the terminal and BASIC for a quick proof, they proceed with the more time consuming coding and accompanying format control of COBOL or NEAT/3. It is quite probable that this same pattern will develop among the BASIC oriented students who subsequently enroll in FORTRAN.

VI. CONCLUSION

The Mini and Midi computer combination seems to be meeting the computing needs of the very diverse programs at Sierra College. Students of widely varying interest and sophistication are utilizing the computing power of our Mini-Midi combination. The computers are very available to students. Finally, this is being accomplished at a very reasonable dollar cost.