

A MODERN-DAY MEDICINE SHOW

by ROBERT L. ALBRECHT,
Control Data Corp.,
Denver, Colorado

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During the summer of 1962, the Denver, Colorado, office of Control Data Corporation gave a course in the use of computers to a group of gifted mathematics students from Denver's George Washington High School (GWHS). Emphasis was placed on the use of a computer as a computational tool to assist students in solving mathematical problems. We had so much fun that we continued the course at GWHS throughout the 1962-63 school year, and extended the program to eight other schools in Denver and Jefferson counties. So far, more than 200 students have been introduced to the hardware as a handy device for getting answers to mathematical problems.

On March 24, a CONTROL DATA 160A and a Flexowriter were moved to GWHS and placed in charge of four students. For the next four days, these students put on a computer demonstration which had many of the characteristics of a "Medicine Show". The show was promoted, produced, and directed by the four students, who were also the stars.

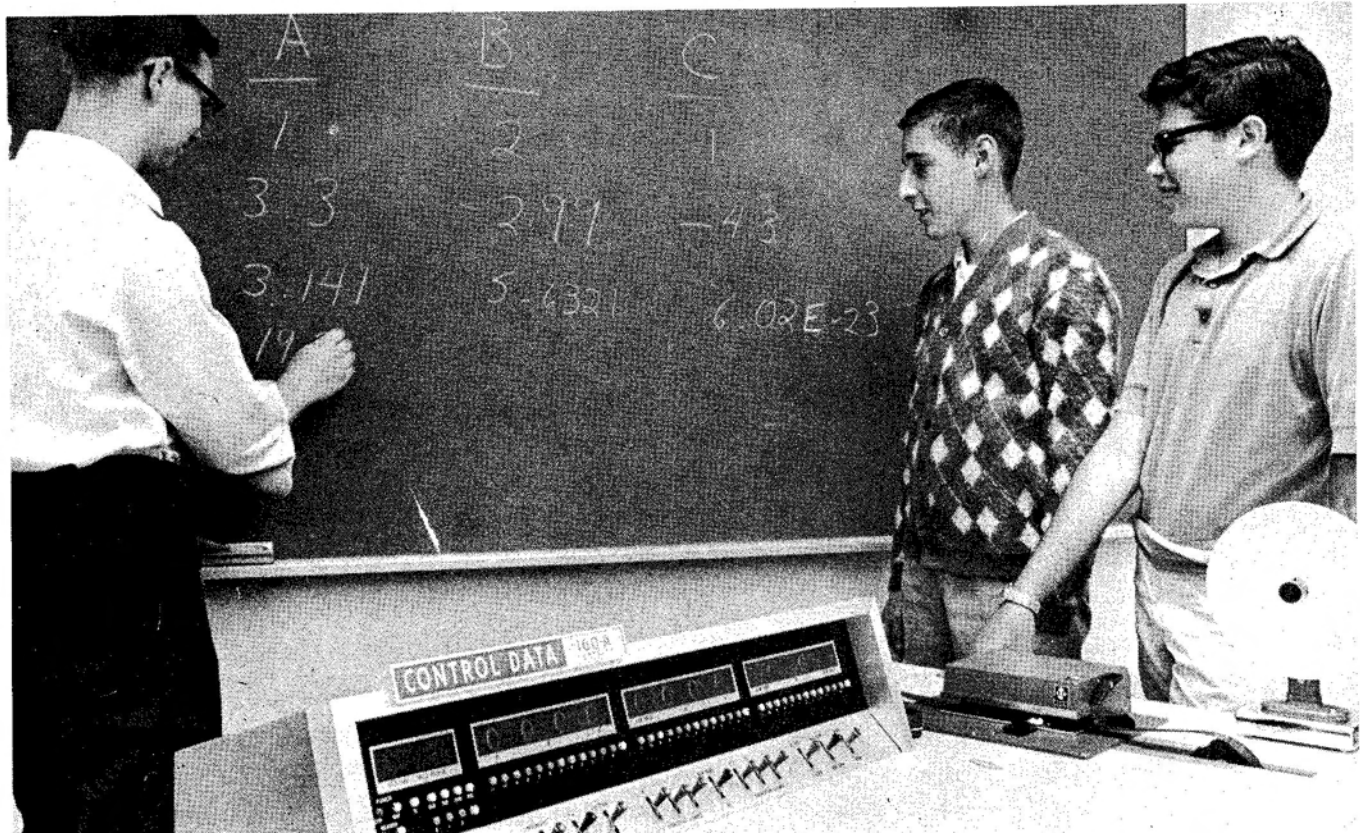
The medicine show at GWHS was the high point of a computer educational program which began quite by accident. In the spring of 1962, I acquired a new neighbor, Irwin Hoffman, a mathematics teacher at GWHS. Irwin invited me to speak to the Math Club at his school on the use of computers for the solution of mathematical problems. Following this talk, several students inquired about the possibility of receiving computer training. I conferred

with Irwin and we decided to organize and teach a course during the summer.

In this initial course, 35 students from GWHS met every Wednesday evening from 7 to 10 P.M. at the Control Data Denver office. We spent the first few meetings discussing computer fundamentals and describing the FORTRAN programming language for the 160A. By mid-summer, the students had become reasonably proficient at writing programs and operating the computer. For the rest of the summer, the Wednesday evening meetings were used primarily for the analysis, programming, and computer solution of mathematical problems. Of the 35 students who began the course, 25 were still going strong at the end of the summer.

The summer course was merely an appetizer for many of the students. They clamored for more training. During the fall semester we set up an advanced course for 12 students. (The rest had graduated.) A bleary-eyed mathematics teacher (Hoffman), a bleary-eyed Control Data instructor (me), and 12 bright-eyed young scholars met every Thursday morning from 7:30-8:30 A.M. before regular school hours. This course was conducted on a seminar basis, using the algebra of polynomials as the mathematical subject. The instructors posed problems. The students did the required mathematical analysis, developed problem solving procedures, programmed their solutions in FORTRAN and ran their problems on the 160A. Introductory courses were set up for beginners. The courses were conducted on an auto-instructional basis with seminar students serving as instructors.

In March, we decided to put on a medicine show at



GWHS. We decided that it would be done entirely by students without any adult supervision. By this time we had about 40 students at various levels of proficiency. We picked Bob Kahn, Al Nelson, Randy Levine, and Fred Ris to run the show. (Bob, Randy, and Fred were juniors, Al was a senior.) We outlined our project to the students and sat back to watch the fireworks.

During the week before the show, the four students

arranged for the use of a room, obtained the equipment and supplies needed, and began an intensive promotional campaign. They drew up a master schedule for the 20 math classes which were to attend, and distributed the schedules to the teachers who were responsible for the classes. After some haggling, they agreed upon a demonstration program, wrote the source program, and checked it out after the 160A had arrived at the school.

Figure 1

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0
0
C      GWHS TEACHER DEMO PROGRAM
C      PROGRAMMED BY RANDY LEVINE
1      FORMAT (45Hi;have;heard;you;do;not;like;assistance;.:.:.)
2      FORMAT (36Hhere;is;your;iddy;biddy;answer;.:.:.)
3      FORMAT (50Hhere;is;ye;olde;easy;answer;.:.:;lazy;tiger;.:.:.)
4      FORMAT (38Hi;will;be;a;more;courteous;gw;patriot.)
5      FORMAT (27Hname;the;new;baby;after;me.)
6      FORMAT (39Hyou;coach;.:.:;let;me;teach;the;class.)
7      FORMAT (45Hwhan;that;aprille;with;his;shoures;shoote;.:.:.)
8      FORMAT (43Hwhen;i;consider;how;my;light;is;spent;.:.:.)
9      FORMAT (35Hi;have;to;be;excused;from;the;room.)
10     FORMAT (I5, 4E16.8)
11     FORMAT (4E16.8)
500    READ 10, JWHICH, A, B, C
      GO TO (15, 25, 35, 45, 55, 65, 75, 85, 95, 105), JWHICH
15     PUNCH 1
      GO TO 105
25     PUNCH 2
      GO TO 105
35     PUNCH 3
      GO TO 105
45     PUNCH 4
      GO TO 105
55     PUNCH 5
      GO TO 105
65     PUNCH 6
      GO TO 105
75     PUNCH 7
      PUNCH 8
      GO TO 105
85     PUNCH 8
      GO TO 105
95     PUNCH 9
105    DSCRIM = (B*B) - (4*A*C)
      IF (DSCRIM) 100, 200, 200
200    X1 = (-B + SQRTF(DSCRIM))/(2*A)
      X2 = (-B - SQRTF(DSCRIM))/(2*A)
      PUNCH 11, A, B, C
      PUNCH 11, X1, X2
      PAUSE 500
      GO TO 500
100    X1REAL = (-B)/(2*A)
      X2REAL = X1REAL
      X1IMAG = (SQRTF(DSCRIM))/(2*A)
      X2IMAG = -X1IMAG
      PUNCH 11, A, B, C
      PUNCH 11, X1REAL, X1IMAG, X2REAL, X2IMAG
      PAUSE 500
      GO TO 500
      END
      END

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Articles, plugging the show, appeared in the school paper, and daily spot announcements over the P.A. system reminded the student body of the forthcoming event. By opening day, our students were indeed prepared.

the medicine show

The 160A was moved in on the afternoon of Monday, the 24th, and turned over to the students the next morning. The demonstration program, chosen in the hope that it would be meaningful and entertaining to the attendees, was checked out. Their source program, shown in Figure 1, was a procedure to compute the real or complex roots of the quadratic equation, $AX^2 + BX + C = 0$. However, it had a gimmick.

By means of a code number entered with the data, the computer could be directed to precede the answers with a Hollerith message. These messages were terms favored by the instructors in their classroom presentations, and which had become cliches familiar to students. During demonstrations, students were asked to provide data for processing; for these results, no Hollerith message was punched. Then the teacher was asked for a set of data; when his results were listed, he was confronted by a familiar phrase preceding the answers. Some samples are shown in Figure 2.

The formal demonstrations were held Wednesday and Thursday, about every half hour, from 8:45 to 3:30 P.M., with a few left over for Friday morning. Because many of the classes were discussing the quadratic formula, a frequently heard request was, "Would you please ask the computer to do the odd exercises on page 263 of our text?" Bob Kahn accommodated one class by running one night's homework on the 160A, and using the Flexowriter to cut a Ditto master of the output tape. He presented a copy to each member of the class.

When the hardware was not being used for demonstrations, it was in constant use by students in the computer educational program. They practically fought over it. In fact, they coerced Irwin Hoffman into arriving every morning at 6:30 to let them into the school, and the custodian had to practically throw them out every evening at 6:00 in order to lock up.

The four "barkers" were excused from classes during

would have to move the computer to make room for a meeting. They rolled the 160A out of the room, down the hall, and set up shop in the main lobby. There, they were immediately surrounded by curious students, and ran informal demonstrations until the middle of the afternoon. At that time, a moving van rolled up to the front door, the gear was packed up, and the medicine show moved on to the next stop.

the show gets results

Well organized and conducted with imagination and showmanship, the performance was a tremendous success. It generated a great deal of interest in additional introductory computer courses. Anticipating this, the boys had already arranged for the use of our classroom facilities and the 160A during spring vacation. Sixty students were signed up during the show, the results of a flyer which they printed and distributed, inviting spectators to enroll in introductory FORTRAN classes.

Sessions began a week later, organized into four sections of 15 students each. The courses were run on an auto-instructional basis. We provided 60 copies of a workbook, *Introduction to FORTRAN Programming*, which we are writing and reproducing in our office to teach the use of computers for mathematical problem-solving in the secondary schools. For a week, the student instructors answered questions and tutored individuals. During the second week, spring vacation, the instructors brought each section to our office for a day of problem-solving on the 160A. Every student had executed at least one FORTRAN program by the end of the week, and several had run more. They chose their own problems, most of them coming from their mathematics text books.

At Washington High, as a result of this activity, we now have nearly 100 students who will be clamoring for additional training during the next school year.

plans for next year

We are sold on medicine shows. In fact, the second show was put on by five students at Denver's Abraham Lincoln High School, and more are anticipated during the next school year.

It will be a year of growth. In adjacent Jefferson

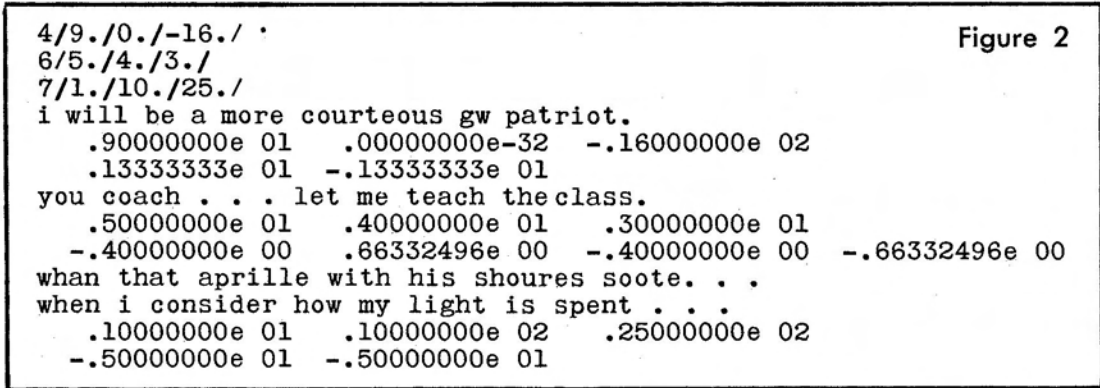


Figure 2

most of the show. On Friday morning, Fred Ris rejoined his algebra class just as it began a discussion of the problem, "Given a set of N people in a room, what is the probability that two of them have their birthdays on the same day of the year?" The class set up some specific cases, and began hand computing the results. Fred jumped up, mumbled something about a computer, and dashed out the room. He ran downstairs, wrote a FORTRAN source program to tabulate the desired probabilities for N=2 to N=150, then compiled and executed the program. He managed to get back to his algebra class before the end of the hour to display his results.

Friday noon, the students were informed that they

County, public school officials are making arrangements to train high school teachers in computer methods, and have invited several universities in the area to assist in implementing an extensive program in computer education. During the next school year, we expect to have courses there in computers and computing, as well as the present courses in problem-solving and answer-getting with FORTRAN. Recognized as a leader in evaluating and adopting new ideas, the Jefferson County public school system's program should provide us with some data for evaluation of several approaches to computer education in the secondary schools. ■

FOUR STUDENTS AT CONTROLS

Computer Performs in School

By MAX PRICE

Denver Post Staff Writer

"This is a computer . . ."

With these words Randolph (Randy) H. Levine, 16, of 43 S. Hudson St., began an explanation of a Control Data 160A Computer for his fellow students at George Washington High School.

He and three other students—Fred N. Ris, 16, of 635 Eudora St.; Alvin D. Nelson, 17, of 65 S. Madison St., and Robert A. Kahn, 16, of 857 Grape St.—demonstrated how to solve difficult math problems in seconds on the computer.

To the amazement and amusement of students in a mathematics class, the four youths produced answers for homework problems.

The four are acknowledged experts in the use of the 160A Computer. Through the cooperation of the Control Data Corp., 655 Broadway, they have taken courses on computer programming and digital computing methods at the firm's offices.

They were given free use of computers to obtain experience in operating the complicated equipment. This was followed by a seminar in which the instructor posed problems for them to analyze and solve.

A \$90,000 computer was sent to George Washington High School by Control Data Corp. for demonstrations in math and science classes.

The four students, under direction of math teacher Irwin J. Hoffman, put the computer through its intricate paces. On hand for a demonstration was Robert L. Albrecht, Control Data applications analyst, who has worked closely with the students in computer courses.

He estimated that about \$20,000 worth of time—based on the

computer rental fee—has been set aside by Control Data for area high school students. Students from Abraham Lincoln High School and five Jefferson County public schools have taken introductory computer courses, in addition to students from George Washington.

Hoffman and Albrecht agreed that problem-solving through use of computers gives students a

deeper insight into math and encourages them toward self-education in the subject.

The four George Washington students have become so skilled in use of the 160A Computer that they are establishing a class of their own for fellow students.

Randy, Fred, Alvin and Robert plan to start the computer class during spring vacation.



Denver Post Photo by Bill Peters

STUDENTS WORK MATH PROBLEMS ON COMPUTER

From left are Robert A. Kahn, Randolph H. Levine, Fred N. Ris and Alvin Nelson, George Washington High School.



Denver area high school students gave computer professionals a show Wednesday at the Assn. of Computer Machinery convention under way this week at the Denver Hilton. Students engaged in working a problem given them by one of the professionals on a Control Data Computer are, from left, Alvin Nelson and Robert Kahn of George Washington High School; Larry Davis of Golden High School, and Randy Lewis, also of George Washington.

—Rocky Mountain News Photo by Bob Talkin.

Students Display Computer Prowess

Four students from high schools in the Denver area, described by their instructors as "gifted and ambitious," are demonstrating their computer prowess at the annual conference of the Assn. for Computing Machinery being held this week in Denver.

The computer programs in the demonstration have been created entirely by the students. The four were employed at the Denver office of Control Data Inc. this summer to develop the demonstration.

The four students' abilities are the result of a program which started with 35 students from Denver's George Washington High School in the summer of 1962.

Since that time the Control Data education program has ex-

panded until 150 students from high schools in Denver and Jefferson County are participating.

Plans for the 1963-64 program are more extensive.

R. L. Albrecht, a senior applications analyst for Control Data in Denver, conceived the program and has directed it.

According to Albrecht, it originated after a chance meeting with Irwin Hoffman, a Denver high school mathematics teacher. Albrecht and Hoffman developed the initial program.

In the program as designed by the two, the goal is to "teach mathematics, not computers."

Much of the work in the program has been done as extra-curricular activity on the students' own time before and after classes.

Albrecht said the students quickly learned fundamentals of mathematical analysis after basic demonstrations and lectures. Students developed problem solving procedures, programmed solutions in the FORTRAN computer language and ran their own problems on Control Data's 160A computer. Computer time is provided without cost to the students.

Special work books for the program have been developed. Mathematical problems solved in the program are extremely sophisticated. Two of the students won top prizes in the Denver area Science Fair.

Students have been eager to demonstrate their knowledge, Albrecht said. Many will serve as teachers in this coming year's program.

Five Area Students Honored

Special to The Rocky Mountain News

SANTA BARBARA, Calif., April 22—Five Denver area high school students received top awards at the Assn. for Educational Data Systems convention here Wednesday.

The five students, associated with the University of Colorado, College of Engineering Computer Science Center in Denver, comprised the largest group from any single area to win awards.

The contest for secondary school students was for the most original computer program. Denver students won two second prizes, two third prizes and an honorable mention.

Winners include Larry Davis of Golden, second prize; Fred Ris of 635 Eudora st., second prize; Richard Mallory of 11350 W. 25th pl., Lakewood, third; Randy Levine of 43 S. Hudson st., third, and Robert Kahn of 857 Grape st., honorable mention.

Davis, Ris, Levine and Kahn are lab assistants in the secondary computer science program at the CU Denver Center. Mallory developed his program on weekends at the center.

The center is operated by the CU College of Engineering with the co-operation of Control Data Corp. and the Denver Chamber of Commerce.

The University provides administrative and clerical facilities, teaching supervision, a classroom and computer space. Control Data Corp. has made available a Control Data 160 computer, peripheral equipment and the services of Robert Albrecht, educational specialist.

Supplies and supporting equipment have been provided by local business concerns through the Chamber.

Starting in September 1963, 144 high school students and 26 high school teachers from metropolitan area high schools have enrolled in the computer science program at the center.



The
Mathematical
Association
of
America

THE ROCKY MOUNTAIN SECTION

FORTY-SEVENTH ANNUAL MEETING
MAY 1-2, 1964

The Colorado College
Colorado Springs, Colorado

FRIDAY, MAY 1, 1964

10:00 A.M.-1:00 P.M.: Registration - - - - - Olin Lounge

1:00-2:00 P.M.: First Session - - - - - Olin Lecture Room

Presiding: COL. J. C. HEMPSTEAD, USAFA

1. *Idempotent Matrices (mod p^n)* (20 minutes)
Professor John H. Hodges, University of Colorado
2. *Applications of Symmetric Function to Statistics* (20 minutes)
Professor W. Mielke, Colorado State University
3. *Estimation with Some Prior Information* (20 minutes)
Professor M. M. Siddiqui, Colorado State University

2:00-2:30 P.M.: Recess

2:30-3:30 P.M.: Second Session - - - - - Olin Lecture Room

Presiding: PROFESSOR GEORGE F. SIMMONS, Colorado College

1. *Chebyshev Lines* (30 minutes)
B. L. Foster, Research Mathematician,
Denver Research Center, Marathon Oil Company
2. *Some Results on T-fractions* (20 minutes)
Professors William B. Jones and W. J. Thron,
University of Colorado
3. *Hankel Transforms and Entire Functions II* (10 minutes)
Professor K. R. Unni, Utah State University

3:30-4:00 P.M.: Recess

4:00-5:00 P.M.: Third Session - - - - - Olin Lecture Room

Presiding: COL. J. W. AULT, USAFA

1. *The Value of a Coalition in Applied Games* (10 minutes)
William C. White, Cadet, USAFA



2. *The University of Colorado Computer Center for Secondary Schools* (20 minutes)

Robert L. Albrecht, Educational Specialist,
Control Data Corporation

3. *Polypack, A set of Polynomial Algorithms* (10 minutes)

Robert A. Kahn, student,
George Washington High School, Denver, Colorado

4. *Logic* (10 minutes)

Randy Levine, student
George Washington High School, Denver, Colorado

5. *Number Theory* (10 minutes)

Larry Davis, student, Golden High School
Golden, Colorado

6:30 P.M.: Dinner - - - - - Palmer Room, Antlers Hotel
(Cascade and Pikes Peak Avenue)

8:00 P.M.: Address - - - - - Palmer Room, Antlers Hotel

Probability and Number Theory

William J. Leveque, Visiting Professor
Colorado University

SATURDAY, MAY 2, 1964

9:00-10:00 A.M.: Business Meeting - - - - - Olin Lecture Room

10:00-11:00 A.M.: Fourth Session - - - - - Olin Lecture Room

Presiding: MAJ. W. P. ROLLINS, USAFA

1. *Generalized Polynomials* (12 minutes)
Captain Daymond E. Helton, USAFA

2. *An Undergraduate Research Program in Mathematics*
(10 minutes)
Professor F. Max Stein, Colorado State University

3. *General Repeated Exponentiation* (10 minutes)
Robert A. Bruce, student, Colorado State University

4. *Nondecreasing Solutions of $y'' = f(x,y)$* (30 minutes)
Professor Jerrold W. Bebernes,
University of Colorado