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There are two primary sources of computer activity among Carleton students: course work and independent study. In many instances we have found that not only has the student learned something about programming and the use of computers from one of these activities, but also a great deal about the subject matter that motivated the computing. In this respect, the computer is an excellent pedagogic device.

In the following outline of our student computer work, I have merely named the computer problems originating in courses but have described more fully some of the work arising from independent study. The 1620 Users Group Library file number is given for those programs that are in the library. To obtain a copy of a program write-up write to *Program Distribution Center, Box 790, White Plains, New York.*

Courses

A. Utilization of Automatic Computers (Mathematics 37)

1. Complete solution to the general quadratic equation.
2. Ordering the numbers in a list.
3. Bisection method for finding roots of an equation.
4. Number of days between dates using the Carleton Binary Simulator (see item D. 10 below)
5. Tabulation of Bessel functions.

B. Introduction to Numerical Analysis (Mathematics 57)

1. Solution of an equation using several iterative methods: false position, Newton, Bairstow, Bernoulli.
2. Inversion of a matrix using method of elimination.
3. Solution of a linear system using the Gauss-Seidel method.
4. Finding the convex hull defined by linear inequalities in two dimensions.
5. Monte Carlo evaluation of a double integral.
6. Interpolation using Lagrange, Newton and Aitken methods.
7. Numerical integration using Newton-Cotes and Gauss methods.
8. Summation of series.
9. Least squares approximation, discrete and continuous, using normal equations and orthogonal polynomials.
10. Chebyshev economization of power series.
11. Rational approximation using reciprocal differences.
12. Fourier approximation.
13. Exponential approximation.
14. Finding the least common multiple and greatest common divisor of a set of positive integers.
15. Minimax polynomial approximation.

C. Seminar on Computer Applications in the Social Sciences (Mathematics 65)

1. Ordering the numbers in a list.
2. Discrete least squares curve fitting.
3. Monte Carlo simulation using a discrete probability distribution.
4. Information storage and retrieval.

Independent Study

The following programs were written under NSF grant GE 1136 during the summer of 1963:

1. *Log Subroutine for Complex Arguments* by Robert A. Brown (1620 File No. 1.6.089)
   This subroutine calculates the real and imaginary parts of the natural logarithm of a complex number.
2. *Boolean Function Transformation* by Katherine A. Wier (1620 File No. 5.0.025)
   A boolean function F is transformed according to three given explicit boolean functions which are used to form a unitary transformation matrix R. The product function E = F * R is the consesequence solution of F and R. This program may be used in automatic medical diagnostics.
3. *Extreme-Point Solution for Rectangular Games* by Richard E. Hammer (1620 File No. 7.0.045)
   This program finds the value of a rectangular game and all extreme points in the solution set of the game.
4. *Approximate Rectangular Game Solution* by Richard E. Hammer (1620 File No. 7.0.046)
   This programs finds bounds on the value of a rectangular game and approximations to a pair of optimal strategies for the game.
5. *Chebyshev Economization of Polynomials* by Robert A. Brown (1620 File No. 7.0.047)
   This program accepts the coefficients of a given polynomial, rearranges terms to an expansion in Chebyshev polynomials, truncates this expansion to a given degree or accuracy, and then rearranges terms again to produce the coefficients of a polynomial in standard form.

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6. *A New Solution to an Old Problem* by Richard E. Hammer
(*Delta-Epsilon*, vol. IV, page 4, Carleton College, Northfield, Minn.)
This paper reports on a numerical dynamic programming approach to the old brachistochrone problem.

The following programs were written as part of the students' independent study requirements:

7. *Numerical Solution of a First-Order Differential Equation by Milne's Method, Using the Runge-Kutta Method to Start* by John M. Karon (1620 File No. 4.0.004)
8. *General Linear Programming Solution* by Richard E. Hammer (unpublished) (See Gass, *Linear Programming*, Chap. 6, Sect. 2, McGraw-Hill, 1958)
9. *Solution of Sequencing Problems* by Robert A. Brown (unpublished)
(See Sasieni, Yaspan, and Friedman, *Operations Research—Methods and Problems*, pp. 250-264, John Wiley and Sons, 1959)
10. *Carleton Binary Simulator* by William R. Gage (1620 File No. 2.0.035)
(Mr. Gage was given honors in independent study for this work.) The Carleton Binary Simulator is an interpretive program that converts the 1620 into a single address, fixed word length, binary computer.

Miscellaneous

1. A program to count ballots in a preferential voting system.
2. A game-playing program for investigating a learning situation.
3. A factor analysis program.
4. A program to match couples for a date.
5. *Carleton SPS* by William R. Gage (1620 File No. 2.0.039)
6. *Carletran* (*Carleton Fortran*) by William R. Gage (1620 File No. 2.0.040)
7. *Music Interpreter* by Richard F. Smiley (1620 File No. 11.0.039)

In addition to the student written programs described above, the numerical analysis students used a new computer language to solve the problems listed in B above. This was the language of *Carleton College Compiler* by Donald H. Taranto (1620 File No. 2.0.038).