CACHE NEWS

News About Computers In Chemical Engineering Education.

No. 14 *April, 1982*

WHAT IS CACHE?

CACHE is a non-profit organization whose purpose is to promote cooperation among universities, industry, and government in the development and distribution of computer-related and/or technology-based educational aids for the chemical engineering profession.

CREATION OF THE CACHE CORPORATION

During the 1960's the rapid growth of computer technology challenged educators to develop new methods of meshing the computer with the teaching of chemical engineering. In spite of many significant contributions to program development, the transferability of computer codes, even those written in FORTRAN, was minimal. Because of the disorganized state of university-developed codes for chemical engineering, 14 chemical engineering educators met in 1969 to form the CACHE (Computer Aids for Chemical Engineering) Committee. Initially the CACHE Committee was sponsored by the Commission on Education of the National Academy of Engineering and funded by the National Science Foundation. In 1975, after several successful projects had been completed, CACHE was incorporated as a not-for-profit corporation in Massachusetts to serve as the administrative umbrella for the consortium activities.

CACHE ACTIVITIES

All CACHE projects are staffed by volunteers, including both educators and industrial members, and coordinated by the Board of Trustees through various Task Forces. CACHE actively solicits the participation of interested individuals in the work of its on-going projects. Information on CACHE activities is regularly disseminated through the CACHE Newsletters. Individual inquiries should be addressed to:

CACHE Corporation
3062 MEB
Salt Lake City, Utah 84112
(801) 581-6916

CACHE TRUSTEES AND MEMBERS

CACHE NEWS

The CACHE News is published one or two times a year to report news of CACHE activities and other noteworthy developments of interest to chemical engineering educators. Persons who wish to be placed on the mailing list should notify CACHE at the above address. This issue was edited by J. D. Seader with contributions from a number of CACHE members and representatives.

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ASEE SUMMER SCHOOL

The ASEE Summer School will be held at the University of California at Santa Barbara during August 1-6, 1982. Areas to be covered at the Summer School include:

(1) New Technical Directions in Chemical Engineering
(2) Expanding Role of Computers in Chemical Engineering Education
(3) Curricula, Courses, and Laboratories
(4) Industrial-University Interactions
(5) Chemical Engineering and Its Interactions with Society
(6) Chemical Sciences and Chemical Engineering

The Computing Sessions in Area (2) are being coordinated by T. F. Edgar, Professor at the University of Texas and President of CACHE. Several CACHE members are participating in these sessions. In addition, a session on process dynamics and control curricula will be conducted under Area (3) by Professor D. A. Mellichamp of CACHE and Professor D. E. Seborg, both of the University of California at Santa Barbara.

The schedule for the computing sessions is given at the end of this article. Following are brief descriptions of each session. There will also be hands-on demonstrations of computer graphics, PLATO, and personal computing during several afternoon periods.

1. Computer Graphics and Modular Instruction (Monday a.m. and p.m.)
   G. V. Reklaitis, Y Arkun,
   D. M. Himmelblau, M. Cutlip,
   S. I. Sandler, M. Bailey

Computer graphics is one component of CAD/CAM, which is revolutionizing production technology in many disciplines. Computer graphics also offers many opportunities for enhancing the learning experience in chemical engineering. Presentations will be given on graphics devices, prototype systems, and applications software such as PLATO. Participants will be able to obtain hands-on experience with computer graphics equipment on Tuesday, Wednesday, and Thursday afternoons.

2. Use of Computers in Teaching Process Design (Tuesday a.m. and Wednesday a.m.)
   J. D. Seader, W. D. Seider,
   R. S. H. Mah, G. V. Reklaitis,
   I. Grossmann, E. J. Henley

Computer-aided process design has gained increased acceptance during the last decade, both in industry and in universities. Since 1974, the FLOWTRAN simulator of Monsanto has been used by 57 different universities in teaching process design. The ChemShare and Simulation Sciences simulators as well as FLOWTRAN are widely used in industry. Development of the ASPEN simulator was completed at MIT early in 1982. The program has been installed at a number of industrial and governmental computing facilities and is beginning to be installed by university computing centers. Experience with these programs will be reported. On the other hand, some faculty elect not to use such tools, employing general-purpose standalone programs or no computers at all. A survey of available standalone programs will be discussed, and information on selected programs will be disseminated to participants. Advantages and disadvantages of various approaches will be discussed.

3. Personal Computing (Tuesday p.m.)
   B. Carnahan, B. Finlayson
   W. Stevens

Inexpensive personal computers offer the potential of performing many chemical engineering calculations that are currently carried out by large digital computers or by hand-held calculators. Reports on the development of personal computer software at the University of Michigan and Northwestern University will be given. Examples of instructional modules will be provided to participants, who will also have the opportunity to test the available software at the Summer School during Tuesday, Wednesday, and Thursday afternoons.

4. Microcomputers in Chemical Engineering Laboratories (Thursday a.m. & Friday a.m.)
   P. R. Rony

Microcomputers have facilitated laboratory data acquisition and automation in industry. However, implementation of microcomputers in university laboratories has been impeded by a lack of knowledge by chemical engineering faculty and by the time commitment required to become sufficiently knowledgeable. In addition, there is a shortage of trained support staff for computer applications. Two courses at Virginia Polytechnic Institute on digital electronics and microcomputer interfacing/programming are designed to remove the mysteries of these topics and to permit students to solve their own problems in the laboratory. The introductory course is required of all juniors, and the elective advanced course is for seniors and graduate students. A talk on "Digital Electronics and Microcomputers for Professors" will summarize the contents of these courses. Following the ASEE Summer School, for participants desiring in-depth background, Professor Rony will offer a comprehensive faculty workshop from August 6-12 at Santa Barbara, with hands-on instruction on digital electronics, microcomputer interfacing, and microcomputer programming. This is described in the next item in this issue of CACHE News.

5. Teaching of Process Synthesis in Process Design (Thursday, p.m.)
   M. Morari, I. Grossman

Tools for performing process synthesis as a preliminary step to process design have progressed from the research stage to actual applications, both in industry and at several universities. Computer programs for process synthesis that are appropriate to use in undergraduate design, such as for separations sequences and heat exchanger networks, will be described and demonstrated. Applications of process synthesis in industry will also be reviewed.

Computing Sessions - ASEE Summer School, 1982
(T. F. Edgar, Coordinator)

	Monday, Aug 2	Tuesday, Aug 3	Wednesday, Aug 4	Thursday, Aug 5	Friday, Aug 6
AM	Computer Graphics and Modular Instruction, I	Use of Computers in Teaching Process Design, I	Use of Computers in Teaching Process Design, II	Microcomputers in ChE Laboratories, I	Microcomputers in ChE Laboratories, II
PM	Computer Graphics and Modular Instruction,II	Personal Computing	Teaching of Process Synthesis in Design		

SECOND CACHE SHORT COURSE on Micrompuer Interfacing/Programming

The first CACHE short course on microcomputer interfacing/programming was held from February 11-15 at Purdue University. Professor William R. Wilcox, Chairman of the Chemical Engineering Department, Clarkson College of Technology, who attended that course, wrote the following comment to CACHE:

> This is to congratulate CACHE on sponsoring Peter Rony's outstanding short course on microprocessors recently held at Purdue. This may turn out to be the single most significant event in CACHE's history.
>
> The course is invaluable for both experimentalists and educators. At last the intricacies of digital electronics are presented in a form readily digested by chemical engineers. The lectures are lucid and interesting.
>
> The excellent hands-on experiments allow the students to put the principles into practice. Practical, useful advice is given at every turn.
>
> I hope CACHE continues to sponsor Peter's course all over the country and that it is well attended by our faculty colleagues."

The second CACHE short course on microcomputer interfacing/programming, co-sponsored by the University of California (Santa Barbara) Chemical Engineering Department, will be held on the UCSB campus from the early evening on August 6 through noon, August 12. These are the days that immediately follow the ASEE Summer School for chemical engineering faculty. An introduction to microcomputers and personal computers will be given by Dr. Rony at the Summer School and will be followed by the hands-on short course. Whether you participate in the Summer School or not, you are welcome to attend the CACHE course. The details of the course are as follows:

LECTURER: Peter R. Rony, Department of Chemical Engineering, Virginia Polytechnic Institute & State University, Blacksburg, VA 24061 (703) 961-6370

TEXTBOOKS: Peter R. Rony, "Introductory Experiments in Digital Electronics and 8080A Microcomputer Programming and Interfacing," Books 1 and 2; Texas Instruments catalog of digital chips. Intel catalogue of interface chips.

MICROCOMPUTER AND BREADBOARDING EQUIPMENT: E & L Instruments, Inc., MMD-1 8080A-based student trainer, DM-25 breadboarding station, SK-10 solderless breadboard, DM-50 single-step board, and DM-29 three-state buffer board.

BACKGROUND REQUIRED: None.

WHAT YOU WILL LEARN: (1) Basic concepts of digital electronics; (2) Breadboarding of digital electronic and microcomputer interface circuits; (3) Microcomputer machine code and assembly language programming; (4) Basic interfacing concepts such as device select pulses, unconditional I/O, conditional I/O, interrupts, flags, semaphores, data bus, control bus, address bus, serial I/O, etc.; and (5) Introductory microcomputer programming concepts, such as byte, word, register, stack, program counter, accumulator, flags, subroutine, increment, decrement, store, load, move, immediate, AND, OR, Exclusive-OR, compare, push, pop, rotate, in, out, etc.

APPROXIMATE NUMBER OF PARTICIPANTS IN COURSE: 20 (two per lab station)

COURSE HOUSING ($167.76 or $206.40): We have made arrangements to house participants in residence halls that are adjacent to the beach on the beautiful UCSB campus, which is located on a scenic oceanside promontory that is 12 miles northwest of historic Santa Barbara. A single room costs $34.46/day and includes three meals/day (unlimited food). A double room costs $27.96/day per person. Payment for room and board is required in advance for the six-day duration of the course. The number of rooms that have been reserved is limited, so please make your reservations as early as possible. Please send your check, payable to Peter R. Rony, to his departmental address by July 15, 1982.

COURSE FEE ($125 or less): As was the case with CACHE Course No. 1, every attempt will be made to minimize the course fee. The four books will cost about $31 total and the equipment rental, $25 per person. Travel and lodging expenses of the speaker will be charged pro-rata to the participants, and should be $69 or less per person, depending upon the number of participants in the course. Please include the tentative course fee of $125 with your advance payment for room and board. Any savings on travel/lodging costs will be refunded.

COURSE REGISTRATION: If you plan to attend, please drop a line to Dr. Rony as soon as possible.

NEW CACHE TRUSTEES

At the November 12-14, 1981, annual meeting of CACHE, four new academic trustees were elected:

1. Michael B. Cutlip is Professor and Head of Chemical Engineering at the University of Connecticut. He received his PhD at the University of Colorado, following which he advanced through the ranks at Connecticut. He spent one year as Senior Visiting Fellow at the University of Cambridge. His main research interests are steady-state and transient studies of heterogeneous catalysis and adsorption, models for catalysis and fuel-cell electrodes, and computer-based instruction.

2. Morton M. Denn is Professor of Chemical Engineering at the University of California at Berkeley and Adjunct Professor of Chemical Engineering at the University of Delaware. He received his PhD at the University of Minnesota in 1964, following which he advanced through the professorial ranks at the University of Delaware. From 1977-81, he was Allen P. Colburn Professor. He received the Professional Progress Award in Chemical Engineering in 1977, was a Guggenheim Fellow in 1971-72, and a Fulbright Lecturer in 1979-80. His areas of research include non-Newtonian fluid mechanics and process control.

3. Stanley I. Sandler is Professor of Chemical Engineering at the University of Delaware. He received his PhD from the University of Minnesota in 1966. He was Visiting Professor at Imperial College (London) in 1973-74 and at Technische Universitat Berlin (West) in 1981. From 1971-76, he was a Camille and Henry Dreyfus Faculty-Scholar. His main area of research is thermodynamics, and he has developed a number of lessons for the PLATO system.

4. William E. Schiesser is the R. L. McCann Professor of Chemical Engineering at Lehigh University. He received his PhD from Princeton University in 1960. In 1973, he was an invited lecturer at the International Symposium on Stiff Differential Equations in Wildbad, Germany. Since 1975, he has served as Chairman for the bi-annual AICA/IMACS International Symposia on Computer Methods for Partial Differential Equations. His areas of research include integration of ordinary and partial differential equations, and dynamic simulation.

FOCAPD-II CONFERENCE

Planning is proceeding for the second conference on Fundamentals of Computer-Aided Process Design (FOCAPD) to be held June 19-24, 1983, at Snowmass, Colorado. The conference is being sponsored by the CAST (Computers and Systems Technology) Division of AIChE and by CACHE, the latter being responsible for arrangements. Professor Arthur Westerberg of Carnegie-Mellon University and Dr. Henry Chien of Monsanto are conference chairman and co-chairman, respectively.

Current plans call for nine sessions during the five-day period. The focus of the meeting will be the presentation of both industrial and academic views on computer-aided process design, with about 90 minutes of each session devoted to a discussion of the issues raised by the speakers. Specific topics are still being selected and reviewed by the advisory committee for the conference: C. Brosilow (Case-Western), B. Carnahan (Michigan), D. Johnston (Shell Development), J. Prausnitz (U.C. Berkeley), J. Seinfeld (Cal Tech), V. Weekman (Mobil Tyco), together with R. Mah (Northwestern), and W. Seider (Pennsylvania), who organized FOCAPD-I that was held in 1980.

COMPUTER GRAPHICS TASK FORCE

The CACHE Computer Graphics Task Force has been engaged in the following four activities:

1. NSF/ASEE Position Paper

The position paper entitled "Computer Graphics in the Chemical Engineering Curriculum," described in CACHE News No. 13, September, 1981, will appear in June, 1982, as part of a collection of commissioned papers prepared by ASEE, under NSF sponsorship, dealing with the impact of advanced technology on engineering education. The paper by Professors Reklaitis, Mah, and Edgar of the CACHE Graphics task force has been reviewed by the trustees of CACHE and will be distributed to Chemical Engineering departments as a CACHE report in the spring of 1982.

2. Special Issue of Computers & Chemical Engineering.

A special issue of Computers and Chemical Engineering devoted to "Applications of Computer Graphics in Chemical Engineering" (Vol. 5, No. 4), as described in CACHE News, No. 13, has just been published. The issue, assembled and edited as a CACHE task force project, contains 11 papers dealing with educational and research utilization of computer graphics. Copies of this issue will be mailed to Chemical Engineering departments that sponsor CACHE.

3. Revision of CACHE Report, "Computer Graphics in Chemical Engineering Education"

The Graphics task force has undertaken a revision/update of the Graphics Report prepared by Professors Carnahan, Mah, and Fogler in 1978. The report is intended to introduce computer graphics technology as well as to survey the potential applications of this technology in chemical engineering. The task force is soliciting comments and suggestions on specific items or general topics that might or ought to be included in the update of the report. Please send your suggestions to G. V. Reklaitis, the task force chairman and Professor of Chemical Engineering at Purdue University.

4. ASEE Faculty Summer School

The Graphics task force is responsible for a pair of sessions on computer graphics and modular instruction at the August 1-6, 1982, ASEE summer school to be held at Santa Barbara. The program will include the following speakers:

Professor Michael Bailey:
"State of the Art: Computer Graphics Hardware and Device-Independent Software"

Professor G. V. Reklaitis:
"Overview of Computer Graphics in ChE"

Professor Y. Arkun:
"Computer Graphics Aids in Teaching Process Control"

Professor David Himmelblau:
The CHEMI Modular Instruction Project"

Professor S. I. Sandler:
"A PLATO Course in Chemical Engineering Thermodynamics"

Professor Michael Cutlip
"A PLATO Course in Chemical Reaction Engineering"

In addition to scheduled presentations, computer graphics equipment will be made available to participants on Tuesday, Wednesday, and Thursday afternoons for demonstration purposes.

ChE COMPUTER GRAPHICS LABORATORY AT PURDUE

Through a substantial grant from the Shell Companies Foundation, the School of Chemical Engineering at Purdue University is establishing an interactive computer graphics laboratory. The facility, housed in the Chemical Engineering Building, will consist of 10 color graphics terminals, a dedicated computer, and a Versatec hard copy device.

The color graphics terminals are MEGATEK raster refresh devices. Two are fully expanded 7290 models, which feature high resolution 19-inch displays, hardware 3-D rotation, scaling, as well as translation, and 2-D clipping. The other eight terminals are basic 6250 models. The terminals will be serviced by a DEC VAX 11/780 with associated disc and tape systems. The computer will be maintained and operated by the professional staff of the Purdue Engineering Computing Network, which already includes several 11/780's, as a service to the School of Chemical Engineering. The graphics laboratory, to be fully operational in mid-1982, is intended as a research facility for ChE faculty and graduate students. The detailed equipment budget for the facility is as follows:

EQUIPMENT BUDGET

	Price	Subtotals
I. Mainframe Computer		
A. Digital Equipment Corp CPU SV-AXHHV-CA VAX CPU, two 28 megabyte disks, expansion cabinet, console terminal, 512kB memory and memory controller	$131,560	
H7112A memory battery backup	9,752	
FP780A floating point acclerator	1,150	
ZE014-CY diagnosit software license for VAX 11/780	1,000	
H9602-DF UNIBUS Expansion Cabinet	3,091	
Ball-KE expansion box	3,128	
70-14956 power supply	3,150	
Shipping	1,000	
		$153,831
B. Trendata Main Memory 14 ea PINCOM 7805 256kB memory boards @ $1,595/ea	22,330	

C. Able Computer Technology Terminal Ports		
One 10048-2 DMAX-16 sixteen-port adaptor with modern control	5,580	
One 10048-1 DMAX-16 sixteen-port adaptor w/o modern control	4,770	
		10,350
D. System Industries Disk System	92,731	
Two 9400-66 disk controllers with two SBI VAX interfaces, with four 256 megabyte disk drives dual-ported, with 5 packs		92,731
E. AVIV Tri-density Tape System	32,100	
One Model 6250 Tri-density Magnetic tape system with 1953 tape unit, 6850 formatter, and PDP 11 TFC 806 interface		
Installation & shipping	1,860	
		33,960
F. Digital Equipment Corp Documentation	2,000	
System Manuals and Print Sets		2,000
G. Software Licenses		
Western Electric Administrative UNIX License	5,000	
University of Berkeley UNIX VAX extended software	500	5,500
H. Site Preparation		
Air Conditioning, 12.5-ton unit	15,000	
Power transformer, .0005 pf isolation, 30kVA, 4-wire Y system and installation	15,000	30,000
I. Network and PUCC Communication Lines	5,700	
Three DEC network interface ports 3 M8200YA and M8202YB sets		5,700
Total Mainframe Computer		$356,402
II. Graphics Terminals		
A. MEGATEK Model 7290 self-contained combination raster & calligraphic graphics controller	22,500	
Interface option IF/DEC - UNIBUS I/F with 15-ft UNIBUS cable	4,000	
Opt. HCRST3 - hardware 3-D rotate, scale translate, 2-D clip	8,000	
Opt. DIS-E - 21" electromagnetic display with 15 mil spotsize, P40 phosphor, phosphor protect, and case	6,750	
Opt. DBBP - double buffered 512 x 512 bit Pl. (3 ea)	6,000	

Opt. DIS-RA - 19" non-interlaced, high-resolution color display, case and 15-ft cable	6,000	
Opt. RGB1 - Single Channel RGB video OP card	2,000	
Opt IPCU-KJG - IPCU with KEY, JOY, and tablet interfaces (2 ea)	4,000	
Opt. KEYJOY - Keyboard (KEY) and Joystick (JOY) mounted together	4,000	
Opt. WAND 7200-F - FORTRAN Graphics package for DEC VMS	4,000	
Opt. HCU-V - Versatec hard copy RASTERIZOR[tm]	10,800	
Installation	720	
Travel for installation (estimated)	280	
B. MEGATEK model 6250 Whizzard Graphic Terminals with self-contained Raster Refresh graphics terminal (8 ea)	135,200	
Option WAND 6250 - FORTRAN Graphics Pkg	600	
Total Graphics		212,050
GRAND TOTAL EQUIPMENT		$568,452

PPDS (Physical Property Data Service) USER MANUAL COMPLETED

With financial support from DuPont and Simulation Sciences, Inc., CACHE has leased, from the British Institution of Chemical Engineers, through the efforts of Professor Rudy L. Motard of Washington University, a version of the PPDS physical property retrieval and estimation program. The service is now installed on a DEC System 20 computer at Carnegie-Mellon University and can be accessed via the TELENET communication network, which provides local dial-up service in most cities. Thus far, three universities have requested a contract from CACHE to use PPDS.

Professor Motard has completed a user manual for PPDS entitled "Introduction to CACHE Version of Physical Property Data Service." Copies of the manual can be ordered by using the order blank at the end of this newsletter.

The CACHE version of PPDS provides retrieval of the 17 constant and 15 variable properties, in a variety of units, including S.I. and British, for 50 compounds.

Input to PPDS is interactive, wherein the user enters replies to questions from PPDS.

Output from PPDS consists of:

1. Tabulated, selected constant properties of pure compounds or mixtures.
2. Tabulated, selected variable properties of pure compounds or mixtures at specified intervals of T and P.
3. Warning messages for less reliable estimates.
4. Array values for user-written programs through FORTRAN interface.

In order to use CACHE-PPDS, contact:

Professor R. L. Motard
Department of Chemical Engineering
Washington University
St. Louis, MO 63130

He will send a contract and additional information. Upon receipt of the signed contract, a purchase order is sent to CACHE to cover an initiation fee of $100 for CACHE-sponsoring departments or $200 for non-sponsoring departments. This should be sent to:

CACHE
Room 3062 MEB
Salt Lake City, UT 84112

The approximate total cost to access CACHE-PPDS by TELENET is $5 per connect hour, payable to Carnegie-Mellon University.

CIChEE COMPUTER PROGRAM CATALOG

Professor J. Lamb of the University of Surrey, under the auspices of Computers in Chemical Engineering Education (CIChEE) has compiled the following information on a number of computer programs that may be of interest to chemical engineering educators and are available at no more than the cost of materials.

1. LINI
   Author; Affiliation:
   R. H. Hill; Heriot-Watt
   Brief Description:
   Conversational linear programming algorithm dealing with up to 10 variables and constraints only of the form <=. Comprehensive output enablescomparison to be made with graphical and manual methods of solution.
   Comments:
   Used extensively in final year process economics option for solution of tutorial problems.
   Language: FORTRAN
   Code Media; Documents Available:
   Listing + Cards; Listing + Test Data + Sample Output + Instruction Sheet
   Charges: Free
   Status: Developed
   Contact: Author

2. MASSBAL
   Author; Affiliation:
   R. K. Sintott; University College Swansea
   Brief Description:
   Linear mass balancing program
   Comments:
   Used for undergraduate design projects for three years.
   Language: BASIC
   Code Media; Documents Available
   Listing; Listing
   Charges: None
   Status: Developed
   Contact: Author

3. UNIDIST
   Author; Affiliation:
   A. Fredenslund; Lyngby
   Brief Description:
   Constant molar overflow distillation programme with UNIFAC(2)
   Comments:
   From EURECHA recommended teaching programme collection (Lyngby). Demonstrates multicomponent distillation for non-ideal systems
   Contact: Murray Rose, E. T. H. Zurich

4. BIDIST
   Author; Affiliation:
   J. V. Edwards; Polytechnic of Wales
   Brief Description:
   Calculates number of plates required for separation by binary distillation
   Comments: none
   Language: FORTRAN
   Code Media; Documents Available
   Listing; listing + sample output + description of package
   Charges: none
   Status: developed
   Contact: author

5. GAMMA
   Author; Affiliation:
   J. A. Lamb;Surrey
   Brief Description:
   Estimates parameters of liquid phase activity coefficient equations from VLE
   Comments:
   Van Laar, Black, Wilson, Orye, Heil, enthalpic Wilson, NRTL, UNIQUAC are covered in one subroutine
   Language: FORTRAN
   Code Media; Documents Available
   Listing + Sample output + PPT/MT; Listing: + User Notes
   Charges: to cover materials
   Status: underdeveloped but usable
   Contact: author

6. API1
Author; Affiliation:
J. A. Lamb, Surrey
Brief Description:
Calculates liquid and vapor enthalpies, volumes, entropies, specific heats, fugacities
Comments:
Seems to work well for high-pressure vapor phase
Language: BASIC
Code Media; Documents Available
Listing + PPT/MT; Listing + user notes
Charges: to cover materials
Status: liquid phase region results not fully tested
Contact: author

7. FLAME
Author; Affiliation:
K. Ahmad & J. A. Lamb; Surrey
Brief Description:
Interactive version of adiabatic flame temperature calculation
Comments:
C. F. CACHE CTEE computer programs for chemical engineering volume 5, problem V-14
Language: FORTRAN
Code Media; Documents Available
Listing + PPT/MT; listing + user manual
Charges: to cover costs
Status: developed
Contact: J. A. Lamb

8. FOKIN
Author; Affiliation:
C. A. Millington; Surrey
Brief Description:
Interactive simulation of first-order reaction kinetics
Comments: none
Language: BASIC
Code Media; Documents Available
Listing + PPT/MT; listing + sample output
Charges: to cover materials
Status: developed
Contact: author

9. EXOTOP
Author; Affiliation:
---; OULU
Brief Description:
This programme enables various control strategies for an exothermal reactor to be compared
Comments:
Part of the EURECHA recommended teaching collection
Status: developed
Contact: Murray Rose, E. T. H. Zurich

10. PFR
Author; Affiliation:
J. Beveredge & R. G. Hill; Heriot-Watt
Brief Description:
Generalized 1-D reactor simulation. Covers adiabatic reactors and non-adiabatic with fixed temperature on the heat transfer fluid side
Comments:
Works well. Used in final year projects for simulation of non-adiabatic reactors and simultaneous reactions
Language: FORTRAN
Code Media; Documents Available
Listing + test data + sample output + user manual; NAG
Charges: free (for teaching use only)
Status: developed (plot option, less so); enhancements envisaged
Contact: R. G. Hill

MICROCACHE PROJECT

The MicroCACHE (MicroComputer Aids for Chemical Engineering) Project, under the direction of Professors Brice Carnahan and H. Scott Fogler, of the University of Michigan, involves the development of a microcomputer-based delivery system for educational materials and programs, and the production of a small number of educational "modules" to test the system and demonstrate its effectiveness. The work is sponsored by the National Science Foundation under CACHE auspices.

A MicroCACHE educational module consists of a sequence of screen displays, program executions, and interactions with the user (a student or practicing engineer) that might include, for example, display of textual information, display of graphical (picture) information, storage and retrieval of engineering data (e.g., equipment characteristics, property parameters), implementation of common numerical methods (e.g., solution of single nonlinear equations, and small systems of linear, nonlinear, and ordinary differential equations, and numerical integration by simple quadrature fomulae), execution of engineering analysis, simulation, and design programs, and administration of quizzes and examinations.

The sequencing of the various displays, program executions, etc., is established by the module writer (e.g., a professor) and supplied to the MicroCACHE supervisory system in the form of a "module command file" (MCF). The MCF consists of a "program" of individual supervisory system commands, usually involving display of text lines from "text files," pictures from "graphics files," questions (possibly involving pictures) from "exam files" and "quiz files," execution of programs in "program files," and execution of programs from system "library files" (e.g., numerical analysis, graphics, and information storage/retrieval subsystems).

The sequencing of various supervisory system commands can be quite rigid, or can be made conditional on user responses; additionally, the user can be given considerable flexibility in sequencing various parts of the module (e.g., skipping over explanatory materials, deciding when to take an exam, etc.) if the module writer so chooses. A system program named "MODPREP" has been written to assist the module writer in preparing the MCF.

In addition to its principal function of processing module commands from the MCF, the supervisor system is responsible for maintaining up-to-date records for each user, including, for example, modules that have been accessed and responses to examination questions (exams involving only multiple-choice questions or questions requiring numerical answers are automatically "scored," while those involving essay questions are not). Additionally, each module is terminated with a (possibly optional) "evaluation" section, in which the user can comment on the educational experience (pointing out errors or poorly constructed submodule sections, for example).

The MicroCACHE supervisory system will also include an independent "analysis" subsystem for use by the instructor to process the information recorded for individual users and to produce summary information for a subclass of users (e.g., results of an examination for all members of a class or collective evaluations for a particular module).

An attempt is being made to make the system very "user-friendly." From the user's standpoint, module processing is strictly menu driven so that very little needs to be known about system details. The module writer, on the other hand, needs to have some knowledge of the system. In particular, the writer needs to know how to use the system editor (to prepare initial versions of text files and exam files), how to call on the graphics, data-base management, and numerical methods subsystem program; and, if analysis and/or simulation/design programs are to be incorporated into the module, how to program in one programming language (preferably BASIC, but FORTRAN is also a possibility).

Some of the major design decisions that have been made are to choose as the prototype hardware an APPLE II Plus microcomputer with 64K bytes of fast memory, two disk drives, a second processor chip (a Z-80, available on a Microsoft "softcard"), and a monochrome monitor. Total system cost is about $3500. The choice of a two-disk system was determined by the decision to store the supervisory system program and the individual user's records on one minifloppy diskette (kept by the user) and to store the module command file and all other files for each educational module on a separate module diskette. The user diskette will contain all information required to process any educational module.

The decision to add the Z-80 processor was dictated by a desire to develop the software for operation under the CP/M operating system, by far the most common operating system for microcomputers. The decision to use Microsoft's BASIC as the principal programming language (despite its lack of structured constructs) was made because of its wide availability, capability of calling on FORTRAN object programs, and the promise of a soon-to-be-released compiler. These choices of hardware and software will make the system operate relatively fast and will allow it to be potentially portable for use on other microcomputers (e.g., CP/M and a compatible BASIC will be available for the new IBM personal computer).

The MicroCACHE project has now been underway for about eight months. The overall system structure has been specified, and some important pieces of software have been written and debugged. Testing of the supervisor and major system components (for example, text, exam, graphics, and module command file preparation programs) will begin soon. Also, a few prototype educational modules are being developed in parallel with the system software work. The system will be described in detail and demonstrated for the first time at the ASEE Chemical Engineering summer School at Santa Barbara in early August of this year, as described in the first news item of this issue of CACHE News.

Testing with student users will begin in the fall of this year. With results of the testing experience in hand, some changes in system specifications and operation will undoubtedly be made. Once the revised system is functioning reliably and a suitable distribution mechanism has been established, the programs will be made available for use by others (probably in 1983).

CHEMI CONTINUATION (PHASE II) PROJECT

Since October, 1979, the second phase of the CHEMI project, funded by NSF, has been underway with D. M. Himmelblau of the University of Texas at Austin as the Principal Investigator. A steering committee including the following was established in November, 1979:

Brice Carnahan, University of Michigan
Dean E. Griffith, Director of Continuing Education at Oklahoma State University
Lee Harrisberger, University of Alabama
Vladimir Slamecka, School of Information and Computer Science, Georgia Institute of Technology
Robert Tinker, Technology Education Research Center, Cambridge, Massachusetts.

The main objective of the project is to make single-topic, stand-alone chemical engineering instructional modules available to students and practicing engineers on stand-alone, small computer systems. About 100 advanced-level modules for chemical engineering are being solicited.

The following table shows the number of modules that have been commissioned and completed in each of seven areas.

Status of New Module Preparation

Area	No. of Modules		
	to be Written	Commissioned	Completed
Process Control	2	2	1
Transport	25	10	4
Material & Energy Balances	21	18	4
Thermodynamics	22	16	3
Kinetics	5	0	0
Stagewise and Mass Transfer	12	2	2
Design	30	14	1
Total	117	62	15

All 500 abstracts that refer to external sources of information on topics not covered by the modules promised have been completed and entered into the computer. Ninety-six modules have been indexed, and 200 module summaries have been prepared.

Detailed evaluations on the material and energy balance, process control, and stagewise process series of modules have been received from the following faculty members:

Process Control	Mode of Use
Professor Franklin G. King, Howard University	self-paced
Professor N. F. Marsolan, Louisiana Tech University	remedial
Professor M. L. Brisk, University of Sydney	remedial
Professor Peter J. Sukanek, Clarkson College of Technology	remedial
Professor Duane D. Bruns, University of Tennessee	self-paced
Material & Energy Balance	
Professor Franklin G. King, Howard University	self-paced
Dr. M. A. Serageldin, Michigan Tech University	remedial
Stagewise & Mass Transfer	
Professor E. Dendy Sloan, Colorado School of Mines	remedial

The results show some modules that need revision. Work will continue on improving the testing materials for the next series of tests with the Continuous Learning Corporation.

The solicitation and preparation of modules is still continuing. Editors who have gaps in their series and would be interested in hearing from prospective authors are:

Design:
Professor James Beckman
Dept of Chemical & Bioengineering
Arizona State University

Thermodynamics:
Professor G. A. Mansoori
Dept of Energy Engineering
University of Illinois
Chicago Circle
Box 4348
Chicago, IL 60680

Transport Phenomena:
Professor Ron Gordon
Dept of Chemical Engineering
University of Florida
Gainesville, FL 32611

Material & Energy Balances:
Professor Eric Snider
Div of Resources Engineering
Dept of Chemical Engineering
University of Tulsa
Tulsa, OK 74104

The preparation of a user-inducement and self-assessment system is about 25% completed. The user inducement information system has been defined insofar as possible, and a contract with National Instruments of Austin, Texas, to design the essential components of the system for subsequent coding has been negotiated. Work on the design was initiated in the middle of October, 1981. The objective of the self-assessment diagnostics effort was to develop a program that suggests sequences of modules to be studied by a student based on:

a) the student's subject preferences, and
b) stored module prerequisite data.

As a first step, the LINK program was developed by Dr. Toshi Inagaki of the University of Tsukuba, Japan, while employed in Austin during the summer of 1981. LINK is a program that prescribes sequences of modules for a student to study in order to reach a specified goal. The sequences are determined from a set of prerequisite relationships among modules. Graphs of these relationships have been provided by chemical engineering professors who have used CHEMI modules in their classes. In many instances, the graphs show multiple paths to a module, creating a logical OR gate. The current ISM program cannot include OR gates in its analysis of prerequisite relationships...only AND gates. LINK can accommodate both.

LINK uses prerequisite data from any set of modules. It has been tested with data from the Material and Energy Balance series of the CHEMI modules.

At the outset of an interaction with LINK, the student is asked to identify a target module (the module at which he wishes to end his study sequence). LINK analyzes the prerequisite relationships, including alternate paths, and the student is provided with one or more sequences of modules that must be studied in order to reach the target module. Multiple parallel sequences result when LINK encounters alternate prerequisite paths to a module.

Currently LINK lists one or more sequences of modules that are prerequisites to the chosen target module. Since alternate paths are normally encountered, the student must then determine which of the multiple sequences to study. Preferably, when a list of modules is compiled, the elements should be linked sequentially, with importance-to-goal ratings and time estimates.

The LINK program will be incorporated into the CHEMI diagnostics software. Prerequisite data for the CHEMI modules will accompany the software when it is to be used in conjunction with the CHEMI modules.

Two versions of the CHEMI-II products will be made available:

1. Retrieval on standard ASCII terminal:
   * ASCII characters only
   * Spelled-out Greek letters, functions, operations, ex: alpha, sqrt( ), Laplace( ), Int( )
   * Simple figures only
   * Printed packet of all complex figures for each module needed
     Hard copy printed output on a line printer is the mode of retrieval.

2. Retrieval on graphics terminal (GIGI)
   * Use alternate character sets for math symbols, Greek letters, etc.
   * Include as many figures as possible
     original version if possible;
     simplified if necessary;
     figure should be all on one screen;
     complex figures that cannot be simplified will have references to the printed figure packet.

Hard copy printed output, if desired, should look as much like the graphics terminal output as possible, using an inexpensive dot matrix printer with graphics capabilities. Printing speed should be considered when choosing between graphics and text modes. Slow printing speeds will be undesirable but may be all that is available even by a Xelox type printer.

DEVELOPMENT OF PROCESS DESIGN CASE STUDIES

At the last CACHE trustees' meeting, it was decided to form a task force to supervise and participate in the development of case studies to aid process design education. Problems of an industrial flavor are to be posed, solved, and made available to the public. The Task Force seeks:

1. People who are willing to participate in the task force or otherwise in the project, and

2. Problem statements (possibly used previously) that would be suitable as case studies.

Almost all chemical engineering undergraduate curricula across the country provide for one or two quarters (or semesters) of design studies of particular processes. The alternatives open to the instructors are the following:

a. Develop case studies on their own. This entails a tremendous amount of work on the part of the instructors and their assistants and is, therefore, highly inefficient;
b. Use the case studies developed by Washington University in cooperation with industry.
c. Use past AIChE student contest problems.

The latter two approaches are used most frequently at present. Over the years, these initially very useful case studies have developed deficiencies, which render them questionable as an educational tool. In particular:

a. Current design philosophy revolves around integrated process design rather than unit operations design This is not reflected in the available case studies.
b. The problems are defined to such a detail that there is very limited scope for the generation of process alternatives, one of the most important goals of design education.
c. The provided solutions are specific, nonsystematic, and do not take advantage of modern synthesis techniques and computer tools. Therefore, they cannot be used to demonstrate the application of general design principles.

It is anticipated that the new task force will move in the following steps:

a. Collection of problem statements (either new or used previously)
b. Selection of about ten problems that show high promise to serve as a vehicle for demonstrating the major concepts and procedures of modern process design.
c. Solution of these problems according to guidelines by design classes at interested universities.
d. Review of the solutions by a review panel, possible corrections by the involved design teams, and compiling of one (or several alternative) final solutions for publication.

People from academia or industry interested in participating in any of the phases of this project are asked to contact

Professor Manfred Morari
Dept of Chemical Engineering
University of Wisconsin
Madison, WI 53706
(608) 263-2923 or 262-1092

FLOWTRAN NEWS

Seven years ago, Monsanto Company first made FLOWTRAN available through CACHE via the United Computing System (UCS) network for educational use. Since then, 57 schools in the United States have used FLOWTRAN. In the 1980-81 academic year, 27 schools used FLOWTRAN. Ten schools have used FLOWTRAN for all seven years of its availability.

CACHE has produced three books to assist educators in teaching FLOWTRAN. Each is in its second edition. The first is "FLOWTRAN Simulation - An Introduction." The second, "CACHE Use of FLOWTRAN on UCS," has just been completely revised by L. T. Beigler and Professor Hughes to reflect changes in the UCS protocol and is now available. The third, "Exercises in Process Simulation Using FLOWTRAN," by J. Peter Clark, was recently revised by T. P. Koehler under the direction of Professor Jude T. Sommerfeld at Georgia Tech. An order form for these books is included at the end of this newsletter.

FLOWTRAN has had a significant impact on chemical engineering education at a large number of schools. It has helped revive an interest in process design and modeling. Anyone interested in using FLOWTRAN can contact: Professor J. D. Seader, MEB 3062, University of Utah, Salt Lake City, UT 84112, (801) 581-6916. Questions regarding communication with the UCS network can be directed to the UCS representative for FLOWTRAN:

Ms. Carolyn Kuehl
United Computing Systems, Inc.
Suite 170
1030 Woodcrest Terrace Drive
St. Louis, MO 63141
(314) 434-6633

EXPERIMENTAL USE OF PLATO WITH SECOND-YEAR STUDENTS

by
C. M. Crowe
Dept of Chemical Engineering
McMaster University
Hamilton, Ontario, Canada L8S 4L7

The following has been abstracted from a more detailed report by Professor C. M. Crowe of McMaster University concerning his experiences in using the PLATO system.

Introduction

One PLATO terminal was installed and activated on January 22, 1981, in a basement room of the of John Hodgins Engineering Building. The second-year students in Chemical Engineering 2D4/2F4, "Mass and Energy Balances, Thermodynamics," were rostered and invited to use the terminal. The catalogue of lessons was composed of 19 lessons from Professor C. A. Eckert, University of Illinois, on mass and energy balancing; 16 lessons from the PLATO catalogue on elementary thermodynamics by Professors N. A. Ashby and S. C. Miller, University of Colorado; and 10 lessons on thermdynamics from Professor S. Sandler, University of Delaware. The experiment ended on April 30, 1981, when the students wrote their final exminations.

The lessons were presented to 60 students in the six modules shown in the table below. The first three modules were for the Illinois lessons, the next two for the Colorado lessons, and one for the Delaware lessons. The Illinois lessons were available to the students for the entire period, but the other lessons were only available for the last six weeks. Students were free to choose any lesson in any sequence.

To access the terminal, a student had to check out a key from the departmental office. However, this undoubtedly limited the use of the terminal but was necessary for security. Overnight and weekend checkouts were permitted.

The objective of the experiment was to evaluate the effectiveness of the PLATO lessons as an adjunct to introductory Chemical Engineering courses. Feedback was obtained by written notes and computer-recorded notes at the terminal, by a questionnaire given out before the final examination, by the statistics of use, and by discussion with students.

Evaluation of Student Feedback

(a) Statistics of Use:

Students' use of lessons was recorded by individual student lesson completion, by lessons completed, by individual student hours and sessions, and by average hours and sessions of usage. Data by individual student are available on request from Professor Crowe. Most student users had more than one session, the median number being 3.5 sessions. Five students had six or more sessions, up to a maximum of nine. The average number of hours usage was 3.7 hours, with a maximum of 12.9 hours.

As shown in the table of lessons, significant use was made of the 19 Illinois lessons, while little or no use was made of the Colorado and Delaware lessons. One reason is that the Delaware lessons were not made available until mid-March. The system would likely have been more heavily used if it had been available in the first semester, at the beginning of the course sequence, and if access had been easier.

One student completed all of the Illinois lessons. While seven or eight students appear to have worked through the lessons systematically, others tried a few lessons from different modules.

(b) Questionnaire:

Fifty-five of the 60 students responded to a questionnaire concerning use of PLATO. According to the statistics compiled, 25 students used the PLATO terminal. Those who did not use PLATO mainly said they had no time. It is likely that more use would have been made if no room key were required. Students who used PLATO would like to have it available in future courses but did not see it replacing any of the existing teaching media. PLATO was seen generally to be somewhat to rather helpful, particularly in reviewing the textbook by Felder and Rousseau, which was required for the course.

(c) Student Comments:
Students provided the following comments, most of which were positive;

The diagram questions were extremely helpful.

Most useful for doing unsteady-state problems.

PLATO is very useful and helps with understanding course material.

Should be used only as a supplement to regular class work.

PLATO tended to be very stimulating when first used, but after a while, I found it tedious and dull.

The calculator on the terminal (was) rather useless.

Problems were not at all that difficult, but were simple enough so that the concepts were easier to understand.

Thus, it was easier to apply the concepts to harder questions appearing on assignments and tests.

The P-V and P-H graphs were very helpful.

(d) Instructor Comments:

A graduate student instructor provided the following impressions:

The Chemical Engineering package was well organized and useful in instructing the basic concepts of material and energy balances.

Some individual units may have been too long with too many repetitious problems. I believe the emphasis on problem formulation as opposed to actual numerical solution was appropriate.

The "touch screen," although a bit of a novelty, may be useful in preventing students from becoming discouraged by having too much typing to do which can be tedious and frustrating.

One major problem I feel is to ensure all students make an honest effort to participate. Perhaps units could be offered in place of some assignments or for extra marks.

Overall Personal Evaluation

Professor Crowe worked all of the Chemical Engineering lessons, as well as numerous PLATO lessons in physics, mathematics, English, and FORTRAN programming. His impressions of PLATO as a learning medium were as follows:

1. It is an excellent means of review and of practice in how problems are solved.

2. The immediate feedback is excellent, and frequent hints about reasons for erros are helpful. I agree with the student's comment that "HELP" sometimes gave too much help.

3. There is no branching to additional instruction, in any of the lessons I tried, for those students who are having trouble.

4. The graphics and touch screen are excellent means of teaching about thermodynamic diagrams.

5. The lessons often lead the student by providing alternatives in the preferred order. The student is relieved of the task of generating the next step, since choices are provided, and wrong choices are not accepted.

6. Generally, the lesson materials are quite elementary, at first-year university or senior high school level.

7. The calculator provided by PLATO is far less convenient than a hand calculator, since often an intermediate result must be rewritten on the next line if COPY is inactive.

Number of PLATO Lessons Tried and Finished

Module		No. Who Finished	No. Who Tried Lesson
1	Introduction to PLATO	13	17
	An Introduction to Stoichiometry	6	11
	Data Analysis	5	7
	Mat. Balances, without Chem. Reaction	6	9
	Mat. Balance advanced	5	7
2	Mat. Balances, with Chem. Reaction	5	8
	Mat. Balances, advanced	5	6
	Ideal Gases and Real Fluids, I	4	6
	Ideal Gases and Real Fluids, II	4	4
	Change of Phase	4	8
	1st Law Thermodynamics, I	4	5
	1st Law Thermodynamics, II	3	2
3	Tot. Energy Bal. Steady-State, I	6	10
	Tot. Energy Bal. Steady-State, II	3	4
	Thermodynamic Diagrams	6	11
	Enthalpy Effects	4	5
	Unsteady State, Mat. Bal.	5	6
	Unsteady State, Energy Bal.	4	6
	Introd to Equilibrium	3	3
4	Thermal Equilibrium	3	2
	Temperature Scales	0	1
	Coefficient of Expansion	0	1
	Heat	0	1
	Heat Transfer	1	0
	First Law of Thermodynamics	1	1
	Work done by Gas	1	0
	Microscopic View of Thermo.	0	0
5	Kelvin Temperature	0	0
	Ideal Gas Law	1	0
	Adiabatic Expansion	1	0
	Second Law of Thermo.	1	0
	Carnot Cycle	2	4
	Carnot Engine	1	1
	Entropy	1	2
	Direction of Irreversibility	1	0
6	Compressibility Factor	1	1
	Compressibility Factor	1	1
	Repressurizer	1	0
	Expansion of Ideal Gas	1	0
	Steam Turbine	1	0
	Draining of Tank	1	0
	Mass Balance - Chem. Reaction	1	0
	Binary Mixtures - Equilibrium	1	0
	Chemical Equilibrium	0	1
	Chemical Equilbrium	0	0

PERSONAL COMPUTING

by
Professor Bruce A. Finlayson
University of Washington

I've used a personal computer for the last two years. It has opened avenues that were not apparent to me after years of using large mainframes (CDC, IBM, DEC). While avoiding the use of trade names, it is relevant that the personal computer I have has a very good graphics sytem and is very easy to use; in alphabetical listings of personal computer manufacturers, it is near the top of the list.

Information can be easily stored and retrieved on a personal computer. I could buy a data-base management system for my personal computer, but I haven't. Instead I've written my own programs. In BASIC, they are much easier to write, test, and modify than are FORTRAN programs I'm accustomed to. My programs may not be the most sophisiticated or the most efficient, but they are personalized to me, and the computer isn't always used anyway. I store my personal and business finances on the computer and code each entry in several ways. It is an easy matter to find all the entries in one or another category, make several such lists, find the intersection or union of these sets, and so forth. If the program does not do precisely what I want, I change it on the spot. It is so easy to make minor changes that it is not even necessary to save all these programs. If I need to know whether the violin teacher has been paid up to date, it takes a few simple commands to find out. If I need to know in December whether my estimated income tax payments are reasonable, it only takes a few commands to find out. I now avoid having to look through piles of pieces of paper, which never seemed to be organized by the time I needed them organized; I look through the computer data base. My programs do not have to handle all contingencies: If it easier to do a job on paper, I do it on paper; if it easier to have the computer do it, I let it.

There are some large data bases now available throughout the United States. For example, investment information is available to anyone with a terminal and a subscription. With a personal computer, however, I can access the data base automatically and have it search for a standard set of information, such as stock prices, highs, lows, volumes for a standard set of stocks. This information, and only the information I need, is then stored automatically on my personal computer for later use. This use illustrates what I see as a growing trend to use information electronically and not on paper. I'm looking forward to sending mail by computer, making hotel reservations by computer, and writing checks by computer.

Some of my early research involved solving partial differential equations for modeling chemical reactors. I now can solve those problems on my personal computer. It takes the computer longer, but it doesn't take me longer. The computer efficiency may be low, but my efficiency is high. On the personal computer, not only is the problem solved, but a graph of the solution is made at the same time. I can change parameters in the model and easily see the effect. This function can be done on many computer systems, but is cheap and easy to do on my personal computer. For example, for flow through porous media, it is a simple matter to investigate allowable time step sizes and grid sizes, and the incorrect choices are shown dramatically on the screen.

In fact, it is the easy graphics that makes the personal computer especially powerful. My high-schol-aged son wrote a program in four hours to allow the user to draw a chemical engineering flowsheet, complete with distillation columns, pumps, heat exchanger symbols. The quality is not as good as on computers oriented to graphics or drafting, but it is adequate for many uses.

After several months of using my personal computer, I discovered that for many small engineering calculations, I preferred not to solve them at work but wait until I went home to solve them on my personal computer. When analyzing the reason, I discovered that it is because on the personal computer using the BASIC language I can write, test, and run the program in much less time than when using FORTRAN on any of the bigger machines. In fact, I can use the computer like a calculator--many times the program is not written down, but just composed on the spot--just like a programmable calculator can be programmed by going through the right key strokes without writing them down.

Advertisements may suggest that you can convince your wife to put her recipes on the computer. I couldn't, although she was quite happy to use the computer as a terminal to catch up on a session of Wall Street Week that she missed. Of course, if my engineering work gets boring, there are always arcade games!

In summary, I see the personal computer used as an extension of its owner. It can be used like a calculator, it can store and retrieve information easily, it can dial the phone automatically and search all sorts of data bases. My efficiency is higher, and I'm less dependent on information written on paper, which simplifies my life.

Addendum

I began with a $1200 computer, 16K RAM memory, a cassette tape drive, and an old TV. Later I added a disc drive to hold floppy discs (this was necessary for data storage and retrieval), a phone modem, and 16K. Still later I added a color monitor and another 16K of memory. I now have 48K RAM in the computer, one disc drive. With my 10 diskettes, I can have 1.4 Mbytes of storage. Of course I would have to sit there and change diskettes on command!

PROGRAMS FOR HAND-HELD PROGRAMMABLE CALCULATORS

The CACHE task force on Microcomputers and Hand-Held Calculators will soon complete a booklet listing chemical engineering programs available for hand-held programmable calculators. The booklet will cite, by subject, programs from the literature and from program exchange clubs and will contain an invitation for users to evaluate and provide critiques of programs that will be published later in a second edition of the booklet. Additional information can be obtained by contacting:

Professor F. William Kroesser
Task Force Subcommittee Chairman
Engineering and Science Division
West Virginia College of Graduate Studies
Institute, WV 25115
(304) 768-9711, ext 453

CACHE TASK FORCES

Most of the work done by CACHE is through the efforts of its task forces. Current task forces and chairmen are as follows. Please note the newly formed task force on process design case studies. Those wishing to work on task forces are encouraged to contact the designated chairman.

Task Force

Data Management:
Professor R. L. Motard
Washington University

CHEMI Continuation:
Professor D. M. Himmelblau
University of Texas, Austin

Graphics:
Professor G. V. Reklaitis
Purdue University

Large-Scale Systems:
Professor J. D. Seader
University of Utah

Personal Computing:
Professor H. S. Fogler
University of Michigan

Microcomputers in the Laboratory
Professor P. R. Rony
Virginia Polytechnic Institute and State University

Process Design Case Studies:
Professor M. Morari
University of Wisconsin-Madison

CACHE COMPUTER PROGRAMS FOR CHEMICAL ENGINEERING STILL AVAILABLE

In 1972, CACHE published seven volumes of "Computer Programs for Chemical Engineering." The volumes covered the following areas: Stoichiometry, Kinetics, Control, Transport, Thermodynamics, Design, and Stagewise Computations. Each volume contains descriptions and listings of from 11 to 24 tested FORTRAN programs prepared by eminent chemical engineering educators. The programs have proven useful for homework problems, classroom demonstrations, design laboratories, and process simulation. The seven volumes are still available individually at prices ranging from $12.95 to $14.95, and as a complete set at $89.95. Complete information on the volumes is available from the current publisher:

Sterling Swift Publishing Company
P. O. Box 188
Manchaca, TX 78652

AICHEMI MODULAR INSTRUCTION SERIES AVAILABLE

AIChE has just published six additional six volumes of the AICHEMI Modular Instruction Series that were prepared by CACHE under the direction of Professor Ernest J. Henley of the University of Houston and William A. Heenan of Texas A and I University. The 12 volumes now available are:

<u>Series</u>

A. Process Control: T. F. Edgar, Editor
   1. "Analysis of Dynamic Systems,"
   2. "Feedback Controller Synthesis"

B. Stagewise and Mass Transfer Operations: E. J. Henley, Editor
   1. "Binary Distillation,"
   2. "Multicomponent Distillation

C. Transport: R. J. Gordon, Editor
   1. "Momentum Transport and Fluid Flow,"
   2. "Momentum Transport, Viscoelasticity, and Turbulence"

D. Thermodynamics: B. M. Goodwin, Editor
   1. "Introduction to Thermodynamic Concepts, the Energy Balance, Volumetric Properties of Fluids and Heats of Reaction"
   2. "Properties of Pure Liquids"

E. Kinetics: H. S. Fogler and B. L. Cyrnes, Editors
   1. "Rates of Reaction, Batch, Mixed-Flow, and Plug-Flow Reactors,"
   2. "Reactors and Rate Data"

F. Material and Energy Balances: D. M. Himmelblau, Editor
   1. "Introduction and Computations for Gases,"
   2. "Saturation and Material Balances"

The modules were designed to be used for outside study, special projects, entire university courses, review courses, correspondence courses, continuing education courses, or to provide new and timely material that can supplement other courses. A tentative outline listing titles and authors of all modules appears in the volume distributed to all chemical engineering departments. The volumes are available from Publications Department, AIChE, 345 East 47 Street, New York, NY 10017, by single volume or by subscription.

CACHE REAL-TIME COMPUTING MONOGRAPHS AVAILABLE

In 1977, the CACHE Real-Time Computing Task Force, under the direction of Professor Duncan Mellichamp, prepared eight monographs on the following topics in Real-Time Computing:

MONOGRAPH I — AN INTRODUCTION TO REAL-TIME COMPUTING

0. Digital Computing and Real-Time Computing Digital Computing (Mellichamp)
1. The Structure of Real-Time Systems (Mellichamp)
2. An Overview of Real-Time Programming (Mellichamp)

MONOGRAPH II — PROCESSING, MEASUREMENTS, AND SIGNAL PROCESSING

3. Processes and Representative Applications (Edgar)
4. Measurements, Transmission, and Signal Processing (Wright)

MONOGRAPH III — INTRODUCTION TO DIGITAL ARITHMETIC AND HARDWARE

5. Representation of Information in a Digital Computer (Fisher and Seborg)

6a. Digital (Binary) Logic and Hardware (Engelberg and Howard)

MONOGRAPH IV — REAL-TIME DIGITAL SYSTEMS ARCHITECTURE

6b. Digital Computer Architecture (Engelberg and Howard)

7. Peripheral Devices and Data Communications (Rudd)
8. Digital Computer/Process Interfacing (Hughes)

MONOGRAPH V. — REAL-TIME SYSTEMS SOFTWARE

9. Assembly Language Programming (Fisher)
10. Utility or Systems Software (White)
11. Multitask Programming and Real-Time Operating Systems (Wright)

MONOGRAPH VI — REAL-TIME APPLICATIONS SOFTWARE

12. Real-Time BASIC (Mellichamp)
13. Real-Time FORTRAN (White)
14. Control-Oriented Languages (Smith)

MONOGRAPH VII — MANAGEMENT OF REAL-TIME COMPUTING FACILITIES

15. System Justification, Selection, and Installation (Smith)
16. System Opera;tions Management and Program Documentation (McCarthy and Weaver)

MONOGRAPH VIII — PROCESS ANALYSIS, DATA ACQUISITION, AND CONTROL ACQUISITION, AND ALGORITHMS

A. Process Analysis and Description (Edgar)
B. Digital Computer Control and Signal Processing Algorithms (Edgar and Wright)

These monographs are intended for use in lab courses, in self-study, and by real-time users at all levels because they contain many detailed examples. The monographs have been in heavy demand, particularly due to the trend towards use of real-time computing in the undergraduate laboratory. The monographs are being used as texts in a number of universities and are available as single volumes at $3.75 and as complete sets at $28.00, plus postage and handling, from

Professor Brice Carnahan
CACHE Publications Committee
Chemical Engineering Department
University of Michigan
Ann Arbor, MI 48109

An order form appears on the last page of this newsletter.