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PROGRAMS FOR DATA PROCESSING AND COMPUTER SCIENCE IN TWO-YEAR COLLEGES

by

Calvin C. Gotlieb

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IN TWO-YEAR COLLEGES *

by

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ABSTRACT

This report examines the two-years program in computer science ("projeto 15") in Brazil and its counterpart in Canada.

KEY WORDS

Computer education, community colleges.

RESUMO:

Este relatório examina o programa de dois anos em computação (projeto 15) no Brasil e o programa correspondente no Canadá.

PALAVRAS CHAVES:

Ensino de computação, escolas técnicas.

CONTENTS

Programs for Data Processing

and Computer Science in Two-Year Colleges

Background

I must start this talk by making it clear that I
have no personal experience with two-year computer
science programs either in Brazil or Canada. I agreed to
make it the subject of my presentation at the request of
Professor Furtado of PUC, who asked me to do so because
the involvement of Brazilian universities in such
programs has, from the beginning, apparently posed some
difficulties, and presented some opportunities.

In order to make sure that I would at least give an
accurate report, if not a first-hand one, I have gone to
some trouble to collect information and talk to people
who are closer to the subject. The substance of what I
have to say is derived from

- conversations with persons in Canada and Brazil who
  are familiar with two-year programs

- papers and surveys - particularly those published
  by the ACM Special Interest Groups in Computer
  Science Education (SIGSE), and in the Application
  of Computers to Education (SICCE)

- a study of calendars and course offerings -
  especially those from two-year colleges in Ontario

Some of the sources are cited in the bibliography
accompanying this paper; most of the papers are being

deposited with the conference organizers, and will be available for reference.

A comment on the Rio Symposium for Developing Countries, held in Rio de Janeiro in August 1972[1], notes how speaker after speaker from the developed countries disclaimed any knowledge of education in developing countries, and proceeded to describe a program, a course, or laboratory in his own university. Therefore let me outline the situation on two-year computer programs in Brazil as I understand it, since I shall be attempting to focus later remarks on aspects that might be of interest here.

- Separate two-year colleges (i.e. community or junior colleges as they are called in North America) are almost unknown in Brazil; only very recently have any been established at all.

- About five years ago CAPRE urged universities in Brazil to offer two-year programs in Business Data Processing to meet the heavy demands from business and industry for persons able to work with computers. Special funding was made available to enable universities to offer these courses.

- After much discussion and soul-searching, a considerable number of universities did undertake to offer such courses, although even now fewer than half do so. Table 1 summarizes the computer science programs offered by the universities participating in the CIDA/COMBRA project.

- For reasons which will be discussed later, there is still considerable controversy about the wisdom of universities becoming involved in two-year programs.

Table 1

Computer Programs at CIDA/COMBRA Brazilian Universities

	Undergraduate		Graduate
	Two-Year	Four-Year	
PUC	YES	NO	M.Sc.,Ph.D.
Federal University of Bahia	NO	YES	NO
Federal University of Paraiba	YES	YES	M.Sc.
Federal University of Pernambuco	YES	YES	NO

Two-Year Colleges

It would be helpful to start with a brief remark about the role of two-year institutions in post-secondary (i.e. after high school) education in North America. Although education is the responsibility of the state governments in the United States of America, and of the provincial governments in Canada, two-year colleges are very numerous in both countries. These colleges have two very distinct functions:

- To enable students to take the first two years of college close to their home, thereby reducing costs and making higher education more accessible. The names "junior college" and "community college" reflect this role. California, for example, has

many such colleges, and a large enrollment of transfer students who go on to a four-year college to complete a degree.

- To provide training and job-oriented education so that graduates can take jobs in industry and business where skills beyond those taught in high schools are needed.

Needless to say, two-year colleges which are expected to be both a junior college, and a job preparation institute, have a more difficult role to fill than those which serve a single purpose. In Ontario the job orientation of the two-year colleges is very clear from their names, Colleges of Applied Arts and Technology or CAATS, from the programs they offer, and from the entrance requirements which can be as little as two years of high school for some courses. Certain programs, e.g. in Business, Data Processing, Technician Training for Chemistry, Mechanical, Civil Engineering, and Electronics, and Community Service are given in almost all of the colleges. Others such as programs for nursing, drafting, surveying, watchmaking, or legal assistant are given in a few. Still others are geared to local industries, e.g., furniture making, mining, aircraft maintenance, marine equipment, etc.. Altogether the 28 CAATS teach an astonishing range of subjects, either as full programs ranging over several semesters, or short courses, a few weeks in duration[2]. Fees are generally low, of the order of $165.00 per semester for a

full time program, or $15.00 for a single course. In general there is relatively little interaction betweeen the CAATS and the university system. They are regarded as complementing rather than competing with one another, although since they are both costly, large scale systems, within the same governmental ministry, ultimately there must be some competition for the same scarce educational funds. Finally, it may be noted that at the current time, when many university graduates are having difficulty in finding jobs in Canada, there is a small, but noticeable shift in enrollment from the universities to the CAATS.

Program Function and Course Content

Of the approximately 1300 two-year colleges in the United States, and 150 in Canada, over two thirds offer courses in computing and business data processing. With such a large number of possibilities there is naturally a very wide variation in course titles and content, and in how computer courses are integrated with other programs. But an examination of the frequencies of the different course offerings, shown in Table 2, which is reproduced from a survey given by Connolly[3], reveals a pattern which is not difficult to explain. It will be noted from Table 2 that:

- an Introductory Course, and Course on FORTRAN, COBOL and an Assembly Language are almost universal (given more than three quarters of the time)
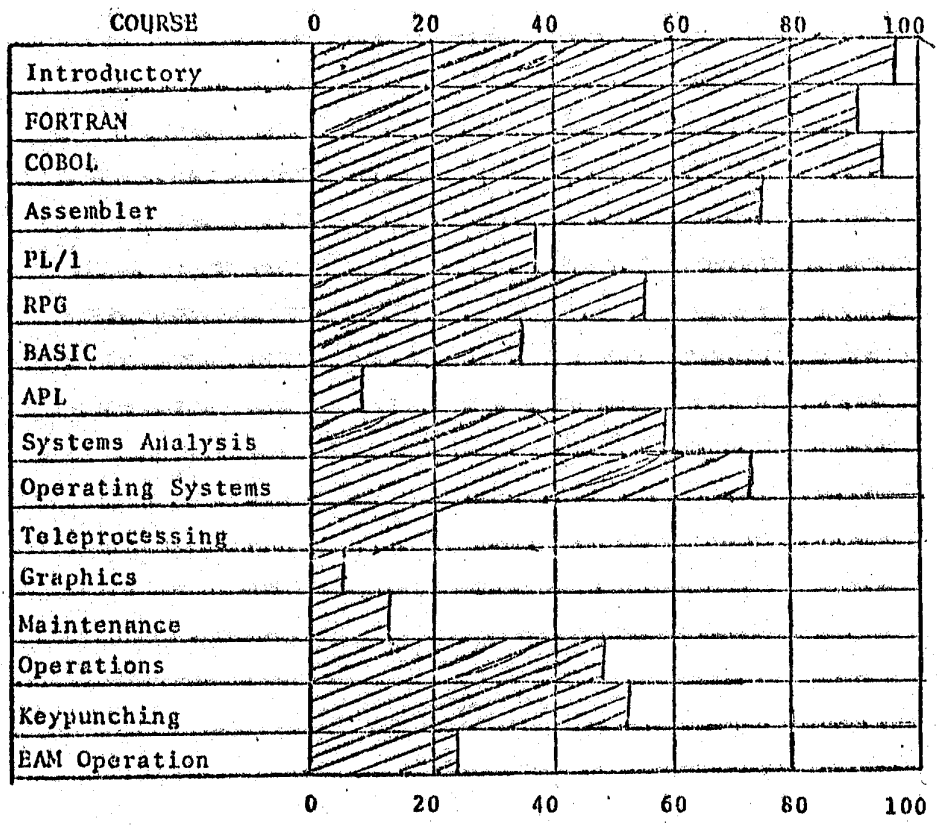
Frequency of Course Offerings at Two-Year Colleges.

after these, the most frequently offered courses,
given in at least 50% of the institutions are those
on Report Generators (RPG), Systems, Analysis,
Operating Systems, Computer Operation and
Keypunching.

About one quarter of the colleges offer courses on
PL/1, BASIC and Electric Accounting Machines (EAM),
but beyond these few courses are widely offered. A
probable exception is Teleprocessing, which at the
time of the survey, was given in 20% of the
colleges, but which has undoubtedly become more
common since.

These statistics are consistent with the following
two facts about enrollment, facts which necessarily
determine the form of the course offerings.

A   Relatively few graduates of a computer or business
     data processing in a two-year college transfer to a
     four-year college degree program. For one thing,
     lower entrance requirements and a lack of college
     level freshman mathematics (particularly Calculus)
     makes transfers difficult. But even more
     important, the job market in computing for two-year
     graduates has been good even during periods of
     employment difficulties in other sectors, so the
     incentives to continue education are not high.

B   There is a definite clustering of programs into
     three groups

- short term courses which let graduates take on jobs as operators of key punches, computers and, to a lesser degree, punched card equipment

- programs extending over several semesters, preparing graduates for jobs as computer programmers and junior system analysts

- business programs, in which computer courses are components of broader programs which include courses on business practices, accountancy, and so on.

It is worth noting that computer maintenance courses are relatively rare, and the main training for these jobs continue to be given by the equipment manufacturers, who may hire graduates of one of the engineering technologies in a two-year college (electrical or electronics) for such purposes. The focus of the teaching effort in the two-year colleges is on a set of about eight courses intended to prepare graduates for jobs which will enable them to carry out, or to at least understand, programming in a business environment.

With such a relatively well defined purpose, it has been possible to define with reasonable sharpness, the objectives and content for a curriculum on Computer Programming in two-year colleges. This has been done in a report prepared by the Committee on Curriculum in Computer Sciences of ACM, through its Subcommittee on Community and Junior College Curriculum. After widespread consultation, and two workshops, the

recommendations for a two-year Associate Degree program were published in the June '77 issue of SIGCSE⁴.

In the recommendations, the computer-related content of the Associate Degree program is classified into two major areas. These are, with their subtopics:

Principles and Techniques of Programming

Data representation, structure, storage and processing

Interface with hardware and software

Programmer Environment

Computer equipment and function

Programming languages in organizations

- Computers in organizations

Overview of an existing applications system

Overview of the systems cycle and the programmer's role

Documentation

Data elements and files

Report requirements and forms control

Quality programming with structured approach

Programming projects concepts

The programming profession

The report, in discussing language instruction and computer access, comes out strongly for COBOL as the preferred major language. Report Generators are favoured but not as the only language, and teaching of an Assembly Language is highly recommended. Strong arguments are made for hands-on experience with computing equipment, including batch-oriented, time-sharing and interactive modes, and access to on-line peripheral equipment. The

report also includes recommendations on Non-computer-related content of the Associate Program including courses on English, Business, Mathematics, Application Areas, and General Education. Besides all the topics mentioned, which are presented with considerable more detail than it is possible to give here, the report goes on to discuss such matters as Faculty, Equipment, and Articulation (i.e., relations with industry, secondary schools and universities).

With this background it is instructive to examine the curriculum of some specific two-year colleges. Of the 28 Ontario CAATS, 22 offer a program in Computer Operations and Analysis, either 4 or 6 semesters, i.e., 2 to 3 years in duration; in addition two offer shorter programs for Computer Operators and Information Processing. Details on two of the Computer Operations and Analysis Programs, those of Seneca College, and Humber College, are given in Appendix 1, taken from the 1977 Calendars for these colleges. It will be noted that these conform quite closely to the Associate Degree curriculum recommendations (although Seneca College is perhaps unusual in that it offers a three-year, 6 semester program, as well as one for two years). The introductory course, emphasis on COBOL and assembler language, hands-on-console experience, and cognate course in English, mathematics and accounting are all present. Descriptions of sample two-year programs offered at other colleges reveal a similar pattern[5]. Thus although the

report of the ACM Curriculum Science Committee is in the form of recommendations, it is reasonable to conclude that to an appreciable degree, these recommendations reflect the programs as actually offered.

Experiences, and Problems

In this section of the survey I would like to review some experiences with two-year programs, and comment on some of the problems encountered with them.

Table 3

Level	No.	To Enter Manpower Pool	Continue Education
Associate	11,000	9,500	2,000
Bachelor's	8,000	5,000	3,000
Master's	3,500	2,500	1,000
Doctorate	500	500	
	23,000	17,000	6,000

Estimates of Degrees to be awarded in Computer Science Data Processing, Information Science, Information Systems, etc. during 1974-75. (See reference 6)

Firstly, by the two basic criteria of enrollment level and job placements of graduates, the two-year programs are a very definite success. Table 3, reproduced from a survey published by Hamblen[6], shows that in 1974/75 of the 23,000 students enrolled in a

computer studies program in USA, almost half (11,000) are in a two-year college, and of the 17,000 who were expected to enter the manpower pool, more than half (9,500) were in two-year programs. A similar situation prevails in Canada. The largest Computer Studies Program of the Ontario CAATS is that of Seneca College in Toronto. In 1977 there are 400 full-time students in each of the three semesters (two semesters make up an academic year), and as well, 600 students per semester in the part time evening program. The total number of students majoring in computer studies in the 28 CAATS is significantly greater than the corresponding number in the fourteen provincial universities. The job placement record in Seneca is nothing short of astonishing. Seneca claims that 99% of their graduates find jobs; this December almost every student has found a job before graduating, and this at a time when there is a very high general unemployment level in Canada. Thus the two-year college computer programs must be judged a success in that they are producing graduates who very quickly find their way into useful jobs.

Yet the two-year college programs are not without their problems. One of these centres around the difficulties in providing adequate computer access so that students will have the varied experience which should be part of good training. The ACM curriculum recommends that practical experience should include:

- programming for a batch oriented computer system

- programming for a time-shared system

- programming in an interactive mode

- hands on access to on-line card readers and printers.

To do this it is felt that there must be access to a system with rapid turn-around, i.e., one that is either time-shared or which supports an in-core compiler of the WATIV type. Moreover, most employers hope to get graduates with some capability on the equipment they happen to have, and this means that students should have experience with hardware supplied by different manufacturers. Needless to say, few if any colleges, have the resources to provide a variety of equipment. If there is on-site hardware at all, it is likely to be a single system, perhaps of the scale of an IBM 370 model 135 or 145. Various solutions are adopted to meet the computer access needs.

- An on-site systems is acquired for both educational use and administrative purposes. This gives rise to the usual conflicts in priorities and scheduling.

- Arrangements are made for service from a nearby university - through remotely connected readers and printers.

- Jobs are batched, and overnight, or more frequent service is provided by transporting them to an available system, e.g., that in a university, a school board, or a service bureau.

• An agreement is worked out with a local company either to have job run, or to bring students in at off business hours.

Even when a college is very well equipped, it can find that its computer system cannot do all that is expected of it. The Burroughs B6700 at Seneca College in Toronto must be the largest system in any community college anywhere. Today, only two years after its installation, it is used around the clock - by day for teaching and by night for administration. Even with this system, students are taken to computers elsewhere, for example to gain experience on minicomputers or to get hands-on operating familiarity with an IBM type computer. In general, two-year colleges have to exercise considerable ingenuity and flexibility to provide their students with the computer access which is a necessary component of their training.

Another problem which two-year colleges face is that many of their students, who do not have full high school matriculation, are not prepared well enough for continuing studies. Language skills especially, are often inadequate and for computer programs the mathematical skills also. This means that an appreciable effort has to be expended on remedial studies. Seneca College's solution to insufficient background in mathematics is to offer a 25 lesson Computer Assisted Instruction series in high school algebra, developed for it by the Ontario Institute for Studies in Education.

This CAI course is taken by almost all entering students. It has turned out to be a very effective system which has been successfully transported to other computers, but needless to say it is a relatively expensive approach to remedial instruction, which will not be open to many institutions.

A problem which is present for all computer studies programs, two-year and four-year alike, is how to make sure that curriculum and faculty keep up-to-date in the face of a technology which continues to change very rapidly. In North America minicomputers have become widely prevalent in the last two or three years. Their penetration into many small businesses is one of the factors which has contributed to the strong demand for computer trained people. This change is not reflected in the courses offered within two-year programs. Now the computing environment is being further transformed by the widespread introduction cf teleprocessing, and networks; the recent dramatic reductions in computer costs which arise out of the availability of low cost microcomputers, complete with mass storage and peripherals, makes it certain the rate of technological change in computers will continue for some time yet. Two-year colleges adopt several practices in their attempts to keep their programs tuned to the changing needs of business and industry. It is common to have advisory boards, with representation from local industry, manufacturers, financial institutions, and so on. Such boards can be

very effective but they are not without their problems. If they take their duties seriously, they watch what is being taught, and recommend changes from time to time. And unless action is taken to respond, to these recommendations, those participating will quickly tire of their role. So the presence of an advisory board implies a responsibility to listen when it offers advice. Other techniques which can be used to keep faculty current is to have them spend semesters working in industry, or with a computer manifacturer. It is important to emphasize that this is not done because, as is so common in South American educational institutions, the faculty have only part time appointments. The main purpose is for faculty to stay current by renewing their contacts with industry. Some two-year colleges are also experimenting with cooperative educational programs like those of the University of Waterloo, in which students interleave their formal education with periods of on-the-job training.

One final difficulty with two-year college programs in computer studies arises out of what may be regarded as a problem of identity. Although efforts such as those of the ACM curriculum committee and the strong job market, are establishing computer programs as useful in their own right, it is probably true that in most two-year colleges computer studies program are integrated with, or part of, the business studies program. This is a situation which does not hold true for four-year programs in

universities. A consequence is that computer studies
does not always get high visibility in the overall
college program. Faculty whose main expertise is in the
computer area may feel that they cannot get sufficient
recognition unless they are prepared to move into other
areas of business education. The faculty in two-year
colleges often feel at a disadvantage relative to those
in four-year institutions, with respect to salary, public
recognition, and so on, and the feeling of computer
faculty that they are in an area which does not always
get its fair share of attention can heighten the
indentity problem.

Comparisons

How much of North American two-year college
programs in computer studies is applicable to the
situation here in Brazil? I have enough experience with
developing countries, through work with the United
Nations and elsewhere, to be hesitant about suggesting
that our methods should be implemented here. This
reservation notwithstanding I believe that there are two
very important similarities.

1.   There is in Brazil, as in North America, a strong
      demand for people with the skills to operate,
      program, and manage computer systems installed in
      business and industry. The greatest demand is for
      people who have the training for an operational
      environment as opposed to, say, a development or
      research environment. I am not sure what

statistics are available in Brazil to document this belief, but there is evidence to support it - as seen for example, from the number of students, embarked on a four-year program in computer studies, who quit in order to take jobs, and the difficulty universities have in keeping faculty in the presence of many attractive positions in industry and government.

2. There is also in Brazil, a problem of identity about the two-year college programs in computer studies, although the problem has a somewhat different flavour from ours. Evidence to support _this_ belief comes from the observation that the Federal University of Minas Gerais, which had been offering perhaps the most successful of the two-year programs in Brazil, decided to convert to a four-year program. One can see why the prestige associated with a formal university level program is important to both students and faculty. But the goals and educational methods for two-year programs and four-year programs are quite different. When a university is given the alternative of offering one or the other, or even if it choose to offer both, there are inevitable conflicts due to competing claims on resources. And these conflicts appear, not only at the level of the ministry of education, but right at the university administration level.

If these two points are accepted, certain consequences follow. They imply that the two-year programs are really needed, and that they must be set up so that they have a recognized status, and supported with the people, equipment and funds which allow them to be truly effective. I doubt if it is possible to make a general statement about whether these programs ought to be undertaken by universities, or whether they should be set up in the framework of special institutions. Where there are community colleges and technical institutes, and there has been an active program to build these in African countries such as Nigeria, it is natural to include two-year computer studies as a key element in the curriculum. When the resources to build new institutions are simply not available, and universities are willing to take on the responsibility for two-year programs, willing to recognize their worth, and are ready to commit the necessary resources to them, surely this should be acceptable too.

In closing I should like to draw attention to one recent development which should make it easier to mount two-year courses, whether in universities or in other institutions, provided certain steps are taken. Minicomputers, and now microcomputers, have reduced the cost of computer processing and memory dramatically. These smaller machines are not quite suitable for class room use as they stand. They need faster and more rugged I/O equipment, and for this country, language processors

and supporting textbooks written in Portuguese. This suggests to me a development effort which might be undertaken in cooperation with those universities in Brazil where there is already a strong computer program. Namely, there should be an effort to select one or perhaps two, small scale inexpensive computers which can serve as standard educational hardware, and to produce textbooks and instructional software, based on the half dozen courses identified earlier in this paper, and on the techniques discussed elsewhere in this conference. I know that CAPRF already supports some projects of this type, including book translation. Even with an intensive program it would take four or five years for the efforts to come to fruition, but I am convinced that demand for the intermediate skills taught in two-year programs will continue to be strong for a very long time, and that providing low cost, standardized, educational tools would make a real contribution to national development.

Acknowledgments

I would like to express my thanks to the various people who have provided the information which has enabled me to prepare this paper. Professor Mario Hattori of the University of Paraiba, and Professor Geovane Magalhães have described the situations at their respective universities here in Brazil. Mr. Klaus Schwartzkopf and R. W. Scott of Seneca College, Toronto, have been very helpful in describing the programs of the Ontario Colleges of Applied Arts and Technology. Mr. J.

Sampson of the University of Alberta very generously turned over to me various materials collected for a panel session on the subject of the paper which was to have been held at IFIP Congress 77, but which was subsequently cancelled. Finally, I would like to express appreciation on my behalf, and if I may, on behalf of all of us, to the Canadian International Development Agency, which through its COMBRA program has made this conference possible.

References

1. R.S. McLean, "The Rio Symposium", ACM SIGCUE Bulletin, 7, no. 1, Jan., 1973, 23-26.

2. These are detailed in "Horizons", the annual guide to educational opportunities in Ontario beyond the secondary school level, published by the Ontario Ministry of Colleges and Universities.

3. F. W. Connolly, "Computers and Two-Year Colleges: Current Course Offerings and Facilities", SIGSE Bulletin, June 1975, pp. 6-11.

4. J. C. Little and others, "Curriculum Recommendations and Guidelines for the Community and Junior College Career Program in Computer Programming", ACM SIGCSE Bulletin, 9, no. 2, June 1977, 17-26.

5. See, for example, those of Harford Community College in Bel Air, Maryland, and McLennan Community College, Waco, Texas, given by Connolly in reference 3.

6. J. W. Hamblen, "Computer Manpower in the United States - Supply and Demand" ACM SIGCSE Bulletin, 7, no. 4, Dec. 1975, 25-43.

APPENDIX

COMPUTER STUDIES DIVISION
PROGRAMS
* * * * * * * * * * * *

TABLE OF CONTENTS

COMPUTER STUDIES DIVISION

SENECA COLLEGE OF APPLIED ARTS AND TECHNOLOGY

A Computer Studies graduate enters the world of work qualified to
accept responsibility immediately in the exciting world of electronic
data processing.

The computer is the most powerful tool yet developed to process the
masses of information in the increasingly complex business organizations
of today, so that timely management decisions may be made. While
computers are only twenty-five years old, by the end of this decade
projections are that the computer and information processing industry
will be one of the largest in existence. A shortage of qualified people
opens great opportunities for the talented, trained and motivated
individual.

CAREER POSSIBILITIES:

Employment opportunities in electronic data processing include:
computer operators who control the operation of the equipment; programmers
who prepare instructions for the computer to solve problems and process
information; systems analysts who develop solutions to information
processing problems of all kinds. In addition, as the impact of computers
on business increases, positions in related industries will expand,
stemming from the need for users to be knowledgeable in computer
information processing.

To succeed in this field the most important ability is to be able to
think logically and solve problems rather than to have specific proven
mathematic skills. Of prime importance, too, is the ability to communicate
with the users of the computer system to identify information needs in
relation to the management functions of planning and control. The
computer systems designer recognizes that his goals are achieved by
people since the computer is only a means to an end in an information
processing system.

The Computer Studies courses at Seneca are oriented towards business
and commercial applications with the objective of providing training
for employment and in the general principles on which the skills are
based. The graduates will have the ability to grow in the ever-changing
environment of the future. To improve the essential skills of communica-
tion and understanding of the world in which we live, students are required
to study English and Communications and Liberal Studies.

To assist in career selection, pre-admission interviews with Computer
Studies faculty are often arranged.

COMPUTER PROGRAMMING AND ANALYSIS
Six Semesters

Graduates from the Computer Programming and Analysis Course normally
begin their careers as junior programmers or systems analysts. From
a given set of problem specifications, they can prepare detailed algor-
ithms documenting the sequence of computer steps necessary to solve a data
processing problem. They convert the steps so documented, to a coded
program in one of the programming languages studied (ASSEMBLER, COBOL,
PL/I and RPG II). Following successful compilation of the computer
program, they can conduct test runs with test data to prove the program
logic. Necessary amendments to the program can be made using compiler
and system diagnostic messages and memory dumps as required.

Graduates are capable of handling problems of multiple input and output
files in a card, tape or disk environment involving file creation and
updating, and employing such techniques as table look-up, sorting, and
structured programming. This may also involve the calling of subroutines
written in languages other than the main program and accessing ISAM and
VSAM files. They understand the structure and operation of Burroughs
and IBM DOS job control language and system utility programs.

In the systems area, CPA graduates are capable of consulting with user
personnel to determine the specific output requirements from a data
processing system. They can examine available input data in consultation
with the operations people involved to devise alternate or revised
methods if necessary to provide economy and efficiency of data supply.
They are capable of work as part of a systems team, under supervision,
to analyze and design computer and other procedures. This includes the
design of forms, files and program specifications and the preparation —
of systems documentation and procedure manuals. They will have experience
in such applications as invoicing, accounts receivable, inventory, sales
analysis, payrolls and financial statements.

In addition, depending upon option selection, graduates will be know-
ledgeable in specific application areas.

ADMISSION REQUIREMENTS: Secondary School Graduation Diploma -
                          Advanced or General Level
                          Grade 12 English desirable.
                          Grade 12 Mathematics or equivalent desirable.

THREE-IN-TWO PROGRAM - in Computer Programming & Analysis
                       for Grade 13 Graduates

The granting of Advanced Standing for Grade 13 studies allows the Computer
Programming and Analysis Course to be shortened to two years from the
normal three.

ADMISSION REQUIREMENTS: Secondary School Honour Graduation Diploma
                          which must include two mathematics with a
                          combined minimum average of 60%, two English
                          and two other academic subjects.

COMPUTER PROGRAMMING AND OPERATING
Four Semesters

Graduates from the Computer Programming and Operating Course normally begin
work in computer operations or programming. They will be able to prepare
detailed algorithms from problem specifications and to code a computer
program in any of the languages studied (COBOL, PL/I, RPG II). They will
be able to debug and test such programs using compiler and system diagnostic
messages. The complexity of programs ranges up to a master update with
multiple input and output files in a card, tape or disk environment. The
graduates will be familiar with such programming techniques as table
lookup, sorting and structured programming.

They will understand the structure and use of IBM DOS and Burroughs job
control language and system utility programs. Graduates will be able to
interpret operating instructions and work in a computer operations environment.
The graduates are also familiar with basic concepts and techniques of systems
analysis and design, and the common business functions in which the computer
is used.

ADMISSION REQUIREMENTS: Secondary School Graduation Diploma -
                         Advanced or General Level;
                         Grade 12 English and Mathematics desirable.

HOW TO ENROLL

Most students wishing to undertake diploma or certificate programs enter
Seneca College in the fall semester, commencing in September of each
year. However, new applicants may be admitted for the spring semester,
commencing in January of each year, although course offerings at these
times may be limited.

Application to Seneca College must be made on the General Application
Form for admission to a College of Applied Arts and Technology which is
available from the college or secondary school guidance offices.

Because applications for admission to Seneca College for spring and fall
semesters are considered well before the commencement of the semester,
early application is advisable.

FEES AND OTHER EXPENSES

Fees: $180.00 per semester ($162.50 tuition plus
                            $ 17.50 Student Activity Fee)

CURRICULUM
COMPUTER PROGRAMMING & ANALYSIS

COURSE CODE: CPA

SEMESTER SUBJECT CODE	TITLE OF SUBJECT	CATEGORY
Semester 1		
ALG 151	Basic Algebra	RT
DPR 131	Data Processing	PR
IBO 121	Introduction to Business Operations	PR
	English and Communications Option	
	Liberal Studies Option	
Semester 2		
CPS 221	Computer Systems	RT
PGM 231	Program Problem Solving	PR
PLI 233	PL/I Programming	PR
	English and Communications Option	
	Liberal Studies Option	
Semester 3		
CBL 334	Cobol Programming	PR
CPS 322	Systems Design	RT
DPR 365	Operating Systems	PR
	English and Communications Option	
	Liberal Studies Option	
Semester 4		
ALG 453	Advanced Business Mathematics	RT
CBL 435	Advanced Cobol Programming	PR
RPG 436	RPG II Programming	PR
	English and Communications Option	
	Liberal Studies Option	
Semester 5		
ACC 513	Management Accounting	RT
ASM 537	Assembler Programming	PR
CPS 523	Systems Analysis	RT
	Open Option	
	Open Option	
Semester 6		
ASM 638	Advanced Assembler Programming	PR
AUD 614	Systems Auditing	RT
CPS 624	Systems Implementation	RT
	Open Option	
	Open Option	

Open Options
A student may achieve an Open Option Credit by successfully completing any
Seneca semester diploma or curriculum subject for which he or she possesses
the necessary prerequisites. Each semester the Computer Studies Division
offers a selection of options in the Computer Applications area which may
be used to achieve an Open Option credit. Those offered depend upon student
interest and faculty availability. Each is designed to enhance the students'
ability in a diploma related area. The following Professional Options are
offered subject to the foregoing restrictions.

CPL 571	Management Science	DPR 467	Computer Operating
CPL 572	Manufacturing Control Applns.	DPR 468	Introduction to Minicomputers
CPL 573	Financial Applications	DPR 533	Fortran Programming
CPL 575	Data Communications	PLI 534	Advanced PL/1 Programming
CPL 578	Data Base Management	RPG 538	Advanced RPG II Programming

Subject Offerings - See Note re Subject Offerings on following page.

CURRICULUM
COMPUTER PROGRAMMING & OPERATING

COURSE CODE: CPO

SEMESTER SUBJECT
CODE

TITLE OF SUBJECT

Semester 1

ALG 151	Basic Algebra	RT
DPR 131	Data Processing	PR
IBO 121	Introduction to Business Operations	PR
	English and Communications Option	
	Liberal Studies Option	

Semester 2

CPS 221	Computer Systems	RT
PGM 231	Program Problem Solving	PR
PLI 233	PL/I Programming	PR
	English and Communications Option	
	Liberal Studies Option	

Semester 3

CBL 334	Cobol Programming	PR
CPS 322	Systems Design	RT
DPR 365	Operating Systems	PR
	English and Communications Option	
	Liberal Studies Option	

Semester 4

CBL 435		Advanced Cobol Programming	PR
DPR 467		Computer Operating	RT
DPR 468	OR	Introduction to Minicomputers	RT
RPG 436		RPG II Programming	PR

Option Restrictions - Computer Programming and Operating students will
receive no credit for NAT 105.

Note re Subject Offerings - All Professional (PR) and Related Theory (RT)
subjects are offered in both the Spring and Fall semesters. Lack of enrolment
may occasionally force postponement of a few subjects, but such postponement
will not affect a student's regular path to graduation.

There is one exception to this: DPR 467 (a CPO 4th semester subject) requires
outside computer facilities and is offered only in the Spring.

COMPUTER PROGRAMMING & ANALYSIS AND COMPUTER PROGRAMMING & OPERATING
Subject Descriptions

ACC 513 - Management Accounting

In this semester subject the student studies the information requirements
of business management, how and where this is obtained from an accounting
system as well as the controls necessary to maintain the accuracy of such
information. In addition, he will become familiar with financial statement
analysis, cash flow statements, cost accounting and budgeting.
Prerequisite: IBO 121

ALG 151 - Basic Algebra

In this semester subject, you concentrate on the solution of computational
problems. Standard mathematical and business problems are solved algebraically.
Prerequisite: None

ALG 453 - Advanced Business Mathematics

The subject includes applying mathematics to business problems such as determing
the mix of production and forecasting sales. Linear programming, model building,
some work in statistical methods and instruction in BASIC programming make up the
subject content.
Prerequisite: ALG 151

ASM 537 - Assembler Programming

In this semester subject the student gains an insight into the concepts of
programming in a low-level language. The S/370 assembler language will be
used as a vehicle to study a third generation computer system, its basic
instruction formats and machine instructions. Problem programs will use
simple input and output files to develop a basic programming facility.
Prerequisite: CBL 435

ASM 638 - Advanced Assembler Programming

This subject is a continuation of Assembler 537 - Introduction to Assembler
Programming. More complex S/370 Assembler instructions will be introduced
and practised in programs using multiple input and output files in both
sequential and direct access processing.
Prerequisite: ASM 537

AUD 614 - Systems Auditing

In this subject the student learns to evaluate the efficiency and control
features of computer-based systems as well as studying the techniques of
auditing such systems. Simulated systems in case studies will be analyzed
and their controls or lack thereof will be assessed.
Prerequisite: CPS 322

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COMPUTER PROGRAMMING & ANALYSIS AND COMPUTER PROGRAMMING & OPERATING
Subject Descriptions

CBL 334 - COBOL Programming

Students will be introduced to the elements of the COBOL language in this
semester subject. They will analyse, flowchart and code COBOL programs
using structured programming techniques. The final program is a full
master file update on disk.
Prerequisite: PGM 231

CBL 435 - Advanced COBOL Programming

The more advanced features and techniques of COBOL programming are intro-
duced in COBOL 435, e.g. additional verbs, table searching techniques,
sorting and accessing non-sequential files. Case studies include more
complicated problems involving multiple input and output files.
Prerequisite: CBL 334

CPL 571 - Management Science

This semester subject provides an introduction to the scientific method
and its application to management in such areas as forecasting and
decision making.
Prerequisite: ALG 453

CPL 572 - Manufacturing Control Applications

In this semester subject you will study the application of the computer
to management of various aspects of manufacturing and production processes
with particular emphasis on inventory control techniques.
Prerequisite: ALG 453

CPL 573 - Financial Applications

This semester subject will include the study of applied mathematics to
financial problems and the application of computer programmed solutions
to these problems.
Prerequisite: ALG 453

CPL 575 - Data Communications

This subject will give the student a basic understanding of Data Communica-
tion. Components and applications are discussed so that upon completion,
the student will be able to apply the knowledge gained to design a basic
telecommunication system.
Prerequisite: DPR 131

CPL 578 - Data Base Management

In this semester subject the student will be introduced to the concepts
of Data Base Management. All phases of the Data Base approach will be
considered, including planning and design, data structures and ultimately
the implementation of applications in a data base system generated on our
Burroughs computer.
Prerequisite: CBL 435

CPS 221 - Computer Systems

In this introduction to the design of data processing systems, basic systems
for different functional areas, within a business will be designed. You
will be introduced to the necessary related techniques of flowcharting,
controls, form and card design, workloads and timing assessments and will
progress from manual to small computer systems design.
Prerequisite: IBO 121, DPR 131

CPS 322 - Systems Design

Your introduction to the design of data processing systems, commenced in
Computer Systems 221, is continued, as the concepts and techniques intro-
duced in this prior semester subject are further developed. You will design,
program and assess computer-based systems for various functional areas,
culminating with an integrated system.
Prerequisite: CPS 221

CPS 523 - Systems Analysis

Computer systems feasibility and needs analysis is essential to the develop-
ment of effective information systems. Topics include the conducting of
a feasibility study and the analytical techniques used in the study, design,
evaluation and implementation of a system. Emphasis will be placed on the
definition of the information system and the design of a computer system
to achieve its priorities of effective management decision-making.
Prerequisite: CPS 322

CPS 624 - System Implementation

Using one or two large scale case studies, you will develop a computer
information system from the point of definition of terms of reference
to system specification, presentation and acceptance. You will draw on
and correlate knowledge acquired in all previous subjects.
Prerequisite: CPS 523

DPR 131 - Data Processing

This is an introductory semester subject designed to give you a thorough
knowledge base in the concepts and basic features of electronic computers.
Numbering systems, data representation, problem solving techniques, and
stored program concepts are introduced. Programming fundamentals, hardware
features and programming systems will be taught through the use of an
introductory student programming language.
Prerequisite: None

COMPUTER PROGRAMMING & ANALYSIS AND COMPUTER PROGRAMMING & OPERATING
Subject Descriptions

DPR 365 - Operating Systems

Complex computers of today require a full range of supporting software
programs to provide an interface with the programmer and the operator.
In this semester subject, you are exposed to the design concepts, operation
facilities and job control language of IBM's Disk Operating System and
Burroughs B6700 Operating System.
Prerequisite: PGM 231 and a working knowledge of COBOL

DPR 467 - Computer Operating

In this semester subject the principles and techniques concerning operating
systems and computer operations dealt with in Data Processing 365 are
continued with more emphasis on problems and practical hands on experience.
Prerequisite: DPR 365

DPR 468 - Introduction to Minicomputers

This subject is geared to meet the needs of the business community in
the minicomputer field. It will include such topics as distributed
processing concepts, comparisons of various minicomputer configurations,
minicomputer programming constraints and techniques, the BASIC programming
language, file design concepts and interactive programming.
Prerequisite: DPR 365

DPR 533 - FORTRAN Programming

This semester subject is designed to teach students to use the computer
as a problem solving device for mathematic problems. The basic concepts
of the FORTRAN language will be introduced and programs will be written
to solve typical mathematic business problems.
Prerequisite: PGM 231

IBO 121 - Introduction to Business Operations

This subject deals with the inter-relationships of activity areas in a
business and the fundamental concepts of the accounting process. Emphasis
is placed on the distribution functions of the business activity (ie. Order
Entry, Billing, Accounts Receivable, Inventory,Purchasing, and Accounts
Payable), and the data flow from one function to another. A case study
of a simulated company is used as the main instructional vehicle.
Prerequisite: None

PGM 231 - Program Problem Solving

Using the top down approach and structured design concepts, you learn the
principal computer programming techniques and problem-solving approaches,
i.e. written algorithms, flowcharting, decision tables. To implement a
computer solution the material is integrated with PLI 233.
Prerequisite: DPR 131

COMPUTER PROGRAMMING & ANALYSIS   AND   COMPUTER PROGRAMMING & OPERATING
Subject Descriptions

PLI 233 - PLI Programming

After the basic instructions of PLI have been taught you will apply them
to the problems solved in PGM 231. While both stream and record I/O will
be used, this is not a comprehensive course in PLI. Its primary purpose
is to introduce you to basic programming concepts and enable you to apply
these to actual problems.
Prerequisite: DPR 131

PLI 534 - Advanced PLI Programming

In this semester subject the student will deal with the advanced application
of the PLI programming language to the solution of increasingly complex
problems.
Prerequisite: PLI 233

RPG 436 - RPGII Programming

This high level programming language is primarily oriented towards small
computer system applications. Problems will involve sequential and random
processing of files using various forms of input.
Prerequisite: PGM 231

RPG 538 - Advanced RPGII Programming

The more advanced features of RPG II are introduced, i.e. extensions to the
standard RPG logic using additional input, calculation and output commands.
Operating system commands for small computer systems (e.g. IBM OCL) are
introduced.
Prerequisite: RPG 436

ENGLISH AND COMMUNICATIONS OPTIONS

To allow students to follow their own interests in English and
Communications, the college offers many options in all semesters.
Different students find different options particularly appealing.
Yet this variety does not prevent them from achieving a basic grounding
calculated to enrich their lives and work. This basic grounding consists
mainly of these four elements:

> Literature (modern to contemporary)
> Rhetoric and language studies
> The Canadian experience
> The mass media

Each semester a Registration Handbook is published in which the
specific English and Communications options to be offered for that
semester are listed and described.

LIBERAL STUDIES OPTIONS

The basic aim of the Liberal Studies Options is to improve students'
opportunities for employment, advancement or further education through
exposure to enriching programs of study.

Liberal Studies options are arranged in four categories:

> Canadian Studies
> Cultural Studies
> Natural Sciences
> Social Sciences

In order to graduate, you must receive credit for FOUR Liberal Studies
options. One of these must be in the Canadian Studies group.
In addition to Canadian Studies, you must get credit in at least two
of the other three groups.

Students may apply for advanced standing in subjects which have already
been completed at the post secondary level.

OPEN OPTIONS

Where the requirements of a diploma course indicate an open option, a
student may select either a professional option from the division in
which they are registered, a professional option from any other diploma
division of the college, a Liberal Studies option, or an English and
Communications option. However, one must have successfully completed
the necessary prerequisites, and the open option semester subject must
not duplicate in whole or in part any semester subject already taken.

DATA PROCESSING DIPLOMA PROGRAM: 25 Courses

As more and more companies, government departments, and other organizat[ion] install computers, the requirements for technicians having a wide range of skil[l] very evident. This program is designed to make available to the student technical expertise in information processing as determined by present business standards, as well as the business skills so extremely important in tod[ay's] society.

The program is divided into three career profiles—a Programming Profile, Sys[tems] Profile and an Operation Profile. Normlly, students on each profile will be tak[en] common courses in their first two semesters. In the third and fourth semes[ters] however, there will be courses specifically oriented to the career profile select[ed].

PROGRAMMING PROFILE

The objective of this profile is to train the student in the areas of programm[ing,] systems analysis and the related areas of accounting, business management personnel to permit him to function in the business environment of Compu[ter] Programming.

Employment Opportunities Successful completion of this program profile equip the graduate to go directly into programming or other related areas

SYSTEMS PROFILE

The objective of this profile is to train the student in the areas of business syste[ms] and systems analysis and management, while at the same time providing necessary skills of accounting computer concepts and facilities, business mana[ge]ment and personnel, to permit him to function in a wide cross-section of the [in]dustrial community requiring systems-trained personnel.

Employment Opportunities Successful completion of this profile equips graduate to enter almost any area of modern business which depends on sys[tems] for its functions. While those areas in business, to which this profile might be [at]tractive, would be too numerous to mention in entirety, definite possibil[ities] would be in such departments as accounting, inventory, production planning control, data processing, and systems development.

OPERATIONS PROFILE

The objective of this profile is to train the students in the basics of comp[uter] operations, systems custodianship, data management, and operations anal[ysis] Courses in systems analysis, accounting, computer concepts and languages provide the student with the necessary skills to permit him to function . valuable employee in an operations or production environment.

Employment Opportunities Succesful completion of this program profile equip the graduate with sufficient knowledge and skills to join a data proces[sing] production installation and to assume major responsibilities in the operat[ing] area.

Admission Requirements: Ontario Secondary School Graduation Diploma.

Location: North Campus.

CURRICULUM

No.	Course Name		PREREQUISITE COURSE No.	Course Name
Computer Studies Courses				
232-170	Intro. Systems Analysis I		233-070	Elements of E.D.P. 3
231-150	Programming Techniques		232-070	Elements of E.D.P. in

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CURRICULUM

No.	Course Name		PREREQUISITE COURSE No.	Course Name
Computer Studies Courses				
233-010	Introduction to E.D.P.*			None
231-010	Languages I (PL 1)* (Double Credit)*			None
231-110	Languages II (Cobol) (Double Credit)		231-010	Languages I (PL 1)
231-210	Languages III (Assembler) (Double Credit)		231-010	Languages I (PL 1)
232-170	Intro. Systems Analysis I		233-010	Intro. to E.D.P.
232-270	Intro. Systems Analysis II		232-170	Intro. Systems Analysis I
234-270	Computer Software		233-010	Intro. to E.D.P.
Related Business Courses				
221-012	Accounting Concepts I			None
221-112	Accounting Concepts II		221-012	Accounting Concepts I
202-010	Computer Mathematics			None
283-110	Statistics		281-010	Business Mathematics
251-010	Personnel			None

English Communications: 2 courses—1 in each of first 2 semesters.

General Studies: 1 course

* These Courses may only be taken by computer programmer students; others by special permission only.

COMPUTER PROGRAMMING CERTIFICATE: 10 Courses

Many people within the business community are finding that their involvement with computers and information processing systems is increasing. To become technically involved in these areas or to develop an awareness of the impact of computers in their everyday lives or employment, this certificate provides students with a sound foundation of studies.

Location: North Campus.

CURRICULUM

No.	Course Name		PREREQUISITE COURSE No.	Course Name
Compulsory Courses: 10 Required				
233-010	Intro. to E.D.P.			None
231-290	Assembler I		233-010	Intro. to E.D.P.
231-351	Assembler II		231-290	Assembler I
231-150	PL/1-I		233-010	Intro. to E.D.P.
231-251	PL/1-II		231-150	PL/1-I
232-170	Intro. Systems Analysis I		233-010	Intro. to E.D.P.
232-270	Intro. Systems Analysis II		232-170	Intro. Systems Analysis I
234-270	Computer Software		233-010	Intro. to E.D.P.
231-710	Cobol I		233-010	Intro. to E.D.P.
231-410	Cobol II		231-710	Cobol I

Management Systems Profile

There is an ever increasing demand in business today for management to be aware of and to work with systems techniques which will improve the efficiency of both organization and operation of the corporate environment. EDP, if used effectively, is a means to this end. However, its effectiveness depends not only on the ability of the EDP specialist but on the ability of management to understand its implications and effectively manage and control its implementation. The management systems profile of the Business Administration program is designed to enhance the students' understanding of this area.

The course structure of this profile requires that the student take Introduction to Systems Analysis I (232-170), Programming Techniques, and Systems Management (232-372) instead of Elements of Systems, Computer Applications and Advanced Marketing Management as specified in the regular Business Administration program.

In addition, the following five courses will be taken as the five available business electives:

Introduction to Systems Analysis II (232-270)
Operating Systems I (233-070)
Operating Systems II (232-030)
Comparative Systems (232-371)
Systems Design (232-370)

BUSINESS ADMINISTRATION CERTIFICATE: 15 Courses

The Business Administration Certificate is designed for the mature student with some business experience who wishes to broaden his scope. A student may however, specialize to some degree in a particular area through the selection of business electives. Interested students should consult with the Chairman, Business Programs.

Location: North Campus.

CURRICULUM

No.	Course Name		No.	Course Name
		PREREQUISITE COURSE		
251-010	Personnel			None
252-710	Principles of Management		251-010	Personnel
252-410	Organizational Development		252-710	Principles of Management
241-010	Marketing I			None
241-110	Marketing II		241-010	Marketing I
221-011	Intro. to Accounting I			None
221-111	Intro. to Accounting II		221-011	Intro. to Accounting I
233-170	Elements of Systems		233-070	Elements of E.D.P.
254-010	Elements of Law I			None
283-110	Statistics			Business Mathematics
252-010	Manufacturing Operations		251-010	None
233-007	Elements of E.D.P.			None

Elective Courses—Choose 3

No.	Course Name		No.	Course Name
281-010	Business Mathematics			
253-810	Personnel Management & Development			None
281-110	Quantitative Analysis I		252-410	Organization Development
			281-010	Business Mathematics or equivalent
241-810	Marketing Management		241-110	Marketing II
223-810	Managerial Accounting		221-111	Intro. to Accounting II
926-101	Economics I			None
941-102	Communications I			None

COMPUTER PROGRAMMING DIPLOMA: 18 Courses

With the rapid growth in the use of computers by industry and government, the is a need for competent programmers. This program will provide you with training in several computer languages, systems analysis, business mathematics, accounti and business management.

Employment Opportunities As a graduate, you will have the technical competence to join, as a junior member of the Data Processing Community, any industrial or governmental department involved with the automated processing information. While the majority of graduates go directly into programming operations associated to the computer area, openings also have been found systems as well as methods and procedures.

Admission Requirements: Ontario Secondary School Graduation Diploma

Location: North Campus.