Introductory Course in Computer Applications in Information Processing for Library and Information Science Schools in India*.
(Education in library and information science. 5).

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[The need for introducing courses in computer applications in library and information systems in the training of information personnel in India, is stressed. Details of an introductory course in computer applications in information handling are presented.]

1 Need for Manpower for Computer Applications in Information Processing

A recent survey** by the Administrative Staff College of India, Hydrabad indicates that electronic computers are being used to an increasing extent in India. Until about 5 or 6 years ago, computer applications were mostly in non-bibliographical areas for example, in scientific computing, accounts work, payroll preparation, inventory control, etc. However, library and bibliographical applications are now being attempted in an increasing measure.

In building up the national information infrastructure to provide effective and fast information services on a national scale, the use of computers is attractive in handling large volume of data and information. The need to participate in international information systems and programmes, so as to benefit from such systems, make it necessary for national/local systems to develop appropriate capability to interact with the computer-based systems. The availability of computer-readable data bases as byproducts of large information systems and services facilitate the development of national information services in different subject fields, based on such data bases, is also an important aspect of the changing information environment. In due course, on-line access to data bases located at global distances may also become possible as has been demonstrated in different parts of the world and at the recent RECON on-line demonstration in Bombay. The Electronics Commission has plans for the wide-ranging use of computers and communication systems in developing and providing access to management and planning data and information in various sectors.

2 Manpower Development Initiatives

It is envisaged that in the coming years there will be more number and wider applications of com-

puters in a variety of data and bibliographical information processing areas in India. In this respect, the developments in the recent past and those envisaged for the 1980s compel our attention to the development of manpower adequate for the emerging information environment in this country and elsewhere.

Some initiatives have already been taken. The Institutes of Technology, university departments, and institutions of higher learning offering courses in computer science, management information systems, automation, etc, include data and information processing by computer as a major topic of the courses. However, computer applications in library and bibliographical information area may not be adequately treated in such courses unless taken as a project. The Documentation Research and Training Centre (Bangalore) (= DRTC) of the Indian Statistical Institute, and the Indian National Scientific Documentation Centre (New Delhi) (= Insdoc) of the Council of Scientific and Industrial Research, introduced, a few years ago, computer handling of information as a subject in their respective training courses in documentation and information science. Various experimental projects in using computers for bibliographical information and data processing have also been taken up by these two institutions to gain practical experience. The University of Delhi Department of Library Science, in changing its earlier syllabus for the Masters degree course to include information science, has introduced some aspects of computer applications in library and information field. Other library schools in the country are also planning the introduction of similar topics at the Masters degree level.

It would, therefore, be helpful to identify the appropriate topics for an introductory course in computer applications in the library and information field for consideration of its inclusion in the Masters programme in library and information science offered by library schools in the country. This could pave the way for the development, in the next few years, of library and information personnel in the country capable of building up on the basic knowledge and experience gained in the library schools to handle computer-

based information storgare and retrieval systems.

3 Proposals for a Core Syllabus of an Inrtoductory Course in Computer Applications

31 BACKGROUND

The DRTC began offering an elementary course in computer applications in information processing in 1968–69. We had then a computer engineer from the ICL to present lectures mainly in punched card techniques, flowcharting and programming using the PLAN language for ICL machines. The faculty in DRTC had extensive discussions with the engineer to acquaint him with the kinds of interests libraries have and for ourselves to learn of the possibilities of computer applications in bibliographical information processing. Small projects were also initiated. The following year we felt the need for having a person specialised in computer science on the teaching staff. Experts from other institutions, such as the School of Automation of the Indian Institute of Science, have also been associated with the course. Subsequently, the computer specialist took DRTC's regular course in documentation and information science and this proved to be mutually beneficial. During the past three years, the course on computer aplications in the library and information field has been built up and modified on the basis of actual teaching of the subject and experience gained in doing projects. We have also been looking at the emerging needs of the country in the field, as the information infrastructure is being built up. Courses offered at centres such as the INSDOC as well as the experiences of some of the DRTC alumni in the computer applications area, have also been taken into account. The course outline presented in this paper is based on these considerations. This paper should be read along with the Paper N outlining a curriculum for the MSc degree in information science, particularly with respect to proposed objectives and the syllabus.

32 OBJECTIVES

The objectives of this Introductory Course in computer applications, viewed in the framework of the overall educational objectives of the course leading to the Masters degree in information science, discussed in Paper N, Sec 2, is summarized below.

At the minimal level, the students completing the course should be in a better position (i) to discuss intelligently with computer specialists the design, development and operation of data and information systems and services; (ii) to grasp the significance of the developments in computer applications in library and information area and (iii) to take up advanced and/or specialized courses in computer applications in information processing. More specifically, the course is intended

1. To acquaint the students with the methods of conversion of records of data and information i nto machine readable form;

2. To familiarize the students with the elements of information theory, coding, etc., and with the basic principles and techniques of automated data processing, file organization, file handling, data structures, and generalised data base management;

3. To familiarise the students with the applications of computer in information storage and retrieval, including the provision of various services, such as current awareness service, selective dissemination of information, retrospective search, and development of data bank; and to acquaint them with approaches to man-machine interface problems;

4. To give the students the knowledge and the opportunity to practise programming techniques using a high level language, particularly in bibliographical information processing;

5. To acquaint the students with the structure and operation of international and regional computer-based information systems and services; and

6. To give the students a basic knowledge of the methods of evaluation of computer-based information systems and services.

33 SYLLABUS

The syllabus is structured in three modules— basic (B), intermediate (I), and core (C)

B   *Basic Course*
   B1 Mechanical methods of information handling and introduction to data processing.
   B2 Basic computer mathematics.

I   *Intermediate Course*
   I1 Introduction to computing
   I2 Introduction to electronic computers
   I3 Information storage and retrieval packages
   I4 International information systems and services
   I5 Program documentation and tape, disk library maintenance.

C   *Core Course*
   C1 Programming
   C2 Introduction to data structures
   C3 Information storage and retrieval

Under each course, the objective, approach to instruction, and contents are briefly outlined.

B   BASIC COURSE

   B1 *Mechanical Methods of Information Handling and Introduction to Data Processing*

OBJECTIVE:

To provide the student with the basic knowledge and experience to use mechanical aids and unit record machines effectively in the automation of library operations; and to give training in punched card data preparation for use in unit record machines and later in computers.

APPROACH

As this course is designed to orient the student from conventional to mechanical methods of information handling, the emphasis should be on the areas

amenable for mechanisation and the resulting man-power saving.

Practical work on unit record machines especially the use of punching machine, verifier, sorter, collator and accounting machine, would be helpful. For example, a small project, such as the production of lists of periodicals sorted according to subject/department code, periodicity, subscription expiry date, etc, may be given. To illustrate the use of the account-ing machine, a report could be generated giving the total amount of subscritpion area-wise/departmentwise.

CONTENT:
Historical development of mechanised systems of library operations. Peek-a-boo system, interior notched card system, edge-notched card system. Punch card and card codes for ICL and IBM. Card design and use of coding sheets, multiple card layout forms. Unit record machines, namely, punching machine, verifier sorter, collator, accounting machine. System design, and report generation using unit record machines,

B2 *Basic Computer Mathematics*

OBJECTIVE:
To introduce the student to those fundamental algebraic, logic and combinatorial concepts from mathematics needed in the subsequent computer science course and show the application of these concepts to various areas of computer and information science.

APPROACH:
The theoretical material should be introduced in a mathematically precise manner with all concepts being illustrated with examples from computer and information science.

CONTENT:
Representation of information namely, symbolic, notational unary, binary and decimal. Binary deci-mal, octal, hexa relationships. Binary logic and truth tables. Functionally complete operations such as associative, non-associative, commutative, non-commutative, distributive, conditional etc. Basic set theory: sets, subsets, operations on sets. Venn dia-grams and reflexive, symmetric and transitive rela-tions. Mappings into, onto, one -to -one mapping. Boolean algebra.

I INTERMEDIATE COURSE

I1 *Introduction to Computing*

OBJECTIVE:
To impart to the student a basic knowledge and experience necessary to use computers in the solution of problems. The proper understanding of the courses that follow depend upon this introduction.

APPROACH:
Attention is to be paid to the solution of compu-tational problems especially of the non-numeric type.

The notion of an algorithm should be stressed through-out and clearly distinguished from that of a program. Every effort should be made to develop the students' ability to analyse complex problems and formulate algorithms for their solution and to draw detailed flowcharts for them, one of them being a project, preferably chosen by the students. For example, periodicals/serials control, KWIC, KWOC indexing.

CONTENT:
Numerical, non-numerical computation. Methods of solution. Algorithms and properties of an algorithm. Decision logic tables. Outline flowcharting and detailed flowcharting. Binary search and bubble sort. Heuristics. Computer problem solving.

I2 *Introduction to Electronic Computers*

OBJECTIVE:
To lay the foundation for more advanced study in computer application. By familiarising the student with computer architecture, that is, the basic struc-ture and organisation of computer with an introduc-tion to assembly language, the course would help them in getting a better understanding of that internal behaviour of computers, particularly digital computers.

APPROACH
Emphasis shoud be placed on the overall struc-ture of the machines and programming techniques. A 'descriptive' presentation of various computer features and arganisation would be helpful. An assembly language of a computer such as that of the IBM system/360 may be introduced and used to describing computer organisation and instruction execution.

CONTENT:
Basic computer units and peripherals. Address-ing techniques. Machine structure and organisation. Instruction formats and execution. Program compila-tion, loading and execution. Compilers and assem-blers. High-level, low-level languages. Introduction to specific computers such as IBM–360 and 370, and ICL 1900 series. Assembly language programming. Introduction to Operating System.

I3 *Information Storage and Retrieval Packages*

OBJECTIVE:
To train the students in the use of commercially available ISR packages and the different approaches of these packages in handling ISR problems.

APPROACH:
Emphasis should be on the different steps and the 'logic' used by the different commercial soft-ware packages. The preparation of input data for the creation of the data base, the construction of user profiles use for in searching the data base and the use of control cards in the different steps involved are to

be explained. Practical work in the use of a few packages, and discussion on the advantages and disadvantages and the possible modifications that could be done to tailor the software to meet the different needs, world be useful.

CONTENT:
Overview of the ' logic ' or methodology of ISR packages: IBM Document Processing System/360, TEXTPAC, IMS/360, STAIRS, CAN/SDI, DRTC's DOCFINDER, ICL-FIND etc.

14 *International Informa.ion Systems and Ser.ices*

OBJECTIVE:
To make the student aware of the characteristics of international computer- based information services and data bases that are available and those being developed in different areas.

APPROACH:
A general survey of the design and structure of international information systems and services. This can be given as project work. The areas covered by the different systems, overlapping in the area of coverage and their operation are to be explained. Spechial emphasis should be given to the cooperation required in the development of such systems and their usefulness with particular reference to national situations.

CONTENT:
MARC, INIS, INSPEC, MEDLA RS/MEDLINE, CAS, AGRIS, CARIS, ISIS, DEVSIS, etc.

15 *Program Documentation and Tape. Disk Library Maintenance*

OBJECTIVE:
To stress the importance of documentation of computer programs and their organisation and to provide the student with knowledge and experience necessary to organise and maintain a computer centre library consisting of documentation of programs and software packages, system manuals, tapes and disk packs.

APPROACH:
The basic documentation standards and flow chart standards are to be explained with the help of manuals on 'systems documentation' and using examples of well documented programs. The students should be asked to prepare documentation of their programs according to the prescribed standards. Organisation of the system manuals collection, tapes and disk packs are to be explained by taking the students to a computer centre library. Some training in copying data sets on to tape/disk for purposes of storage is to be given and the students could be asked to prepare indexes for them.

CONTENT:
Program documentation standards and input-output format description. Organisation of program documentation and system manuals.
Copying and dumping data sets on to tape using utility programs. Tape labels and tape characteristics. Indexing of system back-up tape collection. Data set labels and disk directory entries. Listing of data set names, data set characteristics etc. Copying from disk to disk, disk to tape and dumping on the line printer etc, using standard utility programs.

C CORE COURSE

C1 *Programming*

OBJECTIVE:
This core course aims to present a systematic approach to the study of programming techniques and high-level languages, and is intended to provide the student with the knowledge and experience required to design, code and test programs.

APPROACH:
The student should be introduced to the basic techniques of programming and helped to learn and program in one or more high level languages. Computer facility should be used extensively to illustrate the concepts taught and to give the students actual experience in programming. Many of the flowcharts developed as class work in Course 11 could be programmed and tested to train the students in debugging.

CONTENT:
Constants, variables, identifiers,subsripts, expressions, I/O statements, conditional statements, Any two level languages (COBOL, PL/1, SNOBOL, BASIC). Recursive techniques,table look-up procedures, hashing, collision, addressing, indexing, storage, allocation, sorting, searching, scanning, string manipulation, text-editing, etc. Error conditions and messages, debugging techniques, tracing. Selection of test data. Checking and analysis of computer outputs.

C2 *Introduction to Data Structures*

OBJECTIVE:
To introduce the student to different data structures and the relations which hold among the elements of data involved in problems, the structures of storage media, the methods which are useful in representing structured data in storage and the techniques of operating upon them.

APPROACH:
Each type of data struture schould be considered carefully in terms of the operations which may conveniently be performed, and illustrated with examples in which the structure is useful. The student should

be required to apply the techniques to problems which ilustrate a wide variety of data structures.

CONTENT:

Representation of information as data-bits, bytes, fields, data elements, records, files. Use of pointer or linkage variables to represent data structure. Linear structures and strings stacks queues, LIFO, FIFO. Linked lists double linked, multi-linked circular lists. Character strings of variable length Pointer manipulations. Arrays, matrices, nonlineal structures trees, binary trees. Insertion, deletion and accessing clements of trees. Polish notation.

C3 *Information Storage and Retrieval*

OBJECTIVE:

To give students familiarity with most of the basic concepts of information organisation, updating, search and retrieval techniques to aid in the design of ISR systems and to understand the basics of automatic information processing systems.

APPROACH:

This topic forms the nucleus of the course and is designed to introduce the student to organisation, storage and retrieval of information. Emphasis should be on the development of computer techniques in handling information. The applicability of the techniques developed for both factual data and document systems should be stressed. The student should become familiar not only with the techniques of statistical, syntactic and logical analysis of natural language texts for retrieval, but also with the limitations of these techniques. The manner in which the techniques may be combined into a system for use in an operational environment should be explored through a project.

CONTENT:

Tape, disk utilisation. File organisation techniques sequential file, chained file, inverted file, clustered file, indexed sequential file, direct file. Hierarchical organisation. Thesaurus construction and use. Automatic indexing and abstracting. Computer generation of subject indexes — KWIC/KWAC, POPSI, PRECIS. Automatic classification. Information Finding System: Components and major steps of an IFS-Data base creation, MARC-II format; profile construction; search logic, search methodology. SDI system design. Computer-reader dialogue. Interactive on-line systems. Introduction to data base management hierarchic, network, and relational.

4 Practice Work in Computer Use

It is essential that the teachers of the course engage themselves in projects involving computer applications in information processing. It is also necessary for students to write programs and test them and get practice at the computer terminal or console typewriter. Some practice work is indicated in the syllabus under the different courses. Minimally, they should learn to convert recorded infor-

mation into computer-readable form writing a program for the purpose, retrieve information from the data base created given a descriptor, or combination of descritors and to prepare indexes such as KWIC and KWOC. In this process they would learn the practical aspects of debugging computer programs. Some students may also take up additional projects to get further experience. Several computer programs (COBOL) have been drawn up in DRTC during the past three years as a regular part of the teaching and project work of the teachers and as part of the work of the students.

It is obvious that teachers and students should have access to adequate computer facility. During the course, five students may need 10 to 15 hours of computer time. The teacher may need for his work (excluding those projects supported by outside funding), 10 to 15 hours of computer time in a year. Therefore in a year the computer time cost (as part of the course) will be about Rs. 25,000 to Rs. 30,000 if commercial services are used, or half to one-third the figures if computer services at concessional rates for educational/research purposes are available to the school.

5 Conclusion

The proposal for the introductory course for computer applications in library and information field was discussed at the recent DRTC—INSDOC Seminar on Library and Information Manpower Development. The reactions of the participants were favourable, and the following recommendation was unanimously adopted.

" *Recognising* (i) the current trends and future growth in the applications of the computer in library and information systems in India, and (ii) the need to develop L and I S professionals with knowledge about computer handling of information,

recommends that

(i) an introductory course covering computer applications in information processing and library automation be introduced in the Masters degree courses in L & I S offered in the country;

(ii) the syllabus suggested in Paper J* in the seminar background document be adopted for the introductory course to begin with;

(iii) the curriculum be so designed that the suggested Basic course and Intermediate course are made compulsory, while the advanced/core course in programming, data structures, and designing of computer based information systems, may be offered as an elective;

(iv) provision be made in the departments/schools for making available and to develop as needed, adequate resources — teachers, physical facilities, access to computer etc; and

(v) the curriculum of and the experiences with, the course be reviewed from time to time so as to adapt and upadate the course according to needs of the information infrastructure developments in the country ".

* Same on the one described in this paper