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The attached outline describes a proposed course to cover various topics which are of importance in Data Processing. This might be considered an advanced course, and it is assumed that those attending would be quite familiar with the basic principles of large digital computers. It would be assumed, in fact, that they had some programming experience, but not enough to characterize them as "senior" programmers. The body of knowledge in digital computing has been growing rapidly in recent years. There is not available at present any good integrated written treatment of many of these topics. Many people with substantial experience and insight have acquired a certain judgment in these matters, and this course would be an attempt to abstract from this available experience that information which is communicable and of some generality and importance.

It is believed that with the increased technological specialisation in digital computing many people within the company might benefit from this kind of training, and be better equipped to deal with users of our equipment who, themselves, have acquired substantial technical proficiency in digital computing. At present, it is thought that about 75 hours of instruction over a period of about three weeks would be appropriate for an introduction to the indicated topics.

PROPOSED SCHEDULE OF TOPICS TO BE INCLUDED IN AN ADVANCED COURSE ON PROGRAMMING

I - THE TECHNIQUE OF WRITING AND DEBUGGING A PROGRAM

(a) Planning the procedure and assessing the difficulties.

(b) Flow-charting - Van Neumann Goldstine Suggestions, GUIDE and SHARE Conventions, SAGE System Practices, Automatic Flow-Charting or Analysis of the program by the computer.

(c) Incorporation of re-start procedures.

(d) Writing the program to facilitate debugging.

(e) The need for sensitivity to the possibility of error.

(f) Desirable disciplines in debugging.

(g) Difficulties peculiar to group projects.

II - BRIEF HISTORICAL SURVEY OF THE DEVELOPMENT OF AUTOMATIC PROGRAMMING

(a) Regional assembly.

(b) Symbolic assembly.

(c) Macro instructions, Pseudo-operations

(d) Speed code on the 701.

(e) FORTRAN

(f) Univac Compilers.

(g) Commercial compilers - Report Generator & File Maintenance Systems, Autocoder, COMTRAN.

(h) The SHARE 709 Operating System - A Complete and carefully specified system planned by a group of highly experienced customers.

(i) Languages - the International Algebraic Language.

III - COMPILERS AND INTERPRETERS

(a) Distinction between these and possible advantages of each.

(b) A close look at a very sophisticated compiler - FORTRAN

(c) The translation of programs from one machine language to another, and the simulation of one machine on another.

IV - SALIENT PROPERTIES OF MACHINE ORDER CODES

(a) Floating point arithmetic and associated problems.

(b) Indexing.

(c) Indirect addressing.

(d) Variable length instructions and data.

(e) Parallel operations - Buffering, I/O overlapping, multiplexing.

(f) Conversion problems.

(g) The convert instruction on the 709.

(h) Error detecting and correcting codes.

V - ASSESSING A COMPUTER FOR A PARTICULAR DATA PROCESSING JOB

(a) Speed.
(b) The growth of round-off errors and word length.
(c) The instruction repertoire.
(d) The available library of programs.
(e) The advantages of homogeneous memory.
(f) I/O facilities.
(g) Checking machine performance.
(h) The special requirements of scientific and commercial data processing - what makes a scientific or commercial calculator?

VI - CUSTOMER PRACTICES DESIGNED FOR EFFICIENT MACHINE INSTALLATION OPERATION

(a) Closed shop vs. open shop operation.
(b) Keeping the programmer away from the machine.
(c) Supervisory control or monitor systems.
(d) Organization of customer computing installations.

VII - ADVANTAGES OF STANDARDIZATION IN THE PREPARATION OF PROGRAMS

(a) SHARE Standards.
(b) GUIDE Standards.
(c) Use of standards to facilitate conversion from one computer to its successor.

VIII - MISCELLANEOUS DATA PROCESSING TECHNIQUES

(a) Sorting and Merging.
(b) Addressing, sequencing, automatic facilities, optimum programming.
(c) The efficient use of large random access storage - table look-up, "chaining".
(d) "Learning" in a program - the checker playing program on the 704. Friedberg's experiments.

IX - MISCELLANEOUS SPECIAL PURPOSE AUXILIARY EQUIPMENT.

(a) Peripheral equipment.
(b) Real time facilities - DSU interrupt.
(c) Automation, SEPD equipment and Information Retrieval.

X - THE FUTURE DEVELOPMENT OF COMPUTERS AND NEW APPLICATIONS

(a) A brief look at the STRETCH and HARVEST computers.
(b) Why do we need faster and bigger machines?
(c) Potential future applications and computer powers.

XI - THE SMALL MACHINES - A discussion of the programming requirements of those IBM machines below the 700 series level. The influence of advanced programming ideas in this area will be discussed.

XII - THE ROLE OF COMPUTING IN OUR ECONOMY AND SOCIETY

(a) Statistics on installed and on order IBM Data Processing machines.
(b) Potential development of the computer market.
(c) Computing and automation and their social implications.
(d) Mathematical models, computing and experiments in the control of the cyclical behavior of our economy.