Flowcharting
concepts

Data Processing
techniques

a self-instructional guide

Mark N. Wayne

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Our age is characterized by the perfection of means

and the confusion of goals.--Albert Einstein

Flowcharting Concepts and Data Processing Techniques:
A Self-Instructional Guide

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PREFACE

This book is concerned with the logic of solving problems using a computer. The information that you will learn here is essential to the successful fulfillment of the requirements of assembly language and compiler language courses. Every programmer must be able to read a job description and a systems flowchart and to construct a program flowchart.

This book is the first of a series of self-instructional courses that deal primarily with computer software. It will help considerably if you try to keep in mind the relationship between computer hardware and computer software as you study programming courses. Hardware logic is useless without software to direct and implement the commands that the hardware carries out. Hardware and software are two distinct aspects of an electronic data processing system, but neither can function without the other, just as a player piano needs a piano roll!

This guide is designed to make your learning process as successful as possible. The list of behavioral objectives at the beginning of each chapter tells you exactly what you are expected to accomplish in that chapter. If you can fulfill these objectives, you will do well throughout the book.

Each chapter begins with a motivational Introduction, followed by a list of Behavioral Objectives. The objectives are accomplished in work sections, most of which are illustrated. The chapter ends with Class and Homework Problems, which reinforce the major ideas presented in the chapter.

The appendixes include a glossary of terms that are relevant to this course and a bibliography of materials that you may find helpful.

Make certain that you understand why you answered a particular question incorrectly before covering other topics. In this way, you should be adequately prepared for additional computer programming material.

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Chapter I

Introduction to Flowcharting

Introduction

An EDP (electronic data processing) system is designed to solve problems, but only the programmer can cause that system to fulfill specific needs. In the business world, management uses the computer for the compilation and analysis of different types of information. The specific type of information that management needs can be generated only if the nature of this information is carefully and specifically defined.

The data processing manager's job is to respond to the needs of management. In that capacity he generates job descriptions that define the sources of information and the content and format of the desired results. It is the job of the systems analyst and programmer to accomplish this job description.

The systems analyst generally defines the equipment and files that will be needed to solve the problem, and the programmer specifically defines the steps that the computer must take to handle the information, or input, and produce the desired results, or output.

These steps that the computer must take are defined by the programmer in his program flowchart. The major portion of this book deals with the construction of program flowcharts.

This first chapter offers an introduction to flowcharting. Here you will discover the fundamentals of the job description, the systems flowchart, and the program flowchart. You will learn how to construct a systems flowchart and a basic program flowchart from given job descriptions; this will become the basis for learning more advanced flowcharting techniques in later chapters.

Behavioral Objectives

The student will demonstrate his knowledge of basic systems and program flowcharting concepts by:

1. Listing three components of the systems flowchart and stating its purpose.

2. Stating the purpose of the program flowchart.

3. Drawing and labeling the following systems flowcharting terms when given a flowcharting template:

   (a) punched card,
   (b) punched tape,
   (c) manual input,
   (d) communication link,
   (e) direct-access or on-line storage,
   (f) magnetic tape,
   (g) document or printer,
   (h) display,
   (i) off-line storage.

4. Drawing and labeling the symbols for the following operations flowcharting terms when given a flowcharting template:

   (a) input/output,
   (b) annotation,
   (c) predefined process,
   (d) auxiliary operation,
   (e) terminal,
   (f) process,
   (g) decision,
   (h) manual operation,
   (i) connector.

5. Stating two reasons for the use of input and output buffers in data transfer operations.

6. Listing and defining three components of the job description.

7. Matching the job titles, data processing manager, systems analyst, programmer, and machine operator, with the responsibilities that each person would usually carry out:

   (a) writing a job description,
   (b) writing a systems flowchart,
   (c) writing an operations flowchart,
   (d) coding a source program,
   (e) debugging programming errors,
   (f) machine operations.

8. Constructing a systems flowchart when given input and output data file and hardware descriptions.

9. Constructing a program flowchart when given a job description that requires a basic program loop, normal termination, data input and output, but no input or output editing or computations.

I-1. Input and Output Buffers

1. A buffer is an area in main memory that is used for the storage of data from a computer peripheral device so that the data may be collected in their entirety before they are moved to a working storage area of main memory; or, an area of main memory used for the storage and editing of data to be transferred to a peripheral device after they are manipulated in working storage.

2. Buffers may be used for the editing of input or output data and for faster data processing, because data input and data output can take place at the same time.

3. A data file is a collection of related records. For example, all of the inventory item information from each inventory record makes up an inventory file. Likewise, a composite of all student records at a given institution might be called a student file.

4. Files may be used as a source of data input for manipulation in the central processor or as an external storage area where the results of data manipulation are stored.

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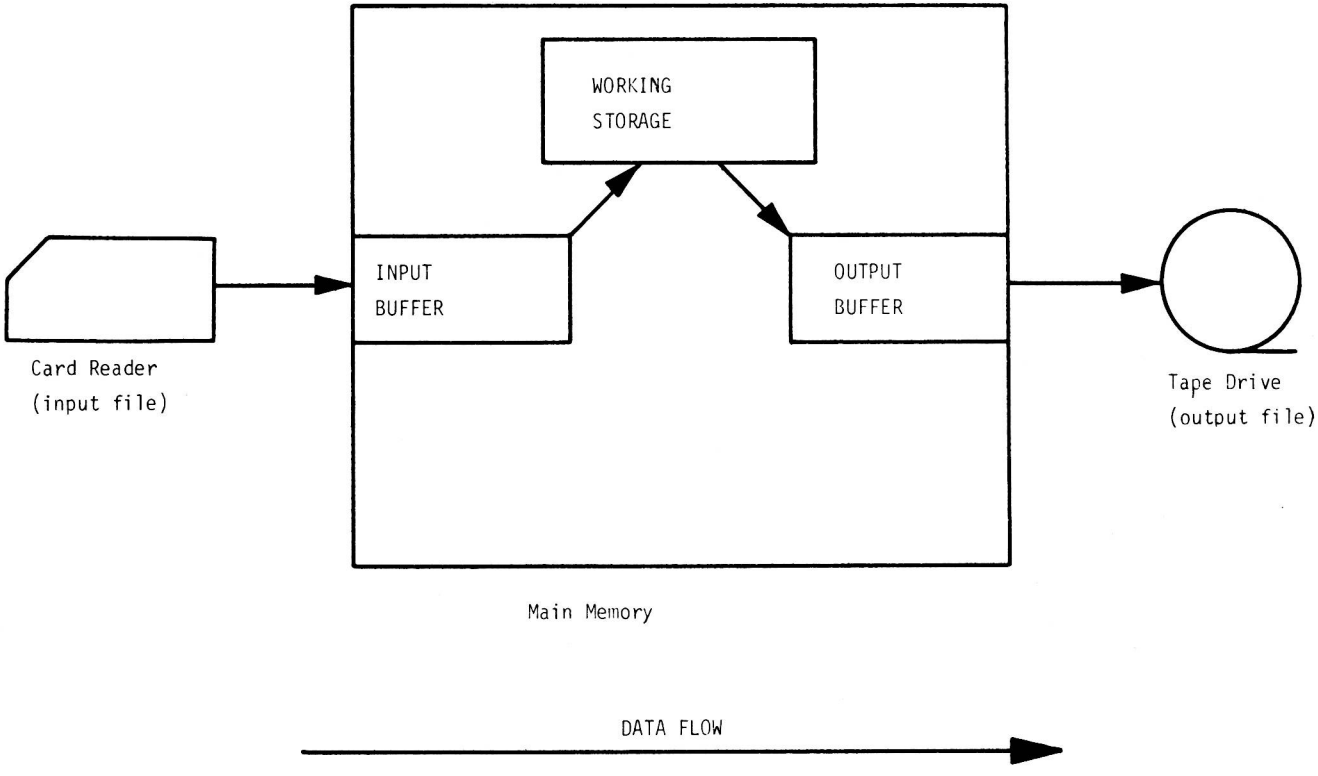

Figure I-1. Input and Output Buffers

I-2. The Job Description

1. The statement of a problem and the description of the form and content of the data input and data output are perhaps the most important steps in solving a problem.

2. Writing the job description is probably the single most time-consuming step in the process of business data processing, but without adequate problem definition the remaining steps of data layout, program flowcharting, program coding, test data design, program compilation, program debugging, program testing, and program documentation are impossible to carry out.

3. The three main components of the job description are:

   (a) the definition of the problem with all necessary facts,

   (b) the description of the format and content of the input files,

   (c) the description of the format and content of the output files or printout.

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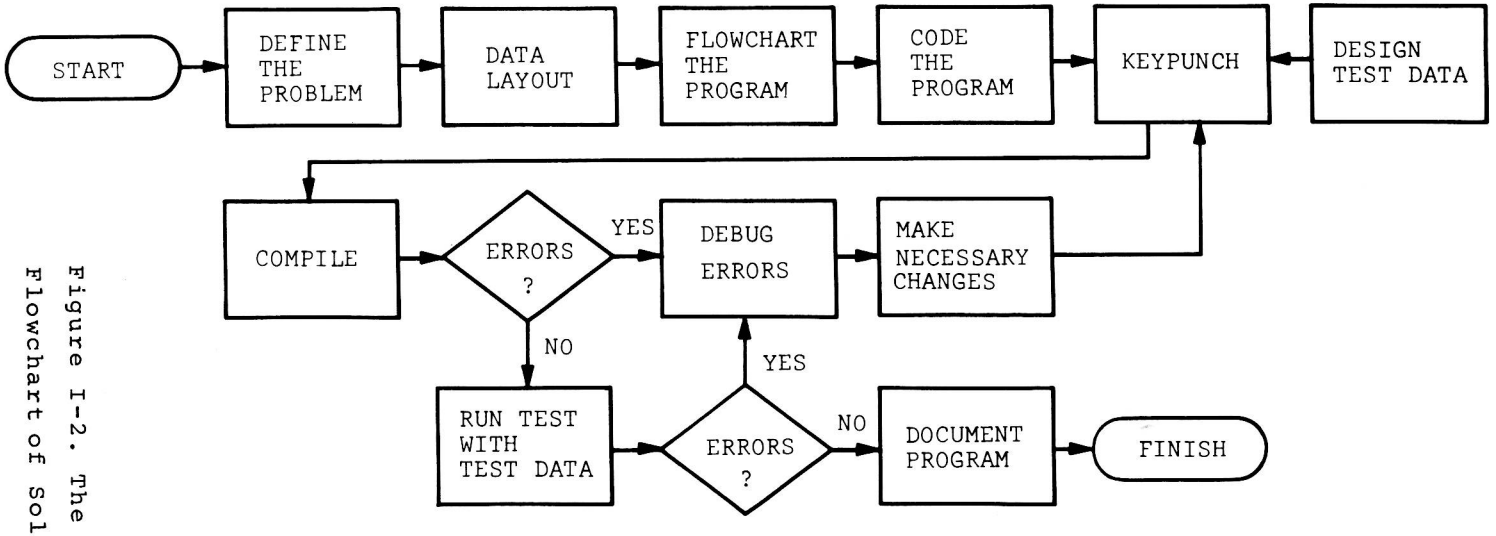

INPUT DESCRIPTION

CARD LAYOUT

EMPLOYEE NUMBER (1-15)	EMPLOYEE NAME (16-41)	WEEKLY SALARY (42-50)	BLANK (51-80)

OUTPUT DESCRIPTION

PRINTER SPACING CHART

EMPLOYEE NAME (1-26)	BLANK (27-30)	WEEKLY SALARY (31-41)	BLANK (42-45)	EMPLOYEE NUMBER (46-60)	BLANK (61-120)

Figure I-2. The Job Description (A Sample Flowchart of Solving a Problem)

I-3. Basic Systems Flowchart

1. The systems flowchart is a schematic representation of the flow of information through the components of a processing system, from source document through keypunching, sorting, and computer processing to the final disposition of output reports and updated files.

2. The three basic components of the system flowchart are brief descriptions of the input files, the program function, and the output files or printout.

3. The systems flowchart shows the configuration and files that are needed to carry out a job.

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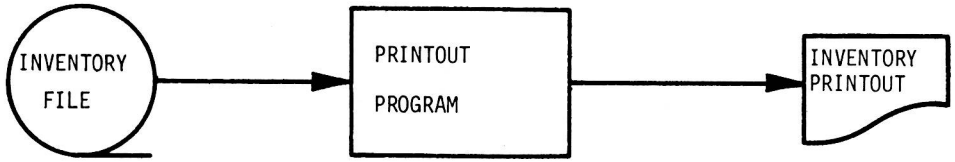

BRIEF INPUT FILE DESCRIPTION (ON MAGNETIC TAPE)

BRIEF PROGRAM DESCRIPTION

BRIEF OUTPUT FILE OR PRINTOUT DESCRIPTION

Figure I-3. Basic Systems Flowchart

I-4. Systems Flowcharting Symbols

1. Punched card--Represents any input/output (I/O) function in which the medium is punched cards or mark-sense cards.

2. Magnetic tape--Represents any I/O function in which the medium is magnetic tape.

3. Punched tape--Represents any I/O function in which the medium is punched tape.

4. Document or printer--Represents any I/O function in which the medium is a document or hard copy.

5. Manual input--Represents any input function in which the information is entered manually at the time of processing by means of such devices as sense switches, control panel buttons, and console keys.

6. Display--Represents any I/O function in which the information is displayed for human use at the time of processing by means of such devices as CRT units, console typewriters, communications terminals, and plotters.

7. Communications link--Used to indicate that information is automatically transmitted from one location to another in one direction or both directions.

8. On-line or direct-access storage device (DASD)--Represents any I/O function in which auxiliary mass storage of information that can be accessed on-line is used; such media include magnetic disk, magnetic drum, and magnetic cards.

9. Off-line storage--Represents any off-line storage of data, regardless of the medium on which the information is recorded.

10. Connector--Used as a connector block in place of lines which may overlap and cause confusion.

11. Off-page connector--Used to link up portions of a flowchart which use more than one page.

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