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PROGRAMMING IN C

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Dedicated to

My Wife Sweta and Son Yuvraj

PREFACE

The idea to bring out this book came from the students who wished for such a book that provides them all the contents in one book and has a number of programming solutions in as simple manner as possible.

This idea inspired me to write a book which could be easily understood by beginners and its content must be in points or step by step with theoretical concepts and their implementation in 'C' programming.

The strength of 'C' Programming lies in its simple and lucid presentation of the subject which will help the beginners in better understanding of the concepts. It adopts a student-friendly approach to the subject matter with many solved and unsolved examples.

I would welcome and appreciate suggestions from the students and faculty to encourage me and incorporate their valuable ideas/corrections in the next editions.

I hope that readers will learn everything what they need to know about C language and write 'C' programs with the help of this book.

Satya Prakash

CONTENTS

1

BASICS OF COMPUTER

OBJECTIVE

The main aim of this chapter is to introduce people about computer and its fundamentals. This book also introduces you to the fundamental concepts of computer programming using the "C" language.

1.1 INTRODUCTION

Nowadays we are using computers in every field like study, research, engineering, satellite, movie, telephone, e-mail, WhatsApp, Facebook, etc. Computer works as a device that accepts input (information in the form of digitalized data) and processes it for some output based on instructions stored in it (See Figure 1.1).

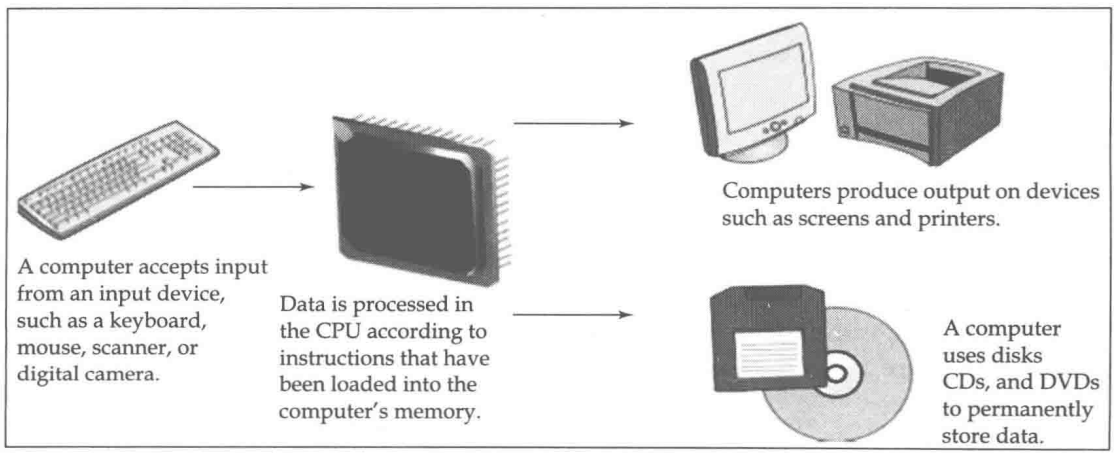

Figure 1.1 Computer system.

The topics are discussed in the following sections:

- What is computer?
- Characteristics of computer
- Generations of computer

- Classification of computer
- Computer organization
- Arithmetic and logic unit
- Control unit
- Memory unit
- Limitation of computer
- Physical component of computer

1.1.1 What is Computer?

The word "computer" comes from the word "compute" which means to calculate. So a computer is normally considered a calculating device that can perform arithmetic operations at enormous speed. It converts one form of data to another form. It is also known as an electronic device.

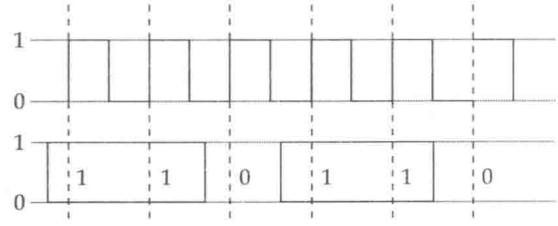

Figure 1.2 Binary digits (0 and 1).

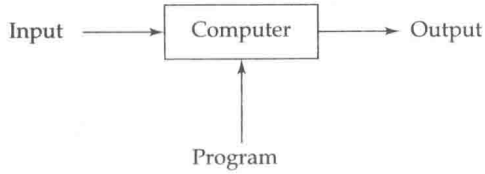

Figure 1.3

The function of any computer system is execution of program from one form to another form. Program means sequence of instructions (program code) along with data as shown in Figure 1.4.

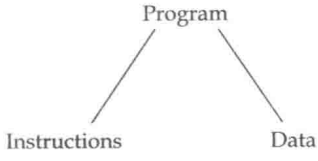

Figure 1.4 Data and instructions.

An instruction is a binary sequence which is designated inside the processor to perform some task, that is, binary sequence is associated with the operation.

Binary sequence = operation

Data means, it is also a binary sequence associated with value.

Binary sequence = value

Program is always stored into the memory because memory is storage device.

Complex computer also include the means for storing data (including the program, which is also a form of data for some necessary duration).

1.1.2 Characteristics of Computer

- **Speed:** Computer has much better speed than humans. Computer can perform the amount of work in a few second while human beings can take to do this in several years. Computer use their speed in Megahertz (MHz).
- **Accuracy:** Degree of accuracy of computers is high. Computers operate their work without error but errors occur because of user's mistakes.
- **Diligence:** Human beings can feel tiredness while they work for hours but computers can work for hours without creating any error and tiredness. Computers can work number of hours without taking rest while human beings need rest in-between the work.
- **Versatility:** Versatility allows us to adapt to many different situations. Similarlary computers can handle many situations simultaneously while human beings cannot. Computer have varied uses or serve many functions: preparing the results of examinations, electricity bills and many more.
- **No IQ:** Computers cannot do anything without user's instruction because its IQ is zero. It can perform the tasks only after users want. It has no intelligence of its own.
- **No feeling:** Computer is a machine therefore it has no feelings. Computers perform their task as per the given instructions but users perform their work on their experience and decision. Similarly, users can make a certain judgment in their daily life but computers cannot make such judgments on their own.

1.1.3 Generations of Computer

The term "computer generation" is widely used particularly by sales personnel of computer manufacturers. Most often it is used in relation to the hardware of computers.

These are the five computer generations. They are as follows:

- 1st generation - (1942-1955)
- 2nd generation - (1955-1964)
- 3rd generation - (1965-1975)

- 4th generation - 1st decade (1976-1985); decade (1986-2000)
- 5th generation - 2000 onwards.

First Generation

- ENIAC (Electronic Numerical Integrator and Computer), EDVAC (Electronic Discrete Variable Automatic Computer), UNIVAC1 (UNIVersal Automatic Computer) were the first generation of computers.
- First generation computer was mainly based on vacuum tube.

Advantages

- It was built of vacuum tubes therefore it was bulky.
- Electronic digital computers are derived from vacuum tube technology.
- It was basically built for calculating their time.

Disadvantages

- Its size was too large.
- Unreliable.
- It was built by thousands of vacuum tubes therefore emitted large amount of heat.
- It required air conditioning.
- Hardware failure rate was too high.
- Non-portable.
- Production was costly and difficult.
- Limited commercial use.

Second Generation

- Second generation computer was manufactured by germanium transistor.
- It occupied less space than the first generation computer.
- In second generation, memory was used with 100 KB.
- FORTRAN (Formula Translation/Translator), COBOL (Common Business Oriented Language), ALGOL (Algorithmic Language) and SNOBOL (String Oriented Symbolic Language) were developed and known as high level language.
- During this generation magnetic disk was also invented as storage device.

Advantages

- It was more reliable than the first generation computer.
- Small in size.
- Less heat was generated than the first generation.
- It is more efficient than the first generation.
- It had wider commercial use.

Disadvantages

- It also required air conditioning.
- Maintenance cost was higher than the first generation computers.

- It was assembled manually.
- Production was costly and difficult.

Third Generation

- Third generation computer was based on IC (integrated circuit) technology.
- Germanium transistors were replaced by silicon transistors.
- A single IC had about 10-100 transistors.
- The size of the main memories reached about 4MB.

Advantages

- It occupied much less space in size than others.
- Reliable.
- Less heat generated.
- Less computational time required.
- Portable.
- Manufactured for general purposes.
- Power required was much less than the previous compalers.
- Easy production and cheaper.

Disadvantages

- It also required air conditioning.
- Sophisticated technology used for manufacturing IC chips.

Fourth Generation (First Decade)

- Fourth generation computer used VLSI (Very Large Scale Integration) circuits, known as microprocessor chips.
- VLSI contains 50000 transistors.
- Idea of semiconductor memories used to develop magnetic memories.
- First OS (Operating System) was developed by Microsoft called MS-DOS(Microsoft Disk Operating Systems).
- ADA language was also developed in this generation.
- It was much cheaper than the previous generation computers.

Second Decade

- Microprocessors and size of main memory increased in this generation.
- In 1994 alpha microprocessor chip was introduced.
- Pentium chip was also used in this generation.
- Hard disk storage was 1-100 GB.
- Fiber optic cables were used in networks.
- Many high-level languages were used like Java, C, C++, PROLOG (Programming in Logic), etc.

Advantages

- Smaller in size because of high component density.
- More reliable.
- No need to heat the generator.
- In some special cases air condition was required.
- It had good complexity.
- Easily portable.
- Cheaper among all generations.

Disadvantage

- Sophisticated technology used for manufacturing LSI (Large Scale Integrated) chips.

Fifth Generation

- Fifth generation computers use concept of artificial intelligence and robotics.
- Main achievement of this generation was multitasking.
- Very Large Instruction Word (VLIW) processor is being used.

1.1.4 Classification of Computers

The computers have been classified into three categories as given below:

1. Digital computers
2. Analog computers
3. Hybrid computers

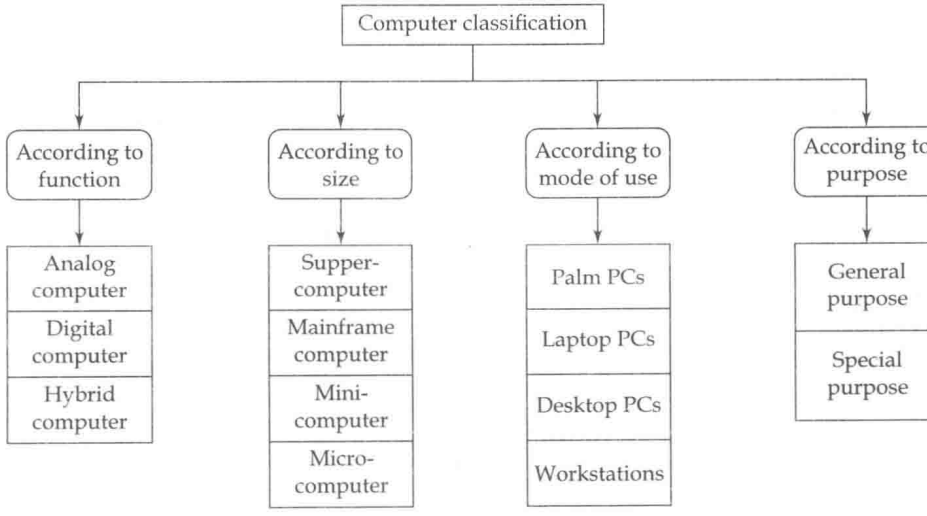

Figure 1.5 Classification of computers.