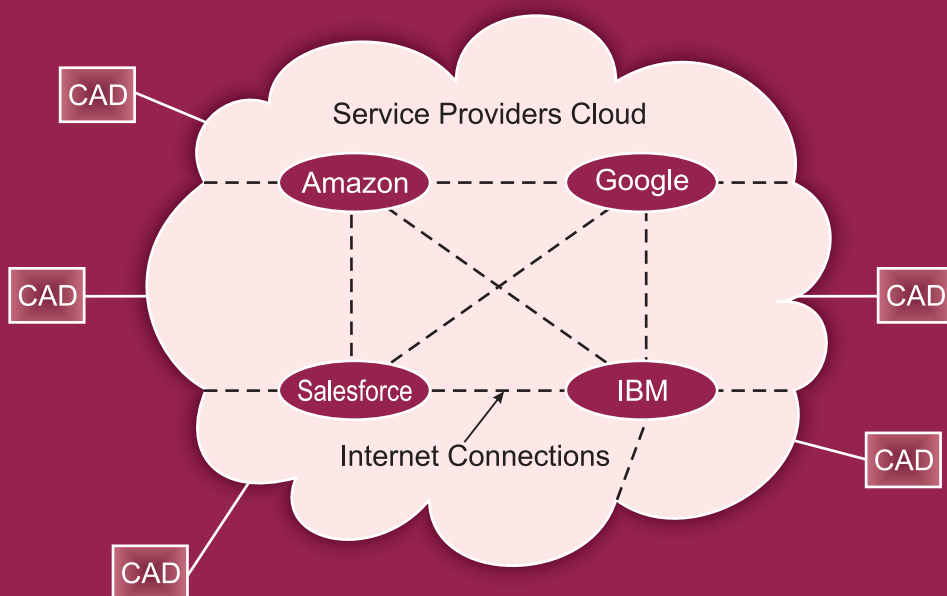


Sixth Edition

Fundamentals of COMPUTERS



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FUNDAMENTALS OF COMPUTERS

Sixth Edition

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2015

FUNDAMENTALS OF COMPUTERS, Sixth Edition

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ISBN-978-81-203-5067-0

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Forty-fourth Printing (Sixth Edition)

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January, 2015

Published by Asoke K. Ghosh, PHI Learning Private Limited, Rimjhim House, 111, Patparganj Industrial Estate, Delhi-110092 and Printed by Mohan Makhijani at Rekha Printers Private Limited, New Delhi-110020.

In memory of
my uncle *Dr. P.S. Viswanathan*
and
my aunt *Srimati Sitalakshmi*

—V. Rajaraman



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Preface

A student must understand how a computer functions in addition to knowing how to program it. The main objective of this book is to explain to a beginner how a computer works. Computer salesmen and advertisers have a tendency of using numerous obscure technical terms to impress customers. Very often such jargon overwhelms many managers and computer users because they do not understand them; hence, another objective of this book is to explain in a simple language what many of these terms really mean. Hardware and software components of a computer are important for its functioning and, thus, both these aspects are explained in this book.

This book is intended as a text for a course on Fundamentals of Computers to be taught concurrently with courses on programming. It would, therefore, be useful for the first course in computers taught in undergraduate and postgraduate courses in computer applications (BCA and MCA). Rapid advances in computer technology have made it imperative for *all engineers* to understand the hardware features of computers besides knowing how to program them in a high level language. A core course is being introduced in undergraduate engineering curricula on fundamentals of computers, and this book would be appropriate for this course. In view of the extensive use of computers in business and industry, students in schools of management require a course on computers, and this book would be appropriate for such a course. There is a trend to introduce computer science as a subject in B.Sc. courses; again, this book can be used as a text in this course.

Besides its use as a text, this book would provide managers, engineers, and scientists a basic introduction to the hardware and software of computers. This knowledge is essential to appreciate the power and deficiencies of computers and to select appropriate applications and hardware.

This book has evolved from a set of notes the first author used in various courses, which have been thoroughly class-tested. These notes have been used for concurrent reading in short intensive programming courses, in computer appreciation courses for managers and engineers, and in undergraduate programmes for engineers.

The first five editions of this book received excellent response from the readers and were highly acclaimed. A number of suggestions were also received from the readers. The

sixth edition has been written by extensively revising the fifth edition along with a co-author. The basic structure of the book has been retained. All chapters were thoroughly reviewed. A number of chapters were rewritten. In particular, Chapter 15 has been rewritten to reflect advances in input/output to computers, including brain computer interface. A new chapter on emerging computing environments including cloud computing has been added to accommodate the changes that have taken place in computer technology in recent times.

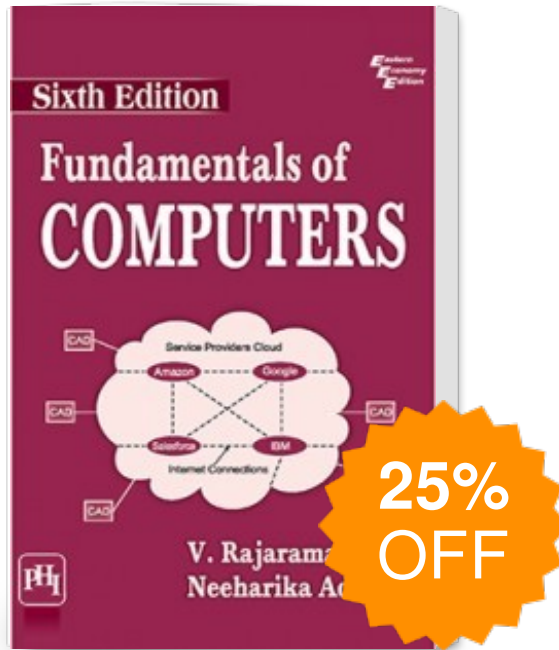
Chapter 1 explains the concept of computer algorithms, computer structure and programming languages. Chapter 2 describes how various types of data are represented and stored in a computer. Chapter 3 describes various devices used to input data and programs to computers and the devices used to write the results of computation. Chapter 4 analyzes the properties of storage devices used to fabricate computer memories. It also describes the structure of different types of memories. In Chapter 5, the logical structure of a processor (also known as the *Central Processing Unit*) of a computer is presented. A small hypothetical computer is used to explain the basic ideas in the design of processors. Chapter 6 discusses how binary arithmetic operations are carried out by a computer. Chapter 7 presents Boolean algebra and its applications in the design of arithmetic and logic circuits. Chapter 8 covers how I-O units, the memory and the processor are interconnected and the methods used to reduce the effects of speed mismatch between these units.

Chapters 9 and 10 are mainly concerned with the software of computers. Chapter 9 introduces the need for high level languages for computers and briefly describes a number of popular programming languages. Chapter 10 presents the important concept of operating systems. It explains how various units are coordinated and their functioning overlapped, using software aids. This chapter has been extensively revised.

Chapter 11 deals with microcomputers. In view of the rapid growth of microcomputer applications, I have devoted a full chapter to this topic and explained the logical structure of microprocessors, the architecture of microcomputers, and their applications. Recently, smart cards and radio frequency identification tags are being extensively used. Both these devices use embedded microprocessors. Thus, a new section has been introduced to describe these. Chapter 12 explains how computers are classified as tablet, laptop (or notebook) computers, PCs, servers, mainframes, distributed and parallel computers, and as first, second, third, and fourth generation machines.

The last four chapters are recent topics not usually found in most ‘first books’ on computers. Chapter 13 describes Computer Networks. It includes Local Area Networks (LANs), Internetworking using TCP/IP protocol, Intranets and Virtual Private Networks. Chapter 14 deals with analog and digital communications. In this chapter, various physical media used in computer communications are introduced. Specifically both wired and wireless communications are discussed. As wireless communications is becoming important, considerable attention has been devoted to spread spectrum and cellular communications. We have also described new wireless systems such as WiMAX and WiGig. Chapter 15 is new and introduces recent advances in input/output of computers. We describe graphical user interfaces (GUI) and how the extra computational load resulting from graphics is supported by use of Graphics Processing Units (GPUs). We illustrate the recent trends towards more natural/intuitive interfaces to computers by describing 3D displays, multi-touch, gesture, and speech interaction systems. We also

Fundamentals Of Computers



Publisher : PHI Learning

ISBN : 9788120350670

Author : V Rajaraman

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