COMPUTER FUNDAMENTALS



COMPUTER FUNDAMENTALS CONCEPTS, SYSTEMS & APPLICATIONS

COMPUTER FUNDAMENTALS

CONCEPTS, SYSTEMS & APPLICATIONS

BY

P.K. SINHA UNIVERSITY OF TOKYO, JAPAN

2003

BPB PUBLICATIONS

B - 14, CONNAUGHT PLACE, NEW DELHI-110001

© BPB PUBLICATIONS, New Delhi

FIRST EDITION - 1990

SECOND EDITION - 1992

THIRD EDITION - 2000

REPRINT 2003

Distributors:

BPB BOOK CENTRE

376, Old Lajpat Rai Market, Delhi-110 006

BUSINESS PROMOTION BUREAU

8/1, Ritchie Street, Mount Road, Madras-600 002

BUSINESS PROMOTION BUREAU

4-3-268-C, Giriraj Lane, Bank Street, Hyderabad-500 195

COMPUTER BOOK CENTRE

12, Shrungar Complex, M. G. Road, Bangalore-560 001

COMPLITER BOOK CENTRE

Kothi No.-535, Sector-7, Panchkula-134 109, CHANDIGARH

Notice

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the written permission of BPB Publications.

Published by Manish Jain for BPB Publications, B-14, Connaught Place, New Delhi and Printed by him at Goyal Offset Printers Delhi-35

ACKNOWLEDGEMENTS

The credit for the publication of the book goes to my father, Dr. Man Mohan Prasad, from whom I got inspiration to write it.

A book of this type naturally gained a number of ideas from previous books on this subject. The author expresses his thanks to all these authors, too numerous to acknowledge individually.

The author would also like to express his heart felt appreciation to his wife who drew some of the figures in the book and cheerfully devoted herself to the book-writing project.

MARCH, 1990

P.K. SINHA

PREFACE

This book is intended for anyone who is interested in computers. It is designed to meet the needs of beginners as well as advanced learners who wish to deal with computers. As computers are being used today in every walk of life, this book can be used by students of computer science, business administration, management, engineering, and general science as well. At the undergraduate level, where an introductory course on computers is included as a part of the curriculum, this book can be used as a textbook. The book can also serve as course material for participants of short term course conducted by various training organizations. Programmers and other computer professionals will also find the book helpful and informative. In short, this book is for everyone who is either excited about computers or interested in knowing about computers.

A knowledge of computers is not a prerequisite to follow the contents of the book. It assumes no background in computers or computer programming. Starting with an introductory chapter, the book goes on to cover all facets of digital computers. It uses the simple-to-complex and easy-to-learn approach throughout. Special attention has been paid to remove unwanted details and to make the material comprehensive, concise and practical. Simple and plain English has been used throughout and the use of computer jargons has been avoided as far as practicable.

All the concepts presented in the book are illustrated with suitable examples as and when required. This will enable the readers to use the book effectively for self-study. In addition to this, each chapter contains a number of review questions and exercises which are carefully designed to provide an insight into the subject matter.

MARCH, 1990

P.K. SINHA

CONTENTS

1. INTRODUCTION		1
CHARACTERISITCS OF COMPUTERS		
THE EVOLUTION OF COMPUTERS		1
The Mark I Computer		2
The Atanasoff - Berry Computer		
The ENIAC		
The EDVAC		
The EDSAC		
Manchester Mark I		
The UNIVAC I		
THE COMPUTER GENERATIONS		4
First Generation		7
Second Generation Third Generation		
Fourth Generation		
Fifth Generation		
1 In Generation		
2. BASIC COMPUTER ORGANIZATION		9
INPUT UNIT		
OUTPUT UNIT		10
STORAGE UNIT	35	10
ARITHMETIC LOGIC UNIT	- 32	10
CONTROL UNIT		10
CENTRAL PROCESSING UNIT		11
THE SYSTEM CONCEPT		11 11
3. NUMBER SYSTEMS		11
SECOND SE		13
NON-POSITIONAL NUMBER SYSTEMS		13
POSITIONAL NUMBER SYSTEMS		13
Binary Number System Octal Number System		
Hexadecimal Number system		
CONVERTING FROM ONE NUMBER SYSTEM TO ANOTHER		
Converting To Decimal From Another Base		15
Converting From Base 10 To A New Base	1 94	
Converting From A Page Oct To A New Base		
Converting From A Base Other Than 10 To A Base Other Than 10		
Shortcut Method For Binary To Octal Conversion	10°	
Shortcut Method For Octal To Binary Conversion		
Shortcut Method For Binary To Hexadecimal Conversion		
Shortcut Method For Hexadecimal To Binary Conversion FRACTIONAL NUMBERS		
TOTAL NUMBERS		22

4. COMPUTER CODES		a .	25
BCD CODE EBCDIC			25 27
Zoned and Packed Decimal Numbers			29
ASCII			31.
COLLATING SEQUENCE			31.
5. COMPUTER ARITHMETIC			35
5 g			
WHY BINARY			35
BINARY ARITHMETIC			36
Addition		N 910	
Sub-traction	* 9		
Multiplication			
Division			a .
6. BOOLEAN ALGEBRA AND LOGIC CIRCUI	TS		45
BOOLEAN ALGEBRA			45
Fundamental Concepts of Boolean Algebra			
Postulates of Boolean Algebra			
The Principle of Duality			
		9	
Theorems of Boolean Algebra			51
BOOLEAN FUNCTIONS		*	31
Minimization of Boolean Functions		2	
Complement of a Function			
- Canonical Forms For Boolean Functions - Conversion Between Canonical Forms		4	-
LOGIC GATES			57
AND GATE			172
OR GATE			
NOT GATE			
NAND GATE		at a second	
NOR GATE	*		
LOGIC CIRCUITS		2 6	61
Converting Expressions To Logic Circuits			- 1
The Universal NAND Gate			
The Universal NOR Gate	90	XI.	
EXCLUSIVE-OR AND EQUIVALENCE Function	ns		
DESIGN OF COMBINATIONAL CIRCUITS			68
Design Of Half-Adder		The sale	
Design Of Full-Adder			
A Parallel Binary Adder	fige 1 T1 1 T 1		
7. PRIMARY STORAGE	to consider the action	w the	75
	place to the		
STORAGE LOCATIONS AND ADDRESSES	a control of Above 1	1 ×	75
STORAGE CAPACITY			76
Why More Bits	*		
Fixed And Variable Word Length Storage			
RAM, ROM, PROM AND EPROM			77
CACHE MEMORY			78
REGISTERS	300		78

		Contents	ш
8			
8. SECONDARY STORAGE DEVICES	5 2		81
SEQUENTIAL AND DIRECT-ACCESS DEVICES	2.5		81
PUNCHED PAPER TAPE			82
MAGNETIC TAPE			82
TAPE CASSETTES AND CARTRIDGES			84
MAGNETIC DISK	× × ×		35
FLOPPY DISK	¥		33
WINCHESTER DISK			39
MAGNETIC DRUM			39
MASS STORAGE			90
OPTICAL DISK			90
MAGNETIC BUBBLE MEMORY	a 11		91
CHARGE-COUPLED DEVICE			91
A NOTE ON STORAGE HIERARCHY			92
			-
9. INPUT - OUTPUT DEVICES			95
		100	, ,
PUNCHED HOLE DEVICES	19		95
Punched Cards			
Punched Paper Tape		265	
MAGNETIC MEDIA DEVICES		C	98
PRINTERS			8
Character Printers			O
Line Printers			
Page Printers			
KEYBOARD DEVICES		10	11
Video Display Terminals		. 10	1
Teleprinter Terminals			
Point-of-Sale Terminals			
Intelligent Terminals			
SCANNERS .		10	14
Optical Scanners		10	
Magnetic-Ink Character Recognition			
OTHER DEVICES		10	17
Computer Output Microfilm		10	N.
Digitizers			
Plotters			
Voice Recognition and Response Devices			
OFFLINE DATA ENTRY DEVICES		10	0
Key-to-Card		10	,
Key-to-Tape			
Key-to-Floppy	Later 199	6	
Key-to-Disk			
10 001/01		1	
10. COMPUTER SOFTWARE		11	2
The state of the s		11)
WHAT IS SOFTWARE		11	2
RELATIONSHIP BETWEEN HARDWARE AND SOFTWARE		11	
TIPES OF SOFTWARE		11:	
ACQUIRING SOFTWARE		11	

11. PLANNING THE COMPUTER PR	.OGRAM			117
PURPOSE OF PROGRAM PLANNING ALGORITHM		man di seri		117 118
FLOWCHARTS				118
Flowchart Symbols				
Sample Flowcharts				
Levels of Flowcharts				
Flowcharting Rules				
Advantages of Flowcharts				
Limitations of Flowcharts	9			
DECISION TABLES				130
PSEUDOCODE				132
12. COMPUTER LANGUAGES				141
ANALOGY WITH NATURAL LANGUAG	GES			141
MACHINE LANGUAGE	323			142
ASSEMBLY LANGUAGE				143
HIGH-LEVEL LANGUAGE				148
COMPILERS			T. Committee of the com	149
INTERPRETERS				151
SOME HIGH LEVEL LANGUAGES				152
FORTRAN				
COBOL				
BASIC				
PASCAL	29			
PL/I				
Other High Level Languages				
CHARACTERISTICS OF A GOOD LANG SUBROUTINES	GUAGE			158 159
13. SYSTEM IMPLEMENTATION AN	D OPERATION	1		161
TESTING AND DEBUGGING				161
DOCUMENTATION				163
CHANGEOVER TO THE NEW SYSTEM	A.			165
Immediate Changeover				10.
Parallel Run				
Phased Conversion				
SYSTEM EVALUATION				167
SYSTEM MAINTENANCE				168
· · · · · · · · · · · · · · · · · · ·				
14. OPERATING SYSTEMS				17:
DEFINITION AND FUNCTIONS			P. (10)	17
EVOLUTION OF OPERATING SYSTEM	21			17:
BATCH PROCESSING	13			17.
JOB CONTROL LANGUAGE	4 Sq 14 - 14	- N 19		17
SPOOLING				17:
MULTIPROGRAMMING				170
MULTIPROCESSING				17
TIME-SHARING				18
ON-LINE PROCESSING				18

REAL-TIME PROCESSING VIRTUAL STORAGE OS-CONTROLLED SOFTWARE Translating Programs Library Programs Utility programs	184 185 186
15. BUSINESS DATA PROCESSING CONCEPTS	189
WALLE TO DIE PROCESSING	
WHAT IS DATA PROCESSING DATA STORAGE HIERARCHY	189
FILE ORGANIZATIONS	189
Sequential Files	190
Direct Files	
Indexed Sequential Files	
FILE UTILITIES	193
Sorting	193
Searching	
Merging	
Copying	
Printing	
Maintenance	
Labelling	
Scratching	
DATA BASE SYSTEMS	195
The Data Base Concept	
Data Base Management System	
Data Base Structuring Techniques	
Advantages and Limitations of Data Base Systems	
16. DATA COMMUNICATIONS AND COMPUTER NETWORKS	203
BASIC ELEMENTS OF A COMMUNICATION SYSTEM	204
DATA TRANSMISSION MODES	204
Simplex	205
Half-duplex	
Full-duplex	
DATA TRANSMISSION SPEED	205
Narrowband	203
Voiceband	
Broadband	
TRANSMISSION MEDIA	205
Wire pairs	
Coaxial cable	
Microwave system	
Communications satellite	
Optical fibers	
DIGITAL: AND ANALOG TRANSMISSION	208
Amplitude Modulation	
Frequency Modulation	
Phase Modulation	
COMMUNICATIONS PROCESSORS	210
Multiplexers	
Concentrators	

	Front End Processors			
	ASYNCHRONOUS AND SYNCHRONOUS TRAN	ISMISSION		21
	SWITCHING TECHNIQUES			21
	Circuit Switching			
	Message Switching			
	Packet Switching			200 J.E
	NETWORK TOPOLOGIES			21
	Star Network			, and
	Ring Network			
	Completely Connected Network			
	Hybrid Network	9 		
	Multipoint Network			
	LOCAL AREA NETWORK AND WIDE AREA	NETWORK		220
	COMMUNICATION PROTOCOLS			221
	Roles of Protocol		E 2	
	The OSI Model			
	Concept of Layering in OSI Model			
	An Example of Message Transfer in OSI Model			
	DISTRIBUTED DATA PROCESSING			225
_	LOSSARY	# W		
	HAISSART			220