

Contents

Preface, xi

Author, xxi

CHAPTER 1 ■ INTRODUCTION AND HISTORIC PERSPECTIVE

INTRODUCTION AND HISTORIC PERSPECTIVE

	1
The First Computers	6
Attributes of the First Computers	8
Von Neumann Architecture	9
Computers' Evolution	11
Moore's Law	13
Classification of Computers	13
Historic Perspective	15
Personal Computers	18
Computer Networks	20
1970s Computers: The First Mainframes	23
1980s Computers: The Last Mainframes	25
"The Network Is the Computer"	26
Network Computers	28
Computing Attributes	29
Terminal Services	32
Client/Server	33
<i>File Server</i>	34
<i>Client/Server</i>	35
Additional "Computers"	42
Key Takeaway	43
REFERENCES	45

CHAPTER 2 ■ DATA REPRESENTATION	47
DATA REPRESENTATION	47
Numerical Systems	48
Decimal Numbering System	49
Other Numbering Systems	50
Binary System	50
Representing Real Numbers	54
Converting Natural Numbers	54
Converting Fractions	57
<i>Explanation</i>	57
Negative Numbers Representation	58
Range of Numbers	61
Computer's Arithmetic	63
Additions and Subtractions	65
Floating Point	67
Scientific Notation	68
THE 754 STANDARD	70
Range of Floating-Point Numbers	72
Special Numbers	74
Converting 754 Numbers	75
Adding Floating-Point Numbers	78
Multiplying Floating-Point Numbers	79
Decimal Numbers Representations	81
Key Takeaway	82
CHAPTER 3 ■ HARDWARE ARCHITECTURE	85
HARDWARE ARCHITECTURE	85
Computer Generations	86
Computer Classification	88
Computer Systems	90
Processor	93
Key Takeaway	95
REFERENCES	95

CHAPTER 4 ■ CENTRAL PROCESSING UNIT	97
PART I: CENTRAL PROCESSING UNIT	97
Registers	97
Stack-Based Architecture	99
Accumulator-Based Architecture	103
Memory-Register Architecture	105
Register-Register Architecture	109
Architecture Summary	112
Processor Paths	113
Instructions Execution	115
Performance	116
Processor's Internal Clock	118
"Iron Law" of Processor Performance	119
CYCLES PER INSTRUCTION-BASED METRIC	122
Performance Estimation	125
Benchmark Programs	127
Calculating and Presenting the Results Obtained	131
Key Takeaway	132
PART II: CENTRAL PROCESSING UNIT	134
Amdahl's Law	134
Processors' Types	138
CISC Technology	141
RISC Technology	145
CISC versus RISC	148
Instruction-Level Parallelism	150
Instruction-Level Parallelism Problems	154
Instruction-Level Parallelism Hazards	156
Data Hazards	157
Resources' Access Conflicts Hazards	158
Dynamic Scheduling	162
Scoreboarding	165
Performance Enhancements	177
Branch Prediction	177

Loop Buffer	182
Key Takeaway	183
CHAPTER 5 ■ MEMORY	185
MEMORY	185
Memory Sizes	187
Memory Organization	188
<i>Explanation</i>	191
Running Programs	194
Estimating the Processor's Utilization	199
Partitions	202
Virtual Memory	205
Paging	215
Segments	220
Swap	225
Memory Performance	226
Memory Organization	231
Memory Technologies	232
Key Takeaway	234
CHAPTER 6 ■ CACHE MEMORY	237
CACHE MEMORY	237
Hit Rate	243
Miss Penalty	247
Address Translation	250
Multiple Processor Architectures	253
Key Takeaway	255
CHAPTER 7 ■ BUS	257
BUS	257
Bus Principle	261
Bus Evolution	264
Hard Drive Buses	271
Serial Bus	273
Extending the Bus Concept	277
Bus Expansion beyond the System Boundaries	280

Reliability Aspects	281
Hamming Codes	288
Key Takeaway	293
CHAPTER 8 ■ INPUT AND OUTPUT	295
INPUT AND OUTPUT	295
Methods for Performing I/O	296
Operating System Considerations	304
I/O Buffering	305
I/O and Performance	309
Key Takeaway	309
CHAPTER 9 ■ STORAGE	311
MASS STORAGE	311
Storage Devices	311
Disk Structure	312
Disk Speed	316
Disk Capacity	318
Performance Enhancements	319
Solid-State Disk (SSD)	320
Access Algorithms	322
Disk Controller	325
Redundant Array of Inexpensive Disks	327
Storage Attached Network (SAN)	336
Network Attached Storage (NAS)	338
Key Takeaway	338
CHAPTER 10 ■ ADDITIONAL ARCHITECTURES	341
ADDITIONAL ARCHITECTURES	341
Computer Classification	341
Grid Computing	350
Service-Oriented Architecture	351
Web Services	354
Cloud Computing	355
Virtualization	360
Key Takeaway	364

CHAPTER 11 ■ SOFTWARE ARCHITECTURES

SOFTWARE ARCHITECTURES	367
Software Architecture	367
Prearchitectural Era	368
Client/Server Architecture	369
Peer-to-Peer (P2P) Architecture	371
Layered Architecture	375
Tier Architecture	377
Object-Oriented Architecture	380
Service-Oriented Architecture	385
CORBA: Common Object Request Broker Architecture	388
Component Object Model (COM) and Distributed COM (DCOM)	391
Java RMI and Java Beans	393
Java 2 Enterprise Edition	399
Aspect-Oriented Architecture	402
Additional Architectures	405
Key Takeaway	410
REFERENCES	412
BIBLIOGRAPHY, 413	
GLOSSARY, 421	
INDEX, 437	