

# **COMPUTER SYSTEMS ARCHITECTURE**

**Jean-Loup Baer**

**COMPUTER SCIENCE PRESS**

# CONTENTS

<b>PREFACE</b> .....	vii
----------------------	-----

## **PART I An Overview of the Computer Space**

<b>1. HISTORICAL SURVEY OF COMPUTER SYSTEMS ARCHITECTURE</b> .....	1
1.1 Introduction .....	1
1.2 Historical Survey .....	3
1.3 Bibliographical Notes and References .....	29
<b>2. DESCRIPTION OF COMPUTER SYSTEMS</b> .....	31
2.1 Levels in the Representation of Computer Systems .....	31
2.2 Global System Structure .....	33
2.3 The Processor Description .....	45
2.4 The Register Transfer Level .....	63
2.5 Modeling the Dynamics of the System .....	68
2.6 Bibliographical Notes, References and Exercises .....	73

## **PART II The Building Blocks and Their Interactions**

<b>3. ARITHMETIC ALGORITHMS</b> .....	76
3.1 Number Systems .....	77
3.2 Addition and Subtraction .....	86
3.3 Multiplication and Division .....	98
3.4 Floating-Point Operations .....	116
3.5 Other Functions of the ALU .....	128
3.6 Bibliographical Notes, References and Exercises .....	130
<b>4. POWERFUL CENTRAL PROCESSORS</b> .....	135
4.1 Basic Requirements for a Pc .....	136
4.2 Speeding Up the Instruction Cycle .....	139

4.3	Look-Ahead and Parallelism .....	147
4.4	The CDC 6600 Central Processor .....	166
4.5	The IBM System 360/91 and 360/195 Central Processors .....	185
4.6	Stack Processors (A First Look) .....	199
4.7	Bibliographical Notes, References and Exercises .....	210
<b>5.</b>	<b>THE MEMORY HIERARCHY</b> .....	<b>216</b>
5.1	Components of the Memory Hierarchy .....	217
5.2	Primary Memory .....	223
5.3	Interleaved Memories .....	239
5.4	Secondary Memory Devices .....	249
5.5	Associative Memory .....	262
5.6	Bibliographical Notes, References and Exercises .....	264
<b>6.</b>	<b>MANAGEMENT OF THE MEMORY HIERARCHY</b> .....	<b>269</b>
6.1	Static and Dynamic Memory Management Schemes .....	269
6.2	Paging Systems .....	273
6.3	Segmented Systems .....	296
6.4	Replacement Algorithms—Two Implementations .....	309
6.5	Cache Memories .....	314
6.6	Bibliographical Notes, References and Exercises .....	322
<b>7.</b>	<b>THE CONTROL UNIT AND MICROPROGRAMMING</b> ....	<b>328</b>
7.1	Components of a Control Unit .....	328
7.2	Microprogramming .....	334
7.3	Applications of Microprogramming .....	355
7.4	Microprogramming System .....	364
7.5	Bibliographical Notes, References and Exercises .....	371
<b>8.</b>	<b>INPUT-OUTPUT</b> .....	<b>375</b>
8.1	Controlling the I/O Function .....	376
8.2	Input-Output Processors .....	387
8.3	I/O Devices .....	401
8.4	Generalities on Plo Programming .....	412
8.5	Simple Models for Evaluating Asynchronous I/O Processing ....	417
8.6	Bibliographical Notes, References and Exercises .....	427

## **PART III    Complete Systems: From Micros to Supercomputers**

<b>9. FROM MICROPROCESSORS TO SUPERMINICOMPUTERS</b> .....	429
9.1 Medium-Size Computers. IBM System 370 Models 155 to 168 (A Review) .....	429
9.2 Minicomputers and Microcomputers: Definitions and Roles ....	431
9.3 A Minicomputer Family: The DEC PDP-11 .....	435
9.4 Microcomputer and Microprocessor Architectures .....	468
9.5 A Minicomputer Stack Architecture: The HP-3000 .....	482
9.6 Bibliographical Notes, References and Exercises .....	487
<b>10. SUPERCOMPUTERS</b> .....	490
10.1 Classifications of Computer Systems .....	491
10.2 Pipelined and Vector Processors .....	500
10.3 Array Processors (SIMD) .....	527
10.4 Multiprocessing Systems (MIMD) .....	547
10.5 Bibliographical Notes, References and Exercises .....	577
<b>11. FUTURE TRENDS IN COMPUTER SYSTEMS ARCHITECTURE</b> .....	587
11.1 Outline of Some Specialized Architectures .....	587
11.2 Distributed-Function Architectures .....	598
11.3 The Impact of VLSI on Future Architectures .....	610
11.4 Bibliographical Notes and References .....	612
<b>INDEX</b> .....	614