Contents

Quotation . . . vii

Preface . . . ix

Introduction . . . xiii

Chapter 1. The Function of Computation . . . 1

1.1. Beginnings . . . 2
1.2. Classes of computers . . . 10
1.3. Analog approach . . . 36
1.4. Hardware–software relationship . . . 37
1.5. Integration and its limits . . . 43
1.6. Conclusion . . . 47

Chapter 2. The Function of Memory . . . 49

2.1. Definition . . . 50
2.2. Related concepts . . . 56
2.2.1. A story of endianness . . . 56
2.2.2. Alignment . . . 56
2.3. Modeling . . . 57
2.4. Classification . . . 59
2.5. Conclusion . . . 61

Chapter 3. Computation Model and Architecture: Illustration with the von Neumann Approach . . . 63

3.1. Basic concepts . . . 64
3.1.1. The idea of a program . . . 64
3.1.2. Control and data flows and mechanisms . . . 65

3.1.3. Models of computation 67
3.1.4. Architectures 72
3.1.5. The semantic gap 80
3.2. The original von Neumann machine 81
3.2.1. von Neumann's computation model 81
3.2.2. von Neumann's (machine) architecture 82
3.2.3. Control 89
3.3. Modern von Neumann machines 90
3.3.1. Abstraction level 91
3.3.2. Base execution outline 97
3.3.3. Possible transfers 100
3.3.4. Summary: advantages and disadvantages of this model 102
3.4. Variations on a theme 104
3.4.1. Classification by bus 104
3.4.2. Harvard architectures 111
3.4.3. Parallelism 113
3.5. Instruction set architecture 117
3.5.1. Storage components 118
3.5.2. Data format and type 126
3.5.3. Instruction set 126
3.5.4. Memory model 127
3.5.5. Execution modes 128
3.5.6. Miscellaneous 128
3.6. Basic definitions for this book 128
3.7. Conclusion 129

Conclusion of Volume 1 131

Exercises 133

Acronyms 135

References 153

Index 173