Contents

1 **What Is Software Performance?** 1
1.1 Non-functional Validation of Software Systems 2
1.2 Performance as a Non-functional Attribute 4
1.3 System vs. Software Performance Analysis 6

2 **Software Modeling Notations** 9
2.1 Basic Notations 9
2.1.1 Automata 11
2.1.2 Process Algebras 12
2.1.3 Petri Nets 14
2.1.4 Message Sequence Charts 15
2.2 Unified Modeling Language 17
2.2.1 E-commerce System 18
2.2.2 Use Case Diagram 19
2.2.3 Component Diagram 20
2.2.4 Interaction Diagram 22
2.2.5 Activity Diagram 25
2.2.6 State Machine Diagram 30
2.2.7 Deployment Diagram 32
2.2.8 Profiling UML 33

3 **Performance Modeling Notations** 35
3.1 Markov Processes 36
3.2 Queueing Networks 39
3.2.1 QN Definition 39
3.2.2 QN Parameterization 40
3.3 Execution Graphs 42
3.4 Layered Queueing Networks 46
3.5 Stochastic Petri Nets 49
3.6 Stochastic Process Algebras 52
3.7 Simulation Models 54

Bibliografische Informationen
http://d-nb.info/1003136397

digitalisiert durch DEUTSCHE NATIONAL BIBLIOTHEK

3.8 UML Profile for Schedulability, Performance and Time 55
3.8.1 PAprofile: Stereotypes and Tagged Values 56

4 Software Lifecycle and Performance Analysis 65
4.1 Software Lifecycle 65
4.2 Performance Analysis Within the Lifecycle 67
4.3 A Simple Application Example 74

5 From Software Models to Performance Models 79
5.1 A General Framework for Model Transformation 79
5.2 Some Transformational Approaches at Work 80
5.2.1 UML-ψ: From UML to a Simulation Model 81
5.2.2 From UML to a Layered Queueing Network 92
5.2.3 SAP•one: From UML to a Queueing Network 115
5.3 Other Transformational Approaches 131
5.3.1 Queueing Network Based Methodologies 131
5.3.2 Petri Net-Based Approaches 133
5.3.3 Methodologies Based on Simulation Methods 134
5.4 Discussion of the Approaches 135
5.5 Desirable Attributes of Software Performance Analysis Techniques 139

6 Performance Model Solution 141
6.1 Model Solution: Foundations and Techniques 142
6.1.1 Operational Analysis 143
6.1.2 Solution Techniques and Related Notations 148
6.1.3 Simulation 153
6.2 Model Solution: Tools 154
6.2.1 SHARPE—Multiple Performance Model Notations 154
6.2.2 SPE·ED—Execution Graphs and Queueing Networks . . . 155
6.2.3 GreatSPN—Stochastic Petri Nets 156
6.2.4 TimeNET—Stochastic Petri Nets 157
6.2.5 TwoTowers—Stochastic Process Algebras 158

7 Advanced Issues in Software Performance 159
7.1 Software Performance and Model-Driven Architecture 159
7.2 Interpretation of Performance Analysis Results 164
7.3 Performance-Based Software Reconfiguration 165
7.3.1 Allowed Reconfigurations 169
7.3.2 Issues to Address 169
7.4 A Unifying Ontology for Software Performance 171
7.4.1 Three Meta-models for Software Performance 172
7.4.2 Building an Ontology from Common Entities: A Bottom–Up Approach 177
7.4.3 Expressiveness Issues: A Top–Down Process 180

References 183

Index 189