

# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
1.1	Offline Algorithms . . . . .	2
1.2	Online Algorithms and Paging . . . . .	9
1.3	An Upper Bound for Paging . . . . .	19
1.4	A Lower Bound for Paging . . . . .	21
1.5	Marking Algorithms . . . . .	25
1.6	Refined Competitive Analysis . . . . .	27
1.6.1	Lookahead . . . . .	27
1.6.2	Resource Augmentation . . . . .	27
1.7	Historical and Bibliographical Notes . . . . .	28
<b>2</b>	<b>Randomization</b>	<b>31</b>
2.1	Introduction . . . . .	32
2.2	A Randomized Online Algorithm for Paging . . . . .	40
2.3	Yao's Principle . . . . .	44
2.3.1	Finite Problems . . . . .	45
2.3.2	Infinite Problems . . . . .	50
*2.3.3	Unbounded Problems . . . . .	52
2.4	Another Point of View: Game Theory . . . . .	55
2.5	A Lower Bound for Randomized Online Algorithms for Paging . . . . .	60
*2.6	A Barely Random Algorithm for Paging . . . . .	64
*2.7	Bounds with Probability Tending to One . . . . .	72
2.8	The Ski Rental Problem . . . . .	76
2.9	Historical and Bibliographical Notes . . . . .	82
<b>3</b>	<b>Advice Complexity</b>	<b>85</b>
3.1	Introduction . . . . .	86

3.2	Self-Delimiting Encoding of Strings . . . . .	90
3.3	Proving Lower Bounds . . . . .	93
3.4	The Advice Complexity of Paging . . . . .	95
3.4.1	Optimality . . . . .	96
3.4.2	Small Competitive Ratio . . . . .	102
3.5	Advice and Randomization . . . . .	105
3.6	Historical and Bibliographical Notes . . . . .	110
<b>4</b>	<b>The <math>k</math>-Server Problem</b>	<b>113</b>
4.1	Introduction . . . . .	114
4.2	A Lower Bound for Deterministic Algorithms . . . . .	117
4.3	Potential Functions . . . . .	121
4.4	$k$ -Server on the Line . . . . .	124
4.5	$k$ -Server on Trees . . . . .	129
4.6	Advice Complexity . . . . .	132
4.6.1	Optimality for the General Case . . . . .	132
4.6.2	Optimality for the Line . . . . .	138
4.6.3	An Upper Bound for the Euclidean Plane . . . . .	140
*4.6.4	An Upper Bound for the General Case . . . . .	144
4.6.5	Advice and the Randomized $k$ -Server Conjecture . . . . .	153
4.7	Historical and Bibliographical Remarks . . . . .	153
<b>5</b>	<b>Job Shop Scheduling</b>	<b>155</b>
5.1	Introduction . . . . .	156
5.2	Deterministic Algorithms . . . . .	160
5.3	Randomized Algorithms . . . . .	168
5.3.1	A One-Competitive Randomized Algorithm . . . . .	170
5.3.2	Bounds with Probability Tending to One . . . . .	170
5.3.3	A Barely Random Algorithm . . . . .	171
5.4	Advice Complexity . . . . .	172
5.4.1	Optimality . . . . .	172
5.4.2	Small Competitive Ratio . . . . .	176
5.5	Historical and Bibliographical Notes . . . . .	181
<b>6</b>	<b>The Knapsack Problem</b>	<b>183</b>
6.1	Introduction . . . . .	184
6.2	Deterministic Algorithms . . . . .	185
6.3	Advice Complexity . . . . .	187
6.3.1	Optimality . . . . .	187
6.3.2	Small Advice . . . . .	188
6.3.3	Logarithmic Advice . . . . .	189
6.4	Randomized Algorithms . . . . .	193
6.4.1	A Barely Random Algorithm . . . . .	193
6.4.2	A Lower Bound for Randomized Algorithms . . . . .	196

6.5	Resource Augmentation . . . . .	197
6.6	The General Case . . . . .	202
*6.6.1	Advice Complexity . . . . .	203
6.6.2	Randomized Online Algorithms . . . . .	208
6.6.3	Resource Augmentation . . . . .	209
6.7	Historical and Bibliographical Notes . . . . .	210
<b>7</b>	<b>The Bit Guessing Problem</b>	<b>211</b>
7.1	Introduction . . . . .	212
7.2	Deterministic and Randomized Algorithms . . . . .	213
7.3	Advice Complexity . . . . .	214
7.4	Advice-Preserving Reductions . . . . .	226
7.4.1	The $k$ -Server Problem . . . . .	227
7.4.2	The Set Cover Problem . . . . .	230
7.4.3	The Disjoint Path Allocation Problem . . . . .	235
7.5	Historical and Bibliographical Notes . . . . .	240
<b>8</b>	<b>Problems on Graphs</b>	<b>241</b>
8.1	Introduction . . . . .	242
8.2	The Coloring Problem . . . . .	243
8.2.1	Deterministic Algorithms . . . . .	244
8.2.2	Advice Complexity . . . . .	249
8.3	The Minimum Spanning Tree Problem . . . . .	251
8.3.1	Deterministic and Randomized Algorithms . . . . .	251
8.3.2	Advice Complexity . . . . .	253
8.3.3	Special Graph Classes . . . . .	257
8.4	Historical and Bibliographical Notes . . . . .	266
	<b>Solutions to Exercises</b>	<b>269</b>
	<b>Glossary</b>	<b>323</b>
	<b>Bibliography</b>	<b>327</b>
	<b>Index</b>	<b>341</b>

<http://www.springer.com/978-3-319-42747-8>

An Introduction to Online Computation  
Determinism, Randomization, Advice  
Komm, D.

2016, XV, 349 p. 58 illus., Hardcover  
ISBN: 978-3-319-42747-8