

Iain T. Adamson

# Data Structures and Algorithms: *A First Course*



Springer

# CONTENTS

## PREFACE

<b>I</b>	<b>DATA STRUCTURES</b>	<b>1</b>
<b>1</b>	<b>ARRAYS, RECORDS AND LINKED LISTS</b>	<b>5</b>
1.1	Arrays. . . . .	5
1.2	Storage of arrays. . . . .	7
1.3	Records. . . . .	11
1.4	Linked lists. . . . .	13
1.5	Exercises 1. . . . .	19
<b>2</b>	<b>STACKS AND QUEUES</b>	<b>27</b>
2.1	Stacks. . . . .	27
2.2	Applications of stacks. . . . .	31
2.3	Queues. . . . .	42
2.4	Exercises 2. . . . .	53
<b>3</b>	<b>BINARY TREES</b>	<b>57</b>
3.1	Binary trees. . . . .	57
3.2	Binary search trees. . . . .	65
3.3	Exercises 3. . . . .	71
<b>4</b>	<b>HEAPS</b>	<b>75</b>
4.1	Priority queues and heaps. . . . .	75
4.2	Exercises 4. . . . .	86

<b>GRAPHS</b>	<b>87</b>
5.1 Graphs and their implementation . . . . .	87
5.2 Graph traversals . . . . .	93
5.3 Exercises 5. . . . .	108
 <b>II ALGORITHMS</b>	 <b>111</b>
<b>6 ALGORITHMS AND COMPLEXITY</b>	<b>113</b>
6.1 Algorithms. . . . .	113
6.2 Complexity of algorithms. . . . .	116
6.3 Exercises 6. . . . .	123
<b>7 SORTING ALGORITHMS</b>	<b>127</b>
7.1 Internal sorting by comparisons. . . . .	130
7.2 Other internal sorting algorithms. . . . .	156
7.3 External sorting algorithms. . . . .	160
7.4 Exercises 7. . . . .	168
<b>8 GRAPH ALGORITHMS</b>	<b>171</b>
8.1 Shortest path algorithms. . . . .	171
8.2 Spanning tree algorithms. . . . .	192
8.3 Exercises 8. . . . .	211
<b>9 SOME MISCELLANEOUS ALGORITHMS</b>	<b>215</b>
9.1 Numerical multiplication algorithms. . . . .	215
9.2 Matrix multiplication algorithms. . . . .	218
9.3 A stable marriage algorithm. . . . .	227
9.4 Exercises 9. . . . .	232
 <b>III STORING AND SEARCHING</b>	 <b>235</b>
<b>10 STORING IN ARRAYS AND LISTS</b>	<b>239</b>
10.1 Sequential and binary searching . . . . .	239
10.2 Hashing. . . . .	243
10.3 Exercises 10. . . . .	254

<b>11</b>	<b>STORING IN BINARY TREES</b>	<b>257</b>
11.1	Storing in binary search trees. . . . .	257
11.2	Storing in AVL-trees. . . . .	260
11.3	Exercises 11. . . . .	278
<b>12</b>	<b>STORING IN MULTIWAY TREES</b>	<b>279</b>
12.1	Multiway search trees. . . . .	279
12.2	B-trees. . . . .	284
12.3	Tries. . . . .	302
12.4	Exercises 12. . . . .	305
<b>IV</b>	<b>SOLUTIONS</b>	<b>309</b>
<b>13</b>	<b>SOLUTIONS TO EXERCISES 1</b>	<b>311</b>
<b>14</b>	<b>SOLUTIONS TO EXERCISES 2</b>	<b>321</b>
<b>15</b>	<b>SOLUTIONS TO EXERCISES 3</b>	<b>329</b>
<b>16</b>	<b>SOLUTIONS TO EXERCISES 4</b>	<b>337</b>
<b>17</b>	<b>SOLUTIONS TO EXERCISES 5</b>	<b>341</b>
<b>18</b>	<b>SOLUTIONS TO EXERCISES 6</b>	<b>347</b>
<b>19</b>	<b>SOLUTIONS TO EXERCISES 7</b>	<b>349</b>
<b>20</b>	<b>SOLUTIONS TO EXERCISES 8</b>	<b>363</b>
<b>21</b>	<b>SOLUTIONS TO EXERCISES 9</b>	<b>375</b>
<b>22</b>	<b>SOLUTIONS TO EXERCISES 10</b>	<b>381</b>
<b>23</b>	<b>SOLUTIONS TO EXERCISES 11</b>	<b>387</b>
<b>24</b>	<b>SOLUTIONS TO EXERCISES 12</b>	<b>397</b>
	<b>INDEX</b>	<b>417</b>