

# Contents

<b>Preface</b>	<b>vii</b>
<b>1 Data Compression Systems</b>	<b>1</b>
1.1 Why compression? . . . . .	1
1.2 Fundamental operations . . . . .	3
1.3 Terminology . . . . .	6
1.4 Related material . . . . .	9
1.5 Analysis of algorithms . . . . .	10
<b>2 Fundamental Limits</b>	<b>15</b>
2.1 Information content . . . . .	15
2.2 Kraft inequality . . . . .	17
2.3 Human compression . . . . .	19
2.4 Mechanical compression systems . . . . .	20
<b>3 Static Codes</b>	<b>29</b>
3.1 Unary and binary codes . . . . .	29
3.2 Elias codes . . . . .	32
3.3 Golomb and Rice codes . . . . .	36
3.4 Interpolative coding . . . . .	42
3.5 Making a choice . . . . .	48
<b>4 Minimum-Redundancy Coding</b>	<b>51</b>
4.1 Shannon-Fano codes . . . . .	51
4.2 Huffman coding . . . . .	53
4.3 Canonical codes . . . . .	57
4.4 Other decoding methods . . . . .	63
4.5 Implementing Huffman's algorithm . . . . .	66
4.6 Natural probability distributions . . . . .	70
4.7 Artificial probability distributions . . . . .	78
4.8 Doing the housekeeping chores . . . . .	81
4.9 Related material . . . . .	88

<b>5</b>	<b>Arithmetic Coding</b>	<b>91</b>
5.1	Origins of arithmetic coding . . . . .	92
5.2	Overview of arithmetic coding . . . . .	93
5.3	Implementation of arithmetic coding . . . . .	98
5.4	Variations . . . . .	113
5.5	Binary arithmetic coding . . . . .	118
5.6	Approximate arithmetic coding . . . . .	122
5.7	Table-driven arithmetic coding . . . . .	127
5.8	Related material . . . . .	130
<b>6</b>	<b>Adaptive Coding</b>	<b>131</b>
6.1	Static and semi-static probability estimation . . . . .	131
6.2	Adaptive probability estimation . . . . .	135
6.3	Coping with novel symbols . . . . .	139
6.4	Adaptive Huffman coding . . . . .	145
6.5	Adaptive arithmetic coding . . . . .	154
6.6	Maintaining cumulative statistics . . . . .	157
6.7	Recency transformations . . . . .	170
6.8	Splay tree coding . . . . .	175
6.9	Structured arithmetic coding . . . . .	177
6.10	Pseudo-adaptive coding . . . . .	179
6.11	The Q-coder . . . . .	186
6.12	Making a choice . . . . .	190
<b>7</b>	<b>Additional Constraints</b>	<b>193</b>
7.1	Length-limited coding . . . . .	194
7.2	Alphabetic coding . . . . .	202
7.3	Alternative channel alphabets . . . . .	209
7.4	Related material . . . . .	214
<b>8</b>	<b>Compression Systems</b>	<b>215</b>
8.1	Sliding window compression . . . . .	215
8.2	Prediction by partial matching . . . . .	221
8.3	Burrows-Wheeler transform . . . . .	232
8.4	Other compression systems . . . . .	243
8.5	Lossy modeling . . . . .	251
<b>9</b>	<b>What Next?</b>	<b>253</b>
	<b>References</b>	<b>257</b>
	<b>Index</b>	<b>271</b>