

# Contents

<b>Preface</b>	<b>9</b>
<b>1 Introduction</b>	<b>11</b>
1.1 Evolutionary Computation. Inspiration and Rationale . . . . .	11
1.2 Book Motivation and Objectives . . . . .	14
1.3 Achievements and Restraints . . . . .	15
1.4 Book Outline . . . . .	17
<b>2 Evolutionary Algorithms. Basic Concepts</b>	<b>19</b>
2.1 Objectives of this Chapter . . . . .	19
2.2 What is an Evolutionary Algorithm? . . . . .	19
2.3 Components of an Evolutionary Algorithm . . . . .	22
2.3.1 Representation . . . . .	23
2.3.2 Population . . . . .	24
2.3.3 Fitness function . . . . .	24
2.3.4 Selection . . . . .	25
2.3.5 Variation operators . . . . .	28
2.4 Summary . . . . .	29
<b>3 Evolutionary Techniques for Multimodal Optimization</b>	<b>31</b>
3.1 Objectives of this Chapter . . . . .	31
3.2 Multimodal Problems and the Necessity for Diversity Preservation . . . . .	32

3.3	Fitness Modification for Diversity Maintenance . . . . .	35
3.3.1	Fitness Sharing . . . . .	36
3.3.2	Cooperative Coevolution . . . . .	38
3.4	Spatial Population Topologies . . . . .	40
3.4.1	Island Model . . . . .	40
3.4.2	Diffusion Model . . . . .	42
3.4.3	Religion-Based Evolutionary Algorithms . . . . .	45
3.4.4	Multipopulation Differential Evolution . . . . .	46
3.5	Replacement Schemes . . . . .	47
3.5.1	Crowding . . . . .	47
3.6	Search Space Division . . . . .	48
3.6.1	Radii-Based Schemes . . . . .	48
3.6.2	Multinational Algorithms . . . . .	58
3.7	Summary . . . . .	59
<b>4</b>	<b>New Variants within the Genetic Chromodynamics Framework</b>	<b>63</b>
4.1	Objectives of this Chapter . . . . .	63
4.2	A Crowding Procedure within Genetic Chromodynamics . . . . .	64
4.3	Application to Function Optimization . . . . .	65
4.3.1	Benchmark Functions . . . . .	67
4.3.2	Task . . . . .	68
4.3.3	Experimental Setup . . . . .	68
4.3.4	Results and Visualization . . . . .	70
4.3.5	Observations . . . . .	73
4.3.6	Conclusions . . . . .	75
4.4	Cloning within Genetic Chromodynamics . . . . .	76
4.5	Reapplication to Function Optimization . . . . .	77
4.6	Summary . . . . .	80
4.7	Future Work . . . . .	80

<b>5</b>	<b>Genetic Chromodynamics for Classification</b>	<b>83</b>
5.1	Objectives of this Chapter . . . . .	83
5.2	Other Evolutionary Classifiers . . . . .	84
5.3	Text Categorization . . . . .	85
5.3.1	Keywords Extraction . . . . .	86
5.3.2	Genetic Chromodynamics Approach to the Spam Filtering Problem . . . . .	88
5.3.3	Experimental Results . . . . .	92
5.4	Crowding Genetic Chromodynamics Classifier . . . . .	93
5.4.1	Diabetes Disease Diagnosis . . . . .	94
5.4.2	Iris Plants Identification . . . . .	96
5.4.3	Observations . . . . .	98
5.5	Summary . . . . .	99
5.6	Future Work . . . . .	99
<b>6</b>	<b>Coevolution for Classification</b>	<b>101</b>
6.1	Objectives of this Chapter . . . . .	101
6.2	Overview . . . . .	102
6.2.1	Cooperative Coevolution . . . . .	102
6.2.2	Competitive Coevolution . . . . .	105
6.3	Cooperative Coevolution Approach to Classification . .	109
6.3.1	Training Stage. The Evolutionary Algorithm Behind . . . . .	110
6.3.2	Cooperative Coevolution Parameters . . . . .	115
6.3.3	Test Stage. Rules Application . . . . .	115
6.4	Competitive Coevolution Approach to Classification .	116
6.4.1	Training Stage. The Evolutionary Algorithm Behind . . . . .	116
6.4.2	Competitive Coevolution Parameters . . . . .	120
6.4.3	Test Stage. Rules Application . . . . .	121
6.5	Experiments. Application to Real-world Problems . .	121
6.5.1	Experiment 1: Cooperative Classification Val- idation . . . . .	122

6.5.2	Experiment 2: Competitive Classification Validation . . . . .	125
6.5.3	Comparison to Standard Data Mining Approaches	128
6.6	Summary . . . . .	129
6.7	Future Work . . . . .	130
<b>7</b>	<b>Topological Species Conservation Hybridized Technique</b>	<b>131</b>
7.1	Objectives of this Chapter . . . . .	131
7.2	Advantages/Disadvantages of the Parent Techniques . . . . .	132
7.3	Description of the Proposed Hybridized Technique . . . . .	133
7.3.1	Motivation . . . . .	133
7.3.2	The Mechanics . . . . .	135
7.4	Application to Function Optimization . . . . .	147
7.4.1	Direct Performance Comparison . . . . .	148
7.4.2	Model Dependence on Radius/Number of Gradation Parameters . . . . .	153
7.5	Summary . . . . .	157
7.6	Future Work . . . . .	157
<b>8</b>	<b>Conclusions and Future Work</b>	<b>159</b>
8.1	Achievements . . . . .	159
8.2	Remarks . . . . .	160
8.3	Further Enhancements . . . . .	161
<b>A</b>	<b>Considered Test Functions Suite</b>	<b>163</b>
<b>B</b>	<b>Real-world Problems Addressed in the Thesis</b>	<b>173</b>
B.1	Fisher's Iris data set . . . . .	174
B.2	Pima-Indian Diabetes data set . . . . .	174
B.3	Breast Cancer data set . . . . .	174
B.4	Spam raw data set . . . . .	175
B.5	Hepatic Cancer Early Diagnosis . . . . .	175
<b>Bibliography</b>		<b>177</b>

**Index** **190**