

Contents

Preface	9
1 Introduction	11
1.1 Problem Statement, Motivation and Aims	11
1.2 Contributions	12
1.3 Book Organization	14
2 Overview of Evolutionary Algorithms	17
2.1 Aims of This Chapter	17
2.2 Underlying Concepts	18
2.3 Components of an Evolutionary Algorithm	19
2.4 Design of an Evolutionary Algorithm	19
2.4.1 Representation of Individuals	21
2.4.2 Fitness Function	21
2.4.3 Population and Initialization	21
2.4.4 Parent Selection	21
2.4.5 Variation	23
2.4.6 Survivor Selection	26
2.4.7 Stop Condition	27

2.5	Applications to Data Mining	27
2.6	Remarks	28
3	Learning Within Support Vector Machines	29
3.1	Aims of This Chapter	29
3.2	Fundamentals of Support Vector Machines	30
3.3	Support Vector Machines for Classification	30
3.3.1	Principle of Structural Risk Minimization	31
3.3.2	Linear Support Vector Machines: The Separable Case	32
3.3.3	Linear Support Vector Machines: The Non-separable Case	39
3.3.4	Nonlinear Support Vector Machines	41
3.3.5	Design of Multi-class Support Vector Machines	44
3.4	Support Vector Regression	47
3.4.1	Linear Support Vector Machines for Regression	48
3.4.2	Linear Support Vector Machines for Regression with Indicators for Errors	49
3.4.3	Nonlinear Support Vector Machines for Regression	50
3.5	Remarks	50
4	Training Within Support Vector Machines	51
4.1	Aims of This Chapter	51
4.2	Linear Support Vector Classification: The Separable Case	51
4.2.1	Properties of the Primal Problem	52
4.2.2	The Karush-Kuhn-Tucker-Lagrange Conditions	54

4.2.3	Lagrange Multipliers and Duality	56
4.2.4	Dual Problem for the Constrained Optimization	57
4.3	Linear Support Vector Classification: The Nonseparable Case	58
4.4	Nonlinear Support Vector Classification	62
4.5	Multi-class Support Vector Machines	63
4.6	Support Vector Regression	65
4.7	Remarks	68
5	An Evolutionary Resemblant of Support Vector Machines	69
5.1	Aims of This Chapter	69
5.2	Previous Evolutionary Interactions with Support Vector Machines	70
5.3	Proposed Evolutionary Resembling Support Vector Machines	71
5.3.1	Representation	71
5.3.2	Initial population	72
5.3.3	Reformulation of the Primal Optimization Problem	72
5.3.4	Multi-class Reconsideration	73
5.3.5	Fitness assignment	74
5.3.6	Stop condition	75
5.3.7	Test step	75
5.4	A Naïve Construction - a Proposal	76
5.4.1	Research question	76
5.4.2	The Naïve Evolutionary Algorithm	76
5.4.3	Preexperimental Planning	77
5.4.4	Task	78

5.4.5	Evolutionary Algorithm Setup	79
5.4.6	Problem Setup	79
5.4.7	Results/Visualization	80
5.4.8	Observations	81
5.4.9	A Chunking Mechanism	82
5.5	Remarks	87
6	A Pruned Evolutionary Resemblant	91
6.1	Aims of This Chapter	91
6.2	The Pruned Evolutionary Algorithm	92
6.3	Preexperimental Planning	95
6.4	Task	95
6.5	Problem Setup	95
6.6	Results	96
6.7	Observations	96
6.8	A Crowding Variant	99
6.9	An All-in-One Enhancement	101
6.10	Discussion	103
6.11	Evolutionary Resemblant versus Canonical Support Vec- tor Learning	104
7	Application of the Evolutionary Resembling Support Vec- tor Machines to Real-World Problems	107
7.1	Aims of This Chapter	107
7.2	Pima Indians Diabetes	108
7.3	Spam Filtering	109
7.4	Iris Classification	110
7.5	Soybean Disease Diagnosis	111

7.6	Boston Housing	112
7.7	Remarks	112
8	Conclusions and Future Work	117
8.1	Achievements	117
8.2	Remarks	118
8.3	Future Directions	119
	Bibliography	121
	Index	132