



Contents

1	Basics	7
1.1	Artificial Intelligence	7
1.2	Vector Space	8
1.3	Turing Completeness	9
1.4	Turing Test	10
1.5	Expert System	11
1.6	AI winter	11
1.7	ImageNet	12
1.8	COCO	12
1.9	MNIST	12
1.10	CIFAR-10	13
1.11	iris	13
1.12	diamonds	14
1.13	tips	14
1.14	推荐网课	15

2	Linear Classifier and Regressor	17
2.1	Linear Function	17
2.2	Linear Classifier	18
2.3	Loss Function	19
2.4	0-1 Loss	19
2.5	Hinge Loss	19
2.6	Square Loss	20
2.7	Exponential Loss	21
2.8	Gradient Descent	21
2.9	Inverse Problem	23
2.10	Condition Number	24
2.11	Overfitting	25
2.12	Regularisation	26
2.13	Norm	28
2.14	p-norm	29
3	Neural Networks and Backpropagation	31
3.1	Neural Network	31
3.2	History	31
3.3	Artificial neuron	34
3.4	Transfer Functions	35
3.5	Gradient Descent	36
3.6	Autoencoder	40
4	Representation and Problem Solving	45
4.1	Knowledge Representation and Reasoning	45
4.2	Knowledge Representation History	45
4.3	Knowledge Representation Basics	48

4.4	Propositional Logic	50
4.5	Search Problem Solving	53
5	Graph Theory and Decision Tree	59
5.1	Graph	59
5.2	Directed Graph	60
5.3	Bipartite Graph	61
5.4	Incidence Matrix	62
5.5	Adjacency Matrix	63
5.6	Eulerian Path	64
5.7	Hamiltonian Path	64
5.8	Dijkstra's Algorithm	65
5.9	Decision Tree	68
5.10	Decision Tree learning	69
5.10.1	Details	70
5.11	Information Gain	71
5.12	ID3	73
5.12.1	Details	74
6	Clustering	77
6.1	Unsupervised Learning	77
6.2	Cluster Analysis	77
6.3	Hierarchical Clustering	78
6.4	Metric	79
6.5	Single-linkage Clustering	80
6.5.1	Overview	80
6.5.2	Algorithm	80
6.6	Complete-linkage Clustering	81
6.6.1	Overview	81
6.6.2	Algorithm	81

6.7	UPGMA	82
6.8	k-means	83
6.8.1	Description	83
6.8.2	Algorithms	84
6.8.3	Complexity	85
6.9	Expectation–Maximisation	85
6.9.1	Description	86
7	Bayesian Prediction	89
7.1	Bayes’ Theorem	89
7.2	Distribution-version of Bayesian Inference	90
7.3	Frequentist	92
7.4	Testing for Statistical Independence	93
8	Applications	95
8.1	Computer Vision	95
8.1.1	Recognition	96
8.1.2	Detection	96
8.1.3	Pose Estimation	96
8.1.4	Tracking	97
8.1.5	Fusion	97
8.2	Natural Language Processing	98
9	Epilogue	101