
CONTENTS

1	INTRODUCTION	1
1.1	Cluster analysis	2
1.2	Parameter estimation	5
1.3	Outline of the thesis	9
I	ON CLUSTER ANALYSIS	11
2	CLUSTERING BASICS	13
2.1	The notion of similarity	14
2.2	Clustering quality	14
2.3	Problem Definitions	16
3	ANALYSIS OF AGGLOMERATIVE CLUSTERING	17
3.1	Preliminaries	18
3.2	Discrete k-center clustering	20
3.3	k-center clustering	24
3.4	Diameter k-clustering	34
3.5	The one-dimensional case	41
3.6	Lower bounds	45
II	ON PARAMETER ESTIMATION	55
4	STATISTICAL MODELS	57
4.1	The parameter estimation problem	58
4.2	General mixture models	60
4.3	Gaussian mixture models	61
4.4	Handy notions from probability theory	67
5	THE CLASSICAL EM ALGORITHM	71
5.1	Convergence of the EM algorithm	73
5.2	The EM algorithm for mixture distributions	77
5.3	The EM algorithm for Gaussian mixtures	78
6	THE STOCHASTIC EM ALGORITHM	81
6.1	The generic SEM algorithm	82
6.2	The SEM algorithm for mixture distributions	83
6.3	The SEM algorithm for Gaussian mixtures	86
7	EXPERIMENTAL ANALYSIS	99
7.1	Implementation	99
7.2	Data sets	100
7.3	Experiments	102
7.4	Results	105