

Two hours

EXAM PAPER MUST NOT BE REMOVED FROM
THE EXAM ROOM AND MUST BE RETURNED

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Modelling and visualisation of high-dimensional data

Date: Thursday 18th January 2018

Time: 14:00 - 16:00

Answer ALL Questions in Section A

Write your answers directly on the exam paper. Only answers written in the boxes on the exam paper will be marked.

Answer ALL Questions in Section B, use a separate answerbook for this Section

This is a CLOSED book examination

The use of electronic calculators is permitted provided they are not programmable and do not store text

[PTO]

*Section A
contains Multiple
Choice Questions
and is restricted*

Section B

Answer *all* questions from this section.

1. *Linear Discriminative Analysis* (LDA) is a popular supervised dimension reduction method. For a labelled data set of C classes ($C > 2$), describe *within-class*, *between-class* and *total* scatter matrices, S_W , S_B and S_T , in LDA with the same notation used in the lecture notes. (6 marks)
2. *Isometric feature mapping* (ISOMAP) is a nonlinear manifold learning algorithm. Describe the main steps of ISOMAP algorithm in detail. (6 marks)
3. Given a data matrix X that is taller than it is wide, prove that every right singular vector of X with singular value σ is an eigenvector of the covariance matrix, $cov(X)$, with eigenvalue σ^2 . (8 marks)