BIRKBECK COLLEGE
University of London

a. Module Specification

Module number
/ /
(For Registry Use)

1. Faculty	2. School	3. Degree(s) of which the module forms part
Social Sciences	Computer Science and Information Systems	MSc in Advanced Information Systems Masters by Research in Computer Science

4. Module title
Computational Intelligence and Visualisation

5. Module value	6. Date from which the module will operate	7. Number of students per intake
Half-unit	2002/2003 academic year	About 25 FT and 25 PT

8. Pre-requisites and co-requisites to the module

Prerequisites: First courses in mathematical foundations, data structures, and algorithms (e.g. as taught in a typical U.K. undergraduate degree in computer science, or conversion MSc, or equivalent)

9. Does the module supersede an existing module?

No

10. Main aims of the module

To study advanced techniques for data analysis and visualisation, including data structures and algorithms, clustering, neural networks and genetic algorithms.

11. Learning outcomes

Knowledge and understanding in the context of the subject

Understanding the main Data Analysis and Visualisation techniques

Subject-specific practical/professional skills

Use of advanced computing techniques for data analysis and visualisation.

Cognitive skills

Ability to solve pattern recognition, forecasting, and data mining problems using the appropriate data analysis technique(s).

General/transferable skills (including key skills)

To understand how data analysis and visualisation techniques can be deployed for solving real world problems.

12. Module structure, syllabus and assessment method

One-term course, 11 weeks, 3 hours per week

Assessment: by written examination and practical coursework. The final course mark will be the exam mark attained. Passing the practical coursework component will be compulsory in order to pass the course overall.

Syllabus:

1. Data Structures and Algorithms.

2. Data Visualisation:
   Mental cognitive maps. Examples. Symbolic representations. Visualised histograms, scatter-plots and box-plots. Principal components and SVD. Correspondence analysis factors. Kohonen self-organising maps.

3. Clustering and Intelligent Clustering:
   K-Means. Hierarchical clustering. Single cluster mining. Interpretation aids. Data decomposition based theory for finding and describing clusters.
   Nearest neighbours, single linkage and related methods.

4. Analysis of Mixed Scale Data:
   Qualitative and quantitative variables. Contingency table and association indices. Correlation and correlation ratio. Association and correlation in terms of the data scatter. Scale transformations and their effects. Data pre-processing.

5. Decision Rules:
   Classification tree and conceptual clustering. Criteria as association indices. Conjunctive description with transformation of the feature space. Discriminant function and support vector machines. Bootstrap, jack-knife and other resampling schemes for model testing and model selection.

6. Introduction to Neural Networks (NNs); conventional vs neural computation; AI vs NNs; NN architectures; classes of learning; biological perspective. NN history;

McCulloch and Pitts neuron model; perceptrons; perceptron learning rule; limitations of perceptrons.

7. Multilayer Perceptrons (MLPs); backpropagation learning algorithm; MLPs as classifiers; local minima; applications of MLPs; Time in neural networks; recurrent NNs; time-delay NNs; leaky-integrator type neural models.

8. Hopfield Networks; Boltzman machines; Reinforcement Learning.

9. Genetic Algorithms: application of concepts from biology and evolution to the development of computer systems.

Background Reading:

1. R. Spence (2001) Information Visualization, ACM Press, isbn 0-201-59626-1.
2. B. Mirkin (1996) Mathematical Classification and Clustering, Kluwer Academic Publishers, isbn 0-7923-4159-7.
3. M. Berthold, D. Hand (1999) Intelligent Data Analysis, Springer-Verlag, isbn 3540658084.
4. Haykin, S. S. (1999). Neural Networks : a comprehensive foundation (2nd ed), Englewood Cliffs, N.J. : Prentice Hall , 1999. ISBN 0132733501

13. Workload

Indicate the number of hours the student will spend in:

Lectures 23

Field Work:

Seminars:

Project Work:20 (2 hours per week coursework)

Tutorials:10

Laboratories:

b. Resources Specification

1. Teaching staff required

Name	Department	% of total teaching
B. Mirkin	School of Computer Science and Information Systems	40%
C. Christodoulou		30%
T. Westerdale		20%
T. Fenner		10%

2. Additional resources required

Accommodation

See course proposal forms

Library

Have you discussed library provision for the course with your subject librarian?

Yes

Other Library Resources required e.g. computing, a-v equipment.

None

Computing

Have you discussed any requirements for the use of specific software packages with CCS technical support staff?

No CCS support required.

CCS No implications

Department No outstanding problems

Part-time teaching

Nil

Other

Nil

3. Reading list

a) Books of which students are expected to own copies

None

b) Books for which a high level of duplication within the library will be needed

None

c) Other required reading

None – several background reading texts will be suggested (see Syllabus above), but the course material – both textual and on-line resources – will be self-contained.

4. Recommendations

AGREEMENT

Dean of Faculty _____ **Date**_____

Head of School _____ **Date**_____

Librarian _____ **Date**_____

Comments _____

CCS Manager _____ **Date**_____

Comments _____

CLOSING DATE: **1 FEBRUARY** PRECEDING THE SESSION IN WHICH TEACHING WOULD BEGIN. YOU MUST ALSO OBTAIN **ALL** OF THE ABOVE SIGNATURES BEFORE YOU SUBMIT THE FORM.

On completion please return to the Dr Brian Harwood, Registrar.