MODULE TITLE	**Machine Learning**	**CREDIT VALUE**	**15**
MODULE CODE	**ECMM422**	**MODULE CONVENER**	**Dr Fabrizio Costa (Coordinator)**

DURATION: TERM	**1**	**2**	**3**
DURATION: WEEKS	**0**	**11**	**0**

Number of Students Taking Module (anticipated)	**50**

DESCRIPTION - summary of the module content

Machine learning has emerged mainly from computer science and artificial intelligence, and draws on methods from a variety of related subjects including statistics, applied mathematics and more specialized fields, such as pattern recognition and neural computation. Applications are, for example, image and speech analysis, medical imaging, bioinformatics and exploratory data analysis in natural science and engineering. This module will provide you with a thorough grounding in the theory and application of machine learning, pattern recognition, classification, categorisation, and concept acquisition. Hence, it is particularly suitable for Computer Science, Mathematics and Engineering students and any students with some experience in probability and programming.
PRE-REQUISITE MODULES ECM3420 or ECMM445

AIMS - intentions of the module

In this data-driven era, modern technologies are generating massive and high-dimensional datasets. This module aims to give you an understanding of computational methods used in modern data analysis.
In particular, this module aims to impart knowledge and understanding of machine learning methods from basic pattern-analysis methods to state-of-the-art research topics; to give you experience of data-modelling development in practical workshops. Neural Networks, Bayesian methods and kernel-based algorithms will be introduced for extracting knowledge from large data sets of patterns (data mining techniques) where it is important to have explicit rules governing machine learning and pattern recognition. Recent development of techniques and algorithms for big-data analysis will also be addressed.

INTENDED LEARNING OUTCOMES (ILOs) (see assessment section below for how ILOs will be assessed)

On successful completion of this module ***you should be able to***:

Module Specific Skills and Knowledge:
1. apply advanced and complex principles for statistical machine learning to various data analysis;
2. analyse novel pattern recognition and classification problems; establish statistical models for them and write software to solve them;
3. apply a range of supervised and unsupervised machine learning techniques to a wide range of real-life applications.
Discipline Specific Skills and Knowledge:
â€‹4. state the importance and difficulty of establishing a principled probabilistic model for pattern recognition;
5. apply a number of complex and advanced mathematical and numerical techniques to a wide range of problems and domains.
Personal and Key Transferable / Employment Skills and Knowledge:
6. identify the compromises and trade-offs which must be made when translating theory into practice;
7. critically read and report on research papers;
8. conduct small individual research projects.

SYLLABUS PLAN - summary of the structure and academic content of the module

- Introductory material: Practical motivation for machine learning, basic ideas of supervised and unsupervised learning, classification, regression;
- Describing data;
- Latent descriptions: k-means, maximum likelihood; mixture models; PCA; ICA;
- Unsupervised learning: Clustering; Locality Sensitive Hashing;
- Supervised models: k-nearest neighbours, linear and non-linear regression, linear discriminant analysis, logistic regression, SVM and maximum margin classifiers;
- Loss functions and maximum likelihood estimators;
- Bayesian learning & sampling;
- Neural nets and deep learning;
- Evaluation of performance, dataset balance;
- Ensemble methods: boosting, bagging, decision trees and random forests Metric learning;
- Markov decision processes: Reinforcement learning (Q-learning).

LEARNING AND TEACHING

LEARNING ACTIVITIES AND TEACHING METHODS (given in hours of study time)

Scheduled Learning & Teaching Activities	30.00	**Guided Independent Study**	120.00	**Placement / Study Abroad**	0.00

DETAILS OF LEARNING ACTIVITIES AND TEACHING METHODS

Category	Hours of study time	Description
Scheduled Learning & Teaching activities	22	Lectures
Scheduled Learning & Teaching activities	8	Workshop/tutorials
Guided independent study	50	Project and coursework
Guided independent study	70	Guided independent study (50 wider reading + 20 workshop preparation)

ASSESSMENT

FORMATIVE ASSESSMENT - for feedback and development purposes; does not count towards module grade

Form of Assessment	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Weekly workshops	8 hours	All	In workshop

SUMMATIVE ASSESSMENT (% of credit)

Coursework	100	**Written Exams**	0	**Practical Exams**	0

DETAILS OF SUMMATIVE ASSESSMENT

Form of Assessment	% of Credit	Size of Assessment (e.g. duration/length)	ILOs Assessed	Feedback Method
Coursework 1	40	20 hours	All	Written
Coursework 2	60	30 hours	All	Written

DETAILS OF RE-ASSESSMENT (where required by referral or deferral)

Original Form of Assessment	Form of Re-assessment	ILOs Re-assessed	Time Scale for Re-assessment
All	Coursework (100%)	All	Completed over the Summer with a deadline in August

RE-ASSESSMENT NOTES

RESOURCES

INDICATIVE LEARNING RESOURCES - The following list is offered as an indication of the type & level of information that you are expected to consult. Further guidance will be provided by the Module Convener

Basic reading:

ELE: http://vle.exeter.ac.uk/

Web based and Electronic Resources:

Other Resources:

Reading list for this module:

Type	Author	Title	Edition	Publisher	Year	ISBN	Search
Set	Shawe-Taylor, J. and Cristianini, N.	Kernel methods for pattern analysis		Cambridge University Press	2006	521813972	[Library]
Set	Christopher Bishop	Pattern Recognition and Machine Learning		Springer	2007	978-0387310732	[Library]
Set	Webb, A.	Statistical Pattern Recognition	2	Wiley	2002	0-470-84513-9	[Library]
Set	Murphy, K.	Machine Learning: A Probabilistic Perspective	1st	MIT Press	2012	978-0-262-018029	[Library]
Set	Hastie, T., Tibshirani, R. & Friedman, J.	The Elements of Statistical Learning: Data Mining, Inference, and Prediction	2nd	Springer	2009	978-0387848570	[Library]
Set	David Barber	Bayesian Reasoning and Machine Learning		Cambridge University Press	2012	978-0-521-51814-7	[Library]

CREDIT VALUE	15	**ECTS VALUE**	7.5
PRE-REQUISITE MODULES	ECM3420, ECMM445		
CO-REQUISITE MODULES			
NQF LEVEL (FHEQ)	7	**AVAILABLE AS DISTANCE LEARNING**	No
ORIGIN DATE	Tuesday 10 July 2018	**LAST REVISION DATE**	Tuesday 06 October 2020
KEY WORDS SEARCH	None Defined		