



## Module Specification

Key Information			
Module title	Machine Learning and Neural Networks		
Level	6	Credit value	15
Member Institution	Goldsmiths	Notional study hours and duration of module	150
Module lead author/ Subject matter expert	Mihalis Niccolou		
Module co-author			

Rationale for the module
Machine learning and neural networks provide means for computer systems to extract useful information out of data. These techniques are widely used in the technology industry for a variety of applications, for example, recommending music and other products to people, identifying faces in photos and predicting trends in financial markets. This module builds upon previous machine learning content in the syllabus, providing you with a deeper understanding and a more powerful toolkit, including coverage of deep neural networks.

Aims of the module
This module provides a broad view of machine learning and neural networks. You will learn how to solve common machine learning problems such as regression, classification, clustering, matrix completion and pattern recognition. You will learn about neural networks and how they can be trained and optimised, including an exploration of deep neural networks. You will learn about machine learning and neural network software libraries that allow you to develop machine learning systems rapidly, and you will learn how to verify and evaluate the results.

## Topics covered in this module:

The topics listed here are an approximation of what will be covered. The topics presented may be slightly revised to ensure currency and relevance. Students will be advised of any changes in advance of their study.

1. Regression and classification
2. Features and distances
3. Supervised clustering
4. Evaluation: accuracy, precision, recall and cross validation
5. Dimensional reduction: principal component analysis
6. Matrix completion
7. Unsupervised clustering
8. Multi layer perceptrons and back propagation
9. Network optimisers
10. Deep and recurrent networks

Approximately 10-12 hours of study will be required per topic. The remaining study time is intended for coursework and examination preparation.

## Learning outcomes for the module

Students who successfully complete this module will be able to:

1. Explain and compare fundamental machine learning concepts and implement machine learning algorithms as working software
2. Analyse the difference between machine learning problems (e.g. supervised/unsupervised, classification/regression, clustering/dimensionality reduction)
3. Select and justify appropriate feature representations for different types of data
4. Describe the essential components and training methods of a neural network and how they can be combined to form moderately complex learning architectures
5. Select and apply standard machine learning methods on data to solve common machine learning problems such as classification, regression and dimensionality reduction

## Assessment strategy, assessment methods

### Summative and Formative Assessments

The module will contain a range of summative and formative assessments. Summative assessments are assessments which contribute directly towards your final grade. Formative assessments do not count directly towards your final grade. Instead, they provide you with opportunities for low stakes practice, and will often provide some sort of feedback about your progress. For example, a practice quiz might provide you with feedback about why a particular answer was wrong.

### Assessment Activities

The table below lists the assessment activity types you might encounter taking the module. It also states if that type of assessment can be automatically graded. For example, multiple choice quizzes can be automatically graded, and so can some programming assignments. It also states if that type of assessment will be found in the summative coursework and the summative examination. More details about the summative assessments are provided below.

Assessment activity type	Can it be automatically graded with feedback in some cases?	Coursework	Examination
Quiz	X	X	X
Writing task		X	X
Programming task	X	X	X
Simulation task	X	X	

### Pass Mark

In order to pass this module, you must achieve at least 35% in each element of summative assessment and an overall weighted average of 40%, subject to the application of rules for compensation. Please refer to the programme regulations for more information.

### Summative Assessment Elements

As this is a module that has a significant amount of theory it is assessed as a theory-based module. This means that the summative assessment is composed of two elements, whose weightings are listed in the table below.

Summative Assessment Component	Percentage of final credit	Deadline
Coursework	50%	Mid session
Examination	50%	End of session

The coursework comprises a variety of practical exercises and quizzes which in total will take up to 25 hours of study time to complete. The examination will be two hours long, and consist of written answer and multiple choice questions.

## Learning resources

The module will draw on a number of different, largely web-based, public resources as well as the resources produced as bespoke material for this module. The standard text book(s) for the module will be:

Christopher Bishop. *Pattern Recognition and Machine Learning*. Springer Verlag. 2007

Kevin Murphy. *Machine Learning: a Probabilistic Perspective*. The MIT Press.2012

Haykin, Simon. *Neural Networks. A Comprehensive Foundation*. PrenticeHall. 1999