# CS342-15 Machine Learning

## 22/23

**Department**
Computer Science
**Level**
Undergraduate Level 3
**Module leader**
Victor Sanchez
**Credit value**
15
**Module duration**
10 weeks
**Assessment**
Multiple
**Study location**
University of Warwick main campus, Coventry

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## Description

## Introductory description

This module aims to provide students with an in-depth introduction to two main- areas of Machine Learning: supervised and unsupervised

## Module aims

It will cover some of the main models and algorithms for regression, classification, clustering and probabilistic classification. Topics such as linear and logistic regression, regularisation, probabilistic (Bayesian) inference, SVMs and neural networks, clustering and dimensionality reduction. The module will use primarily the Python programming language and assumes familiarity with linear algebra, probability theory, and programming in Python.

## Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Intro to Supervised/Unsupervised Learning

- `Decision Trees`

- Linear regression: OLS, regularization, linear classifiers
- Logistic Regression, Multi-class logistic regression Ranking Support Vector Machines
- Feature selection latent factor models (PCA)
- Clustering (k-means, soft k-means)
- Ensemble methods such as Random Forest and Ada Boost
- Probabilistic methods (Bayesian view)
- Model evaluation and model selection
- Introduction to neural networks and convolutional neural networks
- Autoencoders

## Learning outcomes

By the end of the module, students should be able to:

- Develop an appreciation for what is involved in Learning models from data
- Understand a wide variety of learning algorithms
- Understand how to evaluate models generated from data
- Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models

## Indicative reading list

- Mitchell T, Machine Learning, McGraw-Hill, 1997
- S. Rogers and M. Girolami, A first course in Machine Learning, CRC Press, 2011
- C. Bishop, Pattern Recognition and Machine Learning, 2007
- D. Barber, Bayesian Reasoning and Machine Learning, 2012
- Duda, Hart and Stork, Pattern Classification, Wiley-Interscience.

## Subject specific skills

Understand the concept of learning in computer and science.
Understand the difference between supervised and unsupervised learning.
Understand the difference between machine lea ring and deep learning.
Design and evaluate machine and deep learning algorithms.

## Transferable skills

Mathematical analysis of learning methods.
Evaluation of algorithms.
Programming skills in python.

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## Study

## Study time

| Type | Required |
|---|---|
| Lectures | 30 sessions of 1 hour (20%) |
| Practical classes | 8 sessions of 1 hour (5%) |
| Private study | 112 hours (75%) |
| Total | 150 hours |

## Private study description

Background reading on statistics and probability.
Reading of supplemental material to reinforce the concepts covered in class.
Revision of concepts covered in class.

## Costs

No further costs have been identified for this module.

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## Assessment

You do not need to pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

### Assessment group D3

| | Weighting | Study time | Eligible for self-certification |
|---|---|---|---|
| Individual practical assignment | 40% | | No |
| Individual practical assignment. This assignment is worth more than 3 CATS and is not, therefore, eligible for self-certification. | | | |
| In-person Examination<br>CS342 Exam | 60% | | No |

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- Answers provided on Question Paper. No Answerbook required
- Students may use a calculator

### Assessment group R2

| | Weighting | Study time | Eligible for self-certification |
|---|---|---|---|
| In-person Examination - Resit<br>CS342 resit examination | 100% | | No |

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| | Weighting | Study time | Eligible for self-certification |
|---|---|---|---|

- Answerbook Pink (12 page)
- Students may use a calculator

### Feedback on assessment

Feedback via Tabula for coursework

Past exam papers for CS342

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## Availability

### Pre-requisites

Students must have studied CS130 and CS131 OR CS136 and CS137 or be able to show that they have studied equivalent relevant content.

## Courses

This module is Optional for:

- Year 3 of UCSA-G4G1 Undergraduate Discrete Mathematics
- Year 3 of UCSA-G4G3 Undergraduate Discrete Mathematics
- Year 4 of UCSA-G4G4 Undergraduate Discrete Mathematics (with Intercalated Year)
- Year 4 of UCSA-G4G2 Undergraduate Discrete Mathematics with Intercalated Year
- USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
    - Year 3 of G1G3 Mathematics and Statistics (BSc MMathStat)
    - Year 4 of G1G3 Mathematics and Statistics (BSc MMathStat)
- USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
    - Year 4 of G1G4 Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
    - Year 5 of G1G4 Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)

This module is Option list A for:

- Year 4 of UCSA-G504 MEng Computer Science (with intercalated year)
- Year 3 of UCSA-G500 Undergraduate Computer Science
- Year 4 of UCSA-G502 Undergraduate Computer Science (with Intercalated Year)
- UCSA-G503 Undergraduate Computer Science MEng
    - Year 3 of G500 Computer Science
    - Year 3 of G503 Computer Science MEng
- Year 3 of UCSA-G406 Undergraduate Computer Systems Engineering
- Year 3 of UCSA-G408 Undergraduate Computer Systems Engineering
- Year 4 of UCSA-G407 Undergraduate Computer Systems Engineering (with Intercalated

Year)
- Year 4 of UCSA-G409 Undergraduate Computer Systems Engineering (with Intercalated Year)
- Year 3 of USTA-G302 Undergraduate Data Science
- Year 3 of USTA-G304 Undergraduate Data Science (MSci)
- Year 4 of USTA-G303 Undergraduate Data Science (with Intercalated Year)

This module is Option list B for:

- Year 3 of USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
- Year 4 of USTA-GG17 Undergraduate Mathematics and Statistics (with Intercalated Year)