

Module specification

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Module Code	COM763
Module Title	Advanced Machine Learning
Level	7
Credit value	20
Faculty	FACE
HECoS Code	100992
Cost Code	GACP
Pre-requisite module	N/A

Programmes in which module to be offered

Programme title	Core/Optional/Standalone
MSc Computer Science	Core
MSc Computer Science with Advanced Practice	Core
MSc Cybersecurity	Core
MSc Cybersecurity with Advanced Practice	Core
MSc Data Science and Big Data Analytics	Core
MSc Data Science and Big Data Analytics with Advanced Practice	Core
MSc Artificial Intelligence	Core

Breakdown of module hours

Learning and teaching hours	10 hrs
Placement tutor support hours	0 hrs
Supervised learning hours e.g. practical classes, workshops	11 hrs
Project supervision hours	0 hrs
Active learning and teaching hours total	21 hrs
Placement hours	0 hrs
Guided independent study hours	179 hrs
Module duration (Total hours)	200 hrs

Module aims

This module introduces students to the practical challenges of applying machine learning techniques to real-world problems. Building on their existing programming knowledge, students will gain a broad understanding of the key concepts, methodology and techniques required to



develop effective algorithms to analyse large data sets. This will be combined with the analysis techniques required to compare, select and justify the use of appropriate machine learning methods whilst developing programmed solutions.

Module Learning Outcomes

At the end of this module, students will be able to:

1	Critically analyse real-world problems to relate them to contemporary and emerging machine learning methods and theories.
2	Analyse machine learning algorithm and key concepts.
3	Implement machine learning methods using current industry tools, including tracing and debugging.
4	Evaluate and compare different machine learning methods for a given problem experimentally and select the appropriate methods using various assessment criteria.
5	Disseminate the results of machine learning methods and critically propose appropriate improvements.

Assessment

Indicative Assessment Tasks:

This section outlines the type of assessment task the student will be expected to complete as part of the module. More details will be made available in the relevant academic year module handbook.

The assignments will be designed to evaluate and compare a range of machine-learning methods to solve various real-world problems. Students need to analyse and interpret a range of problems and critically evaluate and compare the machine learning algorithms used in the solutions. Students will submit a written report that evaluates different algorithms to begin with, and ended with a report that critically proposed the appropriate improvements to the method.

Assessment number	Learning Outcomes to be met	Type of assessment	Duration/Word Count	Weighting (%)	Alternative assessment, if applicable
1	1,2,3,4,5	Portfolio	5000 Words or Equivalent	100%	

Derogations

Not Applicable



Learning and Teaching Strategies

In line with the Active Learning Framework, this module will be blended digitally with both a VLE and online community. Content will be available for students to access synchronously and asynchronously and may indicatively include first and third-party tutorials and videos, supporting files, online activities any additional content that supports their learning. As this module progresses, the strategies will change to best support a diverse learning environment. Initially, the module will start with a heavier reliance on engaging tutor-led lectures, demonstrations, and workshops to ensure that the students get the relevant threshold concepts. As the module continues experiential and peer learning strategies will be encouraged as the students' progress with their portfolio work. Assessment will occur throughout the module to build student confidence and self-efficacy in relation to the application of machine learning algorithms and key concepts.

Welsh Elements

This module is designed to support Welsh-speaking students in line with the Welsh Language Standards. While the primary delivery will be in English, students will have the opportunity to submit assessments, including coursework and projects, in Welsh if preferred. Relevant module materials, such as reading lists, key texts, and guidance, will be available bilingually upon request, ensuring accessibility for all students. Additionally, where possible, guest speakers, case studies, or examples may include references to the Welsh business context, especially in areas such as data use in local industries and Welsh public sector organisations.

The department encourages students to develop bilingual digital skills by incorporating Welsh-language datasets, tools, and resources where appropriate, offering an inclusive learning environment. We also support the development of bilingual visualisation techniques, enabling students to create digital outputs that reflect the Welsh language, should they wish to do so.

Indicative Syllabus Outline

Types of Machine Learning

- Supervised
- Unsupervised
- Reinforcement learning

Challenges of Machine Learning

- Overfitting and underfitting
- Data preprocessing and feature selection

Classification and Training Models

Machine Learning Algorithms

- Support Vector Machines (SVMs)
- Decision trees
- Ensemble learning
- Random forests



- Dimensionality reduction

Unsupervised Learning Techniques

- Clustering algorithms, including:
 - K-means
 - Hierarchical clustering
 - DBSCAN
- Anomaly detection and outlier analysis

Neural Networks

- Feedforward networks and backpropagation algorithms
- Deep learning architectures, such as:
 - Convolutional Neural Networks (CNNs)
 - Recurrent Neural Networks (RNNs)

Natural Language Processing (NLP)

- Text preprocessing, tokenization, and sentiment analysis
- Named Entity Recognition (NER) and topic modelling

Reinforcement Learning

- Markov Decision Processes (MDPs) and Q-learning
- Exploration vs. exploitation trade-off and policy optimisation

Indicative Bibliography

Please note the essential reads and other indicative reading are subject to annual review and update.

Essential Reads:

- Geron, Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems. O'Reilly. 2019

Other indicative reading:

- E. Alpaydin, Introduction to machine learning. 3rd ed. MIT press. 2014.
- J. Bell, Machine Learning: Hands on for Developers and Technical Professionals. John Wiley & Sons Press. 2015.
- Burkov A. The Hundred-page Machine Learning Book. Self-published. 2019.

Administrative Information

For office use only	
Initial approval date	08/11/2023
With effect from date	Sept 2026
Date and details of revision	March 26 Addition of MSc Artificial Intelligence programme title
Version number	2

