Prifysgol Wrecsam
Wrexham University

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

Programmes in which module to be offered

Programme title	Is the module core or option for this programme
MSc Computer Science	Core
MSc Computer Science with Advanced Practice	Core
MSc Software Engineering	Core
MSc Software Engineering with Advanced Practice	Core
MSc Cyber Security	Core
MSc Cyber Security with Advanced Practice	Core
MSc Data Science and Big Data Analytics	Core
MSc Data Science and Big Data Analytics with Advanced Practice	Core
MSc Computer Science	Core

Pre-requisites

N/A

Breakdown of module hours

Learning and teaching hours	11 hrs
Placement tutor support	0 hrs
Supervised learning e.g. practical classes, workshops	10 hrs
Project supervision (level 6 projects and dissertation modules only)	0 hrs
Total active learning and teaching hours	**21** hrs
Placement / work based learning	0 hrs
Guided independent study	179 hrs
Module duration (total hours)	**200** hrs

For office use only	
Initial approval date	08/11/2023
With effect from date	Sept 2024
Date and details of revision	
Version number	1

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	Weighting (%)
1	1,2,3,4,5	Portfolio	100%

Derogations

None

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.

Indicative Syllabus Outline

- Types of machines learning
  - Supervised
  - Unsupervised
  - Reinforcement learning
- Challenges of machine learning
  - Overfitting and underfitting.
  - Data preprocessing and feature selection.
- Classification and Training models
- Support vector machines, decision trees, ensemble learning, random forests and dimensionality reduction
- Unsupervised learning techniques
  - Clustering algorithms, including K-means, hierarchical clustering, and DBSCAN.
  - Anomaly detection and outlier analysis.
- Neural networks
  - Feedforward and backpropagation algorithms.
  - Deep learning architectures, such as convolutional neural networks (CNNs) and recurrent neural networks (RNNs).
- Natural language processing
  - 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 optimization.

Indicative Bibliography:

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

Essential Reads

A. 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.

A. Burkov A. *The Hundred-page Machine Learning Book.* Self-published. 2019.