Module Specification

Advanced Machine Learning

Version: 2025-26, v1.0, Approved

Contents

Part 1: Information

Module title: Advanced Machine Learning

Module code: UFCEKN-30-3

Level: Level 6

For implementation from: 2025-26

UWE credit rating: 30

ECTS credit rating: 15

College: College of Arts, Technology and Environment

School: CATE School of Computing and Creative Technologies

Partner institutions: None

Field: Computer Science and Creative Technologies

Module type: Module

Pre-requisites: None

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: In this module we will explore advanced machine learning techniques. We will learn about the architecture and applications of various deep learning models, including Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs), and Transformers. We will also cover reinforcement learning, natural language processing (NLP), and generative models. A focus on explainability, fairness in AI, and recent advancements will be included to ensure a

comprehensive understanding of contemporary challenges and innovations in the field.

Features: Not applicable

Educational aims: This module aims to deepen students' knowledge and confidence in advanced machine learning and deep learning methods. By engaging with contemporary techniques and using industry-standard toolkits, students will be prepared to apply these methods to real-world problems, ensuring an understanding of both theoretical concepts and practical applications.

Outline syllabus: An indicative syllabus is as follows:

Foundations of AI & Machine Learning:
- Overview of AI trends and essential tools.
- Recap of machine learning techniques.
- Key toolkits: scikit-learn, TensorFlow, PyTorch.

State-of-the-Art AI Models:
- Transformers and attention mechanisms.
- Large Language Models (LLMs): BERT, GPT.
- Diffusion models and their applications.

Generative AI Techniques:
- Overview of Generative Models: GANs, VAEs.
- Training and optimisation challenges in Generative AI.
- Applications: Data augmentation, image and text generation, simulation.
- Latest developments in GenAI: Diffusion models, LLMs.

Explainability & Ethics in AI:
- Model interpretability: SHAP, LIME.
- Addressing bias, fairness metrics, ethical considerations.

Practical Applications & Case Studies:
- Industry use cases and project-based learning.

Part 3: Teaching and learning methods

Teaching and learning methods: The delivery will comprise lectures, computer practicals and classroom workshops. Emphasis will be on the choice of analysis and on the interpretation and communication of results.

Typically the scheduled teaching hours take the form of:
Whole group lectures, used to deliver new material.
Computer labs where consolidation of previous material via the use of relevant software, and through the completion of analysis templates.

Lectorials to deliver new and supplementary materials via group working.

Module Learning outcomes: On successful completion of this module students will achieve the following learning outcomes.

MO1 Design and Implement Advanced Deep Learning Models such as CNNs, RNNs, and Transformers to various data types and problems as well as utilize advanced techniques such as GANs and VAEs for generating new data.

MO2 Use word embeddings, sequence-to-sequence models, and attention mechanisms for processing and understanding natural language and Apply state-of-the-art NLP models for tasks such as text classification and machine translation.

MO3 Understand and apply GANs and VAEs for generating new data and simulating complex distributions and use generative models in practical scenarios such as data augmentation.

MO4 Explore emerging trends like self-supervised learning, few-shot learning, and large language models and assess recent advancements and their implications for future research and applications.

Hours to be allocated: 300

Contact hours:

Independent study/self-guided study = 228 hours

Face-to-face learning = 72 hours

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://rl.talis.com/3/uwe/lists/D2CC39B0-0C50-3496-8215-B72930ED592A.html?lang=en-GB&login=1

Part 4: Assessment

Assessment strategy: Students will work individually on an AI project that focuses on advanced AI models, such as Transformers, Generative Models (e.g., GANs, VAEs), or Diffusion Models. The project should integrate technical, practical, and ethical considerations.

Key Components:
Project Proposal: A brief outline of the project idea, including the problem statement, planned AI techniques, and the scope of the project.

Implementation & Code: Implementing the chosen AI models, demonstrating training, optimisation, and evaluation of their models. The code should be functional, well-documented, and reproducible using industry-standard tools such as TensorFlow, PyTorch, etc.

Project Report: A detailed report explaining the problem, methodology, model selection, and results. It should also include reflection on the project's challenges and solutions. Ethical considerations should be covered, such as model fairness, biases, and interpretability.

The resit assessment strategy will be the same as for the first sit.

Assessment tasks:

Project (First Sit)

Description: Individual project assignment (2000 - 3000 Words)
Weighting: 100 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4

Project (Resit)
Description: Individual project assignment (2000 - 3000 Words)
Weighting: 100 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Data Science and Artificial Intelligence {Top-Up} [Frenchay] BSc (Hons) 2025-26