Module Specification

Advanced Artificial Intelligence

Version: 2023-24, v3.0, 22 Jan 2024

Contents

Part 1: Information

Module title: Advanced Artificial Intelligence

Module code: UFCFUR-15-3

Level: Level 6

For implementation from: 2023-24

UWE credit rating: 15

ECTS credit rating: 7.5

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: Artificial Intelligence II 2022-23, Machine Learning 2022-23

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: This module will introduce you to the latest thinking in addressing key concerns that frequently occur when creating AI-based solutions to real-world problems.

Features: Not applicable

Educational aims: This module aims at consolidating all knowledge on Artificial Intelligence acquired during the previous two years of study. Emphasis will be on the

assessment of the most suitable technics and methodologies to be utilised in achieving appropriate applications that will provide effective and efficient solutions to complex problem situations. The selected methodologies will then be applied to demonstrate the accuracy of the assessment and design of the solutions and allow for further analysis and evaluation of the strengths of the tools utilised.

Outline syllabus: As befits a fast moving field, the syllabus will be adapted to reflect advances, but will typically cover topics such as:

Learning and Search in large, noisy, constrained, and non-stationary environments, for example some of

'Divide-and-conquer' approaches (including co-evolutionary)

Different Sources of uncertainty and how to deal with them

Advanced optimisation algorithms: CMA-ES, PSO, DE

Multi- and Many objective optimisation,

Interactive AI: working with people

Automated Meta-parameter tuning in optimisation and ML

Learning with an absence of data/ costly evaluations, for example some of:

Active / Transfer Learning

Data augmentation for supervised ML: How do you choose valid transforms (e.g. reflection/rotation/translatation of images, type of noise to add to sensor readings) and relate them to problem statement and requirements

Surrogate model-assisted optimisation & "Active" machine learning

 Choosing what to evaluate (optimisation)/ ask user to label (ML)

How do you evaluate accuracy and robustness of solutions?

"one-shot" learning

e.g. exemplar SVMs, Control-Monitoring architectures,

Incorporating user constraints & preferences within interactive AI

Recommender systems (collaborative vs content based filtering, latent matrix factorisation etc)

Reinforcement learning in Deep Neural Networks

Adversarial networks/ generative systems

Part 3: Teaching and learning methods

Teaching and learning methods: Each topic will be introduced by lectures and guided reading, illustrated by examples of (i) how it occurs in a context familiar to students then (ii) expanded showing how we have tackled the issues in real-world collaborative research projects.   Where appropriate this will be supplemented by talks from industry speakers.

Interwoven throughout each of these topics and their learning opportunities are three assumptions:

(i) Most real world systems will be hybrid in form, blending optimisation, machine learning and (possibly) symbolic reasoning (esp. wrt interactive AI).

(ii) Most domains require documentation of critically informed design decisions and algorithm selection based on relating strengths/weaknesses of different approaches to problem characteristics.

(iii) All real-world applications of AI require the designer to be fully aware of ethical and security implications, and to be able to document their risk analysis and use of appropriate mitigating strategies.

A series of tutorial/lab tasks will provide students with the opportunity to work in groups, designing, implementing evaluating, and documenting solutions to complex problems. These will also form the basis of the module assessment

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

> **MO1** Critically appraise competing AI-based paradigms and algorithms in the context of the issues posed by particular problems

> **MO2** Select and tune appropriate state of the art machine learning   and optimisation algorithms to realistic sized problems illustrating properties such as scale, noise, missing data.

> **MO3** Synthesise, design, and implement appropriate hybrid systems blending different paradigms for complex problems.

> **MO4** Demonstrate skills in evaluating systems and presenting findings in ways appropriate to different audiences.

Hours to be allocated: 150

Contact hours:

Independent study/self-guided study = 114 hours

Face-to-face learning = 36 hours

Total = 150

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://uwe.rl.talis.com/lists/274A371A-686E-B1A0-0D67-172619FBD2A6.html

Part 4: Assessment

Assessment strategy: Students will work in small groups to design, implement and document an AI-based solution to a complex task with 'difficult' characteristics such as time complexity, limited data, or uncertainty in one or more forms.

Assessment will consist of a portfolio the sum of which will demonstrate the development and communication of one or more AI-based solutions to complex problem(s). The problem(s) chosen will exhibit 'difficult' (from an AI-perspective) characteristics.

The portfolio will include a critical review of:

Challenges presented by the problem characteristics,

Candidate approaches considered,

The design and implementation of the chosen (possibly hybrid) system,

The choice of metrics used to evaluate the proposed solution,

The performance of their chosen system.

The resit will take the same form as the first sit assignment. In the event that the group size is necessarily smaller than at first sit, the scale and complexity of the chosen problems will be appropriately scaled.

Assessment tasks:

Portfolio (First Sit)

Description: A series of outputs demonstrating the documentation, implementation and communication of AI-based solution(s) to complex problems exhibiting various 'difficult' characteristics.

Weighting: 100 %

Final assessment: No

Group work: Yes

Learning outcomes tested: MO1, MO2, MO3, MO4

Portfolio (Resit)

Description: A series of outputs demonstrating the documentation, implementation and communication of AI-based solution(s) to complex problems exhibiting various 'difficult' characteristics.

Weighting: 100 %

Final assessment: Yes

Group work: Yes

Learning outcomes tested: MO1, MO2, MO3, MO4

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Computer Science [Sep][FT][Frenchay][3yrs] BSc (Hons) 2021-22

Computer Science [Sep][FT][Villa][3yrs] BSc (Hons) 2021-22

Computer Science [Jan][FT][Villa][3yrs] BSc (Hons) 2021-22

Computer Science [May][FT][Villa][3yrs] BSc (Hons) 2021-22

Computer Science {Foundation}[Sep][FT][Frenchay][4yrs] BSc (Hons) 2020-21

Computer Science [Sep][SW][Frenchay][4yrs] BSc (Hons) 2020-21