Module Specification

Introductory Artificial Intelligence for Robotics

Version: 2023-24, v2.0, 13 Mar 2023

Contents

Part 1: Information

Module title: Introductory Artificial Intelligence for Robotics

Module code: UFCFE3-15-1

Level: Level 4

For implementation from: 2023-24

UWE credit rating: 15

ECTS credit rating: 7.5

Faculty: Faculty of Environment & Technology

Department: FET Dept of Computer Sci & Creative Tech

Partner institutions: None

Field: Computer Science and Creative Technologies

Module type: Module

Pre-requisites: None

Excluded combinations: Introduction to Artificial Intelligence 2023-24

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: Not applicable

Features: Not applicable

Educational aims: In addition to the learning outcomes, the educational experience may explore, develop, and practise but not formally discretely assess the following:

Working as a team member

IT skills in context, in particular e-learning tools
Presentation skills

Outline syllabus: 1. Introduction to Artificial Intelligence:

What do we mean by Artificial Intelligence: the Turing/Searle debate; “strong vs. weak” Artificial Intelligence; Symbolic Processing vs. Computational Intelligence.
The “Black-Box” model of computer systems, and problem solving as search.
Problem types and decomposition: Pattern recognition, modelling and prediction, action selection, planning, optimisation, simulation.
Hybrid systems, and the need for an appropriate choice of paradigms for different parts of a decomposed problem.
Some key technologies for different types of models e.g. Rule-sets, decision trees, multi-layer perceptrons.
Perspective of computers as Finite State Machines, state-based and hierarchical architectures for robots/agents, and their relationship to planning.

2.Search as a metaphor for learning:

Search landscapes, idea that search could be either through complete solutions, or constructive in nature. Combinatorial explosion, and Global/local search heuristics.
Single member uninformed search strategies (depth/ breadth-first) and their relationship to Computer Science concepts such as queues and stacks.
Design of heuristic quality functions. Single member search (branch-and-bound, best-first, A*). Single member heuristic-based search (hillclimbers), illustrated for combinatorial (e.g. rule-set induction) and continuous (e.g. ANN weights) problems.
Population-based search exemplified by: Genetic Algorithm for combinatorial optimisation, Evolution Strategy for continuous domain (optimisation or models e.g. weights of ANN); Ant Colony for populationbased constructive search; Genetic programming and Pittsburgh Learning Classifier System to evolve models (decision trees and rule sets respectively) and boids/flocking algorithms for simulation.

Part 3: Teaching and learning methods

Teaching and learning methods: Module contact time consists of 12 hours of lectures to introduce material and 18 hours of tutorials involving group-work, paper-based and practical exercises. 6 hours of seminars spread throughout the module according to progress of group research and availability of guest speakers, giving a total scheduled contact time of 36 hours.

In addition, over the course of the academic year students should expect to spend approximately (in hours):
Contact time: 36
Assimilation and development of knowledge: 74
Exam preparation: 20
Coursework preparation: 20
Total study time: 150

Each numbered section of the syllabus, as detailed above, represent equal amounts of teaching.

Scheduled Learning

Materials will be introduced via lectures. Tutorials will use a mixture of group-work and individual activities to ground the materials covered in the lectures. Activities will cover a range of paper-based and practical exercises. The latter will illustrate various topics within the context of developing an AI application for a game-playing scenario.

Seminars will highlight recent research and present case studies from real-life applications to illustrate the theoretical subjects covered. As the module progresses, students will be expected to participate in group research and presentations of selected topics during these seminars.

Independent Learning

Students will be expected to learn independently by carrying out reading and directed study outside taught classes. Therefore additional materials, group

activities, discussion exercises and individual practical experience of implementing and using Artificial Intelligence solutions will be delivered via Blackboard. In addition to the tutorials, formative assessment will be provided via weekly selfassessment tests delivered via Blackboard and available throughout the course. One assessed pieces of coursework will be delivered in the form of a task which the students should complete independently and then report their findings via a Blackboard test.

Students should expect to spend around 4 hours per week on this self-directed learning, and coursework.

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

MO1 Identify different types of problem (optimisation, modelling, simulation), and state-based models.

MO2 Explain the concept of learning as search, and illustrate different individual and population-based search methods

MO3 Formulate appropriate representations of problems and associated knowledge

MO4 Use criteria to discriminate, select and apply appropriate paradigms

MO5 Design and implement a range of different search methods

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/modules/ufcfe3-15-1.html

Part 4: Assessment

Assessment strategy: The learning outcomes will be formally assessed in two ways.

An end-of-module examination in controlled conditions will assess knowledge and understanding of the materials covered. This will be of 120 minutes duration, typically conducted as a Blackboard test so that feedback can be easily and automatically provided.

A piece of coursework will be used to assess the student's abilities to apply the technologies they have studied to solving problems. Students will be given a problem to solve, and tested on their solutions, alongside their understanding of, and the appropriateness of the techniques utilised. Typically these will be delivered in the form of Blackboard tests to facilitate the provision of prompt and personalised feedback.

Weekly self-assessments tests on Blackboard will provide the students with opportunities to check their understanding of materials and receive detailed feedback.

Assessment tasks:

Examination (First Sit)
Description: Examination (2 hours)
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4

Set Exercise (First Sit)
Description: Coursework requiring application of AI technologies in order to solve problems
Weighting: 50 %
Final assessment: No

Group work: No
Learning outcomes tested: MO5

Examination (Resit)
Description: Examination (2 hours)
Weighting: 50 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4

Set Exercise (Resit)
Description: Coursework requiring application of AI technologies in order to solve problems
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO5

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Automation and Robotics Engineering {Foundation} [GCET] BEng (Hons) 2022-23