Module Specification

Foundations of AI [TSI]

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Contents

Part 1: Information

Module title: Foundations of AI [TSI]

Module code: UFCE7U-12-1

Level: Level 4

For implementation from: 2023-24

UWE credit rating: 12

ECTS credit rating: 6

College: College of Arts, Technology and Environment

School: CATE School of Computing and Creative Technologies

Partner institutions: Transport and Telecommunication Institute

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: This module will introduce students to the fundamental concepts of modern Artificial Intelligent based systems, the underpinning paradigms, and the ethical and wider context within which they operate.

Features: Not applicable

Educational aims: This module aims to give the students underpinning knowledge and skills in AI techniques and the vocabulary used to describe them. It also aims to promote a consideration of the ethical issues that arise from their use.

Outline syllabus: 1. Introduction to Artificial Intelligence:

What 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 perceptron’s.
Perspective of computers as Finite State Machines, statebased 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 (hill-climbers) 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 population-based constructive search; Genetic programming and Pittsburgh Learning Classifier System to evolve models (decision trees and rule sets respectively) and boids/flocking algorithms for simulation.

3. Symbolic Knowledge Representation:

Knowledge and meta-knowledge; production rules; logic systems; problems of knowledge acquisition. Logic and its limitations:
Logic database (statements, facts, assertions, variables and rules); inference mechanism (search strategy, backtracking); deduction and abduction.
Structure of rule-based systems. Expert systems. Domain of symbolic processing and search techniques: notion of well-defined problems; state-space graphs and trees.
Modern symbolic approaches exemplified by Semantic Web.

4. Alternative forms of Knowledge Representation:

Fuzzy and Probabilistic reasoning: Fuzzy sets, hedges, fuzzy
inference engines. Naïve Bayesian Networks.
Sub-symbolic: exemplified by Natural and Artificial Neural Networks. Simulation of simple neuron-like structures; neuron as a simple computing element, pattern associator; emergent properties; perceptron's; multi-layer neural networks. Back propagation and evolution as alternative learning mechanisms.
Implicit knowledge representation exemplified by instance-based learning (Nearest Neighbour), Case-Based reasoning and variants.

Part 3: Teaching and learning methods

Teaching and learning methods: 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.

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 associated state-based models

MO2 Explain the concept of learning as a search process. Apply through examples different search methods used in individual and population-based learning.

MO3 Identify the different paradigms for representing problems and knowledge (e.g. symbolic, fuzzy, probabilistic and sub-symbolic), and evaluate their main features and differences.

MO4 Design and implement intelligent solutions using at least two different architectures

Hours to be allocated: 120

Contact hours:

Independent study/self-guided study = 96 hours

Face-to-face learning = 64 hours

Total = 160

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/597809CD-3D3F-050E-ABF4-3135F1DB3287.html?lang=en-gb&login=1

Part 4: Assessment

Assessment strategy: There are two parts (Report and Presentation):

Students will complete a series of exercises within the class, they are required to produce a short report critically evaluating the performance and solution suitability for given scenarios.

In groups students will design and code an AI response to a given case study.

The resit will be a rework of the solutions.

Assessment tasks:

Report (First Sit)
Description: A critical evaluation of the outcomes of the labs, drawing conclusions on solution suitability for given problems (1500 words).
Weighting: 50 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4

Presentation (First Sit)
Description: Students will present their strategy, approach and solution to a given project (20 mins).
Weighting: 50 %
Final assessment: Yes
Group work: Yes
Learning outcomes tested: MO1, MO2, MO3

Report (Resit)
Description: A critical evaluation of the outcomes of the labs, drawing conclusions on solution suitability for given problems (1500 words).
Weighting: 50 %

Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO2, MO3, MO4

Presentation (Resit)
Description: Students will present their strategy, approach and solution to a given project (20 mins).
Weighting: 50 %
Final assessment: Yes
Group work: Yes
Learning outcomes tested: MO1, MO2, MO3

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Computer Science and Software Development {Double Degree} [Feb][PT][TSI][5yrs] BSc (Hons) 2021-22

Computer Science and Software Development {Double Degree} [Oct][PT][TSI][5yrs] BSc (Hons) 2021-22