Module Specification

Knowledge-based and Hybrid Systems

Version: 2023-24, v2.0, 27 Jul 2023

Contents

Part 1: Information

Module title: Knowledge-based and Hybrid Systems

Module code: UFCEN1-15-M

Level: Level 7

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: None

Co-requisites: AI for Search and Optimisation 2023-24, Machine Learning Algorithms 2023-24

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: This module will introduce you to the knowledge-based paradigm of Artificial Intelligence. You will gain an understanding of both deterministic and probabilistic approaches, their principles, characteristics and applications to real-world problems.

Putting together this understanding with experience of machine learning and

optimisation algorithms from prior modules , we will then cover how to decompose large problems into smaller tasks, select appropriate algorithms to solve the sub-tasks, and co-ordinate the outcomes of components within a hybrid architecture.

The module give you the opportunity to learn skills in how to select, apply and evaluate solutions involving a range of techniques using the state-of-the-art software tools.

Features: Not applicable

Educational aims: The module introduces students to the paradigm of knowledge-based systems and different forms of knowledge representation and logic.

It then covers the concept of decomposing a large problem into smaller parts and selecting appropriate forms of AI (for example, knowledge-based, machine learning or heuristic optimisation) to solve the sub-tasks.

The module places an emphasis on the practical applications of knowledge-based techniques, enabling students to gain hands-on experience in developing knowledge-based solutions to real-world problems.
The module also enables students to gain core competency in identifying, and formulating context-appropriate responses to, the ethical and societal concerns surrounding the construction and deployment of AI-based solutions

Outline syllabus: The first two weeks will be devoted to establishing core competency in contemporary tools and techniques for group-work management , and the use of key python libraries for producing data visualisations to communicate findings to a range of audiences.

Thereafter the module materials are broadly divided into four topics. Potential wider societal and ethical implications will be highlighted throughout the coverage of each topic.

1. Introduction:

The paradigm of Knowledge-based Systems as an approach to capturing human expertise about a problem and automatically reasoning with the embedded knowledge.

Knowledge and meta-knowledge (e.g., facts, rules, and ontologies).

Problems of knowledge acquisition.

Logic and its limitations:

inference mechanisms: forward/backward chaining, deduction and abduction.

2: Contemporary knowledge based systems such as expert systems, knowledge graphs, and the the semantic web.

3: Probabilistic approaches: Fuzzy Systems, Bayesian models.

4: Hybrid architectures combining different types of AI. Examples include finite state machines. and contemporary methods such as behaviour trees. This topic will also cover Knowledge-Based Agents and multi-agent systems

Part 3: Teaching and learning methods

Teaching and learning methods: Lectures will introduce the core concepts and algorithmic essences of each topic listed in the syllabus. Each topic will be explained and illustrated with intuitive examples, expanded with developing the practical solutions to the real-world problems.

Practical classes will provide supervised activities to cover different problem domains, with an emphasis on developing students' experience of working in small groups to build solutions to real-world problems using contemporary techniques.

A mixture of online resources (through the VLE) and scheduled sessions will provide

background and resources to help students develop their presentation, group-working and project-management skills.

Independent learning study hours include engaged with essential and exploratory reading, practical study, assignment preparation and completion etc.

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

MO1 Critically appraise the strengths and weaknesses knowledge-based paradigms of Artificial Intelligence and compare with other paradigms in the light of considerations such as ethical issues, scaleability and guarantees of correctness/optimality

MO2 Design and implement a knowledge-based approach to a given problem, justifying the methodology used in the light of organisational imperatives (such as correctness, reuse of existing knowledge and maintainability) and ethical and social implications of AI-based solutions such as privacy, fairness and accountability.

MO3 Critically analyse large complex problems, decomposing them into smaller sub-problems to be solved by AI algorithms from different paradigms, justifying the decomposition in terms of the sub-problem characteristics such as pre-existing knowledge, data availability, requirements of formal correctness, and ethical issues such as explainability.

MO4 Design and implement hybrid AI architectures to coordinate different approaches for sub-problems within a larger system, justifying the methodology chosen in terms of criteria such as: organisational imperatives (e.g. reusing existing knowledge and tools); legislative requirements (e.g. formal correctness and explainability); and context-specific requirements for balancing speed, accuracy, and resource management.

Hours to be allocated: 150

Contact hours:

Independent study/self-guided study = 126 hours

Face-to-face learning = 24 hours

Total = 150

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/44DEB312-D9A3-D8DA-3B66-87EB7C0DCC79.html?lang=en-GB

Part 4: Assessment

Assessment strategy: To build confidence, weekly lab-sessions, and end-of-topic 'reflection' sessions will provide the opportunity for informal feedback and discussions.
In addition, weekly formative self-assessments tests on Blackboard will let students check their understanding of materials and receive detailed feedback in their own time.

The learning outcomes will be formally assessed through a portfolio of materials created as part of a small group (typically 3-4).

For the portfolio deliverables, students will work in small groups bringing together the practical skills learned in the lab sessions to create elements of a hybrid solution to a problem - for example, an automated help-desk assistant. Alongside the software deliverables and evidence of how the software runs, they will work together to answer a broader set of questions about the organisational, ethical and societal concerns taken into consideration when designing and implementing knowledge-based systems.

The resit attempt will be assessed in the same way as the first attempt.

Assessment tasks:

Portfolio (First Sit)

Description: Group Coursework composed of a number of deliverables.

The exact number of deliverables may vary from year to year, but typically these will be:
Source code and answers to a set of questions concerning the development of a knowledge-based approach such as, for example, creating a chatbot for a help-desk application.
Evidence of how the system runs e.g. a pre-recorded demo.
Weighting: 100 %
Final assessment: Yes
Group work: Yes
Learning outcomes tested: MO1, MO2, MO3, MO4

Portfolio (Resit)
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Source code and answers to a set of questions concerning the development of a knowledge-based approach such as, for example, creating a chatbot for a help-desk application.
Evidence of how the system runs e.g. a pre-recorded demo.
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:

Artificial Intelligence [Frenchay] MSc 2023-24