Module Specification

Machine Learning Algorithms

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Contents

Part 1: Information

Module title: Machine Learning Algorithms

Module code: UFCEP1-30-M

Level: Level 7

For implementation from: 2022-23

UWE credit rating: 30

ECTS credit rating: 15

Faculty: Faculty of Environment & Technology

Department: FET Dept of Computer Sci & Creative Tech

Partner institutions: None

Delivery locations: Frenchay Campus

Field: Computer Science and Creative Technologies

Module type: Standard

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 you to to a range of contemporary machine learning techniques, their principles, characteristics and applications to real-world problems. It will give you the opportunity to learn skills in how to select, apply and evaluate solutions based on these techniques using the state-of-the-art software tools.

Features: Not applicable

Educational aims: The module introduces students to the paradigm of Machine Learning, and its sub-division into unsupervised, supervised, and reinforcement learning.
The module places an emphasis on the practical applications of Machine Learning techniques, enabling students to gain hands-on experience in developing machine learning 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 machine learning-based solutions

Outline syllabus: The first two weeks will be devoted to establishing core competency in coding, and the use of key python libraries for data manipulation such as pandas.
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 Machine Learning as an approach to automatically learn models from data.

Unsupervised Learning (clustering) for learning from unlabelled data:

algorithms such as k-Means, dbscan, top-down vs bottom-up clustering.

Reinforcement Learning for learning from periodic rewards:

principle of algorithms such as Q-learning, SARSA

Supervised learning for learning from labelled data.

Key technical issues in using ML techniques to solve real-world problems including:

the appropriate use of data for training and testing,

the realties of handling data: preprocessing, dealing with missing values and imbalanced classes.

Formulating application problems, involving various types of data and labels, for example, classification vs. regression vs time-sequence prediction. The implications for appropriate choices of algorithm and evaluation metrics.

2. A range of contemporary supervised learning approaches such as:

instance-based methods (e.g. k-Nearest Neighbours),

rule and decision tree induction,

kernel methods such as support vector machines.

3. Artificial Neural Networks:

perceptrons,

multi-layer perceptrons,

introduction to Deep Learning.

4. Ensemble methods:

bagging and boosting,

Random Forests.

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' hands-on experience in solving real-world problems using contemporary machine learning techniques.

Scheduled teaching and learning study hours include lectures , practical classes/tutorials/project supervision/software demonstration.

Additionally, a mixture of online resources (through the VLE) and scheduled sessions will provide background and resources to help students develop their reflective writing skills.

Independent learning study hours include engagement 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 Compare and contrast the basic principles and characteristics of a range of contemporary machine learning algorithms to assess their suitability for a given problem to be solved.

MO2 Select and apply machine learning algorithms to formulate solutions to different types of machine learning problems, justifying the methodology chosen in terms of criteria such data availability and characteristics, and context-specific requirements for balancing speed, accuracy, and explainability.

MO3 Effectively communicate the results of applying machine learning algorithms to a given problem to different audiences.

MO4 Critically appraise a proposed Machine Learning approach to a given problem, reporting on: (I) how effectively it meets ethical and social considerations of machine learning solutions such as privacy, fairness and accountability, (ii) how it could be improved from those perspectives.

Hours to be allocated: 300

Contact hours:

Independent study/self-guided study = 252 hours

Face-to-face learning = 48 hours

Total = 300

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/161053BF-81A5-4B69-FDB7-D0BFA5BB54F2.html?lang=en-GB&login=1

Part 4: Assessment

Assessment strategy: Weekly lab sessions with worksheets will provide many opportunities for tutors to provide formative feedback.

The learning outcomes will be formally assessed through a portfolio of short in-class tests (A, 15%), a report (B1, 25%) and an individual coursework (B2, 60%).

The module is divided into four topics (Introduction, Supervised Machine Learning, Neural Approaches, and Ensemble methods).

Typically associated with each topic will be:

a coursework deliverable building on work done in the weekly practical sessions (contributes to A),

a short in-class test (typically of 20 minutes duration), to confirm knowledge and understanding of techniques applied in your coursework. (contributes to B2).

Both the coursework deliverables and the in-class tests will taken the form of on-line submissions to an automated marking system (e.g. DEWIS or Blackboard tests) to allow feedback to be easily and automatically provided.

Typically each coursework deliverable will involve submitting:

one or more pieces of source code solving a specified problem relevant to the topic (such as the examples above),

a series of multiple choice/multiple answer questions about the practical, legal and ethical issues surrounding the techniques implemented, and their possible use as part within a larger system.

Additionally, a brief written assignment (B1) considering a proposed case study will provide the opportunity to assess student's ability to:

demonstrate understanding of the ethical concerns surrounding the use of machine learning to create predictive models from data;

and to justify their answer in terms of relevant ethical concepts such as privacy, fairness, accountability and trust.

The resit attempt will be assessed in the same way as the first attempt, except that there will only be a single 2 hour pc-based exam to cover component A.

Assessment components:

In-class test - Component A (First Sit)
Description: Series of in-class tests - one on coding skills, plus one per topic - to assess the student's knowledge and understanding of the materials covered in that topic.
Weighting: 15 %

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

Online Assignment - Component B (First Sit)
Description: Individual Coursework composed of a number of deliverables, submitted to an online system (typically DEWIS) for automatic marking and provision of feedback.

The exact number of deliverables may vary from year to year, but typically these will be:
Submission 1 – source code and answers to a set of questions concerning unsupervised learning, reinforcement learning, and the workflow of developing and evaluating machine learning approaches.

Submission 2 –source code and answers to a set of questions concerning classical supervised machine learning algorithms.

Submission 3 –source code and answers to a set of questions concerning artificial neural networks.

Submission 4 –source code and answers to a set of questions concerning ensemble approaches to machine learning.
Weighting: 60 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2, MO3

Report - Component B (First Sit)
Description: Report critically appraising how a proposed machine learning approach to a given problem addresses ethical and societal concerns, justifying the answer in terms of privacy, accountability, fairness and trust.
Weighting: 25 %
Final assessment: No

Group work: No
Learning outcomes tested: MO4

Examination - Component A (Resit)
Description: PC Lab exams under controlled conditions.
Used to assess the student's coding skills, and knowledge and understanding of the materials covered in the module.
Weighting: 15 %
Final assessment: No
Group work: No
Learning outcomes tested: MO1, MO2, MO3

Online Assignment - Component B (Resit)
Description: Individual Coursework composed of a number of deliverables, submitted to an online system (typically DEWIS) for automatic marking and provision of feedback.

The exact number of deliverables may vary from year to year, but typically these will be:
Submission 1 – source code and answers to a set of questions concerning unsupervised learning, reinforcement learning, and the workflow of developing and evaluating machine learning approaches.

Submission 2 –source code and answers to a set of questions concerning classical supervised machine learning algorithms.

Submission 3 –source code and answers to a set of questions concerning artificial neural networks.

Submission 4 –source code and answers to a set of questions concerning ensemble approaches to machine learning.
Weighting: 60 %
Final assessment: No
Group work: No

Learning outcomes tested: MO1, MO2, MO3

Report - Component B (Resit)
Description: Report critically appraising how a proposed machine learning approach to a given problem addresses ethical and societal concerns, justifying the answer in terms of privacy, accountability, fairness and trust.
Weighting: 25 %
Final assessment: No
Group work: No
Learning outcomes tested: MO4

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Artificial Intelligence [Frenchay] MSc 2022-23