WM9RZ-15 Machine Learning for Intelligent Systems

27/28

Department
WMG
Level
Taught Postgraduate Level
Module leader
Karim El Haloui
Credit value
15
Module duration
4 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

The module introduces key concepts related to Machine Learning (ML) and Artificial Intelligence (AI). Through exploring Linear and Logistic Regression techniques, students will embark on learning critical skills to tackle more advanced Neural Networks architectures. Key focus will be made on data management workflow to enhance performance and robustness of ML algorithms. Relevant AI techniques that are widely used in development of automated vehicles and related areas will be explored.

Module aims

The aim is to equip students with a solid knowledge of key AI techniques pervasive to the development of advanced driving systems and related areas. The module will focus on practical aspects of AI where the students will gain a strong high level understanding of the underlying theory. The emphasis will be on Machine Learning and Deep Learning techniques that are at the nexus of the development of future technologies.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Indicative content

- Introduction to Regression and classification problems:
- Linear regression
- Logistic regression
- Deep learning systems
- Introduction to neural networks
- Convolutional neural networks
- Recurrent neural networks
- Reinforcement learning

Learning outcomes

By the end of the module, students should be able to:

- Develop and optimise neural network architectures, including convolutional and recurrent models. [AHEP:4, M1, M2, M3, M4, M5, M7]
- Demonstrate advanced proficiency in the application of machine learning algorithms by designing data pipelines, selecting suitable optimisation techniques, and conducting model performance analysis. [AHEP:4, M1, M2, M3, M4]
- Propose solutions to improve model generalisation and address common challenges. [AHEP:4, M1, M2, M3, M4, M5, M7]
- Critically evaluate advanced machine learning concepts to design, implement, and assess predictive models for complex data-driven tasks. [AHEP:4, M1]

Indicative reading list

Reading lists can be found in Talis

Specific reading list for the module

Subject specific skills

1. Machine Learning Implementation: Apply supervised, unsupervised, and reinforcement learning algorithms to solve data-driven problems.
2. Neural Network Design: Develop and train architectures such as Convolutional Neural Networks, Recurrent Neural Networks, and Gated-Recurrent Neural Networks for tasks like classification and time-series forecasting.
3. Data Preprocessing and Augmentation: Prepare datasets by cleaning, transforming, and augmenting data to enhance model performance.
4. Model Evaluation: Use metrics like accuracy, precision, recall, F1-score, and confusion matrices to assess model effectiveness.

5. Optimisation Techniques: Implement gradient-based optimisation algorithms, such as stochastic gradient descent (SGD), to train models effectively.
6. Programming with Python and PyTorch: Write code in Python and use PyTorch for building and training machine learning models.

Transferable skills

1. Critical Thinking and Problem-Solving: Evaluate complex situations and develop solutions by applying analytical reasoning.
2. Project Management: Manage end-to-end machine learning workflows, from problem formulation to solution deployment.
3. Data-Driven Decision Making: Interpret and derive actionable insights from data analysis.
4. Collaboration and Teamwork: Work effectively with others during coding tasks or problem-solving exercises.
5. Communication Skills: Convey technical concepts, results, and insights clearly through reports, presentations, and documentation.
6. Time Management: Plan and prioritise tasks to meet deadlines in coding projects and assignments.
7. Technical Literacy: Gain proficiency with modern tools and platforms like Python libraries (e.g., TensorFlow, PyTorch) and Jupyter notebooks.
8. Adaptability: Apply learning to unfamiliar datasets and rapidly evolving technology trends in machine learning and AI.

Study

Study time

Type	Required
Lectures	20 sessions of 1 hour (13%)
Tutorials	8 sessions of 1 hour (5%)
Online learning (scheduled sessions)	2 sessions of 1 hour (1%)
Online learning (independent)	2 sessions of 1 hour (1%)
Private study	58 hours (39%)
Assessment	60 hours (40%)
Total	150 hours

Private study description

1. Reading and Research:
   Students are expected to review lecture notes, textbooks, research papers, and relevant articles on machine learning, neural networks. This self-directed research helps students develop a comprehensive understanding of topics such as deep learning, optimisation algorithms, and data handling. Additionally, students are encouraged to explore the latest developments in AI by reading academic journals and industry reports.
2. Preparation for Labs and Practical Work:
   Before attending lab sessions, students need to familiarise themselves with essential programming languages (e.g., Python) and tools such as PyTorch and Jupyter notebooks (included in the online learning independent hours). Reviewing sample code and tutorials on neural networks, data preprocessing, and optimisation algorithms ensures students are prepared to apply theoretical concepts in hands-on projects effectively.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group A

	Weighting	Study time	Eligible for self-certification
Assessment component			
Machine learning problems	80%	48 hours	Yes (extension)
A collection of 2 to 3 problems depending on their length and complexity to be solved by students involving coding and analysis of the results.			
Reassessment component			
Machine learning problems			No
A collection of 2 to 3 problems depending on their length and complexity to be solved by students involving coding and analysis of the results.			
Assessment component			
Machine learning	20%	12 hours	Yes (extension)

	Weighting	Study time	Eligible for self-certification
fundamentals			

A collection of 1 to 2 problems depending on their length and complexity to be solved by students involving coding and analysis of the results.

Reassessment component

Machine learning fundamentals		No

A collection of 1 to 2 problems depending on their length and complexity to be solved by students involving coding and analysis of the results.

Feedback on assessment

1. Assessment feedback
   Students will receive detailed written feedback that highlights strengths, areas for improvement, and suggestions for how to deepen their understanding. This feedback will focus on the quality of technical analysis, the application of communication system theories.
2. Oral Feedback in Lab Sessions:
   During lab-based practical sessions, immediate oral feedback will be given as students work on tasks such as simulations and system design. This real-time feedback will help students adjust their approach and refine their technical skills as they progress through the module.

Availability

Courses

This module is Core for:

- Autonomous and Electrified Vehicle Technologies