WM9B7-15 Artificial Intelligence & Deep Learning

25/26

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

Description

Introductory description

This module addresses the cutting-edge concepts, applications, and methodologies of artificial intelligence and deep learning applied to real-world problems in different domains, such as computer vision, natural language processing, large language models, or generative AI. This module engages students in a comprehensive exploration of advanced AI and deep learning techniques, theoretical foundations, and practical applications, enhancing their knowledge and skills. The student will have the opportunity to develop algorithms for solving real-world problems, such as hand-written digit recognition, object detection, and sentiment analysis, among others.

Module aims

This module aims to equip students with a profound understanding of advanced Artificial Intelligence and Deep Learning, emphasizing expertise in Computer Vision and Natural Language Processing. By intertwining theoretical knowledge with hands-on applications, the module seeks to cultivate professionals capable of significantly contributing to the implementation of AI and Deep Learning applications and research.

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.

1. Advanced Artificial Intelligence and Deep Learning Foundations:

Introduction to Advanced Artificial Intelligence (AI) and Deep Learning (DL) solutions using unsupervised and supervised learning models.

Deep Learning vs Traditional Learning.

Overview of AI and DL solutions related to computer vision, natural language processing, large language models, or generative AI.

Latest research and emerging technologies in AI.

Python libraries for advanced AI and DL implementations.

1. Neural Networks and Deep Learning:

Perceptron and Multilayer perceptron.

Stochastic gradient descent and Back-propagation.

Deep learning regularization and optimization techniques.

Activation and error functions, overfitting, data normalization, and hyper-parameter tuning.

Model Evaluation and Comparison: Training/validation/test data splits, Cross-validation, Evaluation metrics, Confidence intervals, Statistical significance.

Introduction to Convolutional Neural Networks (CNNs) architectures and their applications.

Python libraries and frameworks for building neural networks for image classification and object detection.

1. Recurrent Neural Networks (RNNs) and Natural Language Processing (NLP):

Recurrent Neural Networks (RNN), Long-Short Term Memory (LSTM), and Gated Recurrent Units (GRU).

Advanced Natural Language Processing (NLP) techniques and Transformers architectures.

Python libraries and frameworks for sentiment or speech analysis or text generation applications.

1. Generative Models:

Autoencoders and Generative Adversarial Networks (GANs).

Python libraries and frameworks for building and training generative models.

Learning outcomes

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

- Investigate and explain advanced algorithms for complex artificial intelligence and deep learning solutions.
- Demonstrate comprehensive understanding of complex underlying concepts of artificial intelligence and deep learning methods, with emphasis on computer vision and natural language processing.
- Apply advanced artificial intelligence and deep learning techniques to real-world problems, including problems related to computer vision, natural language processing, large language models, or generative AI.
- Critically evaluate artificial intelligence and deep learning approaches and their limitations.
- Collaboratively implement and present advanced AI and deep learning applications, such as image classification, text and sentiment analysis.

Indicative reading list

Russell, S.J. & Norvig, P. 2021, Artificial intelligence: a modern approach, Global;Fourth; edn, Pearson, Harlow, United Kingdom.

Bishop, C.M. 2006, Pattern recognition and machine learning, Springer, New York.

Goodfellow, I., Bengio, Y. & Courville, A. 2016, Deep learning, The MIT Press, Cambridge, Massachusetts.

Charu, C. Aggarwal. Neural networks and deep learning: a textbook. Spinger, 2023.

Ketkar, N. and Moolayil, J., 2021. Deep learning with Python: learn best practices of deep learning models with PyTorch (pp. 243-285). New York, NY, USA: Apress.

Venkatesan, R., & Li, B. (2017). Convolutional Neural Networks in Visual Computing: A Concise Guide (1st ed.). CRC Press. https://0-doi-org.pugwash.lib.warwick.ac.uk/10.4324/9781315154282

Shanmugamani, R2018, Deep Learning for Computer Vision: Expert Techniques to Train Advanced Neural Networks Using TensorFlow and Keras, Packt Publishing, Limited, Birmingham. Available from: ProQuest Ebook Central. [19 January 2024].

Bird, S., Klein, E. & Loper, E. 2009, Natural language processing with Python, O'Reilly, Beijing; Cambridge [Mass.].

Foster, D. 2019, Generative deep learning: teaching machines to paint, write, compose, and play, First edn, O'Reilly Media, Inc, Sebastopol, CA.

Interdisciplinary

In particular, combining computer science and mathematics/statistics

International

International demand remains high for graduates with the skills incorporated in this module

Subject specific skills

Ability to evaluate Artificial Intelligence and Deep Learning techniques.

Ability to use Python Libraries and Frameworks to implement Deep Learning applications.

Understanding of Deep Learning techniques applied to computer vision, natural language processing, large language models, or generative AI.

Data Analysis.

Transferable skills

Problem-solving.

Critical thinking and analysis.

Programming.

Project management.

Teamwork and collaboration.

Study

Study time

Type	Required
Lectures	10 sessions of 1 hour (7%)
Seminars	10 sessions of 1 hour (7%)
Practical classes	10 sessions of 1 hour (7%)
Supervised practical classes	(0%)
Online learning (independent)	60 sessions of 1 hour (40%)
Assessment	60 hours (40%)
Total	150 hours

Private study description

No private study requirements defined for this module.

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group A3

	Weighting	Study time	Eligible for self-certification
Group Assessment	30%	18 hours	No
In groups, students will implement and thoroughly review a method relevant to the topics covered in the module and prepare a presentation examining it.			
Assignment	70%	42 hours	Yes (extension)
This assessment requires students to apply and analyse AI and deep learning techniques to a real-world problem. Students will submit an Artificial Intelligence or Deep Learning application, and reflection piece of writing.			

Feedback on assessment

Verbal feedback for group assessment; written feedback for assignment.

Availability

There is currently no information about the courses for which this module is core or optional.