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Module specification

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Module Code	COM661
Module Title	Deep Learning Implementation
Level	6
Credit value	20
Faculty	FACE
HECoS Code	100992
Cost Code	GACP

Programmes in which module to be offered

Programme title	Is the module core or option for this programme
BSc (Hons) Computer Science	Core
BSc (Hons) Computer Science with Industrial Placement	Core

Pre-requisites

N/A

Breakdown of module hours

Learning and teaching hours	12 hrs
Placement tutor support	0 hrs
Supervised learning e.g. practical classes, workshops	12 hrs
Project supervision (level 6 projects and dissertation modules only)	0 hrs
Total active learning and teaching hours	**24** hrs
Placement / work based learning	0 hrs
Guided independent study	176 hrs
Module duration (total hours)	**200** hrs

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Initial approval date	08/11/2023
With effect from date	Sept 2026
Date and details of revision	

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Version number	1

Module aims

This module aims to provide students with a thorough understanding of the principles and practical applications of deep learning techniques. Students will develop the skills to design, implement, and optimize deep learning models for a variety of tasks, including image and speech recognition, natural language processing, and reinforcement learning. Through hands-on project work, students will gain experience with the latest deep learning frameworks and tools, as well as learn best practices for data pre-processing, hyperparameter tuning, and debugging. By the end of the module, students will be able to critically evaluate and apply deep learning methods to real-world problems and communicate their findings effectively.

Module Learning Outcomes - at the end of this module, students will be able to:

1	Demonstrate proficiency in applying concepts and principles of deep learning to design neural network models for complex practical applications.
2	Analyse and compare different deep learning architectures and techniques to optimize model performance and accuracy.
3	Implement advanced deep learning techniques to improve model performance and avoid overfitting.
4	Build, train, and deploy deep neural networks in production environments using industry-standard deep learning practices.

Assessment

Indicative Assessment Tasks:
This section outlines the type of assessment task the student will be expected to complete as part of the module. More details will be made available in the relevant academic year module handbook.

The assignments will be designed to reflect real-world problems and will require students to apply their knowledge of deep learning techniques to develop effective solutions. In addition, students will submit a written report, detailing their approach and the results of their deep learning project work. The written report will allow students to demonstrate their ability to critically evaluate their own work and communicate their findings effectively. Overall, the assessments will provide students with the opportunity to apply their learning in a practical setting, while also developing their technical and communication skills.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)
1	1,2,3,4	Coursework	100%

Derogations

None

Learning and Teaching Strategies

In line with the Active Learning Framework, this module will be blended digitally with both a VLE and online community. Content will be available for students to access synchronously and asynchronously and may indicatively include first and third-party tutorials and videos, supporting files, online activities any additional content that supports their learning.
As this module progresses, the strategies will change to best support a diverse learning environment. Initially, the module will start with a heavier reliance on engaging tutor-led lectures, demonstrations, and workshops to ensure that the students get the relevant threshold concepts. As the module continues experiential and peer learning strategies will be encouraged as the students' progress with their portfolio work.
Assessment will occur throughout the module to build student confidence and self-efficacy in relation to applying the principles of deep learning to design and implement neural network model concepts.

Indicative Syllabus Outline

The following list is indicative and may change:

- Convolutional Neural Networks (CNNs)
  - CNN architecture and applications
  - Object detection and segmentation using CNNs
- Recurrent Neural Networks (RNNs)
  - RNN architecture and applications
  - Sequence-to-sequence models for machine translation
- Generative Models
- Reinforcement Learning
  - Basics of reinforcement learning
  - Deep reinforcement learning
- Advanced Topics
  - Capsule networks
  - Adversarial examples and defences
- Implementation and Optimization
  - Data pre-processing and augmentation
  - Hyperparameter tuning and debugging
  - Distributed deep learning

Indicative Bibliography:

Please note the essential reads and other indicative reading are subject to annual review and update.

Essential Reads

I. Goodfellow, Y. Bengio & A. Courville. *Deep Learning (Adaptive Computation and Machine Learning Series).* MIT Press. 2017.

Other indicative reading

J. Patterson & A. Gibson. *Deep Learning: A Practitioner's Approach.* O'Reilly. 2017.

R.S. Sutton & A.G. Barto. *Reinforcement Learning: An Introduction (Adaptive Computation and Machine Learning series).* MIT Press. 2018.
D. Foster. *Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play*. O'Reilly. 2019.
S. Ravichandiran. *Hands-On Reinforcement Learning with Python: Master reinforcement and deep reinforcement learning using OpenAI Gym and TensorFlow.* Packt Publisher. 2018
D. Rao & B. McMahan. *Natural Language Processing with PyTorch: Build Intelligent Language Applications Using Deep Learning*. O'Reilly. 2019