

# **Artificial Intelligence MSc module details**

# Block 1: Neural Systems and Natural Language Processing

The first part of the module provides a detailed appraisal of several aspects of neural network computing. It provides a history of the subject and then covers in detail the various network paradigms which have become established as useful computational tools. Applications will be discussed, and students will be introduced to problem domains where problem instances may be amenable to solution by neural network techniques. Whilst concentrating on an Engineering approach there will also be discussion of the use of neural networks for cognitive modelling.

The second part of the module presents a deep learning-based approach for natural language processing using Python and relevant pythons' tools and packages such as Jupyter, Pytorch, etc.

The module will cover NLP topics from using Feedforward Neural Networks to more advanced NLP methods based on deep learning (Embedding Words and Types: Sequence Modelling for NLP: Intermediate Sequence Modelling for NLP: Advanced Sequence Modelling for NLP and Classics Frontiers and Next Steps). Natural Language Programming (NLP) and Deep Learning are key skills and necessary tool to appreciate and apply AI techniques for the solution of challenging problems in business and engineering.

# **Block 2: Artificial Intelligence for Mobile Robots**

#### This module consists of two parts:

The first part of the module covers the essentials of mobile robots. It initiates analytical discussion of the hardware and software architectures used to build realworld mobile robot systems. It introduces all the necessary topics required to enable students to develop software to create intelligent autonomous robots, including low-level programming of I/O devices, sensor systems, and artificial intelligence.

The second part of the module provides a comprehensive understanding of autonomous mobile robots and autonomous navigation. This will enable the student to comprehend and argue constructively the space and navigation. Students will be required to analyse, evaluate and construct odometry systems, maps, navigation plans and localisation techniques for mobile robots. Issues related to the sensing, representing and modelling of the environment will be assessed. Some algorithmic solutions will be synthesised and assessed. Advanced issues such as simultaneous localisation and mapping will be critically discussed.



# **Block 3: Fuzzy Logic and Evolutionary Computing**

Computational Intelligence (CI) is a significant branch of Artificial Intelligence (AI) including the Fuzzy Logic and Evolutionary Computing Paradigms, as well as the neural network approach (which is covered in another dedicated block).

The first half of this module will provide an overview of several aspects of fuzzy logic, including a brief history of the subject followed by a comprehensive description of various fuzzy paradigms which have become established as useful computational tools. Applications will be discussed, and students will be introduced to problem domains where problem instances may be amenable to solution by fuzzy logic techniques.

The second half of the module will cover Evolutionary Computing, a heuristic approach for solving optimisation problems that could not be solved by exact mathematical methods (like e.g. linear programming, Lagrange multipliers, etc.). This class of algorithms are extremely versatile and can tackle optimisation problems in engineering, economics, and all applied sciences. This subject contains algorithmic structure based on metaphors such as evolution and collective intelligence. This module will provide students with an appreciation of both theoretical and implementation issues of such algorithms. Selected algorithms will be studied in practical work.

# **Block 4: Research Methods & Applications**

This module provides grounding in the research methods required at MSc level, looking at both quantitative and qualitative approaches including laboratory evaluation, surveys, case studies and action research. Example research studies from appropriate areas are analysed to obtain an understanding of types of research problems and applicable research methods. The research process is considered, examining how problems are selected, literature reviews, selection of research methods, data collection and analysis, development of theories and conclusions; and the dissemination of the research. Project management is studied and issues in obtaining funding and ethics are overviewed. The module exposes students to a variety of research approaches, encourages analysis of research papers and supports students in coming to conclusions concerning directions for MSc projects.

# **Blocks 5 & 6: Thesis Project**

This project module students will formulate research questions and learn how to write a proposal in addition to project managing their dissertation.

Discussion boards encourage students to reflect on module content, addressing key questions and encouraging communication and critical appraisal within the student cohort. These are key transferable skills for postgraduates who wish to continue in academia and for those seeking graduate employment.