MCAST

MQF Level 7

RI7-06-21

Master in Artificial Intelligence for Industry 4.0

Course Specification

Course Description

The implementation of Artificial Intelligence (AI) within industry 4.0 influences all industries including manufacturing, public sector, education and many more, particularly since industry 4.0 focuses heavily on interconnectivity, automation, machine learning and real time data. The MCAST Masters in AI for Industry 4.0 programme focuses on the key knowledge required for solving business challenges and yielding competitive advantage through the application of Artificial Intelligence technologies. It provides the theoretical and practical knowledge to work across industries and implement AI where needed. Graduates will be well versed with the Fundamentals of AI, Machine Learning, Neural Networks, Social Implications, Ethics, Regulation and Business Analysis proficiencies. The MCAST Masters in AI for Industry 4.0 is taught by industry experts and leading academics who are actively engaged in successful careers in their respective fields.

Programme Learning Outcomes

At the end of the programme the students are able to:

1. *Appraise the technologies that constitute AI;*
2. *Identify and implement appropriate AI technology to address specific industry challenges;*
3. *Evaluate proposals involving AI technologies;*
4. *Ensure increased operational efficiency, lower costs, improved customer experience and enhance competitive advantage.*

Entry Requirements

- A relevant first Degree in the sciences, technological or social sciences domains;
- Candidates must also have 2 years full time industry work experience.

Current Approved Programme Structure

Unit Code	Unit Title	ECTS	Year
ETAIN-706-2101	Principles of AI	6	1
ETAIN-706-2102	Machine Learning	6	1
ETAIN-706-2103	Neural networks and classifiers	6	1
ETAIN-706-2104	Robotics and Computer Vision	6	1
ETAIN-706-2105	Deep Learning and Predictive Analytics	6	1
Electives (choose any 3 study units)			
ETAIN-706-2108	Leveraging AI for Manufacturing	6	2
ETAIN-706-2109	Enhancing the Creative Industries with AI	6	2
ETAIN-706-2110	AI in Research and the Applied Sciences	6	2
ETAIN-706-2111	Intelligent Community Services	6	2
BCRTL-706-2105	Smart Information Systems	6	2
Core units			
BCRTL-706-2102	AI driven Business Analytics	6	2
ETAIN-706-2106	The ethical, regulatory, legal and social aspects of AI	6	2
ETAIN-730-2107	Research Project/Dissertation	30	3
	Total ECTS	90	/

Unit: ETAIN-706-2101 - Principles of AI

Unit level (MQF): 7

Credits : 6

Unit Description

This unit introduces the learner to the fundamental principles of Artificial Intelligence. It examines the broadness of the term and provides a detailed overview of each of the technological subsets that constitute the field of Artificial Intelligence. It also introduces the learner to the Ethical, Regulatory, Legal and Social impact of AI to our daily lives and to the overall direction of Industry 4.0. It explores best practices, applicability across industry, deployment challenges, responsibility and AI's various guises.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Explain the subsets of Artificial Intelligence technologies.*
2. *Determine the existence of AI in a system.*
3. *Investigate the potential impact of AI on humanity.*
4. *Investigate potential applications of AI in common business processes/flows.*
5. *Evaluate the direction and challenges that Industry 4.0 presents.*
6. *Argue the use and application of different types of AI (General / Narrow and Classical / Modern).*

Unit: ETAIN-706-2102 - Machine Learning

Unit level (MQF): 7

Credits : 6

Unit Description

This unit builds on the previous unit titled 'Principles of AI' by providing the learner with a more detailed understanding of the Machine Learning (ML) types and techniques found under the Artificial Intelligence (AI) domain. These techniques are grounded in Mathematical theory whereby the software tools utilized are facilitating and automating the process. It must be noted that in covering the ML techniques, a Mathematical element is required for the holistic understanding and appreciation of the process. The learner will also have an opportunity of understanding the standard pipeline adopted when undertaking research in AI so to fully appreciate the importance of every stage of the research pipeline. The focus on this unit is to permit the learner to relate on how ML can be adopted/implemented in their workplace or sector of interest.

Following the review of the research pipeline the key techniques in the predominant ML types are covered both in theory and in practice, each following the same pipeline previously covered. It is important that the learner is able to understand the differences between Supervised and Unsupervised learning as well as the in-between spectrum of these opposing ML types. The ML approach taken to address a problem is very much dependent on the kind of data available the objective of the research and the resources available, for that reason this unit addresses the data exploration and transformation component stages of the research pipeline continuously when covering the ML techniques.

The importance of following a scientific methodology, taking into consideration randomness, repetition and averaging, to reduce the unknown error in evaluation of results, is considered a fundamental concept and shall be stressed throughout this unit.

The assessment of this unit shall take into consideration learner participation as well as a research task. For each topic the learners shall be encouraged to research how the covered material is applied in the sector of their preference and contribute in a forum,

which aids in discussion, contributes to the final assignment and assists in the brainstorming of dissertation/project research idea.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Discuss the subsets of Artificial Intelligence.*
2. *Recognise the existence of AI in a system.*
3. *Assess the potential impact of AI on humanity.*
4. *Identify potential applications of AI in common business processes/flows.*
5. *Appraise the direction and challenges that industry 4.0 presents.*

Unit: ETAIN-706-2104 - Robotics and Computer Vision

Unit level (MQF): 7

Credits : 6

Unit Description

The unit Robotics and Computer vision is intended for learners who are intrigued by artificial intelligence dealing with vision, speech, and signal processing. Learners will acquire knowledge on fundamental concepts of computer vision and with this they will design and build models for vision systems. They will be able to review computer vision techniques which are at the cutting edge of current technology. Knowledge on robotics and hands-on practical works under simulation will help learners to know and interact with business requirements with the goal of being able to offer automation solutions for business. Learners will know how to extract statistically meaningful patterns in data for classification, regression, and clustering to be able to build algorithms that can learn to adapt to new environments and conditions.

The unit is aimed at business entrepreneurs, managers, and business leaders. It is intended to give the learner the fundamental knowledge such that leading a team of engineers and/or data scientists would be possible. The learner will be able to interact with their peers on process development using Computer vision methodologies and simulations on robotics to solve real time business intelligence or decision-making problems. Having the fundamental knowledge in robotics and computer vision solutions will enable the learner to identify appropriate solutions that can be implemented by a team of engineers and data scientists. This unit will also empower the learner with the ability to evaluate proposals involving robotic system solutions and automation that may include computer vision subsystems.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Examine fundamental concepts of computer vision data models.*
2. *Apply methodologies of computer vision to image datasets.*
3. *Evaluate concepts and principles of robotics to sustain better decision making in business applications.*
4. *Perform robotic simulations to advise on automation solutions in business environments.*

Unit: ETAIN-706-2105 - Deep Learning and Predictive Analytics

Unit level (MQF): 7

Credits : 6

Unit Description

This unit builds upon the Machine Learning concepts covered in the previous study units and presents the learners with a more in-depth understanding of Deep Learning by exploring, data types, big data and contrasting its functionality and effectiveness with Machine Learning. This unit also challenges the learners to understand the principles of Predictive Analytics and discover how artificial intelligence is contributing significant advances to its effectiveness.

Although traditional Machine Learning approaches work well for many scenarios, Deep Learning is a subfield of artificial intelligence and Machine Learning that produces favourable results for data types where semantics are not easily extractable, such as images, audio, and text data. With Deep Learning approaches, a multilayer Deep Neural network (DNN) model is applied to vast amounts of data. Deep Learning models often have a substantial amount of parameters; therefore, they require extremely large training sets to avoid overfitting. The goal of the model is to map from an input to an output (for example pixels in an image to classification of the image; audio clip to transcript, etc.). The raw input is processed through a series of functions. The basic idea is that supervised Deep Learning models learn the optimal weights of the functions mapping this input data to the output classification through examining vast amounts of data and gradually correcting itself as it compares the predicted result with the ground truth labelled data.

In this unit, learners will learn the main differences between Machine Learning and Deep Learning, and will learn the fundamental aspects of Deep Learning. This unit also introduces the learners to different types of problems that Deep Learning can solve by understanding how to use Deep Learning software to develop their own solutions. Learners will be exposed to various Deep Learning datasets and frameworks for developing Deep Learning prototypes. Learners will also learn how to analyse problems and design their solutions using Deep Learning techniques. This unit will also encourage

the learners to research about current Deep Learning techniques. Ultimately, learners will also learn how to use Deep Learning techniques for predictive analysis.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Recognise the advantages of Deep Learning over Machine Learning.*
2. *Identify the main methods of Deep Learning and the broad range of Deep Learning applications.*
3. *Examine appropriate Deep Learning techniques to solve specific challenges and create Deep Learning solutions, using Deep Learning software.*
4. *Apply AI driven Predictive Analytics to appropriate challenges in various fields.*

Unit: ETAIN-706-2108 - Leveraging AI for Manufacturing

Unit level (MQF): 7

Credits : 6

Unit Description

The manufacturing industry is driven by an overarching goal of producing more, higher-quality products at lower costs. To this end, the application of machine learning and artificial intelligence in the manufacturing industry took a central role in recent years. This unit starts with an overview of the machine learning data pipeline, neural networks and machine learning techniques, covered in previous study units, and prepares the learner to apply these techniques in the context of manufacturing industries. Starting from critically assessing existing industrial processes, this unit explores the applications of various intelligent solutions ranging from signal/image processing to prediction/regression and classification to:

- Reduce common, painful process-driven losses (e.g. yield, waste, quality and throughput)
- Cost reduction through predictive maintenance and predicting Remaining Useful Life (RUL)
- Improve quality control

Learning Outcomes

On completion of this unit the learner will be able to

1. *Examine the AI/machine learning data pipeline.*
2. *Analyse common industrial processes and application of AI/machine learning techniques to the manufacturing industry.*
3. *Investigate the use of signal/image processing to improve manufacturing efficiency.*
4. *Investigate the use of prediction/regression to improve manufacturing efficiency.*

Unit: ETAIN-706-2109 - Enhancing the Creative Industries with AI

Unit level (MQF): 7

Credits : 6

Unit Description

This elective unit provides the learner with the skills to employ the use of intelligent systems across a broad spectrum of the creative industries with a view to enhancing their value, quality and creativity.

The use and influence of AI in the Creative Industries is growing. AI techniques are already recommending TV shows or music on services such as on Netflix or Spotify, but the potential applications stretch across a number of areas within the Creative Industries including fashion, art, computer games and filmmaking. AI applied to the Creative industries can be used on one hand for the automation of repetitive tasks, for example writing keywords for paintings to let artists dedicate more time to the creation process, and on the other hand, AI can be used to automatically generate the content, for example generating a painting or generating music.

In this module, learners will explore two approaches for applying AI to the Creative Industries: for automating repetitive tasks, and for the creation, production and consumption of new content for the Creative Industries. Learners will explore how the AI techniques learnt in the previous modules can be applied to the Creative Industries within the context of these two approaches. Learners will first identify the several sectors of the Creative Industries and the several use-cases for each sector that AI can be applied. Learners will also identify which best AI technique can be used to develop solutions for each identified use-case. Moreover, learners will understand the impact and advantages that the Creative Industries can benefit from applying AI. Learners will explore different AI libraries, frameworks, tools and platforms for developing AI solutions for the Creative Industries. Ultimately, learners will be introduced to the field of Computational Creativity and how this can be applied to the Creative Industries.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Evaluate the impact and advantages of AI applied to the Creative Industries.*
2. *Identify the main application areas within the Creative Industries in which AI can be applied.*
3. *Examine AI techniques and tools that could be used within the Creative Industries.*
4. *Apply AI technologies for the creation, production and consumption of new content within the Creative Industries.*

Unit: ETAIN-706-2110 - AI in Research and the Applied Sciences

Unit level (MQF): 7

Credits : 6

Unit Description

AI is in the process of revolutionizing science. The fact that pattern matching algorithms have become almost a commodity, and that processing power is now accessible to the average researcher, is revolutionising the study of many applied topics. AI has become an important tool for researchers in that it is capable of spotting patterns in large amounts of collected data which may not have been immediately apparent to the researcher. It is therefore very useful for researchers to understand the usefulness of AI in analysing data across several domains. This unit takes the different possible AI approaches to carrying out research and provides concrete examples of how AI can aid the researcher and scientist in the course of his or her research.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Identify different AI methodologies that can be applied to research.*
2. *Relate AI technologies to a mode of research being adopted.*
3. *Examine how data can be analysed with the help of AI.*
4. *Develop an awareness of the ethical implications of using AI in research.*
5. *Implement a simple AI augmented research system in an applied science context.*

Unit: ETAIN-706-2111 - Intelligent Community Services

Unit level (MQF): 7

Credits : 6

Unit Description

Our communities enjoy a wide variety of services aimed to assist persons in need with day to day help so as to lead an independent life in the community whilst enhancing the quality of life for both the service user and their guardians. Considering Malta's aging population, the need for such services is expected to increase. To this end, the application of AI driven smart technologies across a wide variety of community services is attractive as it allows our communities to benefit from an improved and efficient service. This unit explores the use of AI and machine learning techniques, covered in previous study units, to a range of community services ranging from health to senior citizen care. It covers good-practice examples and case studies of implementations and prepares the learner to apply their skills towards enhancing specific community-based services.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Evaluate the role of AI within community services.*
2. *Discuss the benefits of AI within the context of community services.*
3. *Investigate the use of AI and machine learning techniques in health care.*
4. *Investigate the use of AI and machine learning techniques in senior citizen care.*

Unit: BCRTL-706-2105 - Smart Information Systems

Unit level (MQF): 7

Credits : 6

Unit Description

This elective unit overviews the role that AI contributes to information systems in Industry 4.0. These systems serve several functions including planning, production, inventory control, managing budgets, sales forecasting, and also point of sale transactions and logistics. With specific focus on business process, it explores how they can be optimized to operate at higher efficiency by leveraging on AI technologies.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Investigate the role of AI in information systems for Industry 4.0.*
2. *Justify the benefits of AI in terms of the main support and management processes.*
3. *Assess critically existing business processes for inefficiencies.*
4. *Synthesise effective AI solutions for enhancing process efficiency.*

Unit: BCRTL-706-2102 AI driven Business Analytics

Unit level (MQF): 7

Credits : 6

Unit Description

This unit provides the learners with an essential understanding of business analytics, including its core concepts and implementation of statistics and big data. It proceeds to establish a sound understanding on the benefits that business analytics can leverage from artificial intelligence.

Business analytics involves aggregating, processing, computing, analysing and visualising quantitative data through statistical methods and technologies in order to gain insights for improving strategic decision-making. Business analytics include a range of data analysis methods, data visualisation and reporting for understanding "what happened, what is happening and what will happen." Business analytics has evolved into user-friendly and effective tools by allowing the user to access real-time data and to directly interact with the data. Effective dashboards access directly company data and provide management a tool to instantly analyse what might not be evident in a large complex database. Business analytics also includes sophisticated data analysis methods, such as statistical models and data mining algorithms used for exploring data, quantifying and explaining relationships between measurements, and predicting new records. Methods like regression models are used to describe and quantify relationships, to predict new records and to forecast future outcomes.

In this unit, learners will learn the core concepts of business analytics including the different types of business analytics and the business analytics life cycle. This unit will also introduce learners to various visualisation techniques for visualising data through dashboards that will allow users to gain better insights about their data. In this unit, learners will also learn several statistical methods including descriptive statistics and inferential statistics in order to collect and analyse sample of data to uncover patterns and predict future outcomes for making better scientific decisions. Learners will also investigate the use of decision trees for classification or regression, and clustering techniques to find relationships amongst the data objects. Finally, the learners will be introduced to big data, applying business analytics concepts to big data analytics – the

process of examining big data to uncover useful information that can help management make informed business decisions – and software and tools for applying big data analytics.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Describe the core concept of Business Analytics.*
2. *Present and communicate findings using appropriate data visualisation techniques.*
3. *Implement descriptive and inferential statistic techniques whilst investigating the use of decision trees and clustering techniques.*
4. *Employ cutting edge tools and AI technologies to analyse Big Data.*