Module Title	**Deep Learning**
Course Title	MSc Applied AI
School	☐ ASC ☐ ACI ☐ BEA ☐ BUS ☒ ENG ☐ HSC ☐ LSS
Division	Computer Science and Informatics
Parent Course (if applicable)	
Level	7
Semester	1
Module Code *(showing level)*	CSI_7_DEL
JACS Code (completed by the AQE)	
Credit Value	20 credit points
Student Study Hours	Total: 200 Contact hours: 52 Student managed learning hours: 148 Requirements for Self-Managed Learning Hours: Undertake research work, complete and write up lab exercises and assessments.
Pre-requisite Learning	None
Co-requisites	None
Excluded combinations	None
Module co-ordinator	TBC
Short Description (max. 100 words)	The module introduces neural networks and deep learning, one of the key topics in modern applied AI. The module will provide the student with an in depth understanding of all the components of neural networks, from the different computational building blocks, to the functions to be optimized and finally to the different optimization strategies. The module will present how neural networks can be trained and validated to learn from data to solve specific tasks, and how they evolved into deep neural networks, convolutional neural networks and graph networks, presenting their major architecture concepts.
Aims	The module aims at equipping the student with an in-depth understanding of neural networks and deep learning, providing also broad overview of the different network architectures, understanding their rationale, ideal applications, advantages and drawbacks
Learning Outcomes (4 to 6 outcomes)	**Knowledge and Understanding:** On successful completion of this module, you will have knowledge and understanding of: • Demonstrating a systematic understanding of the domain of neural networks algorithms including the importance of research, methodologies, driving innovation and contribution;

	(covers BCS requirements: 7.1.1 - 7.1.4; 8.1.1 - 8.1.2; 8.2.1; 9.1.1, 9.1.2, 9.2.2; 10.1.1, 10.1.2, 10.2.1) • consistently producing and reviewing research informed work which applies and is at the forefront of the developments in the domain; (covers BCS requirements: 7.1.1, 7.1.4, 7.1.6; 8.1.1 - 8.2.1; 9.1.1 - 9.1.3) • study and management of associated projects including timescales, risk identification/management, cost and quality constraints, as well as ethics working within professional frameworks and social/legal constraints (covers BCS requirements: 7.1.5 - 7.1.9; 8.1.1 - 8.2.2 9.1.3 - 9.2.3; 10.1.1 - 10.2.3) **Intellectual Skills:** • Conduct a critically evaluative analysis of a case-based domain using appropriate analytic and quantitative methods; also developing the in-depth knowledge necessary to identify and apply suitable techniques in order to synthesize advanced theory/practical concepts. (covers requirements: 8.1.1 - 8.1.3; 9.1.1 - 9.1.3; 10.1.1 - 10.1.3) • Specify/critically evaluate a project applying appropriate techniques, life-cycle/methodology; conducting effective independent research (covers BCS requirements: 8.1.1 - 8.1.3; 9.1.1 - 9.1.3; 10.1.1 - 10.1.3) **Practical Skills:** • Develop the in-depth knowledge necessary to identify machine learning project domains and apply suitable techniques in order to synthesize advanced (theory/practical) concepts to design, develop, deploy, and maintain bespoke/innovative machine learning solutions using Python; as well as being able to specify, manage, critically evaluate a project applying appropriate technology, techniques, life-cycle/methodology (covers BCS requirements: 8.2.1, 8.2.1; 9.2.1 - 9.2.3; 10.2.1 - 10.2.3) • Be able to make concise, engaging and well-structured oral and written presentations, arguments and explanations; Communication /presentation of advanced machine learning algorithm-based projects and concepts to a wide range of audiences. (covers BCS requirements: 8.2.1, 8.2.1; 9.1.1 - 9.2.3; 10.2.1 - 10.2.2) **Transferable Skills:** • Critically evaluate existing/emerging deep learning technology and techniques, carrying out independent research, recognize and contribute to opportunities for innovation, deal with uncertainty, evaluate and manage risks, synthesise ideas/theories/solutions and report back appropriately to your peers, also conducting effective peer reviews. (covers BCS requirements: 7.1.1 - 7.1.4) • Self-manage your study time and work effectively to meet deadlines, select and evaluate appropriate knowledge, skills, etc...; also select and evaluate supporting resources/tools for a particular purpose, as well as being able to make effective contributions as team member/leader when required. (covers course outcomes: d1, d4; BCS requirements: 7.1.5 - 7.1.9)
Employability	In the age of Big Data, applications of Artificial Intelligence are currently dominated by deep learning methods, due to their success in field such as computer vision and natural language processing. Enterprises in almost every business sector have started to adopt machine learning-based systems to analyse massive data sets and are requiring the specific application of deep learning models. Having an in-depth knowledge of deep learning along with strong programming skill for

	systems implementation will potentially enhance your employability within the IT marketplace
Teaching and learning pattern	Contact hours includes the following: (please click on the checkboxes as appropriate) √ Lectures ☐ Group Work: ☒ Seminars ☐ Tutorial: ☒ Laboratory ☐ Workshops ☐ Practical ☐ VLE Activities
Indicative content	The module syllabus includes: • Perceptron. Feed forward neural networks, definitions, forward and backward pass, optimization, objective functions. • Activation functions and non linear layers. • Training neural networks, update rules, ensemble, data augmentation, transfer learning. Regularization • Intuition of convolution in 1D and 2D and higher dimension. Convolutional NN. CNN architectures • Recurrent neural networks • Generative models • Unsupervised or weakly supervised DL • Compression/representations with autoencoders • Adversarial attacks to DL, critiques to DL, ethical considerations
Assessment method (Please give details – of components, weightings, sequence of components, final component)	Formative assessment: The students will usually be given a range of weekly tutorial-based tasks (both individual/group work) comprised of formative exercises imparting the knowledge and skills required to satisfy the learning outcomes Summative assessment: Coursework 100%
Mode of resit assessment (if applicable)	Formative assessment: Summative assessment: Coursework 100%
Indicative Sources *(Reading lists)*	**Core materials**: • Aaron Courville, Ian Goodfellow, and Yoshua Bengio, Deep Learning, MIT Press, 2017 . • François Chollet, Deep Learning with Python, 2nd Edition 2020, Manning Publications **Optional materials:** • Charu C. Aggarwal, Neural Networks and Deep Learning: A Textbook, pringer; 1st ed. 2018 edition Michael Nielsen, Neural Networks and Deep Learning, 2019 http://neuralnetworksanddeeplearning.com/
Other Learning Resources	TBD Supplementary materials for all of the software used in the module will be available on the module VLE site.