

H8NNPA: Neural Networks & Prescriptive Analytics

Module Code:	H8NNPA
Long Title	Neural Networks & Prescriptive Analytics APPROVED
Title	Neural Networks & Prescriptive Analytics
Module Level:	LEVEL 8
EQF Level:	6
EHEA Level:	First Cycle
Credits:	10
Module Coordinator:	Isabel O'Connor
Module Author:	Isabel O'Connor
Departments:	School of Computing
Specifications of the qualifications and experience required of staff	Master's degree or PhD in a computing or cognate discipline. May have industry experience also.
Learning Outcomes	
<i>On successful completion of this module the learner will be able to:</i>	
#	Learning Outcome Description
LO1	Describe a range of different neural network models and identify specific applications
LO2	Identify architectures and optimization methods for deep neural network training
LO3	Implement deep learning methods and apply them to data using state of the art deep learning tools
LO4	Explain and evaluate the basic underlying principles of heuristic search as optimization methods to solve complex problems
LO5	Comprehend and apply the methodologies of the most commonly used heuristics (Greedy, Simulated Annealing, Tabu Search, Evolutionary algorithms, Ant Colony optimization)
LO6	Develop new (hybrid) heuristic methods by extending and combining existing heuristic search strategies
LO7	Apply heuristics algorithms to solve complex problems in real-world engineering and business scenarios using the state of the art software tools
Dependencies	
Module Recommendations	
No recommendations listed	
Co-requisite Modules	
No Co-requisite modules listed	
Entry requirements	Learners should have attained the knowledge, skills and competence gained from stage 3 of the BSc (Hons) in Data Science

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Module Content & Assessment			
Indicative Content			
Neural Network Representations and Forward Propagation - From Linear to Non-Linear Classifiers. - Units, Layers, Bias Units. - Building non-linear functions. - The Feed Forward Algorithm			
Backpropagation - Overview of Backpropagation Methods. - Deriving the Backpropagation Equations. - The Backpropagation Algorithm. - Visualizing Backpropagation in TensorFlow			
Refining Backpropagation - Cross Entropy Loss function. - Hyperbolic Tangent Units. - Rectified Linear Units. - Softmax Layers			
Preventing Overfitting - Regularization in Neural Networks. - Early Stopping. - Dropout			
Convolutional Neural Networks - Convolutions. - Pooling Layers. - Implementing a CNN. - Scaling networks with a GPU			
Recurrent Neural Networks - Basic topology. - Motivating examples. - Long Short Term Memory			
Common concepts for evolutionary methods - Representation. - Objective function. - Constraint handling. - Performance analysis			
Single-solution based metaheuristics - Fitness landscapes. - Local search. - Simulated annealing. - Tabu search. - Variable neighbourhood search			
Evolutionary algorithms - Genetic algorithms. - Swarm intelligence. - Memetic algorithms swarm intelligence			
Hybrid metaheuristics Combining metaheuristics with mathematical programming, constraint programming, machine learning and data mining			
Applications I Analytical customer relationship management, Clinical decision support systems, Direct marketing, Fraud detection. Ethics implications			
Applications II Project risk management, oil and natural gas exploration, logistics and transportation. Ethics implications			
Assessment Breakdown			%
Coursework			70.00%
End of Module Assessment			30.00%
Assessments			
Full Time			
Coursework			
Assessment Type:	Continuous Assessment	% of total:	Non-Marked
Assessment Date:	n/a	Outcome addressed:	
Non-Marked:	Yes		
Assessment Description: Ongoing independent and group problem solving activities and feedback.			
Assessment Type:	Project	% of total:	70
Assessment Date:	n/a	Outcome addressed:	3,6
Non-Marked:	No		
Assessment Description: Long-form project which the student produces over the course of the entire semester. Student is required to choose to develop an application in predictive analytics or prescriptive analytics using deep learning or evolutionary techniques.			
End of Module Assessment			
Assessment Type:	Terminal Exam	% of total:	30
Assessment Date:	End-of-Semester	Outcome addressed:	1,2,3,4,5,6,7
Non-Marked:	No		
Assessment Description: Terminal assessment exam taken over 2 hours with four questions of which the student must answer three to address the students' understanding of the underlying theories and concepts			
No Workplace Assessment			
Reassessment Requirement			
Repeat examination <i>Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element.</i>			
Reassessment Description The repeat strategy for this module is an examination. All learning outcomes will be assessed in the repeat exam.			

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Module Workload				
Module Target Workload Hours 0 Hours				
Workload: Full Time				
Workload Type	Workload Description	Hours	Frequency	Average Weekly Learner Workload
Lecture	Classroom & Demonstrations (hours)	24	Per Semester	2.00
Tutorial	Other hours (Practical/Tutorial)	24	Per Semester	2.00
Independent Learning	Independent learning (hours)	202	Per Semester	16.83
Total Weekly Contact Hours				4.00

Module Resources	
<i>Recommended Book Resources</i>	
Goodfellow, I., Bengio, Y. & Courville, A.. (2016), , Deep Learning, MIT Press. Simon, D.. (2013), Evolutionary Optimization Algorithms, Wiley.	
<i>Supplementary Book Resources</i>	
Buduma, N.. (2017), Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms, O'Reilly Media. Chang Wook, A.. (2006), Advances in Evolutionary Algorithms: Theory, Design and Practice (Studies in Computational Intelligence), Springer-Verlag.	
<i>This module does not have any article/paper resources</i>	
<i>This module does not have any other resources</i>	
Discussion Note:	