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

On successful completion of this module the learner will be able to:

#	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 Backpropogation 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
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.

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

Recommended Book Resources

Goodfellow, I., Bengio, Y. & Courville, A.. (2016), , Deep Learning, MIT Press.

Simon, D.. (2013), Evolutionary Optimization Algorithms, Wiley.

Supplementary Book Resources

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.

This module does not have any article/paper resources

This module does not have any other resources

Discussion Note:	