Module Specification	
CSCK503 – Machine Learning in Practice	

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1. Module Details

Module Title:	Machine Learning in Practice

Short Title:	Machine Learning in Practice

Module Code:	CSCK503

Marketing Module Synopsis:	Machine learning is concerned with the extraction and creation of knowledge from data. There is considerable current interest, in both the public and private sectors, in harnessing the technical and commercial benefits that machine learning can realise when applied to collected data. The Machine Learning module is designed to provide students with a comprehensive critical understanding of the domain of machine learning, while at the same time providing a deep and systematic insight into the particle application of the tools and techniques of machine learning using an established machine learning library. By the end of the module students will be in a position to apply practically the knowledge gained in the modern work place.

Credits:	15

Level:	Level 7

Delivery Location(s)	Online

Semester:	Whole Session

Academic Year:	2021-22

Faculty:	Faculty of Science and Engineering

School/Institute (Level 2):	School of Electrical Engineering, Electronics and Computer Science

Curriculum Board (level 1):	Computer Science PGT

Module Coordinator:	Frans Coenen

Other staff:	Helen Mattocks

External Examiner(s):	Neil Gordon, Dan Neagu

Pre-requisites:	N/A

Co-requisites:	N/A

Barred Combinations:	N/A

CE/CPD Provision:	No

Overview:	Machine learning is concerned with the extraction and creation of knowledge from data. Machine learning has been part of the remit of Artificial Intelligence for many years but has witnessed a resurgence with the advent of the idea of Big Data. As consequence there is considerable interest, in both the public and private sectors, in harnessing the technical and commercial benefits that machine learning can realise. The Machine Learning module is designed to provide students with

	a comprehensive critical understanding of the domain of machine learning, and a deep and systematic insight into the practical application of the associated tools and techniques using an established machine learning library.

Notes:	21/22 Modification is minor and needs no further scrutiny. 20/21 Online module provided in collaboration with Kaplan Open Learning.

Maximum Places:	250

Subject:	

HESA Cost Centre(s):	MUST BE COMPLETED FOR APPROVAL

Status:	Modification Approval

The table below is automatically completed from programme data held in Curriculum Manager; during 2019/20 it is likely to have no data or incomplete data until all programme records are in Curriculum Manager.

In Programmes:	Programme Validation Status	Module Status:	Programme Stage / Group / / Sub-group
Computer Science Master of Science (MSc) 2020-21	Validated	Mandatory	Online Flexible Learning Y2 Online Flexible Learning Y2 Mandatory Module 6
Cyber Security Master of Science (MSc) 2020-21	Validated	Optional	Online Flexible Learning Y2 Online Flexible Learning Y2 Required module 7

In Programmes:	Programme Validation Status	Module Status:	Programme Stage / Group / / Sub-group
Data Science and Artificial Intelligence Master of Science (MSc) 2020-21	Validated	Optional	Online Flexible Learning Y2
Big Data Analytics Master of Science (MSc) 2021-22	Validated	Required	Online Flexible Learning Y1 Online Flexible Learning Y1 Mandatory module 3
Artificial Intelligence Master of Science (MSc) 2021-22	Validated	Required	Online Flexible Learning Y1 Online Flexible Learning Y1 Required Module 3

The table below must be completed for module approval, including confirmation that there are zero costs to the student.

Student Cost(s)					
				Costs range:	
Cost Type:	Description:	Value type (exact, approximate or max/min range):	Cost (exact or approximate):	Minimum Cost:	Maximum Cost:
Student Cost	Over the anticipated 8 week module period, an estimated average cost of £12.50 per week for internet access and contribution to the cost of a personal computer (global variations may apply).	Approximate	100.00		

2.   Aims and Content

Educational Aims:

1. To provide an in-depth understanding of established techniques of machine learning, its real-world application and the legal contexts in which machine learning operates.

2. To provide students with comprehensive knowledge of the nature of data and the mechanism that may be used to pre-process data to support machine learning activities.

3. To establish a comprehensive and practical awareness of the techniques and metrics used to evaluate machine learning algorithms.

4. To furnish students with a in-depth and critical knowledge of a range of established approaches to machine learning, including their statistical and mathematical underpinning.

5. To provide a wide-ranging practical knowledge of an established machine learning workbench.

Outline Syllabus:

1. Machine learning fundamentals
The idea of machine learning and the machine learning landscape, the nature of data, supervised and unsupervised learning, performance measures, bias and variance, data confidentiality the ethics of machine learning.

2. Data Preprocessing
The importance of data preparation, missing data, feature selection extraction, data standardization.

3. Dimensionality reduction
Principle Component Analysis (PCA). Visualising high-dimensional data.

4. Linear regression
Linear regression models. Evaluating linear aggression models. Multiple and Polynomial regression. Regularisation.

5. Classification

Binary classification. Classification performance metrics. Significance testing. Multi class classification and Multi label classification.

6. Decision Trees
Information gain, entropy. Ensemble learning. Random forests.

7. Association Rule Mining
Pattern mining. Suport and Confidence. Association rule mining. Sequence mining. Rule induction.

8. Clustering
Cluster algorithms. Hieratchical clustering. Cluster configuration evaluation metrics. Clustering to learn features.

Reading lists and resources:			
Type	**Category**	**Title**	**Description**

3.   Module Outcomes (learning outcomes, skills and other attributes)

Ref No.	Learning Outcome / Skill:	Category:
M1	A well-founded and comprehensive knowledge of the operation of a widely used machine learning workbench.	Learning Outcomes: Master's
M2	A comprehensive and systematic understanding of the legal frameworks in which machine learning operates.	Learning Outcomes: Master's
M3	A practical ability to deploy effectively a variety of tools and techniques within the remit of machine learning.	Learning Outcomes: Master's
M4	A deep and systematic understanding of the limitations of a range of machine learning techniques and how the effectiveness of individual techniques can be analysed.	Learning Outcomes: Master's
S1	Communication skills in electronic as well as written form.	Skills
S2	Self-direction and originality in tackling and solving problems.	Skills
S3	An ability to act autonomously and professionally when planning and implementing solutions to computer science problems.	Skills

Ref No.	Learning Outcome / Skill:	Category:
S4	Experience of working in development teams, respecting others, co-operating, negotiating/persuading, awareness of interdependence with others.	Skills

4. Assessments

Assessment Strategy:
The module features two broad categories of assessment: discussion questions and practical assessments. The first has a focus on moderated active learning, where the faculty member responsible for the module posts discussion questions to which students respond individually and then consider each other's responses. Each discussion question runs over a three-week period. At the end of the first week each student posts a 500 word "initial response". During the second week each student selects two or three responses, made by other students in the first week, and writes a 500 word "follow-up" response. In the third week each student reviews the initial and follow-up responses from the previous two weeks and submits a 500 word executive critical summary with respect to the main themes identified by the responses. Practical assessment adopts the principle of authentic assessment where the assessment tasks to be undertaken are aligned with the kinds of task that students would be expected to undertake in a professional setting. 1. Due to nature of the on-line mode of instruction work is not marked anonymously. 2. Reassessment opportunities offered in line with Code of Practice on Assessment. 3. Penalties for late submission will be in line with Code of Practice on Assessment.

All fields in the table below must be completed for module approval.

Method	Description	Type	Units of Length	Length	Min	Max	Description (re length)	Weighting	Assessment period(s)	Group Work	Must Pass	Final Assessment
Practical assessment	Group Presentation: Machine learning group project resulting in a demonstrable system and group video report (10 minutes) describing and analysing the approach and the results obtained.	Summative	Hours	12	N/A	N/A	Software solution and video report	30 %	Wk08	Yes	No	Yes
Practical assessment	Programming: Individual machine learning challenge resulting in a demonstrable system and supporting analysis in the form of a brief report (500 words).	Summative	Hours	12	N/A	N/A	Software solution and report	30 %	Wk05	No	No	No
Coursework	Discussion Question 2: Participate actively in an online discussion concerning one of the applications of machine learning covered within the module, demonstrating an understanding of the	Summative	Words	N/A	1000	1500	N/A	20 %	Wk07	No	No	No

Method	Description	Type	Units of Length	Length	Min	Max	Description (re length)	Weighting	Assessment period(s)	Group Work	Must Pass	Final Assessment
	key issues and showing original thought.											
Coursework	Discussion Question 1: Participate actively in an online discussion concerning the background to machine learning, demonstrating an understanding of the key issues and showing original thought.	Summative	Words	N/A	1000	1500	N/A	20 %	Wk03	No	No	No

Please see Appendix 1 for details of the outcomes tested by the above assessments.

Module Specification Appendix 1: Assessments and the Outcomes Tested

Module Title	Machine Learning in Practice
Module Code	CSCK503

In the table below, all fields should be completed for approval, except for the **Weighting** field for a **Formative Type** assessment method.

Assessment Method	Type	Weighting	Marked out of	Pass Mark	Learning Outcomes / Skills Tested
Practical assessment	Summative	30 %	100	50	M3, M4, S1, S3, S4
Practical assessment	Summative	30 %	100	50	M2, M3, S3

Assessment Method	Type	Weighting	Marked out of	Pass Mark	Learning Outcomes / Skills Tested
Coursework	Summative	20 %	100	50	M2, S2
Coursework	Summative	20 %	100	50	M1, S1

5. Learning and Teaching Methods

Summary of Learning and Teaching Methods:
The mode of delivery is by online learning, facilitated by a Virtual Learning Environment (VLE). This mode of study enables students to pursue modules via home study while continuing in employment. Module delivery involves the establishment of a virtual classroom in which a relatively small group of students (usually 10-25) work under the direction of a faculty member. Module delivery proceeds via a series of eight one-week online sessions, each of which comprises an online lecture, supported by other eLearning activities, posted electronically to a public folder in the virtual classroom. The mode of learning includes a range of required and optional eLearning activities, including but not limited to: lecture casts, live seminars, self-assessment opportunities, and required and suggested further reading and try-for-yourself activities. Communication within the virtual classroom is asynchronous, preserving the requirement that students are able to pursue the module in their own time, within the weekly time-frame of each online session. An important element of the module provision is active learning through collaborative, cohort-based, learning using discussion fora where the students engage in assessed discussions facilitated by the faculty member responsible for the module. This in turn encourages both confidence and global citizenship (given the international nature of the online student body).

The following table must be completed for module approval, accounting for all hours associated with the credit value of the module, e.g. for 15 credits there should be 150 hours of learning and teaching activity, including independent learning.

Learning and Teaching Method:	Length (Minutes):	Times per Week (if applicable):	Number of Weeks (if applicable):	Calculated Hours (if applicable):	Hours:
Self-Directed Learning	N/A	N/A	N/A	N/A	62
Assignment	N/A	N/A	N/A	N/A	40

Learning and Teaching Method:	Length (Minutes):	Times per Week (if applicable):	Number of Weeks (if applicable):	Calculated Hours (if applicable):	Hours:
E-lecture	N/A	N/A	N/A	N/A	24
Online Discussions	N/A	N/A	N/A	N/A	24

6.   Supplementary Information

If a risk assessment is required for this module for students under 18, please record a summary of the risks:	N/A