MODULE TITLE	**Trends in Data Science and AI**	**CREDIT VALUE**	**15**
MODULE CODE	**MTHM602**	**MODULE CONVENER**	**Dr Saptarshi Das (Coordinator)**

DURATION: TERM	**1**	**2**	**3**
DURATION: WEEKS		**11**	

Number of Students Taking Module (anticipated)	**20**

DESCRIPTION - summary of the module content

Recent advances in science and computing technology have resulted in an explosion of available data, in fields as diverse as biology, climate, engineering, finance and medicine. This has led to the development of new data analytic methodologies, aimed at meeting the challenges associated with processing and understanding "Big Data". In this problem-solving oriented module, you will keep abreast of state-of-the-art data science tools and techniques. Through practical hands-on learning and working with open sourced and in-situ data and sophisticated scientific computing software, you will develop skills and techniques needed to convert complex data sets into useful information. To foster understanding, effective communication is key. Therefore, students will engage with contemporary data science literature, and present their findings in reports, posters, and through digital media to engage with the lay public and with specialists in their chosen science and technology area.

AIMS - intentions of the module

The aim of this module to follow the current trends of modern data science. You will investigate advanced topics in Bayesian Inference, Deep Learning, and Reinforcement Learning, with a focus on relevant applications and datasets in Conservation, Ecology, Environmental and Sustainability Science, Evolution, Human Health, and/or Renewable Energy.
The module will be delivered by engaging with contemporary literature, structured in two-week cycles, following the dynamics of a postgraduate reading group. A reading list will be made available by the module tutors at the start of a cycle. You will either re-create outputs from a research paper/open source collaborative software development program on GitHub, produce a critical appraisal of the published methods and results, or apply the data and/or methodologies from the research paper(s) to a novel problem.
A key learning outcome of the module is the development of effective communication skills. You will work in groups to synthesise key aspects of considered approaches and their application to relevant data sets. Groups will practice presenting their findings at the end of each two-week cycle and prepare for an assessed group presentation in the second half of term.

INTENDED LEARNING OUTCOMES (ILOs) (see assessment section below for how ILOs will be assessed)

Module Specific Skills and Knowledge:	
1	Read and discuss current (less than one year old) approaches in data science and AI;
2	Explain these different approaches and the questions they address;
3	Critically evaluate a range of modern data science approaches;
Discipline Specific Skills and Knowledge:	
4	Identify and implement, with limited guidance, appropriate data science and AI methodologies for solving a range of data-rich problems;
5	Synthesise research-informed examples from the literature into novel written work;
Personal and Key Transferable/ Employment Skills and Knowledge:	
6	Communicate effectively arguments and conclusions based on evidence gathered from data analysis and AI, using a variety of formats appropriate to the intended audience;
7	Reflect effectively and independently on learning experiences and evaluate personal achievements.

SYLLABUS PLAN - summary of the structure and academic content of the module

The module is structured in five blocks of two weeks in which a specific research paper or dataset and related methodologies and approaches are considered in detail. You will work with the most up to date data science and artificial intelligence research, so the syllabus is by design variable. Exemplar topics include:
Bayesian Inference
Parameter estimation and uncertainty quantification;
Bayesian hierarchical models, Bayesian networks;
Deep Learning
Time series – univariate and multivariate;
Image and video analysis, computer vision;
Generative deep learning ;
Reinforcement Learning
Dynamic programming, closed loop optimal management strategy, classical methods;
Deep reinforcement learning;
Application areas:
Geospatial data and remote sensing;
Bioinformatics and omics data for living systems;
Marine and terrestrial video analysis and animal behaviour tracking;
Pollution, microbiological samples: microscopic data, chemical measurements, satellite imaging;
Renewable energy generation and consumption data.

LEARNING AND TEACHING

LEARNING ACTIVITIES AND TEACHING METHODS (given in hours of study time)

Scheduled Learning & Teaching Activities	30.00	**Guided Independent Study**	120.00	**Placement / Study Abroad**	0.00

DETAILS OF LEARNING ACTIVITIES AND TEACHING METHODS

Category	Hours of study time	Description
Scheduled Learning and Teaching activities	5	Interactive lectures
Scheduled Learning and Teaching activities	25	Computer practicals and discussion sessions
Guided independent study	40	Group work
Guided independent study	40	Methodology and data analyses, report writing and preparation for presentations
Guided Independent Study	40	Self-study and background reading

ASSESSMENT

FORMATIVE ASSESSMENT - for feedback and development purposes; does not count towards module grade

Form of Assessment	Size of the assessment e.g. duration/length	ILOs assessed	Feedback method
Draft technical report	1000 words (or equivalent)	1-7	Oral/Written
Practice presentations	2 x 5 minutes	2-4, 6	Oral

SUMMATIVE ASSESSMENT (% of credit)

Coursework	100	**Written Exams**	0	**Practical Exams**	0

DETAILS OF SUMMATIVE ASSESSMENT

Form of Assessment	% of credit	Size of the assessment e.g. duration/length	ILOs assessed	Feedback method
Individual Technical Report	50	3000 words (or equivalent), including a critical appraisal of and reflection about methods and approaches	1-7	Written
Individual Poster Presentation	25	500 words (or equivalent), with a focus on "Why is this method/dataset/approach important and relevant?"	1, 3, 5-7	Oral/Written
Group Presentation	25	15 minutes, addressing the synthesis of methods in an applied context, with a focus on communication	1-2, 4-7	Oral/Written

DETAILS OF RE-ASSESSMENT (where required by referral or deferral)

Original form of assessment	Form of re-assessment	ILOs re-assessed	Time scale for re-assessment
Any	Coursework (100%)	1-7	To be agreed by consequences of failure meeting

RE-ASSESSMENT NOTES

Deferral – if you miss an individual assessment for certificated reasons judged acceptable by the Mitigation Committee, you will normally be either deferred in the assessment or an extension may be granted. The mark given for a re-assessment taken as a result of deferral will not be capped and will be treated as it would be if it were your first attempt at the assessment. If you miss a group work assessment for certificated reasons judged acceptable by the Mitigation Committee, you will complete an individual assignment pro-rata (percentage according to the missed component).
Referral – if you have failed the module overall (i.e. a final overall module mark of less than 50%) you will be required to resubmit the original assessment as necessary. The mark given for a re-assessment taken as a result of referral will be capped at 50%.

RESOURCES

INDICATIVE LEARNING RESOURCES - The following list is offered as an indication of the type & level of information that you are expected to consult. Further guidance will be provided by the Module Convener

Web-based and electronic resources:
ELE – *College to provide hyperlink to appropriate pages*
Other resources:
Recent trends will be made available from current research articles and open source projects on GitHub during the module.
Reading list for this module:

Type	Author	Title	Edition	Publisher	Year	ISBN	Search
Set	Goodfellow, I., Bengio, Y., Courville, A. and Bengio, Y.	Deep learning (Vol. 1, No. 2)		MIT Press	2016		[Library]
Set	Chollet, F.	Deep learning with Python (Vol. 361)		Manning	2018		[Library]
Set	Davidson-Pilon, C.	Bayesian methods for hackers: probabilistic programming and Bayesian inference		Addison-Wesley Professional	2015		[Library]
Set	Gelman, A., Carlin, J.B., Stern, H.S., Dunson, D.B., Vehtari, A. and Rubin, D.B.	Bayesian Data Analysis		CRC Press	2013		[Library]
Set	Albert, J.	Bayesian computation with R		Springer	2009		[Library]
Set	Sutton, R.S. and Barto, A.G.	Reinforcement Learning: An Introduction		MIT Press	2018		[Library]

CREDIT VALUE	15	**ECTS VALUE**	7.5
PRE-REQUISITE MODULES	None		
CO-REQUISITE MODULES	None		
NQF LEVEL (FHEQ)	7	**AVAILABLE AS DISTANCE LEARNING**	No
ORIGIN DATE	Monday 14 December 2020	**LAST REVISION DATE**	Thursday 17 June 2021
KEY WORDS SEARCH	Applied data science; Machine learning; Artificial intelligence; Research		