M.Sc. in Computer Science (Data Analytics)

STUDENT HANDBOOK 2024 | 2025

School of Computer Science, Computer Science (CS) Building, University of Galway

University of Galway School of Computer Science requires all students to have exclusive use of a laptop for use in lectures and labs, for home use of online materials and for participation in online sessions.

The minimum and recommend spec are detailed at https://www.universityofgalway.ie/science-engineering/school-of-computer-science/currentstudents/laptops/.

We also operate a laptop loan scheme for students who cannot afford a suitable laptop (see same address).

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Please note: This handbook is for information only and is correct at time of compilation to the best of our knowledge. However, processes and procedures may change throughout the academic year. Please visit the relevant websites and contact Administrative Offices for up-to-date information.

Section 1: Programme Description

M.Sc. in Computer Science (Data Analytics)

Almost everything we do results in data being created and stored somewhere. Individuals, communities, business, and governments face major challenges in harnessing all this data to create knowledge that will underpin a healthier, safer, more productive world. There is a global shortage of talent and expertise in Data Analytics and Data Science. This MSc and Diploma programme will provide graduates of Computing or related degrees with the deep technical knowledge and analytical skills to succeed in this growth area.

Course Content

The MSc option is a 90-ECTS course with three main elements: foundational modules (20 ECTS), advanced modules (40 ECTS), and a substantial capstone project (30 ECTS).

Foundational modules include: Statistics & Probability; Principles of Machine Learning; Programming for Data Analytics; Tools and Techniques for Large Scale Data Analytics; Applied Regression Modelling; Digital Signal Processing.

Advanced modules include: Deep Learning; Programming for Data Analytics; Tools and Techniques for Large Scale Data Analytics; Applied Regression Modelling; Natural Language Processing; Web and Network Science; Knowledge Graphs; Information Retrieval; Embedded Image Processing; Data Visualisation and Case Studies in Data Analytics.

Capstone Research Project:

From Semester II onwards, students work on capstone projects under the guidance of academic supervisors and submit them in August. During the Summer, students are expected to work fulltime on their capstone projects. Capstone projects are research projects and may have a theoretical or applied focus.

Special Features

This is a distinctive programme that is closely aligned to the research and teaching expertise of the Computer Science discipline and University of Galway's Insight Centre for Data Analytics.

Career Opportunities

Graduates will be excellently qualified to pursue new career opportunities in industry, to establish new ventures or do PhD-level research.

Section 2: General Information

2.1 Academic Calendar 2024-2025

The Academic Calendar is available on:
https://www.universityofgalway.ie/registry/academic-term-dates/#d.en.186426

Academic Year 2024-2025	
Semester 1	
Start of Teaching (UG years (excluding Year 1) and Postgraduate Taught programmes)	Monday 9th September 2024
End of Teaching all years	Friday 29th November 2024
Study Week (All Years, UG & PGT)	Monday 2nd December to Friday 6th December 2024
Semester 1 Exams	Monday 9th December – Friday 20th December 2024
Semester 2	
Teaching (All Years, UG & PGT)	Monday 13th January – Friday 4th April 2025
Easter	**Good Friday 18th April – Easter Monday 21st April 2025**
Field Trips	Monday 7th April – Thursday 10th April 2025
Study Week (All Years, UG & PGT)	Friday 11th April – Thursday 17th April 2025
Semester 2 Exams	Tuesday 22nd April – Friday 9th May 2025
Autumn Repeat Exams	Tuesday 5th August - Friday 15th August 2025
Easter Holidays: Good Friday 18th April to Easter Monday 21st April 2025 **Bank Holidays: Monday 28th October 2024 / Monday 3rd February 2025 / Monday 17th March 2025 / Monday 5th May 2025 / Monday 2nd June 2025 / Monday 4th August 2025**	

2.2 Key Contact Details

Programme Director

Programme	Programme Director	Room	E:mail
M.Sc. in Computer Science (Data Analytics)	Dr. Frank Glavin	CSB-3004	frank.glavin@universityofgalway.ie

Technical and Administrative Staff

Administrative Staff		Room	E:mail
Ms Deirdre King	School Manager	CSB-3013	Deirdre.king@universityofgalway.ie
Ms Thérèse McIntyre	School Operations Officer	CSB-3014	Therese.mcintyre@universityofgalway.ie
Ms Geraldine Healy	Administrative Assistant	CSB-3014	geraldine.healy@universityofgalway.ie
IT Technical Staff			
Mr Peter O'Kane	Chief Technical Officer	CSB-3038	Peter.okane@universityofgalway.ie
Mr Joe O'Connell	Senior Technical Officer	CSB-3037	Joe.oconnell@universityofgalway.ie
Mr Pearse Carroll	Senior Technical Officer	CSB-3037	pearse.carroll@universityofgalway.ie

The School of Computer Science is located in the Computer Science (CS) Building, Floor 3
For directions to the CS Building please click (Ctrl+Click) here

Student Registry Help Desk

The Student Registry Help Desk provide the following services:

- Admissions, Registration, Exams and Conferring queries
- Prospectus pick up
- Replacement ID Cards
- Exam Transcript requests
- Course Withdrawal / Leave of Absence
- Validation and Stamping of Forms e.g. social welfare, medical card application
- Change of Name/ Change of Address requests
- Registration and Statements
- Employment and verification requests

Student Registry Help Desk: Location: Ground floor, Áras Uí Chathail, which is situated on the main campus. Tel: (091) 495999 / askregistry@universityofgalway.ie
Registered Students can visit the Front Desk service which is open Monday to Friday 9:30am-12:30pm & 1:30pm-4:00pm. Web link for further details as follows:
https://www.universityofgalway.ie/student-registry-helpdesk/

Useful Contact Numbers (http://www.universityofgalway.ie/about-us/contact-us/)

Student Registry Help Desk	(091) 495999
ISS Help Desk	(091) 495777
Admissions Office	(091) 495999
Accommodation & Welfare Office	(091) 493540
Disability Support Service	(091) 492813
Fees Office	(091) 492386
Health & Safety Office	(091) 492678
Campus Security / Emergency	(091) 493333
Student Counselling	(091) 492484
Student Health Unit	(091) 492604
Student's Union Shop	(091) 492411
General Emergency	999 / 112
Local Garda Station	(091) 538 000
Hospital (UHG)	(091) 524222
Samaritans	116 123 (freephone 24/7)

Student Support

For a summary of supports and services available to students, please click (Ctrl+Click) here

College of Science & Engineering Student Support Officer

Kelly Moore is the Student Support Officer in the College of Science & Engineering, and provides support for students during their time at university. The role of the Student Support Officer is to provide confidential, non-judgmental support and an empathetic space for students to share their concerns. In addition, a student advisor can offer personal support and advice on topics such as study planning, time management and any personal challenges that may compromise their ability to study. For further details please visit the following web link: https://www.universityofgalway.ie/cosestudentadvisor/

Student Support Officer: Location: Mondays, Wednesdays and Thursdays in Room 218, Arts/Science Concourse Building. Tuesdays in Room 1046, Alice Perry Engineering Building. Fridays available remotely via online meetings.
Direct Tel: 086 0834435 / Email: kelly.l.moore@universityofgalway.ie

2.3 Registration

Online registration opens on **Thursday, 15th August 2024** for postgraduate taught students. Details of relevant dates can be found on: (https://www.universityofgalway.ie/registration/quick-links/registration-dates/). Students will receive an email from Registration before online registration opens inviting students to register online. Students should register as soon as possible for their programme, and following receipt of an email from ISS, activate their University of Galway campus account (see paragraph 2.4 below). Further registration details can be found on: https://www.universityofgalway.ie/registration/.

MSc DA students who studied at University of Galway (National University of Ireland, Galway) before cannot register for modules (or equivalent modules) which they have already completed in a previous course at University of Galway (National University of Ireland, Galway). **Thus, former University of Galway/NUIG students need to contact the Programme Director by start of term if they have completed any of the MSc DA modules or equivalent modules already in a previous course at University of Galway (National University of Ireland, Galway). See Section 2.19 for further details.**

2.4 Activating your University of Galway Campus Account

New students will receive a welcome email from ISS "*Activating your new University of Galway campus account*" which will be sent to a student's personal email address following registration.

This email will provide students with a **University of Galway email address** and a **temporary activation password**. It also describes the steps new students need to take to activate their new University of Galway campus account. A campus account will allow students to access many important services during their time at University of Galway.

Further details on the steps to follow to activate a new student campus account can be found here: https://www.universityofgalway.ie/information-solutions-services/studentrecordssystem/studentaccess/newstudents/

For existing students, please follow the steps outlined in the following link: https://www.universityofgalway.ie/information-solutions-services/studentrecordssystem/studentaccess/existingstudents/

2.5 Student ID Cards

Students can collect their ID cards from the Student Reghelp Desks, first floor, Áras Uí Chathail from the start of term: https://www.universityofgalway.ie/registration/quick-links/id-cards/. Alternatively, students can request their ID card to be posted: https://www.universityofgalway.ie/registration/quick-links/id-cards/1styearpostgraduatestudentidcarddistribution/

2.6 Maps

University of Galway Campus maps can be located on the University's website at: https://www.universityofgalway.ie/buildings/maps/

2.7 Examinations

The Examinations Office posts all results to the home address of each candidate. It is the responsibility of students to ensure that their home address is correct on their record. Click on the link for info on how to register an address change. Please note you must allow 2 weeks for your change of address request to be processed.

Results

Results will **NOT** be given on the telephone to candidates, or to anyone acting on their behalf.

Examination Timetables

Examination timetables may be viewed on the University of Galway web page at the following address: https://www.universityofgalway.ie/exams/timetable-advice/examtimetable/. Students personalised timetables will be available on the WEB here on a date to be advised by the Exams Office and Exam Timetable and Amendments can only be accessed either On-Campus or via Remote Access.

Timetables will NOT be posted to students.

Please be advised:

- Check the Amendments page OFTEN as changes may occur up to the day of the exam.
- Revisions to timetables will be published only on the Examinations Office web page.
- Revisions to timetables will not be posted to individuals or appear on personal timetables.

Repeat, Appeals and Re-checks

Strict deadlines apply for appeals and re-checks and completed online application forms must be submitted to the Examinations Office by the relevant deadlines as detailed on the website links as follows: https://www.universityofgalway.ie/exams/results/appeals/ and https://www.universityofgalway.ie/exams/results/rechecks/. A fee must be lodged with both the Appeal and Re-check Forms. Fees are refunded if the outcome is positive. Further detailed information is provided in the above links.

Exam Board Sittings

The examinations board will sit in June and October where relevant examination, project and theses grades will be processed by the College of Science & Engineering.

Deferral of Exams

A guide for exam deferrals is available at:
https://www.universityofgalway.ie/exams/timetable-advice/deferrals/.
This guide is to assist students with the process and provides a direct link to the College of Science & Engineering's online specific Deferral Form.

2.8 Student Services

Coming to University is a major milestone in your life and a point of changeover in your life. You are facing into some challenges and many opportunities. You will encounter the enjoyment and challenges of independence and decision-making and responsibility for your own well-being and lifestyle.

Student Services is a team that are core to the personal and academic development of students. Student Services is under the management of the Vice President for the Student Experience. Student Services is committed to enhancing the individual student experience by providing an excellent service which supports the holistic development of the person, thereby enabling each student to achieve their full academic potential. Through valuing, recognising and supporting each staff member and by forging strong alliances within the University Community, Student Services will assist University of Galway to become a truly Student-Centred University.

Student Services provides many services as follows:

- Access Centre; Career Development Centre; Societies and Sports; Welfare and Wellbeing.

Further detailed information and contact details on all the Student Services offered by University of Galway may be found at: https://www.universityofgalway.ie/student-services/.

2.9 Student Counselling

The counselling service is part of a network of support services offered by University of Galway. It provides professional counselling, which is **free** and **confidential** to all students of University

of Galway. Life as a student is exciting and challenging, an achievement usually gained after much hard work and preparation. It can also be stressful at times. You may find you are experiencing personal difficulties which are affecting your ability to study and to take full advantage of the opportunities available to you at University of Galway. This is where student counselling can help. Student counselling are a team of qualified and experienced counsellors and psychotherapists. The service operates within the Code of Ethics and Practice agreed by their respective accrediting bodies including IACP, IAHIP and PSI. The services provided include:

- Pre-counselling assessment, individual counselling, and psychotherapy
- Group work
- Information and referral
- A consultation service for those who may have concerns about a student.

Further information including available online services and emergency contact details can be located on the following weblink: https://www.universityofgalway.ie/counsellors/

Counselling Services: Location: No. 5 Distillery Road, University of Galway
Direct Tel**:** 091 492484 Ext**.** 2484
E-mail**:** counselling@universityofgalway.ie

2.10 International Students

The **International Office** provide advice, information, and support service for all International Students. For incoming international students information is available on https://www.universityofgalway.ie/international-students/

All international students are strongly encouraged to attend English for Academic Purposes (EAP) classes which are specifically designed to equip international students with specific English skills to help them with their studies. Please refer to https://www.universityofgalway.ie/englishlanguage/ourcourses/ for more details.

The International Student Officer, Ms. Louise Kelly may be contacted at International Office, University of Galway. Tel 353 91 493581, E-mail: louise.kelly@universityofgalway.ie. Ms. Kelly acts as an identifiable point of contact with the various Student Services in the University to ensure that any problems of adjustment are minimised. She helps International Students adjust as quickly as possible to their new environment, so that they can derive maximum benefit and enjoyment from their life at University of Galway.

2.11 Computer Science Account and Swipe Card Access to Labs

The School of Computer Science has several undergraduate and postgraduate rooms which are available for use by our students. The rooms have hot swap desks, with laptop docking stations allowing use of external monitor, keyboard, mouse and the high-speed network. Students must provide their own laptops https://www.universityofgalway.ie/science-engineering/school-of-computer-science/currentstudents/laptops/. All students who are taking a module/course with the School of Computer Science are entitled to use the open access labs

in the CS Building outside of scheduled timetable use (Note: CSB-G001 is available to all University of Galway students using main University of Galway account). Depending on their course, they may also have swipe card access to further project rooms in the CS Building.

Computer Science students are also given access to print on our shared printers, and to use our web and database servers which can be used for course or project work. To gain access to these resources, students will be given Computer Science accounts automatically after a student registers for one of our modules/courses, and students will receive an email to their University of Galway email to indicate the account is ready for use. The initial password is included in the email. Students can login to our intranet to setup the web/database/linux resources https://web1.cs.universityofgalway.ie/intranet/

Students who have issues with their Computer Science computer account, docking stations, monitors or swipe card access in the Computer Science Building should log a call to Computer Science Technical officers at: support@cs.universityofgalway.ie. Useful links for further related info: https://www.universityofgalway.ie/science-engineering/school-of-computer-science/currentstudents/.

Students who have issues with their main University of Galway account, Wi-Fi, Canvas, personal laptops or any PC/printer on the rest of campus should refer to the University of Galway helpdesk: https://www.universityofgalway.ie/information-solutions-services/services-for-students/.

2.12 DISC - Computer Programming Drop-In Support Centre

Computer DISC is a Computer Programming Drop-In Support Centre for all University of Galway students who are taking any programming/software development courses. The DISC is a free service that supports all students with their self-directed learning in computing topics at all years and levels in University of Galway. The centre is located in room CSB-1001 on 1st floor of the Computer Science (CS) Building.

What services does Computer DISC provide to students?

- Facilities for students to sit and work on programming problems
- One-to-one advice and support for students, and focused small group tutorials
- Books, courseware, web links, and other learning resources for programming students
- A website with information and an email service for all queries
- Advice for students who wish to learn new programming languages autonomously
- Assistance with new technologies for project work such as Final Year Projects

DISC Website: https://www.universityofgalway.ie/science-engineering/school-of-computer-science/currentstudents/computerdisc/

2.13 Canvas

Canvas is the Virtual Learning Environment (VLE) used at University of Galway. Canvas is a modern, user-friendly VLE that allows students to access learning materials, reading lists, assessment information and other course-related content.
https://universityofgalway.instructure.com/

When a student registers for a course or module with the University of Galway, they are automatically enrolled on the corresponding course on Canvas. Enrolments are recognised by Canvas within 24 hours of registration. If students have problems accessing Canvas, they should contact the Library and IT Service Desk. The Service Desk can assist students with queries regarding problems with their password, e-mail account or logging in to Canvas.

If students are unable to see courses when they log into Canvas, they will need to check their registration statement to ensure they are correctly registered. Within Canvas, University of Galway students have access to 24x7x365 support via the Help menu. This Canvas support team can answer most queries related to the Canvas environment including how to submit assignments, how to see the gradebook, and where to access course materials. They also provide advice on how Canvas features can be used.

2.14 Plagiarism

Plagiarism refers to copying another author's work without due reference or acknowledgement of the author. Plagiarism is not acceptable. It is essential that the candidate acknowledge other people's work, when used by the student. The submitted work must be prepared by the candidate alone, and must be the result of the candidate's own effort, skills and knowledge. It is unacceptable for candidates to knowingly permit others to copy their work. Self-plagiarism (re-using own previously submitted content and passing it off as "new") is also not permitted. It is also not permitted to submit content for assessment which has been produced using Artificial Intelligence and claiming it as your own work. University of Galway has a strict code of practice for dealing with plagiarism, please refer to the following link for further details: https://www.universityofgalway.ie/plagiarism/.

2.15 Information Solutions and Services (ISS)

ISS aim to provide students with access to the ICT facilities which they need to succeed in their studies at University of Galway. These facilities include high speed Internet access, a University of Galway email account, access to the resources of the James Hardiman Library and assist with accessing Canvas, the virtual learning environment. These services are accessible from the on-campus PC suites and from suitably equipped laptops using the on-campus wireless network. A Campus Account (CASS) provides students access using a single User ID and Password to all computing services, other than E-mail. To activate your Campus Account *(see paragraph 2.4 above*), students should follow the instructions as outlined in the following weblink: https://www.universityofgalway.ie/information-solutions-services/studentrecordssystem/studentaccess/.

ISS Service Desk: Location: Ground floor of the James Hardiman Library
Contact by raising a service ticket: Service Desk Ticketing System
Direct Phone: 091 495777 or the Library & I.T. Service Desk: 091 495399

2.16 Career Development Centre

The Career Development Centre provides students at University of Galway with a quality career guidance and information service focused on facilitating and empowering students to manage their own career development and empowering students to make successful transitions towards fulfilling careers.

Details of the services provided to students by the Career Development Centre include:
Guiding students in their career journey through:

- One-to-one career guidance
- Career seminars and events
- Psychometric testing
- Dedicated careers information hub for students (on-campus and virtual)
- Self-guided modules

Connecting students with employers through:

- Jobs fairs and employer events
- Job vacancy system
- Networking opportunities

Helping students to compete in the jobs market to the best of their ability through:

- CV workshops, e-learning, and unlimited AI feedback
- Interview skills workshops, e-learning, and software to practice and improve
- Applications advice: including Postgraduate and Job Applications
- Employment skills workshops and employability award

Further information on the range of services provided by the Careers Development Centre can be found at: https://www.universityofgalway.ie/career-development-centre/

Career Development Centre: Location: Arts/Science Building (1st Floor)
Tel: +353 (0)91 493589

2.17 Out of Hours Working

Out of hours work refers to all University operations conducted outside normal hours.
For up to date details on the University's Safety Statement Policy and Out of Hours Working, please click on the following web link: University of Galway Safety Statement

2.18 Parking on Campus

Parking spaces in University of Galway fall into several categories:

- Staff Only; Student Only; Shared use (staff & student permit holders); Visitor/non-permit

holder; Pay-and-display/Pay by Phone (P&D) spaces; "Reserved" spaces and loading bays.

Student parking permits are available for registered students, details as below.

To purchase/renew your Student Parking Permit carefully read the instructions contained in the following guide PermitApplicationsGuide2024 then visit the Online Payment System to book your permit.

If you park in a "Pay and Display" space, you must buy a ticket from the nearby machines or use the Pay by Phone option and display your ticket on your dashboard face up, regardless of what other type of permit you might have. If you buy a P&D ticket, you can only park in spaces marked with blue lines and text ("P&D/Í&T").

A park and ride service operates from Dangan car park. Further information and timetable details are available from: Park & Ride Bus Timetable 2023.

Parking at University of Galway is operated by APCOA Ireland. If you have a parking related query, please contact: Ireland.permits@apcoa.ie / telephone: 0818 462899.

2.19 Library

The Student ID card also acts as a Library card. Students must have a current card in order to gain entrance to the Library. Details on the services provided by the library are available at Library - University of Galway. The Library and IT Service Desk are located on the ground floor of the library and provides advice and support to students on both Library and IT services (e.g., User ID/passwords, book loans, printing Wi-Fi access).

2.20 Module Descriptions

Modules – Semester I

1CSD	Modules	
Core	CT4100 Information Retrieval	Credits: 5
Core	CT5120 Introduction to Natural Language Processing	Credits: 5
Core	CT5165 Principles of Machine Learning	Credits: 5
Core	CT5102 Programming for Data Analytics	Credits: 5
Optional	CT5105 Tools & Techniques for Large Scale DA	Credits: 5
Optional	MP305 Modelling I	Credits: 5
Optional	ST2001 Statistics for Data Science 1	Credits: 5
Optional	ST311 Applied Statistics I	Credits: 5
Optional	CT561 Systems Modelling and Simulation	Credits: 5
Optional	MA284 Discrete Mathematics	Credits: 5
Optional	EE551 Embedded Image Processing	Credits: 5

Note: In the event that students have previously taken one of these modules as a University of Galway student, then you cannot enroll again in a module that you have previously been awarded credits for. Students that are affected can select from the other optional modules offered on the syllabus.

CT4100 Information Retrieval *(students who completed CT4100 or CT422 "Modern Information Management" at University of Galway (NUI Galway) before cannot take CT4100 in the MSc DA and must contact the Programme Director to get it replaced.)*
The course introduces some of the main theories and techniques in information retrieval. The main models and their strengths and limitations are covered. Approaches to designing and analysing weighting schemes are studied. Practical approaches to design algorithms for efficient retrieval are covered. Several sub-areas are covered: web search, recommender systems, relevance feedback, clustering, and learning approaches are also included.

CT5120 Introduction to Natural Language Processing
Natural Language Processing (NLP) is concerned with the automatic analysis, interpretation and annotation of textual data. Applications of NLP are in the extraction of information from text, linking text to databases or other structured knowledge, classification, summarization, translation and generation of text, etc. This module introduces students to the field of NLP,

including linguistic, statistical and machine learning foundations, primary challenges and approaches to the syntactic and semantic analysis of textual data, and applications in summarization, chatbot development, knowledge extraction and opinion mining. The course ends with a discussion of ethical aspects in NLP.

CT5165 Principles of Machine Learning (*students who completed module CT4101 before do take CT5165 in the MSc DA since both modules are sufficiently different. But students who completed any other University of Galway (NUI Galway) Machine Learning module before need to contact the Programme Director who will then decide if CT5165 will need to be replaced.*)

Machine Learning is concerned with algorithms that improve their performance over time, as they are exposed to new data. This module introduces learners to the different categories of machine learning tasks and provides in-depth coverage of important algorithms for tackling them. Its focus is on the theory underlying ML algorithms. In addition, the learners gain experience of implementing algorithms from scratch, as well as using ML software tools to select and apply these algorithms in applications, and they evaluate and interpret the results. Topics include: 1. Overview of Machine Learning & Major Categories of Task 2. Supervised Learning Principles and Information-Based Learning 3. Similarity-Based Learning 4. Evaluating Classifier Performance, Practical Advice, and Some Machine Learning Tools 5. Linear Regression in One and Multiple Variables 6. Linear Classifiers with Hard and Soft Thresholds 7. Probabilistic Machine Learning

CT5102 Programming for Data Analytics

This module will introduce programming for data analytics using open-source programming tools. It will focus on the R programming language and its associated powerful frameworks for data manipulation, analysis and visualisation such as *caret* and *ggplot*. Topics will include R programming fundamentals, Data Loading, Data cleaning transformation and merging, Exploratory Data analysis and visualisation, use of machine learning libraries for regression, time series and classification operations.

CT5105 Tools and Techniques for Large Scale Data Analytics

Prerequisite for selecting CT5105: Existing knowledge of foundational Java.

Large-scale data analytics is concerned with the processing and analysis of large quantities of data, typically from distributed sources (such as data streams on the internet). This module introduces students to state-of-the-art approaches to large-scale data analytics. Students learn about foundational concepts, software tools and advanced programming techniques for the scalable storage, processing and analysis of high- volume and high-velocity data, and how to apply them to practical problems.

** This module uses Java as programming language. Knowledge of Java is a prerequisite for participation in this module. **

Planned topics include: Definition of large-scale computational data analytics; Overview of approaches to the processing and analysis of high volume and high velocity data from distributed sources; Applications of large-scale data analytics; Foundations of cluster computing and parallel data processing; Introduction of selected relevant frameworks (e.g., Apache Hadoop and Spark). MapReduce; Advanced programming concepts for large-scale data analytics; Concepts and tools for large-scale data storage; Stream data analytics; Event Processing; Techniques and open-source tools for large-scale analytics; Computational statistics and machine learning with large-scale data processing frameworks such as Spark. Columnar data storage.

MP305 Modelling I

This course introduces the student to modelling techniques for four different real-world problems. The problems cover the topics network-flow optimisation, activity networks, network analysis and game theory.

ST2001 Statistics for Data Science 1

The course provides an introduction to probabilistic and statistical methods needed to make reasonable and useful conclusions from data. Topics include probabilistic reasoning, data generation mechanisms, modern techniques for data visualisation, inferential reasoning and prediction using real data and the principles of reproducible research. The course will rely heavily on R (a free open-source language) and will include examples of datasets collected in a variety of domains.

ST311 Applied Statistics I

An introduction to methods and applications in applied statistical inference. This module is offered as an optional module, building on the statistical inferential methods demonstrated in pre-requisite module ST238/ST2002 or similar modules. Various non-parametric hypothesis tests are demonstrated and a comparison of suitability of applying non-parametric and parametric methods is discussed. The module also builds on regression modelling, where topics covered include model estimation, model checking and inference for simple linear regression and multiple linear regression models, and procedures in variable selection. Models discussed are applicable for a single quantitative response with quantitative and/or qualitative predictors.

CT561 Systems Modelling and Simulation

Simulation is a quantitative method used to support decision making and predicting system behaviour over time. This course focuses the system dynamics approach. The course covers the fundamentals of simulation, and describes how to design and build mathematical models. Case studies used include: software project management, public health policy planning, and capacity planning.

MA284 Discrete Mathematics

This course covers topics in combinatorics, graph theory, and their applications. Section titles are as follows. Addition and multiplication principles; Permutations and combinations; Ordered and unordered selections with repetition; Inclusion and Exclusion; Graph isomorphism, subgraphs, connectedness; Vertex colouring; Planarity; Trees.

EE551 Embedded Image Processing (students who completed EE551 before at University of Galway (NUI Galway) cannot take this module in the MSc AI again and need to select a different optional module instead.)
This module covers the concepts and technology that are central to embedded image processing. The course material is supported by practical examples and laboratories/assignments using Python software.

Prerequisites for taking EE551:(1) Knowledge of signal and system analysis including Fourier analysis and filtering. Knowledge of matrix algebra. (2) Knowledge of Python would be an advantage.

Modules – Semester II

1CSD	Modules	
Core	CT5108 Data Analytics Project	Credits: 30
Core	CT5133 Deep Learning	Credits: 5
Core	CT5113 Web and Network Science	Credits: 5
Core	CT5100 Data Visualisation	Credits: 5
Core	CT5103 Case Studies in Data Analytics	Credits: 5
Optional	CT5121 Advanced Topics in Natural Language Processing	Credits: 5
Optional	CT5166 Knowledge Graphs	Credits: 5
Optional	ST2002 Statistics for Data Science 2	Credits: 5
Optional	ST312 Applied Statistics II	Credits: 5

Note: In the event that students have previously taken one of these modules as a University of Galway student, then you cannot enroll again in a module that you have previously been awarded credits for. Students that are affected can select from the other optional modules offered on the syllabus.

CT5108 Data Analytics Project

On successful completion of this module the learner will be able to apply a variety of data analytic techniques to solve a real-world problem diagnose a problem and design a data-analytics based solution conduct and report on exploratory analysis of the problem domain produce an in-depth report (thesis) describing the problem, the diagnosis and approaches to solving it demonstrate that they can research, apply and evaluate state-of-the-art techniques in data-analysis. This project requires a demonstration of in-depth analysis, problem solving and reporting of a data analytic problem.

CT5133 Deep Learning

This is an advanced module in machine learning, focusing on neural networks (NNs), deep NNs, and connectionist computing. Students learn about the basic principles and building blocks of deep learning, and how to implement a deep neural network 'from scratch'. They also learning about software libraries and tools, and gain experience of applying deep learning in a range of practical applications. The module includes substantial practical programming assignments. This module is intended for students who have completed a first course in machine learning, such as CT475, and already have a good grounding in supervised learning topics including: classification and regression; evaluation of classifiers; overfitting and underfitting; basic algorithms such as k-nearest neighbours, decision tree learning, logistic regression, and gradient descent.

CT5113 Web and Network Science

This module will provide the student with the skills to extract, clean and analyse data from the Web. The focus will be graph and network analytic approaches to Web-mining. Topics include: graph theory, network modelling, social network analysis, community-finding techniques, models of information diffusion, link prediction, evaluation techniques. There will be practical sessions on using graph-data bases and graph visualisation tools such as Gephi. The student will learn how to apply Web mining techniques to applications such as recommender systems, adaptive personalisation, authority ranking.

CT5100 Data Visualisation

This module with teach the fundamentals of data visualization. It will cover basic design principles and the principles underlying human perception, colour theory and narrative. It will focus on the use of open standards for the presentation of data on the Web such as HTML, CSS, SVG, JavaScript using libraries such as D3.js, jQuery.js and Dimple.js.

CT5103 Case Studies in Data Analytics

Case studies will be presented as standalone blocks by practitioners, researchers and academics in areas that are considered relevant to many real-world problems that may be encountered by graduates of the programme. Students are expected to use this module to conceptualise the problems involved in their end -of-year project.

CT5121 Advanced Topics in Natural Language Processing

Advanced topics in natural language processing, including deep learning for NLP, machine translation and language resources. This module covers topics in the following areas: * Use of neural networks, deep learning and large language models for solving NLP tasks * Advanced NLP techniques including textual similarity, event extraction and question answering. * Multilingual and multimodal NLP techniques including machine translation * Applications of NLP in digital humanities, legal NLP, language learning or other similar areas

CT5166 Knowledge Graphs

Knowledge graphs are a fundamental part of many enterprise systems and this module will teach the fundamentals for working with knowledge graphs. This will focus on how knowledge graphs can be applied in enterprise and students will learn about the data models for knowledge graphs (including semantic web standards such as RDF), reasoning over knowledge graphs, linked open data, knowledge graphs in enterprise, knowledge graph extraction and knowledge graph linking. As such this module will teach the general principles of knowledge graphs alongside the technical tools used for these. This module will also build on techniques from artificial intelligence and natural language processing to show how automatic tools can create and manipulate knowledge graphs.

ST2002 Statistics for Data Science 2

This course will introduce commonly used techniques in statistics when analysing data from experiments and observational studies. Topics include classical and modern methods in interval

estimation, regression models for prediction problems, modern approaches for visualising multivariate data and the principles of reproducible research.

ST312 Applied Statistics II

Methods and applications in applied statistical inference. This module discusses factors for consideration in experiment design and demonstrates methods in the analysis of data emerging from designed experiments. Topics covered include confounding, blocking, a completely randomized design and a randomized block design, two-way ANOVA. The module also demonstrates regression modelling for a qualitative response, i.e. methods in logistic regression and generalized linear models.