Programme Specification (Undergraduate) FOR ENTRY YEAR: 2021/22

Date created: 06/12/2023 **Last amended:** 06/12/2023 **Version no.** Choose an item.

1. Programme title(s) and code(s):

BSc Mathematics and Artificial Intelligence

BSc Mathematics and Artificial Intelligence with a year in industry

a) HECOS Code

HECOS Code	%
100403 (mathematics)	15
100400 (applied mathematics)	15
100402 (mathematical modelling)	5
100404 (operational research)	5
101032 (probability)	5
100406 (statistics)	10
101034 (statistical modelling)	5
100956 (programming)	10
100359 (artificial intelligence)	15
100992 (machine learning)	15

b) UCAS Code (where required)

G108

2. Awarding body or institution:

University of Leicester

3. a) Mode of study

Full-time

b) Type of study

Campus-based

4. Registration periods:

BSc Mathematics and Artificial Intelligence

The normal period of registration is 3 years

The maximum period of registration 5 years

BSc Mathematics and Artificial Intelligence with a Year in Industry

The normal period of registration is 4 years

The maximum period of registration 6 years

5. Typical entry requirements

ABB including an A in A-Level Mathematics.

6. Accreditation of Prior Learning

APL will not be accepted for exemptions from individual modules, however may be considered for direct entry to year 2, on a case by case and subject to the general provisions of the University APL policy.

7. Programme aims

The programme aims to

- foster confidence, convey knowledge and develop expertise in mathematics, including an appreciation of the usefulness of mathematics;
- provide an education and training in mathematics which includes fundamental concepts and gives an indication of the breadth of mathematics;
- develop an appreciation of the necessity for rigorous justification of assertions and the need for logical arguments;
- develop the ability to model the world using mathematics, and to be able to produce relevant and robust solutions to real world problems;
- The skills and experience to write and use software applications.
- An understanding of programming paradigms and software development methods.
- A knowledge of the theory and concepts that underpin Mathematics and Computer Science.
- An ability to model and understand complex data and use it to solve problems.
- To select and apply appropriate tools (technical and analytical) to solve novel, data-related problems, in particular using machine learning and other AI systems.
- enable students to develop self-confidence gained through the provision of careful guidance in the first level, with increasing independence later;
- improve students' team working skills;
- stimulate intellectual development and develop powers of critical analysis, problem solving, written communication skills and improve presentational skills;
- develop the ability to communicate solutions to problems and mathematical concepts in general using language appropriate to the target audience;
- develop competence in IT and the use of mathematical software and programming, applying them to the analysis and use of AI systems;
- enhance practical computing skills by learning software in common use;
- raise students' expertise and understanding to a point where they could embark upon postgraduate study in mathematics and AI;
- develop the ability to complete independent project related to the development, analysis and use of AI systems;

In addition to the aims above, the "with Industry" variant of the programme aims to:

- place students on challenging and relevant industrial placements;
- enable students to use and develop the knowledge and skills gained during the taught part of the programme; and
- develop students' career management and development skills.

For Foundation Year variant, see Foundation Year Programme Specification

8. Reference points used to inform the programme specification

- QAA Framework for Higher Education Qualifications in England, Wales and Northern Ireland
- QAA Benchmarking Statement Mathematics, Statistics and Operational Research (MMath)
- QAA Annex to subject benchmark statement: Mathematics, statistics and operational

research (2015)
- PDR report (April 2011)
- University Learning Strategy
- University Assessment Strategy
- University Employability Strategy
- NSS Survey
- First Destination Survey
- External Examiner's Reports

9. Programme Outcomes

Unless otherwise stated, programme outcomes apply to all awards specified in 1. Programme title(s).

a) Discipline specific knowledge and competencies

i) Mastery of an appropriate body of knowledge

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Knowledge of basic theory, basic techniques of analysis, algebra, applied mathematics, and statistics.	Lectures, specified reading, problem classes, surgeries, poster presentations. In addition, elements of e-Learning are incorporated.	Written examinations, assessed written and computational problems. Assessed oral and poster presentations.
Ability to recognise sound arguments and valid proofs.	As above.	Assessed written projects and problem sheets, and seminar discussions.
Knowledge of basic techniques, and model problems.	As above.	Assessed practical classes.
Knowledge of a computing language and software.	Computer practical classes.	Final year project.
Recall and *describe* Mathematical and Computer Science techniques relevant to the field of Mathematics and Artificial Intelligence.	With industry variant: Use of software packages on placement	With industry variant: Assessed case studies and short projects. Specific projects undertaken on placement where applicable Placement reports

ii) Understanding and application of key concepts and techniques

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Novel applications of basic knowledge. Exposition of logical structure. Ability to generalise and specialise.	Lectures, tutorials, problem classes, marked assignments.	Written examination, assessed problems, project report.
Proof techniques. Ability to apply an algorithm for the solution of a standard problem. Ability to apply theorems to solve particular problems.	Lectures, tutorials, problem classes, marked assignments.	Written examinations, assessed problems.

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Mathematical modelling. Application of computer algorithms for solving problems in machine learning and AI.	Computer practical classes.	Assessed practical classes.
With industry variant: Applications of mathematical theory in an industrial setting	With industry variant: Specific projects undertaken on placement where applicable	With industry variant: Placement reports
Apply knowledge of Computer Science and Mathematical techniques to solve problems relevant to the fields of Mathematics and AI.	Working through exercises in industrial placement record book. Specific projects undertaken on placement	Industrial placement record book including formal report on placement.

iii) Critical analysis of key issues

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Analysis of problem and selection of appropriate proof or solution strategy. Critical appraisal of solutions. Analyse and solve more 'messily defined' finance management problems. Analysis of IT problems.	Lectures, problem classes, feedback on assessed problems, project supervision.	Written examinations, assessed problems, Project report.
With industry variant: Analysis of how projects are set up and managed within an industrial setting	With industry variant: Working through exercises in industrial placement record book. Specific projects undertaken on placement where applicable	With industry variant: Industrial placement record book including formal report on placement.

iv) Clear and concise presentation of material

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Presentation of results (both informal and to a variety of audiences), participation in scientific discussion.	Tutorials, Group workshops, Presentation workshops, project supervision. Feedback on assessed written pieces.	Group presentations. Project presentations.
Ability to write coherent reports. Software presentation.	Guidance from project supervisor.	Assessed essays. Project presentation.
With industry variant: Presentation of mathematical ideas to a mixed audience (i.e. not all mathematically-trained) within an industrial setting	With industry variant: Working through exercises in industrial placement record book. Specific projects undertaken on placement where applicable	With industry variant: Specific projects undertaken on placement where applicable Assessed essays. Project presentation. Industrial placement record book including formal report on placement

v) Critical appraisal of evidence with appropriate insight

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Project design.	Project supervision	Project reports.

vi) Other discipline specific competencies

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Knowledge of mathematical, AI, and data analytics software such as Python, R, MATLAB and Frameworks such as Tensorflow.	Lab classes, and purpose designed handbooks.	Assessed problems, projects.
Mathematical modelling skills. Language of data analytics	Group projects. Project and lectures, e-Learning. With industry variant: Use of software packages on placement	Project reports. Written examinations and presentations. With industry variant: Industrial placement record book including formal report on placement

b) Transferable skills

i) Oral communication

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Present technical information to peers and tutors in an appropriate form, and deliver presentations to non-mathematical audiences	Tutorials, workshops.	Presentation assessment.
Respond to questions on presentations	Project supervision, presentation workshops. With industry variant: Presentation opportunities on placement where applicable	As above. With industry variant: Industrial placement record book including formal report on placement
Project and poster presentation	As above.	As above.
Demonstrate fluent and sustained scientific, technical and business communication.	As above.	As above.
Respond to technical questions with accurate and concise answers.	As above.	As above.

ii) Written communication

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Report writing.	Project supervisions.	Assessed reports.
Mathematical communication	Tutorials.	Assessed questions.

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
With industry variant: Presenting technical information to peers and tutors in an appropriate form and communicating technical information and mathematical arguments in an appropriate form for a given audience	With industry variant: Opportunities for written reports while on placement. Formal placement report.	With industry variant: Industrial placement record book including formal report on placement

iii) Information technology

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Use of Windows and Linux, when appropriate. Use of specialist software packages and frameworks. Office software.	Induction. Laboratories.	Marked project work. Project reports
To understand and articulate the limitations of Information Technology, especially when storing and processing large quantities of data.	As above.	Assessed coursework.
With industry variant: Office software including mathematical software	With industry variant: Use of specialist packages on placement	With industry variant: Industrial placement record book including formal report on placement

iv) Numeracy

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Use of analytical and graphical methods.	Induction. Laboratories. With industry variant: Use of specialist packages on placement	Written examinations, project reports. With industry variant: Use of analytical and graphical methods on placement

v) Team working

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Scientific discussion. Communicate effectively with other team members. Organisation, time management	Group problem solving. Group projects.	Group assessment (including peer assessment).

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
With industry variant: Team working in an industrial setting (*with industry*) • Work with other team members to identify, distribute and undertake tasks necessary to complete a project • Communicate effectively with other team members to ensure effective operation of the team • Demonstrate ability to choose a format and communication appropriate to your work environment	With industry variant: Experience of working within a commercial organization. Working through exercises in industrial placement record book. Specific projects undertaken on placement where applicable	With industry variant: Industrial placement record book including formal report on placement.

vi) Problem solving

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Analysis, breakdown, synthesis, critical examination. Mathematical modelling skills.	Lectures, problem workshops, group work, projects.	Marked problems, assessed group work, project assessment.
Solve a variety of small and large problems through the integration of knowledge of Mathematics, and Computer Science.	As above.	As above.
Students can describe a systematic approach to analysing and solving data-science problems and apply these to new problems	As above.	As above.
Learn to solve novel problems creatively.	As above.	As above.
With industry variant: Problem analysis and solution for `messily defined' problems in an industrial setting.	With industry variant: Experience of working within a commercial organization. Working through exercises in industrial placement record book. Specific projects undertaken on placement where applicable.	With industry variant: Industrial placement record book including formal report on placement.

vii) Information handling

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Conduct background research and literature surveys. Summarise content from information sources.	Project supervision. With industry variant: Experience of working within a commercial organization at a distance	Individual and group project reports. Some assessed material only provided through e-learning resources. With industry variant: Industrial placement record book including formal report on placement
Demonstrate a broad understanding of problems and issues that arise in the location, organization, processing and evaluation of data.	As above.	As above.
Ability to gather and evaluate information to independently gain new knowledge.	As above.	As above.

viii) Skills for lifelong learning

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
Study skills.	Resource based learning. Study skills booklet.	Examinations, assessed problems, project assessments. Meeting deadlines. Project reports. Destinations data. With industry variant: Industrial placement record book including formal report on placement Successful feedback from placements.
Demonstrate knowledge and understanding of professional and ethical issues, and aspects of the law, in the context of Computing Professionals.	Structured support decreasing through years. Guest speakers.	As above.
Make and justify decisions based on the sustainability (e.g. ecological impact) of a proposed solution.	Induction library session. Study skills handbook. Project supervision.	As above.
Develop and implement personal plan of work to meet a deadline. Independence and time management. Careers and business awareness.	As above. With industry variant: Experience of working within a commercial organisation	As above.

10. Progression points

This programme follows the standard Scheme of Progression set out in Senate Regulations – see the version of Senate Regulation 5 governing undergraduate programmes relevant to the year of entry.

For the 'with industry' variant:
In cases where a student has failed to meet a requirement to progress he or she will be required to withdraw from the course.
Students will revert to the degree without industry version of their course if:

- they fail to acquire a placement; or
- they fail any modules requiring re-sits in the placement year, unless subject to mitigation; or
- their credit-weighted average for year 2 is less than 50%; or
- they fail to pass the assessment related to the placement; or
- the placement is terminated through no fault of the student after less than 9 months and no suitable alternative placement can be found.

In the event that a module requires a re-sit with mitigation (i.e. is uncapped), and the student has met all the other criteria, arrangements will be made for the student to re-sit the module and continue with the placement secured.

For students on all variants of the degree, cases where a student has failed to meet a requirement to progress he or she will be required to withdraw from the course.

a) Course transfers

Programme structure admits transfer from this degree to BSc or MMath Mathematics after successful completion of Year 1.

11. Criteria for award and classification

This programme follows the standard scheme of undergraduate award and classification set out in Senate Regulations – see the version of *Senate Regulation 5 governing undergraduate programmes* relevant to the year of entry.

12. Special features

While this programme provides the skills and knowledge required to develop machine learning algorithms for data analysis within industry or research, it provides a foundational knowledge of mathematics and computational skills that will allow students to graduate into a wide range of roles.

This programme offers a 'with industry' variant. This allows students to take a placement between their 2nd and their final year and provides additional support before, during and after the placement. All students can transfer from the standard Mathematics and AI degree onto the with-industry option at any point before the start of the 2nd year, in line with the progression rules described above. Year in Industry takes place between second and third years.

13. Indications of programme quality

- The programme will be subject to standard University of Leicester procedures for quality assessment, including Annual Developmental Review, Periodic Developmental Review, Quality Office review, liaison with College Academic Committee, and the programme will report to the Mathematics and Informatics departments' Learning and Teaching Committees.

- An External Examiner will be appointed according to Senate regulations 7.18-7.60.

- There will be systematic, regular evaluation by students registered with the programme,

including anonymous evaluation of sessions and modules.

- A representative from this programme (both with and without industry variants) will be appointed to each of the Student Staff Committees for Mathematics and Informatics Departments (1 rep goes to each).

- The programme's teaching staff will engage with University procedures for peer assessment of teaching and marking.

14. External Examiner(s) reports

The details of the External Examiner(s) for this programme and the most recent External Examiners' reports for this programme can be found at exampapers@Leicester [log-in required]

UNIVERSITY OF LEICESTER

Programme Specification (Undergraduate) FOR ENTRY YEAR: 2021/22

Date created: 06/12/2023 **Last amended:** 06/12/2023 **Version no.** Choose an item.

Appendix 1: Programme structure (programme regulations)

The University regularly reviews its programmes and modules to ensure that they reflect the current status of the discipline and offer the best learning experience to students. On occasion, it may be necessary to alter particular aspects of a course or module.

BSc Mathematics and Artificial Intelligence

Level 4/Year 1 2022/23

Credit breakdown

Status	Year long	Semester 1	Semester 2
Core	60 credits	30 credits	30 credits
Optional	n/a	n/a	n/a

120 credits in total

Core modules

Delivery period	Code	Title	Credits
Year long	MA1014	Calculus & Analysis	30 credits
Year long	MA1114	Linear Algebra	30 credits
Sem 1	MA1061	Probability	15 credits
Sem 1	CO1102	Programming Fundamentals	15 credits
Sem 2	MA1202	Introductory Statistics	15 credits
Sem 2	CO1107	Algorithms, Data Structures and Advanced Programming	15 credits

Notes

Core: 75% Maths modules, 25% Informatics modules

Level 5/Year 2 2023/24

Credit breakdown

Status	Year long	Semester 1	Semester 2
Core	n/a	60 credits	45 credits
Optional	n/a	n/a	15 credits

120 credits in total

Core modules

Delivery period	Code	Title	Credits
Sem 1	MA2032	Vector Calculus	15 credits
Sem 2	MA2041	Mathematical Foundations of AI and Machine Learning	15 credits
Sem 1	MA2132	Advanced Linear Algebra	15 credits
Sem 1	MA2403	Statistical Distributions and Inference	15 credits
Sem 2	MA2021	Differential Equations and Dynamics	15 credits
Sem 1	MA2042	Advanced Discrete Mathematics	15 credits
Sem 2	MA2206	Statistical Data Analysis	15 credits

Notes
100% Maths modules

Option modules

Delivery period	Code	Title	Credits
Semester 2	MA2133	Algebra	15 credits
Semester 2	MA2511	Business Applications of Mathematics	15 credits

Delivery period	Code	Title	Credits
Semester 2	CO2106	Data Analytics	15 credits

Notes
This is an indicative list of option modules and not definitive of what will be available. Option module choice is also subject to availability, timetabling, student number restrictions and, where appropriate, students having taken appropriate pre-requisite modules.

Level 6/Year 3 2024/25

Credit breakdown

Status	Year long	Semester 1	Semester 2
Core	30 credits	30 credits	30 credits
Optional	n/a	15 credits	15 credits

120 credits in total

Core modules

Delivery period	Code	Title	Credits
Year long	MA3582	Maths and AI Project	30 credits
Sem 1	MA3077	Operational Research	15 credits
Sem 1	MA3081	Machine Learning for Data Analysis and AI	15 credits
Sem 2	MA3022	Data Mining and Neural Networks	15 credits
Sem 2	MA3082	Nonlinear Optimisation (Operational Research 2)	15 credits

Notes
100% Maths modules

Option modules

Delivery period	Code	Title	Credits
Semester 1	CO3091	Computational Intelligence and Software Engineering	15 credits
Semester 1	CO3101	Computers, Society & Professionalism	15 credits
Semester 1	MA3012	Scientific Computing	15 credits
Semester 2	CO3002	Analysis and Design of Algorithms	15 credits
Semester 2	MA3201	Generalised Linear Models	15 credits
Semester 2	MA3202	Introduction to Functional Data Analysis	15 credits

Notes

This is an indicative list of option modules and not definitive of what will be available. Option module choice is also subject to availability, timetabling, student number restrictions and, where appropriate, students having taken appropriate pre-requisite modules.

Appendix 2: Module specifications

See undergraduate module specification database (Note - modules are organized by year of delivery).

Appendix 3: Skills matrix