

**1. Programme Title(s) and UCAS code(s):**

- a) BSc Mathematics and Artificial Intelligence (G108)  
BSc Mathematics and Artificial Intelligence with a year in industry

b) [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

- c) UCAS Code (*where required*)

**2. Awarding body or institution:**

University of Leicester

**3. a) Mode of study:**

Full-time

**b) Type of study:**

On campus

**4. Registration periods:**

The normal period of registration is three years (4 years for “With Industry” variants)

The maximum period of registration is five years (6 years for “With Industry” variants)

**5. Typical entry requirements:**

ABB including an A in A-Level Mathematics.

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## **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;

For the Year in Industry variant only, these additional programme aims apply:

- Prepare students for career and training opportunities which relates to their degree – in both the private and public sectors, and voluntary organisations.
- Construct effective applications for placement opportunities.

Provide students the opportunity to recognise suitable plans for transitioning into the workplace.

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

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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:**

<b>Intended Learning Outcomes</b>	<b>Teaching and Learning Methods</b>	<b>How Demonstrated?</b>
<b>(a) Discipline specific knowledge and competencies</b>		
<b>(i) Mastery of an appropriate body of knowledge</b>		
<p>Knowledge of basic theory, basic techniques of analysis, algebra, applied mathematics, and statistics.</p> <p>Ability to recognise sound arguments and valid proofs.</p> <p>Knowledge of basic techniques, and model problems.</p> <p>Knowledge of a computing language and software.</p> <p><i>Recall and describe</i> Mathematical and Computer Science techniques relevant to the field of Mathematics and Artificial Intelligence.</p>	<p>Lectures, specified reading, problem classes, surgeries, poster presentations. In addition, elements of e-Learning are incorporated.</p> <p>Computer practical classes.</p> <p>With industry variant: Use of software packages on placement</p>	<p>Written examinations, assessed written and computational problems. Assessed oral and poster presentations.</p> <p>Assessed written projects and problem sheets, and seminar discussions.</p> <p>Assessed practical classes.</p> <p>Final year project.</p> <p>With industry variant: Assessed case studies and short projects.</p> <p>Specific projects undertaken on placement where applicable</p> <p>Placement reports</p>
<b>(ii) Understanding and application of key concepts and techniques</b>		
<p>Novel applications of basic knowledge. Exposition of logical structure. Ability to generalise and specialise.</p> <p>Proof techniques. Ability to apply an algorithm for the solution of a standard problem. Ability to apply theorems to solve particular problems.</p> <p>Mathematical modelling. Application of computer algorithms for solving problems in machine learning and AI.</p> <p>With industry variant: Applications of mathematical theory in an industrial setting</p> <p><i>Apply</i> knowledge of Computer Science and Mathematical techniques to solve problems relevant to the fields of Mathematics and AI.</p>	<p>Lectures, tutorials, problem classes, marked assignments.</p> <p>Lectures, tutorials, problem classes, marked assignments.</p> <p>Computer practical classes.</p> <p>With industry variant: Specific projects undertaken on placement where applicable</p> <p>Working through exercises in industrial placement record book. Specific projects undertaken on placement</p>	<p>Written examination, assessed problems, project report.</p> <p>Written examinations, assessed problems.</p> <p>Assessed practical classes.</p> <p>With industry variant: Placement reports</p> <p>Industrial placement record book including formal report on placement.</p>

Intended Learning Outcomes	Teaching and Learning Methods	How Demonstrated?
<b>(iii) Critical analysis of key issues</b>		
<p>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.</p> <p>With industry variant: Analysis of how projects are set up and managed within an industrial setting</p>	<p>Lectures, problem classes, feedback on assessed problems, project supervision.</p> <p>With industry variant: Working through exercises in industrial placement record book. Specific projects undertaken on placement where applicable</p>	<p>Written examinations, assessed problems, Project report.</p> <p>With industry variant: Industrial placement record book including formal report on placement.</p>
<b>(iv) Clear and concise presentation of material</b>		
<p>Presentation of results (both informal and to a variety of audiences), participation in scientific discussion.</p> <p>Ability to write coherent reports. Software presentation.</p> <p>With industry variant: Presentation of mathematical ideas to a mixed audience (i.e. not all mathematically-trained) within an industrial setting</p>	<p>Tutorials, Group workshops, Presentation workshops, project supervision. Feedback on assessed written pieces.</p> <p>Guidance from project supervisor.</p> <p>With industry variant: Working through exercises in industrial placement record book. Specific projects undertaken on placement where applicable</p>	<p>Group presentations. Project presentations.</p> <p>Assessed essays. Project presentation.</p> <p>With industry variant: Specific projects undertaken on placement where applicable Assessed essays. Project presentation.</p> <p>Industrial placement record book including formal report on placement</p>
<b>(v) Critical appraisal of evidence with appropriate insight</b>		
Project design.	Project supervision	Project reports.
<b>(vi) Other discipline specific competencies</b>		
<p>Knowledge of mathematical, AI, and data analytics software such as Python, R, MATLAB and Frameworks such as Tensorflow.</p> <p>Mathematical modelling skills. Language of data analytics</p>	<p>Lab classes, and purpose designed handbooks.</p> <p>Group projects. Project and lectures, e-Learning.</p> <p>With industry variant: Use of software packages on placement</p>	<p>Assessed problems, projects.</p> <p>Project reports. Written examinations and presentations.</p> <p>With industry variant: Industrial placement record book including formal report on placement</p>

**(b) Transferable skills****(i) Oral communication**

<p>Present technical information to peers and tutors in an appropriate form, and deliver presentations to non-mathematical audiences</p> <p>Respond to questions on presentations</p> <p>Project and poster presentation</p> <p>Demonstrate fluent and sustained scientific, technical and business communication.</p> <p>Respond to technical questions with accurate and concise answers.</p>	<p>Tutorials, workshops.</p> <p>Project supervision, presentation workshops.</p> <p>With industry variant: Presentation opportunities on placement where applicable</p>	<p>Presentation assessment.</p> <p>With industry variant: Industrial placement record book including formal report on placement</p>
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**(ii) Written communication**

<p>Report writing.</p> <p>Mathematical communication</p> <p>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</p>	<p>Project supervisions.</p> <p>Tutorials.</p> <p>With industry variant: Opportunities for written reports while on placement. Formal placement report.</p>	<p>Assessed reports.</p> <p>Assessed questions.</p> <p>With industry variant: Industrial placement record book including formal report on placement</p>
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**(iii) Information technology**

<p>Use of Windows and Linux, when appropriate. Use of specialist software packages and frameworks. Office software.</p> <p>To understand and articulate the limitations of Information Technology, especially when storing and processing large quantities of data.</p> <p>With industry variant: Office software including mathematical software</p>	<p>Induction. Laboratories.</p> <p>With industry variant: Use of specialist packages on placement</p>	<p>Marked project work. Project reports</p> <p>Assessed coursework.</p> <p>With industry variant: Industrial placement record book including formal report on placement</p>
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**(iv) Numeracy**

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
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**(v) Team working**

<p>Scientific discussion. Communicate effectively with other team members. Organisation, time management</p> <p>With industry variant: Team working in an industrial setting (<i>with industry</i>)</p> <ul style="list-style-type: none"> <li>• Work with other team members to identify, distribute and undertake tasks necessary to complete a project</li> <li>• Communicate effectively with other team members to ensure effective operation of the team</li> <li>• Demonstrate ability to choose a format and communication appropriate to your work environment</li> </ul>	<p>Group problem solving. Group projects.</p> <p>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</p>	<p>Group assessment (including peer assessment).</p> <p>With industry variant: Industrial placement record book including formal report on placement.</p>
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**(vi) Problem solving**

<p>Analysis, breakdown, synthesis, critical examination. Mathematical modelling skills.</p> <p>Solve a variety of small and large problems through the integration of knowledge of Mathematics, and Computer Science.</p> <p>Students can describe a systematic approach to analysing and solving data-science problems and apply these to new problems</p> <p>Learn to solve novel problems creatively.</p> <p>With industry variant: Problem analysis and solution for 'messily defined' problems in an industrial setting</p>	<p>Lectures, problem workshops, group work, projects.</p> <p>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</p>	<p>Marked problems, assessed group work, project assessment.</p> <p>With industry variant: Industrial placement record book including formal report on placement</p>
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**(vii) Information handling**

<p>Conduct background research and literature surveys. Summarise content from information sources.</p> <p>Demonstrate a broad understanding of problems and issues that arise in the location, organization, processing and evaluation of data.</p> <p>Ability to gather and evaluate information to independently gain new knowledge.</p>	<p>Project supervision.</p> <p>With industry variant: Experience of working within a commercial organization at a distance</p>	<p>Individual and group project reports.</p> <p>Some assessed material only provided through e-learning resources.</p> <p>With industry variant: Industrial placement record book including formal report on placement</p>
<b>(viii) Skills for lifelong learning</b>		
<p>Study skills.</p> <p>Demonstrate knowledge and understanding of professional and ethical issues, and aspects of the law, in the context of Computing Professionals.</p> <p>Make and justify decisions based on the sustainability (e.g. ecological impact) of a proposed solution.</p> <p>Develop and implement personal plan of work to meet a deadline.</p> <p>Independence and time management.</p> <p>Careers and business awareness.</p>	<p>Resource based learning. Study skills booklet.</p> <p>Structured support decreasing through years.</p> <p>Guest speakers.</p> <p>Induction library session. Study skills handbook. Project supervision.</p> <p>With industry variant: Experience of working within a commercial organisation</p>	<p>Examinations, assessed problems, project assessments. Meeting deadlines. Project reports. Destinations data.</p> <p>With industry variant: Industrial placement record book including formal report on placement Successful feedback from placements.</p>

### 10. Progression points:

This programme follows the standard scheme of award and classification set out in Senate Regulation 5 modified as follows:

#### ***For the 'with industry' variant:***

A Placement Student will revert back to the degree without Year in Industry if:

1. They fail to secure a year in industry role.
2. They fail to pass the assessment related to the year in industry.
3. The year in industry ends early due to the behaviour of the Placement Student not being in accordance with the University's Regulations for Students, Student Responsibilities. The Placement Student will need to suspend for the remainder of the academic year. To prevent such an incident from happening, processes are in place to identify any possible issues or concerns early in the year in industry role. This includes a start check, regular communications, visits to the workplace (physical and/or virtual) and evaluation. Communication and contact between the Placement Student, Placement Provider and



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University provides support should issues arise.

4. They discontinue their Year in Industry. A student can return to their campus-based studies no later than the end of teaching week 2 at the start of the academic year should they decide to discontinue their Year in Industry they should complete a Course Transfer Form. If a Placement Student decides to discontinue their Year in Industry after this point, they will need to suspend their studies for the remainder of the academic year.

Nine months is the minimum time required for a year in industry to be formally recognised. If the year in industry is terminated earlier than 9 months as a result of event outside of the Placement Students control (for example redundancy, or company liquidation), the following process will be adopted:

1. If the Placement Student has completed 1 – 6 months, they will be supported to search for another placement to take them up to the 9 months required for the year in industry to be formally recognised. If the Placement Student does not find a placement to meet this criterion they will be required to suspend and transferred onto the degree without Year in Industry.
2. If the Placement Student has completed 7-8 months, they will be supported to search for another placement to take them up to the 9 months required for the year in industry to be formally recognised. If the Placement Student cannot source an additional placement to take them to 9 months, assessments related to the year in industry will be set for the student to make it possible for the individual learning objectives for the year in industry to be met. This will allow the Year in Industry to be recognised in the degree certificate.
3. A Placement Student will not be permitted to undertake a placement which runs across two academic years.

### **11. Scheme of Assessment**

The programme follows the standard scheme of award and classification set out in [Senate Regulation 5](#).

### **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.

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

### **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.

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- 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 Examiners**

The details of the External Examiner(s) for this programme and the most recent External Examiners' reports can be found [here](#).

## Appendix 1: Programme structure

### First Year

SEMESTER ONE	SEMESTER TWO
MA1014 Calculus & Analysis (30cr)	
MA1114 Linear Algebra (30cr)	
MA1061 Probability (15cr)	MA1202 Introductory Statistics (15cr)
CO1102 Programming Fundamentals (15cr)	CO1107 Algorithms, Data Structures and Advanced Programming

Core: 75% Maths modules, 25% Informatics modules

### Second Year

SEMESTER ONE	SEMESTER TWO
MA2032 Vector Calculus (15cr)	MA2021 Differential Equations and Dynamics (15cr)
MA2132 Advanced Linear Algebra (15cr)	MA2206 Statistical Data Analysis (15cr)
MA2403 Statistical Distributions and Inference (15cr)	MA2042 Advanced Discrete Mathematics (15cr)
MA2041 Mathematical Foundations of AI and Machine Learning (15cr) *	<b>15 credits of options</b>
<b>OPTIONS</b>	<b>OPTIONS</b>
none	MA2133 Algebra (15cr)
	MA2511 Business Applications of Mathematics (15cr)
	CO2106 Data Analytics (15cr)

Core: 100% Maths modules

### Third Year

SEMESTER ONE	SEMESTER TWO
MA3077 Operational Research (15cr)*	MA3022 Data Mining and Neural Networks (15cr)
MA3081 Machine Learning for Data Analysis and AI (15cr)	MA3082 Nonlinear optimization (Operational Research 2) (15cr)
MA3582 Maths and AI Project (30cr)	
<b>15 credits of options</b>	<b>15 credits of options</b>
<b>OPTIONS</b>	<b>OPTIONS</b>
CO3091 Computational Intelligence and Software Engineering (15cr)	CO3002 Analysis and Design of Algorithms (15cr)
CO3101 Computers, Society & Professionalism (15cr)	MA3201 Generalised Linear Models (15cr)
MA3012 Scientific Computing (15cr)	

Core: 100% Maths modules

\* - To be suitable for Maths and Informatics students

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**Appendix 3: Module specifications**

See module specification database <http://www.le.ac.uk/sas/courses/documentation>

**Appendix 4: Skills matrix**