



## Programme Specification (PG)

Awarding body / institution:	Queen Mary University of London
Teaching institution:	Queen Mary University of London
Name of final award and title:	Master of Science in Artificial Intelligence and Machine Learning in Science
Name of interim award(s):	PG Cert/PG Dip
Duration of study / period of registration:	2 years (PT)
Queen Mary programme code(s):	I4F4
QAA Benchmark Group:	Computing
FHEQ Level of Award:	Level 7
Programme accredited by:	
Date Programme Specification approved:	
Responsible School / Institute:	School of Physical and Chemical Sciences

Schools / Institutes which will also be involved in teaching part of the programme:

School of Mathematical Sciences

Collaborative institution(s) / organisation(s) involved in delivering the programme:

### Programme outline

The need to collect, analyse, model, understand and interpret big data is permeating all aspects of society. Artificial Intelligence (AI) is creating a revolution in all fields, thanks to the advancements in computational power, and the increased availability both of efficient algorithms and of high-quality data. Machine learning, advanced data analysis techniques, and interpretation skills adapted to a wide ranges of scenarios are not part of the training and skills in undergraduates of traditional STEM programmes. Consequently, there is a significant high demand for professionals with the breadth of knowledge, skills and tools that this programme supported by the Schools of Physical and Chemical Sciences and Mathematical Sciences provides.

The MSc programme in Artificial Intelligence and Machine Learning in Science will cover:

- Fundamentals of Probability and Statistics
- Scientific programming
- Supervised and unsupervised machine learning methods
- Deep learning methods
- Modelling and simulation techniques applied to a wide range of datasets
- Big Data management, visualisation and analysis.

The programme is taught by experts from the two Schools and all departments in them, and it focuses on developing the students' experience on the most interesting and new datasets that only active researchers can access and explore together with the students. The students' interests will be matched to a wide variety of topic-specific modules and projects allowing them to develop their skills on relevant scientific datasets.

The delivery of the programme will involve a combination of face-to-face teaching and interactive workshops to cover the theoretical and topic-specific aspects of the programme. Students will have the opportunity to develop practical coding skills and use state-of-the-art software in extensive computer lab sessions. Students will acquire unique research experience by carrying out a research-based project where they will expand the concepts and tools learnt in the taught modules to high profile cutting-edge topics.

Highlights:

- New programme with a unique and comprehensive combination of topics in Artificial Intelligence and cutting-edge applications.
- Emphasis on big data applications in a wide range of research fields.
- No previous knowledge of coding and machine learning is assumed.

### Aims of the programme

The aim of the MSc programme in Artificial Intelligence and Machine Learning in Science is to provide students with the breadth and depth of knowledge required to apply state-of-the-art analysis and modelling techniques to the widest contexts, interpret the resulting predictions and assess their quality. The wide range of competences required for the delivery of the programme is provided by academic staff in the School of Physical and Chemical Sciences and in the School of Mathematical Sciences.

More specifically, the programme aims to:

- \* Provide students with an in-depth understanding of a range of topics including principles of probability and statistics, data management, visualisation and analysis, machine learning and deep learning tools and models.
- \* Develop practical coding skills essential to apply artificial intelligence to the any field and any dataset.
- \* Develop analytical and critical skills for assessing and developing the tools needed for data modelling.
- \* Enable students to acquire substantial research experience through a final research-based project.

This programme will equip students with the knowledge, skills and competencies to address the widest variety of problems and datasets. Specifically, it will generate highly skilled graduates better prepared for a career as data scientists.

This data-centred programme enables the graduates to develop their skills in the field they consider more interesting with a variety of datasets available and, then, transfer their experience and knowledge to the widest range of fields.

### What will you be expected to achieve?

Students who successfully complete the programme are expected to possess the following knowledge/skills/attributes:

#### Academic Content:

A 1	Knowledge and understanding of key theory concepts and practical applications of probability and statistics.
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A2	In depth knowledge of key theory concepts and practical aspects of artificial intelligence methods.
A3	In depth knowledge of key concepts and practical aspects of data management, exploration and visualisation.
A4	Ability to engage critically and reflectively with different sources of scientific literature and science-informed models.

Disciplinary Skills - able to:	
B1	Independently identify, select, combine and use computational tools to manage, analyse, and visualise datasets.
B2	Critically assess and reflect on the performance and reliability of machine learning and modelling methods.
B3	Write, test and document scientific code to perform a range of tasks, including searching and extracting information from databases, performing predictions, analysing and visualising data.
B4	Conduct and report on a significant piece of research work related to the problems and challenges of machine learning applications.

Attributes:	
C1	Ability to use problem-solving skills and computational tools to solve unfamiliar problems
C2	Ability to communicate complex ideas and concepts in a clear, concise and informative way that is appropriate for the audience
C3	Ability to work with information that may be incomplete or uncertain
C4	Ability to work effectively as part of a team
C5	Ability to manage time, prioritise workload and work to deadlines

## How will you learn?

Acquisition of knowledge and understanding in taught modules will generally be achieved by on campus face-to-face teaching and interactive workshops. These will be complemented and supported by extensive online content (videos, slides, practice questions etc...) that will be made available before each session.

The programme has a strong emphasis on the development of practical skills, including coding and report writing, which will be achieved through extensive computer lab sessions. Individual support will be provided during these sessions by academic and research staff to reinforce theory and concepts covered in face-to-face teaching sessions.

The ability to assess and characterise datasets, independently evaluate and compare models and their performances will be also developed through coursework based on the critical assessment of the practical work on a variety of datasets. The project module will give the students the opportunity to develop research, communication and reporting skills through weekly support provided by the supervisory team. Additional taught sessions in this module will provide support for the development of writing and oral communication skills, and for the understanding of plagiarism and academic conduct matters.

## How will you be assessed?

The assessment of the taught modules will involve a combination of coursework and written examination, with the exact

proportion of the two types of assessment depending on the specific module. Coursework will vary from module to module and it may include in-class tests, problem sheets, lab reports and code writing. The project will be assessed through a written dissertation, the supervisor evaluation of practical work and an oral presentation.

### How is the programme structured?

Please specify the structure of the programme diets for all variants of the programme (e.g. full-time, part-time - if applicable). The description should be sufficiently detailed to fully define the structure of the diet.

The duration of the programme is 2 calendar years for PT.

The programme consists of 6 15-credit taught modules (3 for each of the first two semesters), a 30-credit taught module running in semesters 1 and 2, and a 60-credit project module running in semesters 2 and 3.

Two modules are core (the project 60-credit module and the Machine and Deep Learning 30-credit module) and two modules are compulsory (two modules in term A).

The bulk of the project will be carried out in the third semester, with some preliminary work performed in the second semester. Supervision of the projects will be provided by individual members of the academic staff or by a team of academics covering the necessary range of expertise.

For the part-time programme:

Year 1:

Semester 1

Choose one from these elective modules:

MTH739P [7] Topics in Scientific Computing [SMS] (15 credits)

MTH766P [7] Programming in Python [SMS] (15 credits)

Semesters 1 and 2

Core module:

SPC707P [7] Machine and Deep Learning [SPCS] (30 credits)

Semester 2

Choose one from these elective modules:

In the overall programme you should choose three from these elective modules so that at least one is selected within each subgroup:

\* Subgroup A of elective modules: deepening technical or theoretical knowledge

MTH776P [7] Bayesian Statistics [SMS] (15 credits)

MTH750P [7] Graphs and Networks [SMS] (15 credits)

SPC724P [7] Cloud Computing in AI [SPCS] (15 credits)

\* Subgroup B of elective modules: exploring applications in specific fields

MTH783P [7] Time Series Analysis for Business [SMS] (15 credits)

SPC722P [7] AI in Astrophysics and Space Science [SPCS] (15 credits)

SPC723P [7] ML in Materials Discovery [SPCS] (15 credits)

Year 2:

Semester 1:

Compulsory modules:

MTH794P [7] Probability and Statistics [SMS] (15 credits)

SPC721P [7] Research Methods [SPCS] (15 credits)

Semester 2

Programme Title: Artificial Intelligence and Machine Learning in Science

Choose two from Semester 2 elective modules, so that in the overall programme you have chosen three from the Semester 2 elective modules with at least one selected within each subgroup (A and B)

Semesters 2 and 3

Core module:

SPC720P [7] Research Project in Data Science (60 credits)

Academic Year of Study PT - Year 1

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
Programming with Python	MTH766P	15	7	Elective	1	Semester 1
Topics in Scientific Computing	MTH739P	15	7	Elective	1	Semester 1
Machine and Deep Learning	SPC707P	30	7	Core	1	Semesters 1 & 2
Bayesian Statistics	MTH776P	15	7	Elective	1	Semester 2
Time Series Analysis for Business	MTH783P	15	7	Elective	1	Semester 2
Graphs and Networks	MTH705P	15	7	Elective	1	Semester 2
AI in Astrophysics and Space Science	SPC722P	15	7	Elective	1	Semester 2
ML in Materials Discovery	SPC723P	15	7	Elective	1	Semester 2
Cloud Computing in AI	SPC724P	15	7	Elective	1	Semester 2

Academic Year of Study PT - Year 2

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
Probability and Statistics	MTH794P	15	7	Compulsory	2	Semester 1
Research Methods	SPC721P	15	7	Compulsory	2	Semester 1

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
Bayesian Statistics	MTH776P	15	7	Elective	2	Semester 2
Time Series Analysis for Business	MTH783P	15	7	Elective	2	Semester 2
Graphs and Networks	MTH705P	15	7	Elective	2	Semester 2
AI in Astrophysics and Space Science	SPC722P	15	7	Elective	2	Semester 2
ML in Materials Discovery	SPC723P	15	7	Elective	2	Semester 2
Cloud Computing in AI	SPC724P	15	7	Elective	2	Semester 2
Research Project in Data Science	SPC720P	60	7	Core	2	Semester 2

### What are the entry requirements?

UK: a 2:1 or above at undergraduate level in:

- \* Mathematics
- \* Physics
- \* Chemistry
- \* Computing
- \* Engineering
- \* Any other STEM subjects

International:

\* an international qualification of similar standing to the above.

\* English language entry requirements (IELTS scores): overall  $\geq 6.5$ , reading  $\geq 5.5$ , writing  $\geq 6.0$ , listening  $\geq 5.5$ , speaking  $\geq 5.5$ .

### How will the quality of the programme be managed and enhanced? How do we listen to and act on your feedback?

\* Each individual module including the project module will be evaluated following the existing procedures in the School of Physical and Chemical Sciences. Module evaluations will be an opportunity for students to give anonymous feedback, with numerical results indicating satisfaction and free-text fields to raise any necessary concerns.

\* The Student-Staff Liaison Committee (SSLC) provides a formal means of communication and discussion between the School and its students. The committee consists of student representatives together with appropriate representation from staff within the school. It is designed to respond to the needs of students, as well as act as a forum for discussing programme and module developments. The SSLC meet regularly throughout the year.

\* The School operates a School Education Committee (SEC), chaired by the Director of Education (DoE), which oversees and advises on all matters relating to the delivery of taught programmes at school level including quality assurance. This includes monitoring the application of relevant QMUL policies and reviewing all proposals for module and programme approval and amendment, before submission to Taught Programmes Board. Student views are incorporated in this Committee's work in a number of ways, such as through consideration of items referred by the SSLC and by consideration of student surveys,

including module evaluation questionnaires.

\* An Annual Programme Review (APR) will also take place, allowing the programme lead the opportunity to evaluate and reflect on the achievements of the programme, and in particular to document the steps taken to address both student and employer feedback.

### What academic support is available?

\* The School has a dedicated Student Support Officer (SSO) who is available to discuss any student-related problem. Additionally, each student will be allocated an academic advisor. SSO and advisors who will provide pastoral support and academic advice to all the students on the programme.

\* At the beginning of the research project module each student will be allocated a personal research supervisor who is a member of academic staff and is the primary source of guidance on all matters relating to the research project component of the degree programme.

\* Each module has a module coordinator, whose role is to ensure that the module runs smoothly, and that an appropriate level of information is provided to students of the module.

### Programme-specific rules and facts

None

### How inclusive is the programme for all students, including those with disabilities?

Queen Mary has a central Disability and Dyslexia Service (DDS) that offers support for all students with disabilities, specific learning difficulties and mental health issues. The DDS supports all Queen Mary students: full-time, part-time, undergraduate, postgraduate, UK and international at all campuses and all sites.

Students can access advice, guidance and support in the following areas:

- \* Finding out if you have a specific learning difficulty like dyslexia
- \* Applying for funding through the Disabled Students' Allowance (DSA)
- \* Arranging DSA assessments of need
- \* Special arrangements in examinations
- \* Accessing loaned equipment (e.g. digital recorders)
- \* Specialist one-to-one "study skills" tuition
- \* Ensuring access to course materials in alternative formats (e.g. Braille)
- \* Providing educational support workers (e.g. note-takers, readers, library assistants)
- \* Mentoring support for students with mental health issues and conditions on the autistic spectrum
- \* Reasonable adjustments will be made to the computer-based aspects of the module, for example in enabling accessible technologies, additional teaching support, and/or extra time for students with visual or motor impairments that impact routine computer use.

In addition:

- \* Written notes, handouts and any other asynchronous material will be provided in advance where appropriate on our digital learning platform, and in different readable formats upon request.
- \* Module pages on the platform will meet the baseline standard defined in the School, following the checklist for accessibility (e.g. closed captions for videos, descriptions for images etc.)
- \* QReview and other mixed media (e.g. Zoom) will be used in order to provide recordings of sessions.
- \* Microphones will be used in classrooms.
- \* Hard copies of all relevant books to be made available in the library, or printed copies of electronic resources provided upon

request, for those that cannot read from a computer screen.

\* Detailed advice from the SPCS Student Support Officer for affected students, including liaising with the QMUL disability service.

### Links with employers, placement opportunities and transferable skills

Although there are no placement opportunities on the programme, academic staff involved in the programme have national and international experience in their respective research fields and regularly work with internal and external partners (DERI, Turing Institute, AWE, etc.). Graduates could also progress to careers in data science in the widest range of fields, since the programme aims to provide them with coding skills and practical experience in the use and evaluation of AI techniques that can be transferred to most fields. Most employers require project and coding developments in the context of job interviews. This programme and in particular the "Research Method" module will train the graduates to address these styles of interviews.

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## Programme Specification Approval

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**Person completing Programme Specification:**

Marcella Bona

**Person responsible for management of programme:**

Marcella Bona

**Date Programme Specification produced / amended by School / Institute Education Committee:**

**Date Programme Specification approved by Taught Programmes Board:**