Programme Specification (PG)

Awarding body / institution:	Queen Mary University of London
Teaching institution:	Queen Mary University of London
Name of final award and programme title:	MSc in Artificial Intelligence with Machine Learning
Name of interim award(s):	PGCert, PGDip
Duration of study / period of registration:	1 calendar year full time
Queen Mary programme code(s):	I4U8
QAA Benchmark Group:	Computing
FHEQ Level of Award:	Level 7
Programme accredited by:	N/A
Date Programme Specification approved:	
Responsible School / Institute:	School of Electronic Engineering & Computer Science

Schools / Institutes which will also be involved in teaching part of the programme:
School of Electronic Engineering & Computer Science

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

Programme outline

This MSc programme, as its already existing sibling programme MSc Artificial Intelligence, builds on the strengths of School of EECS, QMUL. These strengths collectively places it in an ideal yet unique position to offer an excellent MSc programme in AI: it is ideal since many of its research groups have already been long-established as leaders in their respective research fields (e.g., Game AI group, Vision Group, Centre for Digital Music, Robotics, and Cognitive Science); it is unique because the school collectively covers almost all major topics on AI where external competition often lacks in part.

The programme is organised in three semesters. The first semester has five modules that operate on a 3+2 scheme: 3 core modules that cover the foundational machine learning techniques and artificial intelligence, and 2 optional module to select from other relevant AI topics (robotics, games and ethics). The second semester has 3 core modules that are themed around principles and deployment of machine and deep learning methods and data mining . In the third semester, students carry out a large project on the AI topic that they want to specialise in, after agreeing on a specific topic with an academic supervisor in the first semester, and completing the preparation phase over the second semester.

The programme brings together our teaching, research and industrial contacts to allow students to mix the different AI topics that best suits their personal requirements and future plans. Students will be offered lectures that explain the fundamental AI concepts, universal machine learning tools essential for any AI job profile, and specific practical and research skills on all five of

the AI topics. Students will gain experience with cutting-edge tools such as Deep Neural Networks (DNN), Recurrent Neural Networks (RNN), and Generative Adversarial Networks (GANs) via regular exercises and practical labs. Students will be taught by world-renowned academics in their specific subject areas, and have regular contacts with them throughout the duration of the programme.

Core modules:
- Principles of Machine Learning
- Artificial Intelligence
- Computational Creativity
- Neural Networks and Deep Learning
- Data Mining
- Machine Learning Deployment
- MSc Project module

Elective modules:
- Advanced Robotics Systems
- Interactive Agents and PG
- Cognitive Robotics
- Ethics, Regulation and Law in Advanced Digital Information Processing and Decision Making.

Aims of the programme

This programme aims at training those who would like to pursue a career in the booming field of Artificial Intelligence (AI). It covers the hottest AI topics – games, ethics, robotics, vision, music, and language – each backed up by a respective research group at QMUL that is world-leading. Practical machine learning skill development is at the core of this programme, which is specifically designed to maximise employment potential across a wide spectrum of industrial and academic posts related to AI.

AI is rapidly changing the way we live, work and learn. There is however a real shortage of AI talents worldwide, both to serve the industry and drive future research. AI jobs are amongst the best paid in industry nowadays – an AI Specialist typically earns among the highest salaries, while having a solid AI background is strongly desired in multiple research disciplines.

This MSc programme importantly recognises such need for training cutting-edge AI talents, and is specifically designed to maximise student employability on AI-specific jobs. It achieves that by putting together a programme that is:
- comprehensive, by covering all five of the most popular AI topics
- up-to-date, where each topic backed up by a world-leading group with cutting edge research
- unique, by offering Game AI that represents some of the most advanced AI to date (e.g., AlphaGo)
- practical, by focusing on developing practical machine learning skills across all five AI topics.

More specifically, this programme aims to:
- enable students to acquire the essential knowledge, skills, competency, and scientific awareness necessary for a successful career in many AI-based industries.
- develop systematic awareness of the current development of AI, themed around all five AI topics
- master topic-specific expertise so that they develop expertise in applying scientific knowledge, mathematics and ingenuity to develop advanced solutions for technical, societal and commercial problems in selected AI areas
- equip students with practical machine learning programming skills universal to AI topics covered by this programme and beyond

There will be an option in each of the programmes for students to incorporate a year in industry (after the taught material, before the project). This is an established model for programmes in EECS, which has been well received by students and employers.

This programme is a sibling of the MSc Artificial Intelligence programme currently running at QMUL, which attracts more than a 100 students per year and close to 1000 applications.

What will you be expected to achieve?

Students who successfully complete this programme will be able to understand:
- the principles underlying modern general AI and Ethics
- the principles of AI in games and modern game development
- the principles of AI in computer vision and its applications in object recognition, tracking and re-identification
- the principles of AI in robotics, including geometric, kinematic, and dynamic robots manipulation, vision and machine learning specifically for robotics
- the principles of AI in music identification and generation,
- the principles of AI in natural language processing, including language prediction, machine translation, and sentiment analysis

Academic Content:	
A 1	A comprehensive knowledge and understanding of scientific principles and methodology necessary to underpin their education in AI, and an understanding and know-how of the scientific principles of related disciplines, to enable appreciation of the scientific and engineering context, and to support understanding of the relevant historical, current and future developments and technologies.
A 2	Knowledge and understanding of mathematical and statistical methods necessary to underpin their education and to enable them to apply a range of mathematical and statistical methods, tools and notations proficiently and critically in the analysis and solution of AI problems.
A 3	A comprehensive knowledge and understanding of mathematical and computational models relevant to all AI topics on offer, and an appreciation of their limitations.
A 4	Awareness of developing technologies related to own specialisation.

Disciplinary Skills - able to:	
B 1	Ability to apply and integrate knowledge and understanding of machine learning disciplines to support study of AI and the ability to evaluate them critically and to apply them effectively.
B 2	Ability to identify, classify and describe the performance of AI algorithms through the use of analytical methods and modelling techniques.
B 3	Ability to apply quantitative and computational methods, using alternative approaches and understanding their limitations, in order to solve AI problems and to implement appropriate action.
B 4	Ability to extract and evaluate pertinent data and to apply AI analysis techniques in the solution of unfamiliar problems.
B 5	Ability to investigate and define the problem, identifying any constraints including environmental and sustainability limitations; ethical, health, safety, security and risk issues; intellectual property; codes of practice and standards.

Attributes:	
C 1	Engage critically with AI knowledge and ethical principles
C 2	Have a global perspective of the value of AI, particularly with respect to its use and value in the big data era

C 3	Demonstrate rounded intellectual development
C 4	Be able to communicate their work to technical and non-technical audiences.
C 5	Develop research capacity and demonstrate information expertise: Work with information that may be incomplete or uncertain, quantify the effect of this on the AI design and, where appropriate, use theory or experimental research to mitigate deficiencies.

How will you learn?

By attendance at lectures (typically 16 hours per week), tutorials (typically 8 hours per week), and labs (typically 8 hours per week). Each non-project-based module involves lectures, problem solving coursework and practical sessions. Lectures are used to introduce principles and methods and also to illustrate how they can be applied in practice. Coursework allows students to develop their skills in problem solving and to gain practical experience. Practical sessions provide students with guidance and help while solving a problem. These lessons take the form of exercise classes and programming laboratories that allow the students to learn-by-doing in order to complement the lectures.

Individual projects are undertaken during the third semester, under the supervision of an academic member of staff with whom there are weekly consultancy meetings. These are used for students to report on their progress, discuss research and design issues and plan their future work. This develops and reinforces students' ability to communicate technical ideas clearly and effectively. The Projects Coordinator also runs a thread of taught sessions to support the project module. A number of industrial-linked projects are offered each year, which students can apply for.

How will you be assessed?

The assessment of taught modules normally consists of a combination of written examination and coursework.

The project is examined on the basis of a written report, a formal oral presentation, and, where applicable, a demonstration of any software and/or hardware developed by the student.

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.

In the first semester (Sem B), students have to take:
- 3 compulsory modules: (1) Principles of Machine Learning; (2) Artificial Intelligence; (3) Computational Creativity.
- 2 electives from: (4) Advanced Robotics Systems; (5) Interactive Agents and PG; (6) Cognitive Robotics; (7) Ethics, Regulation and Law in Advanced Digital Information Processing and Decision Making.

In the second semester (Sem C), students have to take 3 compulsory modules: (1) Neural Networks and Deep Learning; (2) Data Mining; (3) Machine Learning Deployment.

In the third semester (Sem A), all students have a final project, potentially industrial-linked.

All modules are worth 15 credits, with the exception of the final project, which is worth 60 credits.

Programme Title: MSc in Artificial Intelligence with Machine Learning

Academic Year of Study FT - Year 1

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
Principles of Machine Learning	ECS7020P	15	7	Compulsory	1	Semester 2
Artificial Intelligence	ECS759P	15	7	Compulsory	1	Semester 2
Computational Creativity	ECS7022P	15	7	Compulsory	1	Semester 2
Advanced Robotics Systems	ECS7004P	15	7	Elective	1	Semester 2
Interactive Agents and PG	ECS7016P	15	7	Elective	1	Semester 2
Cognitive Robotics	ECS794P	15	7	Elective	1	Semester 2
Ethics, Regulation and Law in Advanced Digital Information Processing and Decision Making	ECS7025P	15	7	Elective	1	Semester 2
Neural Networks and Deep Learning	ECS7XXP	15	7	Compulsory	1	Semester 3
Data Mining	ECS766P	15	7	Compulsory	1	Semester 3
Machine Learning Deployment	ECS7XXP	15	7	Compulsory	1	Semester 3
Project	ECS750P	60	7	Core	1	Semester 1

What are the entry requirements?

Information on the entry requirements for this programme can be found at:
http://www.eecs.qmul.ac.uk/postgraduate/entry-requirements

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

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

Each school operates a Learning and Teaching Committee, or equivalent, which advises the School/Institute Director of Taught

Programmes on all matters relating to the delivery of taught programmes at school level including monitoring the application of relevant QM 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 student membership, or consideration of student surveys.

All schools operate an Annual Programme Review of their taught undergraduate and postgraduate provision. The process is normally organised at a School-level basis with the Head of School, or equivalent, responsible for the completion of the school's Annual Programme Reviews. Schools/institutes are required to produce a separate Annual Programme Review for undergraduate programmes and for postgraduate taught programmes using the relevant Undergraduate or Postgraduate Annual Programme Review pro-forma. Students' views are considered in this process through analysis of the NSS and module evaluations.

What academic support is available?

All students are assigned an academic advisor during induction week. The advisor 's role is to guide their advisees in their academic development including module selection, and to provide first-line pastoral support.

In addition, the School has a Senior Tutor for postgraduate students who provides second-line guidance and pastoral support for students, as well as advising staff on related matters.

Every member of teaching staff holds 2 open office hours per week during term-time.

Additional academic support is provided to those students who are successful in securing an industrial-linked project.

Programme-specific rules and facts

N/A

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.

EECS also adheres to QMUL's EDI principle, which aims to create an inclusive environment for education. These include a series of equality policies on gender and racial diversity (http://hr.qmul.ac.uk/equality/governance/policies/), the recently formed Race Equality Action Group (http://hr.qmul.ac.uk/equality/protected-characteristics/race/the-race-equality-action-group/) and EECS Bronze Athena Swan for gender equality.

Links with employers, placement opportunities and transferable skills

The School has a wide range of industrial contacts secured through research projects and consultancy, our Industrial Experience programme and our Industrial Advisory Panel.

The Industrial Advisory Panel works to ensure that our programmes are state-of-the-art and match the changing requirements of this fast-moving industry. The Panel includes representatives from a variety of Computer Science oriented companies ranging from SMEs to major blue-chips. These include: Microsoft Research, Royal Bank of Scotland, BT Labs, Oaklodge Consultancy, Intel Research, The Usability Company, Hewlett Packard Labs and Arclight Media Technology Limited.

Recent graduates have found employment as IT consultants, specialist engineers, web developers, systems analysts, software designers and network engineers in a wide variety of industries and sectors. A number of students also go on to undertake PhDs in electronic engineering and computer science. Merril Lynch, Microsoft, Nokia, Barclays Capital, Logica,, Credit Suisse, KPMG, Transport for London, Sky and Selex ES are among the organizations that have recently employed graduates of EECS programmes.

Transferable skills are developed through a variety of means, including embedding of QM Graduate Attributes in taught modules and the third semester project, together with the opportunity to participate in extra-curricular activities, e.g. the School's E++ Society, the School's Annual Programming Competition and external competitions with support from the School.

Students have the opportunity to undertake an industrial-linked project in the third semester - these are very competitive.

Programme Specification Approval

Person completing Programme Specification:	Rupal Vaja
Person responsible for management of programme:	Diego Perez Liebana
Date Programme Specification produced / amended by School / Institute Learning and Teaching Committee:	
Date Programme Specification approved by Taught Programmes Board:	