Postgraduate Programme Specification:
MSc in Advanced Computer Science <with pathway>

1. Summary

School	Computer Science
Faculty	Engineering & Physical Sciences
Awarding Institution	The University of Manchester
Programme Accreditation	BCS
Relevant QAA benchmark(s)	Subject Benchmark for Masters' Degrees in Computing

Award	Programme Title	Duration	Mode of study
MSc	Advanced Computer Science <with specialisation in *pathway*>	1 year	Full-time
MSc	Advanced Computer Science <with specialisation in *pathway*>	2 -4years	Part-time
MSc	Advanced Computer Science <with specialisation in *pathway*>	3-4 years	Modular
PG Diploma	Advanced Computer Science	1 year	Full-time (exit award only)
PG Diploma	Advanced Computer Science	2-3 years	Part-time (exit award only)
PG Diploma	Advanced Computer Science	2-3 years	Modular
PG Certificate	Advanced Computer Science	1 year	Full-time
PG Certificate	Advanced Computer Science	2 years	Part-time (exit award only)
PG Certificate	Advanced Computer Science	2 years	Modular

Available Pathways for specialisation: Advanced Web Technologies, Artificial Intelligence, Computer Security, Computer Systems Engineering, Data and Knowledge Management, Digital Biology, Multi-Core Computing, Semantic Technologies, Software Engineering.

Benchmarks and Frameworks: as a Master programme, the MSc in ACS corresponds to Level 7 of the Framework for Higher Education Qualifications (see http://www.qaa.ac.uk/academicinfrastructure/FHEQ/EWNI08/default.asp) and is guided by the the **QAA** subject benchmark for masters' degrees in computing (see http://www.qaa.ac.uk/Publications/CircularLetters/Documents/QAA386_Computing.pdf).

Role of this Programme Specification: to outline the intended knowledge, understanding, skills and attributes of a student completing that course. It also gives details of teaching and assessment methods as well as linking the course to the framework for HE qualifications and any subsequent professional qualification and career path.

Date of Completion:

Further Links: Programme web site at http://www.cs.manchester.ac.uk/postgraduate/taught/programmes/acs/ and Handbook at http://www.cs.manchester.ac.uk/postgraduate/prospectus/ .

2. Aims and Intended Learning Outcomes

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The aim of this programme is to provide students with a state-of-the-art collection of knowledge, understanding, and skills in the area of Advanced Computer Science. This collection aims to be, on the one hand, of sufficient **breadth** so as to reflect the discipline's breadth of techniques and areas and, on the other hand, of sufficient **depth** so as to provide the student with the relevant knowledge, understanding, and skills at an advanced level. It is designed for students with a good first degree in Computer Science or related areas who wish to broaden and deepen their understanding, knowledge, and skills, and aim at a career in either Industry or Academia.

1	**At PG Certificate level:** Produce high quality of computing professionals and researchers across a broad range of Computer Science
2	**At PG Diploma level**: Produce the highest quality of computing professionals and researchers across a broad range of Computer Science
3	Provide a vehicle for dissemination of leading-edge knowledge and skills, focusing on the research strengths of a large School covering most major topics in Advanced Computer Science and its applications
4	Continue to attract the highest-quality students from the UK and overseas
5	Provide an opportunity to engage in a small research project in Advanced Computer Science
6	**At MSc level**: As above 2 – 5 together with 6 and 7: Offer the opportunity to focus on one of a range of specialisations.
7	Provide high quality training and experience in research in Advanced Computer Science

A. Knowledge & Understanding

Students will be able to:

A1.	**(At all levels)** Acquire a knowledge of a range of advanced topics in Computer Science beyond undergraduate level and at the forefront of research
A2.	**(At all levels)** Understand, apply and develop leading-edge technologies in three of the following themes: • Advanced Web Technologies • Data Engineering and IT Governance • Biohealth Informatics • Managing Data • Learning from Data • Reasoning and Optimisation • Making Sense of Complex Data • Mobile Computing • Parallel Computing in the Multi-core Era • Security • Software Engineering 1 • Software Engineering 2
A3.	**(MSc & PG Diploma)** Have a knowledge & understanding of research methodology & practice

B. Intellectual Skills

Students will be able to:

B1.	Develop and evaluate original ideas in a research context **(MSc and PG Diploma levels only)**
B2.	Use methodologies for development of computational systems at an advanced level **(All)**

B3.	Perform problem-solving in academic and industrial environments **(All)**

C. Practical Skills	
Students will at MSc, PG Diploma & PG Certificate levels be able to:	
C1.	Develop applications to satisfy given requirements
C2.	Organise & pursue a scientific or industrial research project **(MSc and PG Diploma only)**
C3.	Use, manipulate and develop large computational systems
C4.	Perform independent information acquisition and management

D. Transferable Skills and Personal Qualities	
Students will be able to:	
D1.	Work and communicate effectively as a team member
D2.	Prepare and present seminars to a professional standard **(MSc level only)**
D3.	Understand ethical issues related to professional activities
D4.	Write theses and reports to a professional standard **(MSc and PG Diploma)**
D5.	Perform independent and efficient time-management

These Aims and Intended Learning Outcomes are informed by the QAA subject benchmark for computing, and relate as following to those mentioned there: A1-A3 are covered in 5.1; B1–B3 are coverd in 5.4; C1-C3 are covered in 5.2 and 5.4; C4 is covered in 5.5; D1, D2, D4, and D5 are covered in 5.3 and 5.4; D3 is covered in 5.2 and 5.1.

Further relevant informatio can be found at
http://www.cs.manchester.ac.uk/postgraduate/prospectus/ and
http://www.campus.manchester.ac.uk/tlao/map/teachinglearningassessment/teaching/degreeregulations/ .

3. Teaching, Learning, and Assessment Methods

The programme's teaching and learning forms and assessment methods are informed by the QAA subject benchmark for computing, and are designed to ensure that any student graduating with an MSc in Advanced Computer Science have demonstrated the understanding, awareness, and skills at threshold level as described in Section 7 of the benchmark.

We use a variety of teaching forms, from face-to-face lectures via supervised and unsupervised labs, to self-study elements and supervised projects. Where appropriate, we use blended learning and enquiry-based learning. In general, knowledge-intensive parts of a course-unit are taught through lectures (either face-to-face or via alternative delivery), with aspects of self-study and enquiry-based learning. Other parts of our course units that are aimed at the students' acquisition of skills (either intellectual or practical) are mostly taught through (supervised or unsupervised) labs and workshops. These are also often used to enhance the students' communication and teamwork skills.

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All our course units combine knowledge and understanding learning outcomes with suitable skills learning outcomes. Moreover, in Computer Science, applying a certain technology, formalism, or method is a key requirement for understanding it **fully.** As a consequence, all our taught course units use coursework as a part of formative assessment, to deepen (and assess) both knowledge and understand and to teach (and assess) relevant skills. As a default, our course-units are assessed 50% through coursework and 50% through exam, to give equal weight to normative and formative assessment. We allow, however, for limited flexibility and, if a course unit's specific features require it, for assessments through 66% coursework and 34% exam, or other distributions.

We are implementing a best-practice model for designing 'implementation related coursework' so that it (i) enhances students' experience, (ii) enhance students' skills in applying good (software) design practice, (iii) can be assessed fairly and effectively.

The defining regulations and procedures for the MSc programme are laid down in the University's Ordinances and Regulations

Learning & Teaching Processes for A (to allow students to achieve intended learning outcomes)	**Assessment** (of intended learning outcomes)
ALL Because of the very wide range of topics and content, each advanced course unit utilises methods appropriate to the subject matter.	A1 – A3 are assessed by a mixture of written examinations, computer-based practical work, and a range of coursework assessments including assessed miniprojects, group projects, reports, essays etc.
ALL Small group lectures, supervised laboratory work, mini-projects (group & individual) and independent preparatory learning are the main vehicles for dissemination of knowledge & understanding during the first half of the programme	
MSc and Diplom level Following the taught part of the programme, students undertake a programme of supervised individual research, leading to a 90 cr dissertation at **MSc level** and a 30 cr dissertation at **PG Diploma level**	A1- A3 is also assessed via the research project which includes an oral presentation of the research, and examination of the dissertation.

Learning & Teaching Processes for B	**Assessment**
B1. is mainly demonstrated during the research project, and the Research Skills & Professional Issues unit (COMP60990).	B1. & B3 are developed and assessed during the research project through presentation of a seminar and examination of the dissertation, as well as the Project Progress Report (COMP60990).
The intellectual ability B2. is learned through small-group lecturing and practical lab exercises designed to put theoretical knowledge into practice.	B2. is assessed through laboratory exercises, either marked on-line or by written report.
B3. is mainly demonstrated during the research project, mini-projects and problem-based learning in teams.	B3 is also assessed by reports from mini-projects (individual & group).

Learning & Teaching Processes for C	**Assessment**
C1. and C3. are demonstrated in practical lab exercises and mini-projects, as well as during the research project.	C1. and C3. are assessed through laboratory exercises, either marked on-line or by written report.

C2. and C4. are demonstrated during the research project. C4. is also present in many course units.	C2. and C4. are developed and assessed during the Research Skills and Professional Issues unit and the Research Project through presentation of a seminar and examination of the dissertation
The practical skill C4. is demonstrated in the preliminary preparation for each course unit	C4. is assessed by COMP60990, the Research Project and by a report or marked presentation in some course units.

Learning & Teaching Processes	Assessment
D1. is evident in team practical projects used in a number of course units, supported through eLearning environment	D1. is assessed through reports and marked presentations.
D2. is demonstrated during COMP60990, the research project seminar, and also within a number of course units.	D2. is assessed during the research project seminar, where there is feedback on presentation skills.
D3. is demonstrated in COMP60990	D3 and D4. are assessed by the research project dissertation, and the Preliminary Project Report.
D4. is demonstrated through lab practical and mini-project reports and the research project dissertation.	
D5. is demonstrated by the ability to meet a number of deadlines throughout the year, and to effectively carry out a research project on time	D5. is assessed by course unit teachers & the exams office, who must ensure coursework and dissertations are submitted on time. The research project internal examiners assess progress of the project at the project seminar.

Support for student learning and development:
In addition to the Director of PGT, we have two Associate Directors of PGT in place whose main responsibility is the pastoral care for the MSc in ACS students and, as members of the school PG Committee, to monitor students' attendance and progress, and to overlook the general running of the MSc in ACS. Students are encouraged to contact the Directors when problems arise and are informed of this during the introductory period. The school also has a drop-in Advice Centre for lunch-time help-sessions. During the period of the second Semester and the research project, an individual assigned supervisor is also available. Relationship with the supervisor is outlined in the Programme Handbook and the Research Skills and Professional Issues course unit COMP60990.

We also have a well-functioning Student Support Office, led by Gill Lester, whose members provide reliable support for students in all aspects of their learning and development, and work closely with the directors and the PG committee through monthly meetings and other means.

We are using eLearning environments for timely communication with and amongst students, and are currently implementing a **default model** for providing feedback via suitable eLearning mechanisms. This model is set to ensure that students are provided with timely feedback on their coursework, and use the eLearning environment to communicate amongst themselves and with the teaching staff.

We implement a project model where the students submit, around mid-May, a Project Progress Report (worth 30 of the 90 credits of the project). In this way, students are encouraged to develop early a clear vision and plan for their project and communicate it to their supervisors in writing, so that potential issues regarding technical misunderstandings or writing problems can be detected early and appropriate actions be taken.

COMP60990 lecturers, who are also a member of the PG Committee, collaborate with its members and with the school's eLearning Champion to ensure that projects are allocated and supervised in an effective way, and that feedback is provided in a timely and constructive manner.

All students are directed to the Faculty's PDP web site and encouraged to participate, and the site is also linked from the MSc Handbook http://www.cs.manchester.ac.uk/postgraduate/prospectus/.
We have also collected links to relevant information for PGT students at EPS's SOS web site, currently available at http://130.88.138.26/~sosshared/comp/index.html .

4. Programme Structure

A student following this programme chooses **three themes**, each consisting of a conceptually coherent set of two course units of 15 credits each. This makes up the 90 credits **taught** part of the programme.
In addition, they follow the COMP60990 (Research Skills and Professional Issues) course unit and work on their project: the project is assessed in two parts, through the Project Progress Report (which counts 85% of the 30 credits for COMP60990 and the Dissertation (60 credits).

A student who chooses three themes that belong to a given **pathway,** e.g., Software Engineering 1 and 2, and whose project is in an area suitable for this pathway (which is determined by the examiners) can choose to graduate with an

MSc in Advanced Computer Science *with specialisation in Software Engineering.*

A full list of pathways and related themes can be found in Table **X1.**

Course units in general:

Course units are taught in an intensive mode over a period of 6 weeks: 1 day a week for the first 5 weeks are 'taught' days consisting of lectures, supervised labs etc., which are complemented with 1.5 days a week for the first 5 weeks of practical exercises and 2.5 days of a coursework completion week (the 6th week) are also practical exercises. Some of the practical exercises are assessed work. By default, course units are assessed through coursework (50%) and end-of-semester examination (50%). However, flexibility is allowed in the delivery and assessment, allowing methods appropriate for each subject. Further information is available at: http://intranet.cs.man.ac.uk/Intranet_subweb/Postgrad/ .

Chronology of the programme:

The (full time version of the) programme lasts 1 year, and starts in **September** with an **induction week,** during which
• introductory talks for each course unit are offered
• the structure of the programme, expectations, rules & regulations, pathways and themes are explained (the allocation of course units to themes and themes to pathways is shown in the Curriculum map and in the handbook)
• (in case they haven't yet) students choose themes and course units
• students take part in an on-line course about plagiarism and
• students take English Language assessments and, depending on their outcome, are advised to attend (free) in-sessional English classes. This is followed up and re-enforced if required.

Semester 1: September – January

Students usually take **60 credits-worth of course units** in the 1st semester, i.e. four of the course units identified in Figure 1 below, two from each Semester 1 theme. In particular, they follow 2 course units in Period 1 (one course unit per Semester 1 theme chosen) and 2 course units in Period 2 (one course unit per Semester 1 theme chosen).

In addition, they follow selected sessions of COMP60990, "Research Skills and Professional Issues", related to academic and professional literacy, ethics, testing usability, careers, etc.

Semester 2: January - May

Students usually take **30 credits-worth of course units** in the 2nd semester, i.e. two of the course units from one Semester 2 theme, identified in Figure 1 below. To continue towards the research project for MSc

award, students need to pass the taught component in this Semester. In addition, they follow selected sessions of COMP60990 "Research Skills and Professional Issues".

By the end of January, the project allocation process takes place, and students start with the background research of their project and prepare their **Project Progress Report**. The report counts towards 85% of the 30 credits of COMP60990, the rest is assessed in session through course work.

In addition to passing the taught course units, the mark awarded to the Project Progress Report must be at least 40%. If the Report receives marks between 30% and 40%, the student can re-submit the report and, in case it gets at least 40%, exit the programme with a Postgraduate Diploma. Otherwise, the student is deemed to have failed the component and exits with a Postgraduate Certificate according to the assessment regulations.

Core Project Work: May – September

The student continues to work on his/her project, and writes up a dissertation (or Group and Individual Reports for group projects). The dissertation counts 60 credits towards the 90 credits of the project mark (the other 30 credits are made up from the COMP60990 mark, which is mostly determined by the Project Progress Report mark).

Summary of the exit qualifications:

A student with 60 credits from the taught part can exit with a PG Certificate.

A student who has passed all 90 credits of the taught part, and with at least 40% awarded for his/her Project Progress Report can exit with a PG Diploma.

Neither PG Certificate nor the PG Diploma can carry a **pathway** specialisation.

Figure 1: Course Units and themes they belong to

1. (Semester 1) Advanced Web Technologies:
   (a) COMP60411 Semi-structured Data & the Web
   (b) COMP60421 Ontology Engineering for the Semantic Web
2. (Semester 1) Data Engineering and IT Governance:
   (a) COMP60711 Data Engineering
   (b) COMP60721 IT Governance
3. (Semester 2) Biohealth Informatics:
   (a) COMP60532 Principles of Digital Biology
   (b) COMP60542 Introduction to Health Informatics
4. (Semester 1) Managing Data:
   (a) either COMP60711 Data Engineering or COMP60411 Semi-structured Data & the Web
   (b) COMP60321 Advanced Database Management Systems
5. (Semester 1) Learning from Data:
   (a) COMP61011 Machine Learning & Data Mining
   (b) COMP61021 Modelling & Visualization of high-dimensional data
6. (Semester 2) Reasoning and Optimisation:
   (a) COMP61132 Automated Reasoning and Verification
   (b) COMP61142 Optimization for learning, planning & problem-solving
7. (Sem. 2) Making Sense of Complex Data (students taking this theme must take Learning f. Data):
   (a) COMP61332 Text Mining
   (b) COMP61342 Computer Vision
8. (Semester 2) Mobile Computing:
   (a) COMP61232 Mobile Systems
   (b) COMP61242 Mobile Communications
9. (Semester 1) Parallel Computing in the Multi-Core Era:
   (a) COMP60611 Parallel Programs and their Performance
   (b) COMP60621 Designing for Parallelism and Future Multi-core Computing
10. (Semester 1) Security:
    (a) COMP61411 Cryptography
    (b) COMP61421 Computer & Network Security
11. (Semester 1) Software Engineering 1:
    (a) COMP61511 Software Engineering Overview
    (b) COMP61521 Component-based Software Development
12. (Semester 2) Software Engineering 2:
    (a) COMP61532 Pattern-based Software Development
    (b) COMP61542 Agile and Test-driven Development

Figure 2: Pathways and themes that belong to them

1. **Advanced Computer Science**: though not a pathway, a student can choose any three themes to get MSc in Advanced Computer Science.
2. **Advanced Web Technologies**: for this pathway, a student chooses the Advanced Web Technologies theme and any other two themes.
3. **Artificial Intelligence**: for this pathway, a student chooses at least two themes from Advanced Web Technologies, Learning from Data, Reasoning and Optimisation, and Making Sense of Complex Data, plus one other theme.
4. **Computer Security**: for this pathway, a student chooses the Security theme and any other two themes.
5. **Computer Systems Engineering**: for this pathway, a student chooses the Mobile Computing theme and the Parallel Computing in the Multi-core Era theme, plus any other third theme.
6. **Data and Knowledge Management**: for this pathway, a student chooses any two themes from Advanced Web Technologies, Data Management, Learning from Data, Reasoning and Optimisation, Making Sense of Complex Data, plus a third theme.
7. **Digital Biology**: for this pathway, a student chooses Biohealth theme and any two other themes.
8. **Multi-core Computing**: for this pathway, a student chooses the Parallel Computing in the Multi-core Era theme and any other two themes.
9. **Semantic Technologies**: for this pathway a student chooses the Advanced Web Technologies theme, the Reasoning and Optimisation theme, and any other third theme.
10. **Software Engineering**: for this pathway, a student chooses the Software Engineering 1 and 2 themes and any other third theme.

4. Mechanisms for Programme Revision

The school has created the new role of a PG Strategy Leader. Together with members of a PG Strategy Team, we will analyse the running programme in terms of recruitment of students and successful graduation, and plan changes.

March 2nd, 2012