ROYAL HOLLOWAY
University of London

PROGRAMME SPECIFICATION

This document describes **M.Sci. degree programmes in Computer Science**. This specification is valid for new entrants from: **September 2015**

The aims of all M.Sci. degree programmes in Computer Science are:
- to produce graduates with the ability to engage in the lifelong learning and with the skills required for a professional career in a computer-based environment or for a research career in Computer Science and related areas;
- to develop a mastery of computing-related cognitive abilities and skills as described in the QAA Computer Science benchmark statement;
- in a flexible and progressive structure, to develop students knowledge and understanding of essential facts and theory, with the ability to use this knowledge to devise, specify, design, implement, test, document and critically evaluate computer-based systems;
- to develop an advanced understanding of professional and ethical issues involved in the deployment of computer technology;
- to produce graduates with a range of personal attributes relevant to the world beyond higher education, including information retrieval and use, numeracy, the ability to devise and present logical arguments to inform and support actions, and organisational skills.
- to develop an advanced understanding of knowledge and current awareness of current problems and/or new insights in the area of computing science research.

The programmes described here correspond to level 7 of the QAA framework. The length of these degrees vary from four years for the M.Sci. programmes to five years for the M.Sci. with a year in Industry programmes.

Apart from the year in industry, each stage comprises one year of 30 credits-time study during which the student must follow courses to the value of four units (one unit is roughly equivalent to 30 national credits).

The programmes provide progressive structures in which students are able to gain ever-wider knowledge and understanding, and appropriate skills. The programmes contain a combination of mandatory and elective courses to introduce students to the theory and practice of Computer Science, including software development techniques and the technologies underlying specific application areas such as gaming and robotics.

The structure encourages students to develop their own interests through informed choice among specialist options. In the final two years of the M.Sci. programmes, students undertake projects, which accounts for 25% of their studies in the penultimate year and 50% of their studies in the final year. There is a free choice of other penultimate and ultimate stage courses reflecting (i) core material, such as compiler theory, operating systems and concurrent programming, (ii) modern applications such as computer games technology, web design and digital sound and music, and (iii) currently important research areas such as machine learning, information security, software language engineering, intelligent agents, computational finance and bioinformatics. They will also attend core and optional courses in their final two years that reflect their specialism.

Further information
Learning outcomes
Teaching, learning and assessment
Details of the programme structure(s)
Progression and award requirements
Student support and guidance
Admission requirements
Further learning and career opportunities
Indicators of quality and standards

This document provides a summary of the main features of the programme(s), and of the outcomes which a student might reasonably be expected to achieve if 30 credits advantage is taken of the learning opportunities provided. Further information is contained in the College prospectus, the College Regulations and in various handbooks issued to students upon arrival. Whilst Royal Holloway keeps all its information for prospective applicants and students under review, programmes and the availability of individual courses are necessarily subject to change at any time, and prospective applicants are therefore advised to seek confirmation of any factors which might affect their decision to follow a specific programme. In turn, Royal Holloway will inform applicants and students as soon as is practicable of any substantial changes which might affect their studies.

Learning outcomes
Teaching and learning in the programmes are closely informed by the active research of staff, particularly in the areas of computer learning, information security, compiler algorithm design and analysis, languages and computer architectures, combinatorial algorithms and complexity, and bioinformatics. The programmes provide opportunities for students to develop and demonstrate knowledge of both core subject material and specialised research areas.

The students will have an opportunity to develop and demonstrate the following learning outcomes:
Knowledge and understanding
- an advanced knowledge and understanding of the facts, concepts, principles and theories relating to computing and computer applications;
- mastery of the implications of recent research in Computer Science, artificial intelligence and related fields, and how such research results can be incorporated into computer-based systems;
- a command of the professional, moral and ethical aspects of the use of computer-based systems, and ability to recognise any risks or safety aspects in a given context;
- knowledge of how computers are programmed and used; advanced programming; software engineering and team work for developing a significant software system; the fundamental technologies used for artificial intelligence; the functioning of the Internet and the World Wide Web; the main concepts of database technology and design; background theory necessary for a deeper understanding of computing and computers;
- depending on their programme of studies, students may also gain a knowledge of the following key practical application technologies: operating systems; graphics; robotics, bioinformatics, information security, applied artificial intelligence and human-computer interfaces; theoretical foundations of algorithms and programming;

Additional for Computer Science (Year in Industry)
- appreciation of the importance of computing and information technology for commerce and industry and an understanding of expected industry changes and the effects they will have.

Additional for Computer Science (Information Security)
- a command of the fundamental aspects of cyber security;
- a mastery of the identification and appropriate application of security controls.

Skills and other attributes
- ability to deploy appropriate theory, practices and tools for the modelling, specification, design, implementation and evaluation of computer-based systems (including stand-alone computer systems, information systems, embedded systems, distributed systems and web-based systems) to meet given requirements under practical constraints;
- employ the research skills needed to investigate a defined topic under supervision, through an extended individual project;

- interpersonal skills, including the ability to work as a member of a development team, recognising/respecting the viewpoints of others, recognising the different roles within a team and the different ways of organising teams**;***
- problem identification, analysis and solution using critical assessment and reasoned argument;***
- taking responsibility for own learning and developing habits of reflection on that learning;***
- skills in written communication, project documentation, verbal presentation; numeracy and computation***
- use of information technology (including spreadsheets, databases, word processing, email and WWW);***
- information handling and retrieval (including the use of libraries and computer technology);***
- ability to work autonomously, and to demonstrate time management and organisational skills;***

Additional for Computer Science (Year in Industry)
- ability to apply knowledge and skills in computing to large-scale practical applications.

* transferable skills

Teaching, learning and assessment
Teaching and learning is mostly by means of lectures, small-group tutorials, practical and problem classes, supervised computing laboratory work, group work, completion of coursework and private study, guided independent study and research in the stage three individual project.
Assessment of knowledge and understanding is typically by formal, unseen written examination, coursework assignments, project reports, oral presentations, and the final stage project report. Transferable skills are also inherently assessed through the assignments, reports and oral presentations. Feedback is provided on students' performance in coursework, both assessed and non-assessed, and during tutorial and practical sessions. 30 credits details of the assessments for individual courses can be obtained from the Department.

Details of the programme structure(s)
Please note that the list of available courses offered is subject to change and not all courses run each year. A 30 credits list of courses for the current academic year can be obtained from the Department.

STAGE 1		
CS1801	Object oriented programming	30 credits
CS1802	Software development	30 credits
CS1820	Computing laboratory (robotics)	15 credits
CS1830	Computing laboratory (games)	15 credits
CS1840	Internet services	15 credits
CS1890	Software design	15 credits
CS1860	Mathematical structures	15 credits
CS1870	Machine fundamentals	15 credits

STAGE 2		
CS2800	Software engineering	15 credits
CS2810	Team project	15 credits
CS2821	Systems Programming	15 credits
CS2830	Robotics	15 credits
CS2846	Human Computer Interaction	15 credits
CS2850	Operating systems	15 credits
CS2855	Databases	15 credits
CS2860	Algorithms and complexity	15 credits
IY2760	Introduction to information security	15 credits
IY2840	Computer and network security	15 credits

STAGE 3/4

CS3001	Year out in Industry	30 credits
CS3821	30 credits unit project *(cannot be taken with CS3810)*	30 credits
CS3822	Individual project in artificial intelligence	30 credits
IY3821	30 credits unit project (Information Security)	30 credits
CS3110	Bioinformatics	15 credits
CS3210	Image processing	15 credits
CS3220	Fundamentals of digital sound and music	15 credits
CS3250	Visualisation and exploratory analysis	15 credits
CS3450	Software verification	15 credits
CS3480	Software language engineering	15 credits
CS3470	Compilers and code generation	15 credits
CS3490	Computational optimisation	15 credits
CS3510	Functional programming and applications	15 credits
CS3580	Advanced data communications	15 credits
CS3750	Concurrent and parallel programming	15 credits
CS3846	HCI *(cannot be taken with CS2846)*	15 credits
CS3870	Advanced algorithms	15 credits
CS3920	Computer learning	15 credits
CS3945	Semantic Web	15 credits
CS3930	Computational finance	15 credits
CS3940	Intelligent agents and multi-agent systems	15 credits
IY3840	Malicious software	15 credits
IY3660	Applications of cryptography	15 credits

STAGE 4/5

CS4001	Deferred Year in Industry	30 credits
CS4821	Computer Science M.Sci. project	Two units
CS4822	Computer Science (Artificial Intelligence) M.Sci. project	Two units
IY4500	Information Security M.Sci. project	Two units
CS4100	Data analysis	15 credits
CS4200	On-line machine learning	15 credits
CS4920	Computer learning *(cannot be taken with CS3920)*	15 credits
CS4930	Methods of computational finance *(cannot be taken with CS3930)*	15 credits
CS4945	Semantic Web *(cannot be taken with CS3945)*	15 credits
CS4450	Software verification *(cannot be taken with CS3450)*	15 credits
CS4234	Large-scale data storage and processing	15 credits
CS4490	Computational optimization *(cannot be taken with CS3490)*	15 credits
CS4940	Intelligent agents and multi-agent systems *(cannot be taken with CS3940)*	15 credits
CS4580	Advanced data communications *(cannot be taken with CS3580)*	15 credits
CS4520	Fundamentals of digitial sound and music *(cannot be taken with CS3520)*	15 credits
IY4606	Smart cards/Token security and applications	15 credits
IY4609	Digital forensics	15 credits
IY4610	Security testing theory and practice	15 credits
IY4612	Cyber security	15 credits

- At stage two or stage three, students may choose to substitute a 15 credits (½) unit course for another unit outside the department provided the department approves the external unit. Students taking an industrial year take one of the additional courses CS3001 or CS4001 and thus have five units in their penultimate or final year.

- While students are normally allocated a specific lab for any given course they are registered for, they may if they wish attend additional labs of that course where space allows.
- Students for each year are expected to take part in the Advanced topics seminar course (CS3010). This course is not part of the degree programme but attendance will be placed in the student's transcripts.

The course units taken for each of the M.Sci. Degree Programmes are as follows:

M.Sci. Computer Science G403

First	CS1801* *mandatory, non-condonable for the purposes of progression* CS1820, CS1830, CS1840, CS1860, CS1870, CS1890 *mandatory, condonable*
Second	CS2800 *mandatory, non-condonable for degree title* CS2810 *mandatory, non-condonable for degree title* CS2850, CS2855, CS2860, IY2760 *mandatory, condonable* *two further non-project CS2XXX or IY2XXX elective courses*
Third	CS3821 *mandatory, non-condonable for degree title* *six further non-project CS3XXX or IY3XXX elective courses*
Final	CS4821 *mandatory, non-condonable for degree title* Four further non-project courses from the above Stage 4/5 list

A year out in industry (CS3001) may be taken between second and third year or between the third and fourth year (CS4001).

M.Sci. Computer Science with Year in Industry G404

First	CS1801* *mandatory, non-condonable for the purposes of progression* CS1820, CS1830, CS1840, CS1860, CS1870, CS1890 *mandatory, condonable*
Second	CS2800 *mandatory, non-condonable for degree title* CS2810 *mandatory, non-condonable for degree title* CS2850, CS2855, CS2860, IY2760 *mandatory, condonable* *two further non-project CS2XXX or IY2XXX elective courses*
Third	CS3001 *mandatory, non-condonable for degree title (cannot be taken with CS4001)*
Penultimate	CS3821 *mandatory, non-condonable for degree title* *six further non-project CS3XXX or IY3XXX elective courses*
Fourth	CS4001 *mandatory, non-condonable for degree title (cannot be taken with CS3001)*
Final	CS4821 *mandatory, non-condonable for degree title* *Four further non-project elective courses from the above Stage 4/5 list*

M.Sci. Computer Science (Information Security) G500

First	CS1801* *mandatory, non-condonable for the purposes of progression* CS1820, CS1830, CS1840, CS1860, CS1870, CS1890 *mandatory, condonable*
Second	CS2800 *mandatory, non-condonable for degree title* CS2810 *mandatory, non-condonable for degree title* IY2760, IY2840, CS2860, CS2850, CS2855, CS2821 *mandatory, condonable*
Third	IY3821 *mandatory, non-condonable for degree title* IY3840, IY3660 *mandatory, condonable* *four further non-project CS3XXX elective courses - to a total of 2 units of Computer Science*
Final	IY4500 *mandatory, non-condonable for degree title* *Four further non-project elective courses from the above Stage 4/5 list with two being IY4XXX courses - to a total of 2 units*

A year out in industry (CS3001) may be taken between second and third year or between the third and fourth year (CS4001).

M.Sci. Computer Science (Information Security) with Year in Industry G502

First	CS1801* *mandatory, non-condonable for the purposes of progression* CS1820, CS1830, CS1840, CS1860, CS1870, CS1890 *mandatory, condonable*
Second	CS2800 *mandatory, non-condonable for degree title*

	CS2810 *mandatory, non-condonable for degree title* IY2760, IY2840, CS2860, CS2850, CS2855, CS2821 *mandatory, condonable*
Third	CS3001 *mandatory, non-condonable for degree title (cannot be taken with CS4001)*
Penultimate	IY3821 *mandatory, non-condonable for degree title* IY3840, IY3660 *mandatory, condonable* *four further non-project CS3XXX elective courses - to a total of 2 units of Computer Science*
Fourth	CS4001 *mandatory, non-condonable for degree title (cannot be taken with CS3001)*
Final	IY4500 *mandatory, non-condonable for degree title* Four further non-project courses from the above Stage 4/5 list with two being IY4XXX courses - to a total of 2 units

M.Sci. Computer Science (Artificial Intelligence) GG47

First	CS1801* *mandatory, non-condonable for the purposes of progression* CS1820, CS1830, CS1840, CS1860, CS1870, CS1890 *mandatory, condonable*
Second	CS2800 *mandatory, non-condonable for degree title* CS2810 *mandatory, non-condonable for degree title* CS2850, CS2855, CS2860, IY2760 *mandatory, condonable* *two further non-project CS2XXX or IY2XXX elective courses*
Third	CS3822 *mandatory, non-condonable for degree title,* CS3920 *mandatory, condonable* *five further non-project CS3XXX or IY3XXX elective courses*
Final	CS4822 *mandatory, non-condonable for degree title* CS4100, CS4200 *mandatory, condonable* *Two further non-project elective courses from the above Stage 4/5 list to a total of 1 unit*

A year out in industry (CS3001) may be taken between second and third year or between the third and fourth year (CS4001).

M.Sci. Computer Science (Artificial Intelligence) with Year in Industry GG74

First	CS1801* *mandatory, non-condonable for the purposes of progression* CS1820, CS1830, CS1840, CS1860, CS1870, CS1890 *mandatory, condonable*
Second	CS2800 *mandatory, non-condonable for degree title* CS2810 *mandatory, non-condonable for degree title* CS2850, CS2855, CS2860, IY2760 *mandatory, condonable* *two further non-project CS2XXX or IY2XXX elective courses*
Third	CS3001 *mandatory, non-condonable for degree title (cannot be taken with CS4001)*
Penultimate	CS3822 *mandatory, non-condonable for degree title,* CS3920 *mandatory, condonable* *five further non-project CS3XXX or IY3XXX elective courses*
Fourth	CS4001 *mandatory, non-condonable for degree title (cannot be taken with CS3001)*
Final	CS4822 *mandatory, non-condonable for degree title,* CS4100, CS4200 *mandatory, condonable* *Two further non-project elective course from the above Stage 4/5 list to a total of 1 unit*

* Students taking the above degree programmes may take CS1802 instead of CS1801 as *mandatory, non-condonable for the purposes of progression* at the discretion of the department.

Progression and award requirements
The progression and award requirements are essentially the same across all M.Sci. Degree programmes at Royal Holloway. Students must pass units to the value of at least 90 credits (three full units) on each stage of the programme. On some programmes there may be a requirement to pass specific courses in order to progress to the next stage, or to qualify for a particular degree title (see programme structure above).
To progress from stage two to the following stage the student must achieve at their first attempt an average calculated to two decimal places of 50.00% or above. To progress from the penultimate to final stage the student

must achieve both of the following criteria
- a weighted average of 55.00% or above computed to two decimal places, where the second stage average is weighted as 1 and the penultimate stage average is weighted as 2;
- a grade of 55.00% or above computed to two decimal places in one of the following courses CS3821, IY3821 or CS3822.

Students who fail to progress from stage two will be transferred to a B.Sc. programme.

M.Sci. students who fail to progress to the final stage will also be transferred to a B.Sc. programme. In particular: - students taking M.Sci. Computer Science and M.Sci. Computer Science (Year in Industry) who fail to progress will be transferred to B.Sc. Computer Science; students taking M.Sci. Computer Science (Information Security) and M.Sci. Computer Science (Information Security) with a Year in Industry who fail to progress will be transferred to B.Sc. Computer Science (Information Security); students taking M.Sci. Computer Science (Artificial Intelligence) and M.Sci. Computer Science (Artificial Intelligence) with Year in Industry who fail to progress will be transferred to B.Sc. Computer Science (Artificial Intelligence).

Student support and guidance
- Advisors: All students are allocated a personal academic advisor who meets with them regularly through the programme. The advisor's role is to advise on academic, pastoral and welfare issues. Students have tutorials with their advisor during the first year.
- The programme co-ordinator, the director of pastoral care, the director of undergraduate studies and the head of department provide a back-up system of academic, pastoral and welfare advice.
- All staff are available and accessible. Initial contact can be arranged via email or through the departmental office.
- A student handbook is supplied to every student, and course notes and other learning resources are available either in hard copy or on the department's web site.
- Induction sessions are run at the start of each academic year by technical support staff on the use of the departmental computing systems.
- Technical back up is provided by the systems support staff for problems with using the departmental computing system.
- Extensive supporting materials and learning resources are available in the College libraries and the Computer Centre.
- Careers advice is provided by the College Careers Service and the Departmental Employability Tutor..
- Students have access to all College and University support services, including Student Counselling Service, Health Centre and the Disability and Dyslexia Services for students with disabilities and Specific learning Difficulties.

Admission requirements
Details of the Department's typical offer for each programme of study is available on the Course Finder web page. However, the Department also has flexibility in its admissions and offers policy and strongly encourages applications from non-standard applicants. Students whose first language is not English may also be asked for a qualification in English Language at an appropriate level. For further guidance it may also be helpful to contact the Recruitment and Partnership Office.

Further learning and career opportunities
Computer Science opens up a wide range of career opportunities for graduates and the department has a number of important links with industry. Computer Science graduates from the Department have found employment in a wide range of jobs. Many have gone into software houses such as Logica, while others have entered larger organisations such as British Telecom, Texas Instruments and BAE Systems. A large number enter careers with a management or financial slant, for example Accenture or large multi-national companies. The College Careers Office organises recruitment visits by companies and there are a number of careers fairs during the year when final year students can make useful contacts with prospective employers. In addition, the industrial year programme allows students to work within a company for one year between the second and final years. Students taking this

option often find that the employer will encourage them to apply for posts at the completion of their degree. For further details please refer to the Careers Service.

Indicators of quality and standards
Royal Holloway's position as one of the UK's leading research-intensive institutions was confirmed by the results of the most recent Research Excellence Framework (REF 2014) conducted by the Higher Education Funding Council (HEFCE). The scoring system for the REF 2014 measures research quality in four categories, with the top score of 4* indicating quality that is world-leading and of the highest standards in terms of originality, significance and rigour and 3* indicating research that is internationally excellent. 81% of the College's research profile was deemed to be within the 4* or 3* categories, an increase of over 20% since 2008. The results for the quality of our research outputs placed Royal Holloway 15th in the UK based on an overall Grade Point Average (GPA) score and 20th in the UK for 4* and 3* research.

Computer Science is ranked 11th in the UK for the quality of its research output, with 32.2% classified as 4* (world leading) and 54.5% as 3* (internationally excellent). This is an outstanding performance that reflects the department's strong research culture and significant expansion in its research portfolio, which transmits to the inspiring teaching that delivered across the degree programmes. 40% of the Research Impact has also been classified as 4* (world leading), which reflects the strong engagement the department has with companies and the influence that its research has in the economy and society.

In the 2014 National Student Survey the Computer Science Department was joint sixth in the UK (third in England) rankings for Computer Science departments.

List of programmes
All the programmes are taught entirely by staff at Royal Holloway, University of London, and either lead to degree awards of the University of London or alternatively Diploma of Higher Education awards of Royal Holloway and Bedford New College. The QAA subject benchmark statement in Computer Science describes the general features which one might expect from Honours Degree programmes in the subject, and can therefore be used as a point of reference when reading this document (see www.qaa.ac.uk). UCAS codes are given in parentheses (see www.ucas.ac.uk).

MSci Honours Degree programmes in Computer Science
  MSci Computer Science (G403)
  MSci Computer Science with Year in Industry (G404)

Specialist Honours Degree programmes within Computer Science
  MSci Computer Science (Artificial Intelligence) (GG47)
  MSci Computer Science (Artificial Intelligence) with Year in Industry (GG74)

Combined Honours Degree programmes with Computer Science as a major component
  MSci Computer Science (Information Security) (G500)
  MSci Computer Science (Information Security) with Year in Industry (G502)