ROYAL HOLLOWAY

University of London

PROGRAMME SPECIFICATION

This document describes **B.Sc. Degree programmes in Computer Science**. For Joint and Combined Honours Degree programmes, please also refer to the equivalent document(s) for the other subject(s). This specification is valid for new entrants from: **September 2016.**

The aims of all B.Sc. 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 computing-related cognitive abilities and skills as described in the QAA Computer Science benchmark statement;

- to develop, in a flexible and progressive structure, 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 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.

The B.Sc. degree programmes correspond to level 6 in the QAA framework. The length of these degrees varies from three years for standard B.Sc. programmes to four years for the B.Sc. with a year in Industry programmes.

Apart from the year in industry, each stage comprises one year of full-time study during which the student must follow courses to the value of 120 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 stage of the B.Sc. programmes, students undertake a project, which accounts for 25% of their studies. There is a free choice of other final stage courses reflecting both core material, such as compiler theory, and currently important research areas such as machine learning, information security, software language engineering, intelligent agents, computational finance and bioinformatics.

Further information

Learning outcomes

Teaching, learning and assessment

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 full 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

- knowledge and understanding of the essential facts, concepts, principles and theories relating to computing and computer applications;

- understanding 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;

- understanding 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;

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Additional for programmes with a 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)

- an appreciation of the fundamental aspects of cyber security;

- an ability to identify and apply appropriate 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. Full 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 full 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
CS1860	Mathematical structures	15 credits
CS1870	Machine fundamentals	15 credits
CS1890	Software design	15 credits

STAGE 2		
CS2800	Software engineering	15 credits
CS2810	Team project	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			Strand
CS3001	Year out in industry	30 credits	
CS3810	Half unit project *(cannot be taken with CS3821, CS3822)*	15 credits	
CS3821	Full unit project *(cannot be taken with CS3810)*	30 credits	
CS3822	Individual project in artificial intelligence	30 credits	AI

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IY3821	Full unit project (Information Security)	30 credits	IS
CS3110	Bioinformatics	15 credits	
CS3220	Digital audio and applications	15 credits	
CS3470	Compilers and code generation	15 credits	
CS3490	Computational optimisation	15 credits	
CS3510	Functional programming and applications	15 credits	
CS3870	Advanced algorithms	15 credits	
CS3250	Visualisation and exploratory analysis	15 credits	AI
CS3920	Machine learning	15 credits	AI
CS3930	Computational finance	15 credits	AI
CS3940	Intelligent agents and multi-agent systems	15 credits	AI
CS3945	Semantic Web	15 credits	AI
CS3580	Advanced data communications	15 credits	DNS
CS3750	Concurrent and parallel programming	15 credits	DNS
IY3606	Smart cards/Token security and applications	15 credits	IS
IY3609	Digital forensics	15 credits	IS
IY3612	Cyber security	15 credits	IS
IY3660	Applications of cryptography	15 credits	IS
IY3840	Malicious software	15 credits	IS
CS3480	Software language engineering	15 credits	SE
CS3846	Human-Computer Interaction (*cannot be taken with CS2846*)	15 credits	SE

- Key to the strands of courses presented above:

  - AI – Artificial Intelligence

  - IS – Information Security

  - SE – Software Engineering

  - DNS – Distributed and Networked Systems

- At stage two or stage three, students may choose to substitute a 15 credit course for another one outside the department provided the department approves the external unit. Students taking an industrial year take additional course CS3001 and thus have 150 credits in their 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.

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The course units taken for each of the Degree Programmes in Computer Science is as follows:

B.Sc. Single Honours Computer Science G400

First	CS1801* *non-condonable for the purposes of progression*
	CS1820, CS1830, CS1840, CS1860, CS1870, CS1890
Second	CS2800 *non-condonable for degree title*
	CS2810 *non-condonable for degree title*
	CS2850, CS2855, CS2860, IY2760
	two further non-project CS2XXX or IY2XXX elective courses
Final	CS3821
	six further non-project CS3XXX or IY3XXX elective courses

A year out in industry (CS3001) may be taken between second and final year.

When available, part-time students will take 50% of the courses for each year, taking six years in total. In year 1 of stage 1, students must take CS1801, CS1820 and CS1830. In year 1 of stage 2 students must take CS2800, CS2810 and CS2855 In year 2 of stage 2, students must take CS2860.

B.Sc. Computer Science with Year in Industry G402

First	CS1801* *non-condonable for the purposes of progression*
	CS1820, CS1830, CS1840, CS1860, CS1870, CS1890
Second	CS2800 *non-condonable for degree title*
	CS2810 *non-condonable for degree title*
	CS2850, CS2855, CS2860, IY2760
	two further non-project CS2XXX or IY2XXX elective courses
Third	CS3001 *non-condonable for degree title*
Final	CS3821
	six further non-project CS3XXX or IY3XXX elective courses

B.Sc. Computer Science (Artificial Intelligence) G4G7

First	CS1801* *non-condonable for the purposes of progression*
	CS1820, CS1830, CS1840, CS1860, CS1870, CS1890
Second	CS2800 *non-condonable for degree title*
	CS2810 *non-condonable for degree title*
	CS2850, CS2855, CS2860, IY2760

	two further non-project CS2XXX or IY2XXX
Final	CS3822
	six further non-project CS3XXX or IY3XXX elective courses, of which at least two must be from the Artificial Intelligence (AI) strand

A year out in industry (CS3001) may be taken between second and final year.

B.Sc. Computer Science (Artificial Intelligence) with Year in Industry G7G4

First	CS1801* *non-condonable for the purposes of progression*
	CS1820, CS1830, CS1840, CS1860, CS1870, CS1890
Second	CS2800 *non-condonable for degree title*
	CS2810 *non-condonable for degree title*
	CS2850, CS2855, CS2860, IY2760
	two further non-project CS2XXX or IY2XXX elective courses
Third	CS3001 *non-condonable for degree title*
Final	CS3822
	six further non-project CS3XXX or IY3XXX elective courses, of which at least two must be from the Artificial Intelligence (AI) strand

B.Sc. Computer Science (Information Security) G407

First	CS1801* *non-condonable for the purposes of progression*
	CS1820, CS1830, CS1840, CS1860, CS1870, CS1890
Second	CS2800 *non-condonable for degree title*
	CS2810 *non-condonable for degree title*
	CS2850, CS2855, CS2860, IY2760, IY2840
	One further non-project CS2XXX or IY2XXX elective course
Final	IY3821, IY3840, IY3660
	four further non-project CS3XXX or IY3XXX elective courses

A year out in industry (CS3001) may be taken between second and final year.

B.Sc. Computer Science (Information Security) with Year in Industry G406

First	CS1801* *non-condonable for the purposes of progression*
	CS1820, CS1830, CS1840, CS1860, CS1870, CS1890

Second	CS2800 *non-condonable for degree title*
	CS2810 *non-condonable for degree title*
	CS2850, CS2855, CS2860, IY2760, IY2840
	One further non-project CS2XXX or IY2XXX elective course
Third	CS3001 *non-condonable for degree title*
Final	IY3821, IY3840, IY3660
	four further non-project CS3XXX or IY3XXX elective courses

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

B.Sc. Computer Science with Management G4N2

First	CS1801 *non-condonable for the purposes of progression*
	CS1830, CS1840, CS1860, CS1890
	two out of MN1205, MN1305, MN1405 and MN1705 (one per term)
Second	CS2800 *non-condonable for degree title*
	CS2810 *non-condonable for degree title*
	CS2860, CS2855, IY2760
	one further non-project CS2XXX or IY2XXX elective course
	two out of MN2205, MN2305, MN2405, MN2705 (one per term)
Final	CS3821 OR CS3810
	four or five further non-project CS3XXX or IY3XXX elective courses-to a total of 90 credits of Computer Science
	30 credits of Management courses MN3XXX (see Management handbook for options)

A year out in industry (CS3001) may be taken between second and final year.

B.Sc. Computer Science and Mathematics GG41

First	CS1801 *non-condonable for the purposes of progression*
	either (CS1840 and CS1890) *OR* (CS1860 and CS1870)
	MT1710, MT1720, MT1810, MT1820
Second	CS2800 *non-condonable for degree title*
	CS2810 *non-condonable for degree title*

	CS2860

one further non-project CS2XXX or IY2XXX elective course

MT2630, MT2800

30 credits of Mathematics courses MT2XXX (see Mathematics handbook for options) |
| Final | CS3821 OR CS3810

two or three further non-project CS3XXX or IY3XXX elective courses - to a total of 60 credits of Computer Science, **excluding CS3490 and CS3870**

60 credits of Mathematics courses MT3XXX (see Mathematics handbook for options) |

A year out in industry (CS3001) may be taken between second and final year.

B.Sc. Computing and Business GN41

| First | CS1801 *non-condonable for the purposes of progression*

CS1840, CS1890

MN1205, MN1305, MN1405, MN1705 |
|---|---|
| Second | CS2800 *non-condonable for degree title*

CS2810 *non-condonable for degree title*

CS2855

one further non-project CS2XXX or IY2XXX elective course

MN2205, MN2305, MN2405, MN2705 |
| Final | CS3821 OR CS3810

two or three further non-project CS3XXX or IY3XXX elective courses - to a total of 60 credits of Computer Science

60 credits of Management courses MN3XXX (see Management handbook for options) |

A year out in industry (CS3001) may be taken between second and final year.

Progression and award requirements

The College's Undergraduate Regulations include full details on progression and award requirements for all undergraduate programmes offered by the College. 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 and this will put restrictions on courses in which failing marks can be condoned (see programme structure above for details). Additionally, there are some requirements on the number of courses that must be passed in order to qualify for particular joint or combined Honours degrees.

Eligible students who wish to transfer to the equivalent MSci of their programme must do so before the start of stage three. To transfer from stage two to the following stage in the MSci the student must achieve, at their first attempt, a stage average calculated to two decimal places of 50.00% or above.

Students who are registered for BSc in Computer Science but who fail the second stage of their programme will be eligible for the award of Certificate of Higher Education in Computer Science, if they have fulfilled the requirements to progress from first to second stage of their degree programme, including a pass in CS1801 (or CS1802 if taken instead), and passed at least 120 Computer Science credits from either the first or the second year.

Students who are registered for BSc in Computer Science or Computer Science with Management but who fail to graduate will be eligible for the award of Diploma of Higher Education in Computer Science or Diploma of Higher Education in Computer Science with Management, if they have fulfilled the requirements to progress from second to third stage of their degree programme and passed at least 120 CS credits from either the second or third year, *including* passes in CS2800 and CS2810.

Students who are registered for BSc in Computer Science or Computer Science with Management but who fail to graduate will be eligible for the awards of Diploma of Higher Education in Computing Studies or Diploma of Higher Education in Computing with Management Studies, if they have fulfilled the requirements to progress from second to third stage of their degree programme and passed at least 90 Computer Science credits from either the second or third year, not including passes in both CS2800 and CS2810.

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.

All of the single-honours degree programmes in Computer Science are accredited by the British Computer Society and by the European Quality Assurance Network (EQANIE). The 2014 BCS accreditation visit panel also identified our teaching of Software Engineering as an area of best practice.

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 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).

Single Honours Degree programmes in Computer Science

BSc (Hons) Computer Science (G400)

BSc (Hons) Computer Science with Year in Industry (G402)

Specialist Honours Degree programmes within Computer Science

BSc (Hons) Computer Science (Artificial Intelligence) (G4G7)

BSc (Hons) Computer Science (Artificial Intelligence) with Year in Industry (G7G4)

Combined Honours Degree programmes with Computer Science as a major component

BSc (Hons) Computer Science with Management (G4N2)

BSc Computer Science with Management (Year In Industry) [Exit Award Only]

BSc Computer Science (Information Security) (G407)

BSc Computer Science (Information Security) with Year in Industry (G406)

Joint Honours Degree programmes with Computer Science as an equal component

BSc (Hons) Computer Science and Mathematics (GG41)

BSc (Hons) Computing and Business (GN41)

BSc Computing and Business (Year In Industry) [Exit Award Only]

Diploma of Higher Education

(Only available to students registered for BSc in these subjects but who fail to graduate, subject to passing required courses as detailed in the Progression and award requirements section. Not available for admission through UCAS)

DipHE in Computer Science

DipHE in Computing Studies

DipHE in Computer Science with Management

DipHE in Computing with Management Studies

Certificate of Higher Education

(Only available to students registered for BSc in these subjects but who fail the second stage, subject to passing required courses as detailed in the Progression and award requirements section. Not available for admission through UCAS)

CertHE in Computer Science