Programme Specification

A statement of the knowledge, understanding and skills that underpin a taught programme of study leading to an award from The University of Sheffield

1	**Programme Title**	Computer Science
2	**Programme Code**	COMU103 (MComp), COMU101 (BSc)
3	**JACS Code**	I100
4	**Level of Study**	Undergraduate
5a	**Final Qualification**	Master of Computing with Honours (MComp) Bachelor of Science with Honours (BSc Hons)
5b	**QAA FHEQ Level**	Masters (COMU103), Bachelors (COMU101)
6	**Intermediate Qualification**	Bachelor of Science with Honours (BSc Hons)
7	**Teaching Institution** (if not Sheffield)	Not applicable
8	**Faculty**	Engineering
9	**Department**	Computer Science
10	**Other Departments involved in teaching the programme**	None
11	**Mode of Attendance**	Full-time
12	**Duration of the Programme**	4 years (MComp), 3 years (BSc)
13	**Accrediting Professional or Statutory Body**	British Computer Society
14	**Date of production/revision**	September 2023

15. Background to the programme and subject area

Computer Science is the fundamental discipline of the information and communication age. Computing now permeates every aspect of life, ranging from business and medicine to science, engineering and the humanities; and skilled personnel are required to harness and exploit the growing power of computing devices.

A degree in Computer Science covers a wide spectrum of knowledge, ranging from mathematics, algorithms and data structures, software engineering, hardware and networks to human and professional issues. It also develops a wide range of technical and interpersonal skills, including analysis and design, computer programming, team management, report writing, presentation skills and enterprise. Our Computer Science degree has a strong theoretical basis and a high practical content. Key features include project teamwork at all levels, building real business systems for clients, and a project dissertation. At the higher levels, students may pursue advanced topics in computer speech and language processing, 3D computer graphics, adaptive intelligence, the intelligent web, distributed systems and computer security and forensics.

Our curriculum reflects the latest research developments and professional standards in Computer Science. Teaching is informed by the research activity of staff, which has an international reputation for the quality of its research. In the 2021 Research Excellence Framework (REF), 99% of our research was rated in the top two categories, meaning it is classed as world-leading or internationally excellent. The Department is rated 8th nationally for the quality of our research environment. Close links are maintained with industry-leading companies through the department's Industrial Advisory Board. Our degrees are accredited by the British Computer Society, providing a route to the professional status of Chartered Engineer (CEng), Chartered Scientist (CSci) and Chartered Information Technology Professional (CITP).

See the Department of Computer Science website: http://www.shef.ac.uk/dcs for more information.

16. Programme aims

The aims of the programme are:

1. To provide a thorough academic grounding in the core subject matter of Computer Science, with advanced study paths informed by the Department's wide-ranging research interests;

2. To develop technical, professional and managerial skills through exposure to practical, industrially-oriented projects, emphasising teamwork and communication as well as software design and development skills;

3. To provide a route to professional accreditation through the British Computer Society, leading to partial (BSc) and full (MComp) CITP, CEng and CSci accreditation;

4. To expose students to leading-edge world-class research in Computer Science (BSc) and engage students in advanced research areas and methods (MComp);

5. To produce immediately employable graduates with an industrially relevant mix of knowledge, practical skills and self-motivation (BSc) and with leadership and enterprise skills (MComp);

6. To provide an international dimension with opportunities for study in universities in other countries.

17. Programme learning outcomes

Knowledge and understanding - On successful completion of the programme, students will have obtained:	
K1	A full understanding of programming languages and styles, algorithms and data structures.
K2	A full understanding of discrete and continuous mathematical foundations for computing.
K3	A full understanding of software engineering, analysis and design methods and process management.
K4	A full understanding of artificial intelligence and biologically-inspired models of machine reasoning.
K5	An appreciation of computer hardware design and computer network architectures.
K6	An appreciation of the wider context of professional practice, including the relationship between computer science and society, the environment and the Law.
K7	An appreciation of the commercial and industrial dimension to computing, through interaction with clients.
K8	A deep understanding of aspects of theoretical and applied computer science and symbolic calculi (core topic for the degree).
K9	A deep understanding in a range of research-led topics taught in the third (BSc and MComp) and fourth (MComp) years of the degree.

Skills and other attributes - On successful completion of the programme, students will be able:	
S1	To function in an Information and Communication Technology (ICT) environment using appropriate technology such as email, the Internet, shared data and code repositories.
S2	To conceive, design and write correct working computer programs in several different programming styles, using a variety of compilers and development environments.
S3	To construct and manipulate formal and mathematical models.
S4	To apply a software engineering process and take a project through the stages of the software lifecycle, using design notations and software engineering tools selectively.
S5	To communicate effectively in writing, present a two-sided argument, expose technical information clearly, comprehend and summarise research-level material with proper citation of sources.
S6	To communicate effectively in speaking, interview and interact productively with a client, present and defend a substantial piece of work, engage with others and respond effectively to questions.
S7	To work effectively in a team, demonstrating personal responsibility and group management ability, interpersonal skills, leadership and delegation, and plan to meet deadlines.
S8	To design solutions for complex problems to meet a customer's needs within the context of a wider business practice.
S9	To research material from multiple published sources, comprehend and filter such material and from it synthesize theories, principles or designs pertinent to a practical, problem-solving project.

S10	To demonstrate personal initiative, self-motivation and problem-solving skills, through the selection and taking through to completion of a practical, problem-solving individual project with a research dimension.
S11	**(MComp only):** To demonstrate group initiative and enterprise within a group project.

18. Teaching, learning and assessment

Development of the learning outcomes is promoted through the following teaching and learning methods:

The Department fosters an environment with many opportunities for individual and group learning, but the responsibility for learning rests with the student, who must be personally organised and self-motivated to make the most of the programme. Teaching is offered through formal lectures, seminars, computer laboratories, problem-solving classes and project supervision.

Lectures are formal presentations to a large class of students by a lecturer. The purpose of a lecture is to motivate interest in a subject, to convey the core concepts and information content succinctly, and to point students towards further sources of information. Lectures are interactive and students are encouraged to ask questions at suitable points. Students are expected to take notes during lectures, adding detail to published course materials (which should be printed and brought to the lecture, when provided in advance on electronic media). The learning outcomes *K1-K9* are supported mainly through this mode.

Seminars are longer semi-formal presentations to a class of students by a lecturer, researcher, industrial partner or student, describing an area of their current research or business. There is typically more opportunity than in a lecture to structure the session internally with questions, problem solving and other kinds of interactive or shared learning experience, in which the students may also participate in the teaching and lead discussions. The learning outcomes *K7* and *S5-S9* are directly promoted through this mode, with indirect support for *K1-K6, K8-K9*.

Computer laboratories are sessions supervised by teaching assistants (under the direction of the responsible lecturer) in which students work at a computer, to develop a specific practical skill, such as familiarisation, computer programming, or the use of a software engineering or mathematical modelling tool. The learning outcomes *S1-S4* are promoted mainly through this mode, with indirect support for *K1-K3*.

Problem-solving classes are sessions conducted by a lecturer with a class of students, in which exercises are completed interactively and solutions are provided within the period. The purpose of such a class is to help students engage with, and assimilate the material presented in lectures and start to apply this knowledge. The learning outcomes *K2-K6* and *K8* are supported through this mode.

Project supervision involves regular meetings with a student's individual or group project supervisor, who may also be their personal tutor. During each session, students report on their progress to the supervisor, who highlights further areas of investigation, helps with technical problems, advises about the content and structure of technical reports and generally encourages the students to organise their time effectively. The learning outcomes *S5-S11* are directly promoted through this mode, with *S1-S4* supported indirectly.

The transition to self-motivated learning is encouraged through specialist teaching materials such as lecture handouts or copies of lecture slides, supplied via the Department's website. Set course texts and background materials are available through the University libraries, at bookshops and also via the Internet. Active learning is fostered and promoted through engagement in practical work, such as exercises, assignments and projects.

Exercises are short tasks, either writing computer programs or working out solutions to other kinds of set problem, which are typically reviewed at the end of the session. Learning outcomes *K1-K9* and *S1-S4* may be supported this way.

Assignments are typically offered in stages over a number of weeks, involving the design and implementation of a software system to perform a given task, or the researching of a body of information leading to the writing of a discursive essay on a given topic. Learning outcomes *S1-S5* are supported by this; indirectly *K1-K9* are reinforced.

Projects are undertaken individually or in groups over one or two semesters. Projects typically solve a larger problem, possibly for an industrial client, possibly with a research dimension. Individual projects require personal organisation and presentation skills; group projects also require group organisational and communication skills. Learning outcomes *K6-K7* and *S1-S11* are supported by this; indirectly, *K1-K5, K8-K9* are reinforced.

Private study makes up more than half of the time allocated to each module. Students are expected to read around the topics of each module and follow especially any directed reading from recommended course texts. Private study will include further investigations prior to exercises or projects and also consolidation of lecture notes.

Opportunities to demonstrate achievement of the learning outcomes are provided through the following assessment methods:

Modules may be assessed by formal examination, by practical assignments, by an individual or group project, or by some combination of these methods.

Examinations are typically 2-hour question papers, in which students' answer 3 from a choice of 4 questions. A typical question has 40% of the credit devoted to the recall of knowledge and information and 60% of the credit devoted to applying this knowledge actively to solve a short problem. Examinations test the knowledge learning outcomes *K2-K9*, but also provide evidence of practical skills *S3* and *S5*, and, to a lesser extent, evidence of previous engagement in *S2* and *S4*.

Assignments are typically 10-20 hour pieces of continuously assessed coursework, which students complete individually or in groups as directed. An assignment may have multiple stages, each offered over a 2-3 week period, delivered to separate deadlines. Assignments both develop and assess the practical skills *S2-S5* and they are the main means of assessing programming ability *K1, S2*. ICT skills *S1* are assessed indirectly.

Individual dissertation projects are completed at Level 3, typically over two semesters. Students select a topic, research the background literature, prepare a survey/analysis report at the interim assessment stage, and apply this knowledge in a practical, problem-solving project which typically involves the design, implementation and testing of a substantial piece of software. The final assessment stage is by dissertation and poster session, assessed independently by two examiners. A *viva voce* examination may be held to form a common view in cases of insufficient evidence or divergent opinions. The learning outcomes *S5-S6, S9-S10* are directly assessed, together with specialist areas of knowledge from *K8-K9*. Practical skills in *S1-S4* and knowledge in *K1-K7* may be assessed indirectly.

Group projects are completed at Levels 1, 2 and 4, over one or two semesters. Student teams are given topics (Level 1) or negotiate topics with their industrial clients or research sponsors (Levels 2, 4). Teams prepare analysis and design documents (Levels 1, 2), or draft research papers (Level 4), demonstrate a working software system (Levels 1, 2) or research solution involving software, designs or theories (Level 4), and provide a final report, together with timesheets, minutes and other evidence of their group management strategy. Credit is awarded to the team as a whole on the basis of the quality of the work, as evidenced in the final report, interim documentation (all Levels) and reported client satisfaction (Levels 2, 4). Credit is weighted towards individual team members based on their participation, as evidenced in the minutes, timesheets and other indicators of the division of workload and responsibility, which may include *viva voce* interviews. The learning outcomes *S2, S4-S8* are directly assessed in software projects, together with *K6-K7* in industrial projects. The learning outcomes *S5-S7, S9* and *S11* are directly assessed in research projects, which may also assess *S2-S4* according to the type of project. Indirectly, *K1-5, S1* may be assessed (all Levels) and *K8-K9*.

Proportions of types of assessment by level can be found on the UniStats website: http://unistats.direct.gov.uk/

19. Reference points

The learning outcomes have been developed to reflect the following points of reference:

Subject Benchmark Statements
https://www.qaa.ac.uk/quality-code/subject-benchmark-statements

Framework for Higher Education Qualifications (2014)
https://www.qaa.ac.uk/docs/qaa/quality-code/qualifications-frameworks.pdf

University Vision and Strategic Plan
http://www.sheffield.ac.uk/strategicplan

Faculty of Engineering Placement Guidelines and Checklist

The pathway structure through the degree programme was determined originally by *SARTOR, 3rd Edition, 1997*, and updated in the light of the UK Standard for Professional Engineering Competence, which is the primary point of reference for degrees offering professional accreditation in engineering and related areas, such as computing.

The degree programme is formally accredited by the British Computer Society (BCS). The prominence given to practical, industrially related project work is supported by the BCS and our *Industrial Advisory Board*, which includes leading companies such as IBM, Nvidia and ARM.

The content of the modules at Level 3 are directly informed by the *research interests* of the Department and so conforms to the *University Mission Statement* to provide research-led teaching.

The workload fits comfortably within the guidelines laid down by the University, and is monitored by *external examiners*, who also review the content and standards of the programme.

20. Programme structure and regulations

Our degree programmes are designed with a common curriculum at Levels 1-2, broadening out into many advanced study paths at Levels 3-4. The common core satisfies the requirements for accreditation by the British Computer Society. It also permits direct transfers between the related degrees in *Computer Science*, *Software Engineering* and *Artificial Intelligence and Computer Science* and delayed transfers from related dual honours programmes. The Computer Science degree is the most general of our degrees and has the least restriction on module choice.

Level 1 has a fixed core of 120 credits consisting of five modules running through the year: *Java Programming, Foundations of Computer Science* (the underlying mathematics)*, Devices and Networks, Machines and Intelligence* and *Introduction to Software Engineering*, a group systems development exercise which forms the foundation for other group software development modules in later years, and two topics taught in single-semester blocks: *Web and Internet Technology, Introduction to Algorithms and Data Structures*. Students take part in a Faculty-wide project. the *Global Engineering Challenge*, which runs for one week prior to the start of Semester 2. In this week-long project, all first year students in the Engineering Faculty tackle real-world problems from a global perspective, working in interdisciplinary teams to develop solutions to real-life problems faced by developing communities.

Level 2 contributes to the final degree classification (1/3 BSc, 1/5 MComp) and has a completely fixed structure.   One subject is taught throughout the academic year: *Automata, Logic and Computation*. The remaining six topics are taught in single semester blocks. In the first semester the topics taught are *Data Driven Computing*, *Systems Design and Security*, and *Functional Programming*. In the Spring semester students cover *Robotics*, *Logic in Computer Science*, and participate in *The Software Hut*. This is an industrial group project developing software systems for external clients and continues the theme of group software development from the previous year.

Students may transfer freely between this programme and the single honours degree programmes listed above at any time up until the end of Level 2. Dual honours students may transfer back into the single honours programme at the previous Level. Transfers between MComp and BSc are also freely permitted up until the end of Level 2, at which point students must maintain a higher standard to continue on the MComp, otherwise they must transfer to the BSc. Resit examinations are held in August for Levels 1 and 2, although project-based assessments and some coursework cannot be repeated within the same year. Students take part in another Faculty-wide project, *Engineering – You're Hired*, which runs for one week prior to the start of Semester 2. Building on the 1st year 'Global Engineering Challenge' project, students again work in interdisciplinary teams and are expected to draw on subject knowledge to work on projects that have been devised in conjunction with industry.

Level 3 contributes to the final degree classification (2/3 BSc, 2/5 MComp) and consists of the core 40-credit *Dissertation Project*, 10-credit *Finance and Law for Engineers,* approved units to the value of 70 credits from a variety of research led topics such as: *Adaptive Intelligence, Software Re-engineering, Computer Security and Forensics, The Intelligent Web, Speech Processing, 3D Computer Graphics, Text Processing, Theory of Distributed Systems, Modelling & Simulation of Natural Systems*, *Advanced Algorithms*, and *Undergraduate Ambassadors Scheme in Computer Science*.

BSc students graduate on completing Level 3 successfully (see full regulations). MComp students must maintain a higher standard (no lower than class 2/ii) to proceed to Level 4, otherwise they may seek to graduate immediately under the BSc regulations. The *Individual Project* must be passed at the first attempt to gain honours and accreditation (see section 21). A student failing to graduate on the first attempt may repeat Level 3 once and hopefully graduate, but without honours.

Level 4 contributes to the final degree classification (2/5 MComp). Prior to 2018 entry, students must take one of or both of the 30-credit group *Darwin Research Project* and the 45 credit group project *Genesys*. From 2018 entry, students must undertake the *Darwin Project*, a year-long research-oriented group project, and may choose to undertake *Genesys*, an industry-focussed team project. Further topics are selected from the following research led modules: *Testing and Verification in Safety Critical Systems*, *Machine Learning and Adaptive Intelligence, Software Development for Mobile Devices, Network Performance Analysis and Parallel Computing with Graphical Processing Units.* There are also three follow-on courses from advanced modules in level 3: *Natural Language Processing, Software and Hardware Verification*, and *Speech Technology*. Finally, a variety of Level 4 versions of level three modules are offered in case a student regretted his/her module choice at Level 3. The extra modules are *Text Processing, Speech Processing, 3D Computer Graphics*, and *Computer Security and Forensics.*

MComp students graduate on completing Level 4 successfully (see full regulations below). A student who, exceptionally, fails to meet the required standard (no lower than class 2/ii) may graduate with a BSc.

Detailed information about the structure of programmes, regulations concerning assessment and progression and descriptions of individual modules are published in the University Calendar available online at http://www.sheffield.ac.uk/calendar.

21. Student development over the course of study

Level 1: Students learn the Java programming language, covering the basics of syntax, program construction and compiler tools. Later, they learn about object-oriented design, standard library packages, and how to use Java's self-documentation. Students learn about software lifecycles, the Unified Modelling Language (UML) design notation and the use of various Computer-Aided Software Engineering (CASE) tools. Through *Introduction to Software Engineering*, student teams learn how to pick up projects partway through the software lifecycle and progress them to the next stage. Students also acquire discrete mathematics for logic and formal specification, followed by matrix manipulation, probability and statistics, aided by the MatLab tool. Students learn about human and machine intelligence, and are trained in how to present a reasoned argument. Later, they learn how to program intelligent search algorithms in Java. Students also learn about the software and protocols essential in today's web-based world.

Level 2: Forms a foundation for the more advanced courses in Levels 3 and 4. Students learn the essential skills they will require as professional software engineers or computer scientists. The topics covered include the functional style of programming currently through the vehicle of Haskell. They learn about automata, formal languages and the theory of computation. The *Systems Design and Security* module extends their knowledge of program design techniques and includes an introduction to databases and security. They are introduced to machine learning and pattern processing in a module themed around the notion of data as a resource and to artificial intelligence and robotics. In the 2nd semester student teams compete in the *Software Hut* industrial project to deliver systems for external clients, applying the techniques and methods learned earlier.

Level 3: The capstone achievement is the *Dissertation Project*, a major piece of research and development requiring initiative and problem-solving skills. The project starts with a review of relevant literature and technology followed by detailed design, implementation and testing, and a written dissertation. Students demonstrate their working systems at a poster session, run like a technology fair with industrial visitors. Students are also required to study *Finance and Law for Engineers* which covers the legal and ethical framework in which software is developed and used. The COM third year taught modules are research-led, and the choice of modules depends on the student's interests and sometimes their choice of project.

Level 4: The capstone achievement is a group research project, the *Darwin Project*, which occupies a quarter (*Darwin*) of a student's time during the year. Prior to 2018 entry, students may alternatively undertake *Genesys*, in which students work in a group to develop software for clients in industry and the public sector. In both of these modules, students learn to organise themselves professionally, holding structured meetings and producing action minutes. The groups act on their own initiative to determine strategy, make decisions, allocate resources and evaluate progress. In *Darwin*, the group works to solve a research problem, developing a research proposal initially and generating a publishable paper at the end, whilst in *Genesys*, the group develops software for clients in industry and the public sector. Students in both entry cohorts may optionally undertake *both* these modules, but for entry from 2018 the research-oriented *Darwin Project* is core. Other knowledge and skills acquired depend on the students' personal interest (see above).

Upon Graduation: Students successfully completing the 3-year BSc programme graduate with the title: *Bachelor of Science with Honours (BSc Hons) in Computer Science*. Students successfully completing the 4-year MComp programme graduate with *Master of Computing (MComp) in Computer Science*.

Professional Development: The Computer Science degree programme (MComp, BSc) is accredited by the British Computer Society (BCS), the Chartered Institute for Computing and Information Systems. *Accreditation* recognises that a degree programme meets the requirement for the professional formation of a Chartered Information Technology Professional, a Chartered Engineer or a Chartered Scientist, and so opens the way to these professional statuses. Students graduating with BSc Hons. In Computer Science automatically obtain *Partial CITP, CEng and CSci Accreditation*. Students graduating with MComp. in Computer Science automatically obtain *Full CITP, CEng and CSci Accreditation*.

After gaining at least three years' professional work experience in the computing and information systems field, MComp graduates may apply to the British Computer Society to obtain the status of Chartered Information Technology Professional and either Chartered Engineer or Chartered Scientist, as appropriate to their work. BSc graduates who subsequently complete a further advanced study programme (such as an accredited MSc in Computer Science) may likewise apply after gaining similar professional work experience.

comu101 – ver24-25

22. Criteria for admission to the programme

Detailed information regarding admission to the programme is available at http://www.shef.ac.uk/prospective/

The standard requirement is three A-levels, of which one must be in *Mathematics*. Other equivalent national and international qualifications are accepted; see http://www.shef.ac.uk/dcs/undergrad for more details. Wider access is also offered to students lacking suitable A-level qualifications for science and engineering through the Foundation Year; see https://www.sheffield.ac.uk/dcs/undergraduate/courses/foundationyear for more details.

A general University of Sheffield admissions requirement is GCSE English. Non-native speakers of English must demonstrate suitable competence in the language. The preferred test is IELTS, though others are accepted. See the English Language Teaching Centre website http://www.shef.ac.uk/eltc/ for more information.

23. Additional information

The Department of Computer Science is housed in the modern, purpose-built Regent Court building and has its own dedicated computing facilities. The Department is internationally recognised for its teaching and research (in the 2021 Research Excellence Framework (REF), 99% of our research was rated in the top two categories, meaning it is classed as world-leading or internationally excellent).

An international dimension is offered through the *Study Abroad* programme, in which students may spend part of their degree in an overseas University. See http://www.sheffield.ac.uk/globalopps for more details.

The Department offers course materials and information services to students via the departmental intranet. The *Department of Computer Science Undergraduate Student Handbook* governs all local aspects of academic student life, with regard to services offered, computer etiquette, and local regulations. See the Department of Computer Science website: http://www.shef.ac.uk/dcs for more information.

This specification represents a concise statement about the main features of the programme and should be considered alongside other sources of information provided by the teaching department(s) and the University. In addition to programme specific information, further information about studying at The University of Sheffield can be accessed via our Student Services web site at http://www.shef.ac.uk/ssid/.

comu101 – ver24-25