Department of Computer Science and Technology



MPhil in Advanced Computer Science

Course Information for Applicants

UNIVERSITY OF CAMBRIDGE

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Welcome!

This guide should give you the essential information about this course. If it you have further questions you are welcome to ask us, the Postgraduate Education Team, by email graduate-admissions@cst.cam.ac.uk.

The course is supported by:

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Postgraduate Education Team

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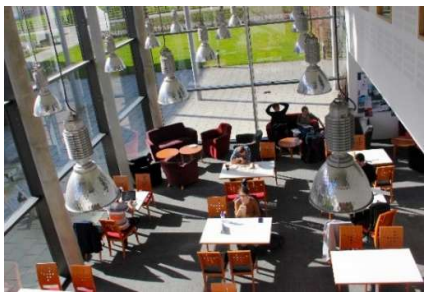
Department of Computer Science and Technology

The Department of Computer Science and Technology was founded in 1937 as the Mathematical Laboratory, located on the part of the New Museums Site now occupied by the Arup Building. Its name changed to the Computer Laboratory in 1969, and the Computing Service was established as part of the same department in 1970. In 2001, the Department moved to purpose-built facilities in West Cambridge. In 2017, it was renamed the Department of Computer Science and Technology.

The Department of Computer Science and Technology and is part of the School of Technology along with Engineering, Chemical Engineering and Biotechnology and the Judge Business School.



The department occupies the William Gates Building. The large central entrance corridor is known as The Street. MPhil students use Teaching Rooms LT2, FS07 and FW26 and the Teaching Laboratory SW02.



Other facilities include a café on the ground floor, and small kitchens around the department. There are also cafés in the West Hub, the Ray Dolby building, and at the end of JJ Thomson. A Sainsbury's supermarket is a ten-minute bike ride away at Eddington, and there is a state-of-the-art Sports Centre on the West Cambridge site.

Applications

The Basics

The MPhil in Advanced Computer Science (the ACS) is designed to prepare students for doctoral research, at Cambridge or elsewhere. Typical applicants will have undertaken a first degree in computer science or an equivalent subject, and will be expected to be familiar with basic concepts and practices. The ACS is a nine–month course which starts in early October and finishes at the end of June. It covers advanced material in both theoretical and practical areas, as well as instilling the elements of research practice. The course combines lectures, seminars and project work in various combinations tailored to the individual student. The course code for the MPhil in Advanced Computer Science is **CSM3**.

Prerequisites

Applicants for the MPhil in ACS are expected to have met the following prerequisites:

- first-class Honours degree, or equivalent, in computer science. Alternatively, a degree of equal status in engineering, science, or mathematics where the applicant can demonstrate significant relevant preparation for the Cambridge MPhil course.
- mathematics to A-Level standard or equivalent
- programming experience
- a good IELTS or TOEFL score, where an English Language qualification is necessary.

Applications

Formal application for admission for the MPhil degree must be made via the applicant portal https://www.postgraduate.study.cam.ac.uk/apply. The deadline for all applications is in February of the year preceding the October admission. However, if you are applying for funding support from the University and Cambridge Trust, please see the Funding competitions section below for the relevant deadlines.

Applications can only be considered by the Department once they are complete. The application will require the submission of the following supporting documentation:

- transcript
- two academic references
- one personal reference *(only required if applying for the Gates Cambridge Scholarship)*
- CV

Course specific questions

The application form also requires the following:

- A project proposal of no more than 500 words
- Choose five modules chosen from the current year's syllabus (see section 3)
- Programming experience.

Research project proposal

Students will spend a considerable amount of their time carrying out an individual research project under the supervision of a member of faculty. Your brief research proposal will identify the area in which you wish you work and a possible research problem in that area.

This proposal is not by any means binding; rather it serves to help us with our assessment of your application as well as identify potential supervisors. Candidates who are not yet certain of their area can visit the webpages of the various research groups and faculty members for inspiration.

Funding competitions

Applicants wishing to be considered for funding competitions should check their eligibility and the deadlines on the University's Postgraduate funding webpage: https://www.graduate.study.cam.ac.uk/finance/funding

Postgraduate Loans for postgraduate degrees for UK residents are also available: https://www.gov.uk/funding-for-postgraduate-study

The Course

This course consists of:

- 5 taught full modules
- 12 units from the Research Skills programme
- a research project report of no more than 15,000 words.

The project can be research- or application-oriented, and industrial collaboration is possible. Project selection and planning occurs in the first term, and the project is undertaken in the following two terms. A final report is submitted at the end of the project.

Course Advisers

In Michaelmas Term, you will be assigned a Course Adviser who will monitor your progress, meet with you at least once during the term and write a progress report. In Lent Term, Project Supervisors take over as adviser. MPhil students will also have a Postgraduate Tutor assigned to look after pastoral matters by their College.

Modules

Module choices should ideally underpin your research project. You should select your modules in consultation with your course adviser. Students usually study 3 modules in Michaelmas Term and 2 in Lent Term. Taught modules are delivered in a range of styles and generally consist of 16 contact hours over 8 weeks. There are traditional lecture courses, lecture courses with associated practical classes, reading clubs, and seminar style modules. **Each module is assessed independently.**

The modules available change each year. To give you a sense of the range of modules available, information about this year's modules is available on the Course pages webpage: https://www.cl.cam.ac.uk/teaching/2627/acs.html.

Research Skills Programme

The Research Skills Programme is designed to provide advice on and training in a variety of practical skills required for research. The skills learnt will be useful in your individual project, other research-led modules, and in your future career. All MPhil students are required to take 12 units in total which includes the core units and a number of optional units. See https://www.cst.cam.ac.uk/teaching/masters/rsp.

Core Units

There are 4-5 mandatory core units, covering topics such as 'Academic English', 'Academic Writing', and 'How to prepare a research presentation'.

Optional Units

You should choose units that are most relevant to your research plans, and supplementary to your previous experience. Optional units will not require coursework to be completed or submitted beyond participation in the session itself. Some options will involve practical work, which will be carried out during the session, but which will not be formally assessed.

Assessment and Examining

Students must obtain an average mark of **60%** (300/500 marks) across all taught modules and **60%** (420/700 marks) in the project to obtain the MPhil degree. The Distinction grade is awarded to candidates obtaining **75%** (900/1200 marks) and greater overall.

Coursework and Written Tests

Modules may be assessed by a combination of tests and/or coursework. Coursework may consist of recorded 'ticks' for ungraded assignments and/or graded term papers, practical reports, or essays. Ticks for ungraded reading assignments, oral presentations, or practical work may constitute a maximum of 25% of the coursework for any individual module.

Written papers may be set on selected modules. Test questions are marked according to a marking scheme and solution notes that are made available to the course examiners and agreed in advance of the test.

Students are recommended to use the 'study weeks' immediately after and immediately before the Cambridge full terms to revise for the tests and to complete coursework.

Deadlines

Formal notices of the schedule and format of written and take-home tests, and of coursework deadlines, will be shared with all students each term. Written and take-home tests are usually set during the first week of following term, as are coursework deadlines.

Deadlines are taken seriously and marks will be deducted for late coursework submission. The penalty will be calculated as follows: **penalty = n/10 x mark** where **n** is the integer part of the number of days late, rounded up to the nearest integer. Failure to submit the **research project** by the published deadline will result in outright failure of the course.

Oral examinations (viva voce examinations)

After the final meeting of the Examiners for the course, the Examiners will announce which students will be called for an oral examination after the meeting. An oral examination can only improve a result or leave it unchanged.

Research projects

Every student is required to conduct a substantial research project. A research project is equivalent to seven taught modules.

ACS teaching staff will propose research projects that they are willing to supervise; these will be published online in Michaelmas Term. Projects can be research oriented or application oriented. Industrial collaboration on projects is possible.

Project selection and planning is in Michaelmas Term. The project itself is undertaken in Lent and Easter Terms.

A member of the faculty's academic staff will be appointed as a project supervisor. A member of the faculty's academic staff may be appointed as a project advisor. The supervisor and advisor will assist you in producing a Project Proposal document and work plan. The supervisor, the adviser, and the Management Committee must all approve the Project Proposal document prior to you starting work on the tasks specified in the Proposal.

If the research project involves experiments on human subjects, approval from the Department's Ethics Committee is required.

The supervisor will monitor the progress of the project and a formal progress review will be conducted in conjunction with you and advisor at the end of Lent term. Presentations of work in progress will be given in the second week of Easter term to all students and departmental teaching staff.

Research Groups

Students are integrated into the research culture of the Department by joining one of the research groups. Students are expected to attend the Department's and research group's programme of seminars. An element of the research training will be in the context of a research group and will be overseen by their project supervisor.

Algorithms & Complexity

This research theme focuses on the mathematical modelling and analysis of algorithmic processes. A particular interest is the study of the complexity of such processes. Research spans logic and algorithms, computational complexity, quantum computing, and the analysis of classical and quantum algorithms. Current work explores topics including logical definability, learning theory, coding theory, cryptography, graph theory, random walks on graphs, graph isomorphism, and the development of algorithms for complex and graph-structured data.

Computer Architecture

Computer Architecture has been at the heart of the Department's research since its foundation. Early work on mechanical calculators and analogue computers led to the development of EDSAC, the world's first practical stored-program computer in 1949.

Today, research considers traditional general-purpose CPUs, GPUs, and accelerators for areas like machine learning, artificial intelligence, scientific computing and data processing. Strong connections exist with security research through the CHERI project, machine learning and artificial intelligence, and programming language research via compilers and binary modification tools. The group collaborates widely with industry in both hardware and software.

Graphics, Vision & Imaging Science

Computer graphics, computer vision and imaging science address creating, capturing, rendering, and analysing visual information in the forms of 2D/3D images, geometry, appearance, deformation, and motion models.

The tasks of computer graphics and vision are profoundly related. Machine learning is utilised to exploit this relationship and develop effective systems for digitizing and interacting with the visual world. Research combines novel software and hardware to tackle some of the fundamental problems of computer graphics, vision, and imaging. This often involves working with capture and display technologies, such as motion capture sensors, cameras, prototype displays, augmented and virtual reality headsets, or humanoid robots.

Human Centred Computing

The goal of human-centred computing is to create technologies that better meet human needs, through studying the needs of humans. Research addresses grand challenges using diverse research methods a vast range of disciplines. The group contributes to core fields of computer science such as human-computer interaction, computer graphics, visualisation, and display technologies. This work supports business, engineering, creative practice, and collaborative processes to address global challenges. Members of the group are also leaders in emerging specialist fields including affective computing, computer music, human-robot interaction, diagrammatic reasoning, computational photography, end-user programming and ubiquitous computing.

Machine Learning & Artificial Intelligence

The goal of the research in artificial intelligence and machine learning is to understand, represent, model, learn and reason about problems in the real world. AI technologies are created to benefit society and increase social awareness. The theoretical methods span all varieties of deep learning, classical statistical learning, computational biology, knowledge representation, Bayesian inference, causal modelling, logical reasoning, probabilistic reasoning, visual reasoning, stochastic processes, human-like computing, and natural language processing. These methods and approaches are applied in numerous settings such as personalised medicine and education, automated theorem proving, policy work and data, systems applications, sensor networks, and end-to-end solutions in the African context.

Mobile Systems, Robotics & Automation

This research theme encompasses the fundamental challenges introduced by systems that either move autonomously or are made mobile by human movement. The research spans issues related to how to make these systems more efficient, how to design algorithms that control and coordinate autonomous mobility and communication, and how to devise suitable machine learning models to analyse the data produced by them. This thrust also involves the investigation of security and privacy aspects and the interfaces between devices/robots and users.

Natural Language and Information Processing (NLIP)

The aim of Natural Language Processing is to develop computational models for analysing and generating human language. Research in the Department encompasses many areas of NLP, ranging from fundamental theory to real-world applications.

The models developed are mainly based on modern machine learning techniques. On the theoretical side, research seeks to understand the structure needed to represent language, how language is learned and processed by people, and how language varies between people and over time. On the application side, the ALTA institute develops

technology to support second language teaching and assessment. Other researchers work on automated fact checking, dialogue systems, document summarisation and scientific text processing, as well as interdisciplinary work in various domains such as healthcare and cybercrime. Collaborations with other departments are supported by Cambridge Language Sciences.

Programming Languages, Semantics and Verification

Research in this group is centred around the study of programming languages, logic, and mathematical models, addressing hardware, software, and networks. It spans a wide range of applied and theoretical work: programming language design, compilers, and program analysis; the development of interactive theorem provers and automatic proof procedures; the formal verification of computational systems; and semantic models using techniques such as structural operational semantics, type systems, domain theory, category theory, finite model theory and linear logic. Work is in progress on the underlying mathematical structures of these, and on their application to the study of higher-order typed programming languages; object-based languages; low-level machine languages; foundational languages for concurrent, distributed and mobile computation; hardware description languages; security and networking problems; database theory; and computational complexity.

Security

Computer security spans topics such as privacy, safety and maintainability. Areas of focus include access controls, protocols, cryptology, formal methods, hardware design, biometrics and usability, as well as the dependability of whole systems, which involves the economics of information security and spills over into policy.

Groups collect data on cybercrime and abuse for use by researchers worldwide (the Cambridge Cybercrime Centre); develop novel vulnerability-mitigation mechanisms that are now starting to appear in commercial CPU designs (the CHERI project); and study tamper-resistance and emission security (the Tamper Lab).

Inspiration is drawn from tackling real problems, and work is support by funding from collaborations with commerce and industry in the UK and overseas.

Systems & Networking

One of the largest groups in the Department and at its heart since its foundation, this group undertakes research and teaching in all aspects of computer systems, including computing and communications hardware and software, operating systems, distributed and mobile systems, and legal and policy implications. The group has a strong tradition of design, implementation, and deployment of working platforms. Recent work includes the Xen hypervisor (2003), NetFPGA (2008), and the MirageOS unikernel system (2013). The group has a track record of commercialising research through successful startups.

Student Community, Representation and Support

MPhil students are active members of the Faculty community and have a range of opportunities to contribute feedback, shape the student experience, and engage with faculty life. Student representatives serve on key committees and forums, including the Staff-Student Consultative Forum and Postgraduate Students' Forum, ensuring that postgraduate perspectives are heard in discussions about teaching, facilities, and the wider student experience. MPhil students are represented on the Faculty Board of Computer Science and Technology by a Junior Member. Elections for members are held in the November of each academic year. Postgraduate students also have a representative on the **Postgraduate School of Technology Committee.**

Alongside formal representation, students can take advantage of a vibrant and inclusive community. Initiatives such as **Women@CL** provide mentoring, networking, career development opportunities, and events that support women and non-binary people in computing research. Local activities include our **Speaker Lunches** where invited female speakers talk about their work, research, career issues and other relevant topics. This provides positive female role models to our students and early career researchers. The Department also run a local career development workshop.

Additionally, the annual Oxbridge Women in Computer Science Conference is organised in collaboration with the University of Oxford, with participants from other UK universities also invited. These activities help foster a welcoming environment, encourage leadership and professional development, and connect students with researchers, academics, and industry professionals. For more information, see http://www.cst.cam.ac.uk/women or email women-at-CL-admin@cst.cam.ac.uk.



Afterwards…

Graduation

Graduation ceremonies are handled by the Colleges, and you will graduate with your College. Congregations are generally held about three times a term and once in the Long Vacation. The earliest date MPhil students can graduate is at the mid-July ceremony.



Applying to study for a PhD

Applications

There are two intakes of research students each year: 1 October (preferred), and 5 January 5. The latter date may be of interest to MPhil students as there is a small possibility that students might not graduate until the beginning of the new academic year.

If you are considering applying for admission at Cambridge as a research student after the MPhil in Advanced Computer Science, you should complete an online application form available via your CamSIS self-service webpage. It is very important to discuss your research ideas with a potential supervisor before submitting your application.

See the Research webpage http://www.cl.cam.ac.uk/research/ to gain some insight into our current areas of research.

Applicants should submit:

- A **research proposal** (maximum **3,000 words**) outlining your proposed area of research and first-year deliverables, demonstrating awareness of existing work in the field and identifying opportunities for original contribution.
- **Two academic references**, including **one from a member of the Department of Computer Science and Technology**.

Transcripts do not need to be resubmitted as part of the application process.

Offers for research study are conditional on successful completion of the MPhil, the support of a supervisor, funding, College membership, and final Degree Committee approval.

See also the Course Information for PhD Applicants booklet.

Postgraduate Education Office

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