UNIVERSITY OF BIRMINGHAM

SCHOOL OF
COMPUTER
SCIENCE
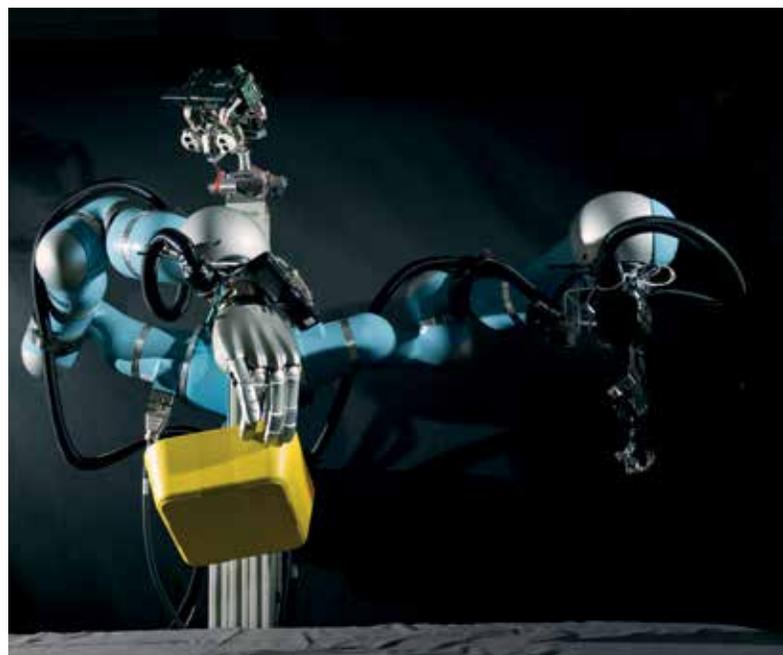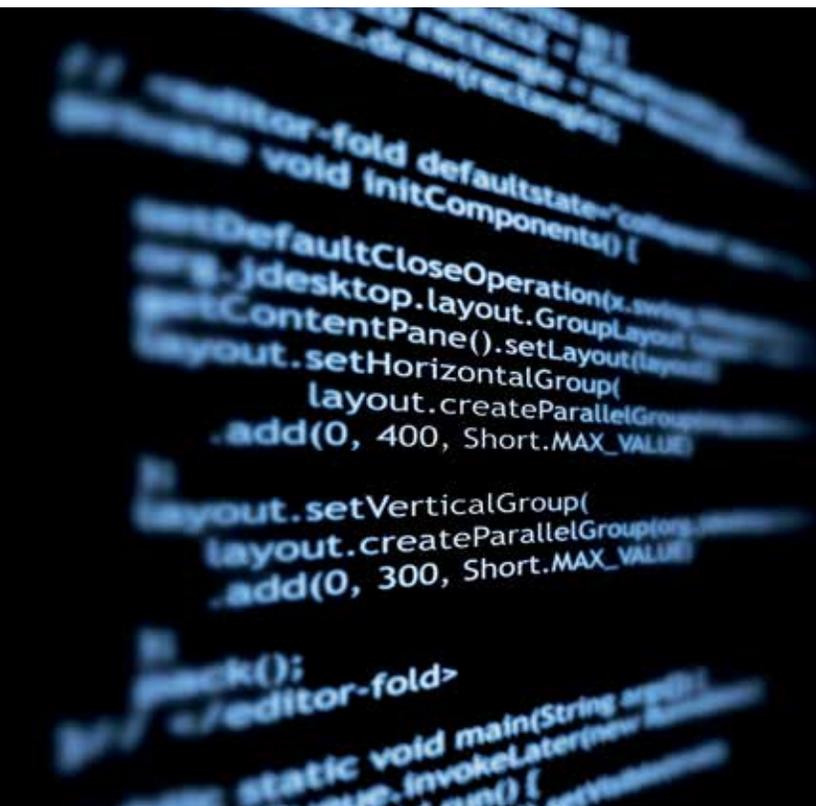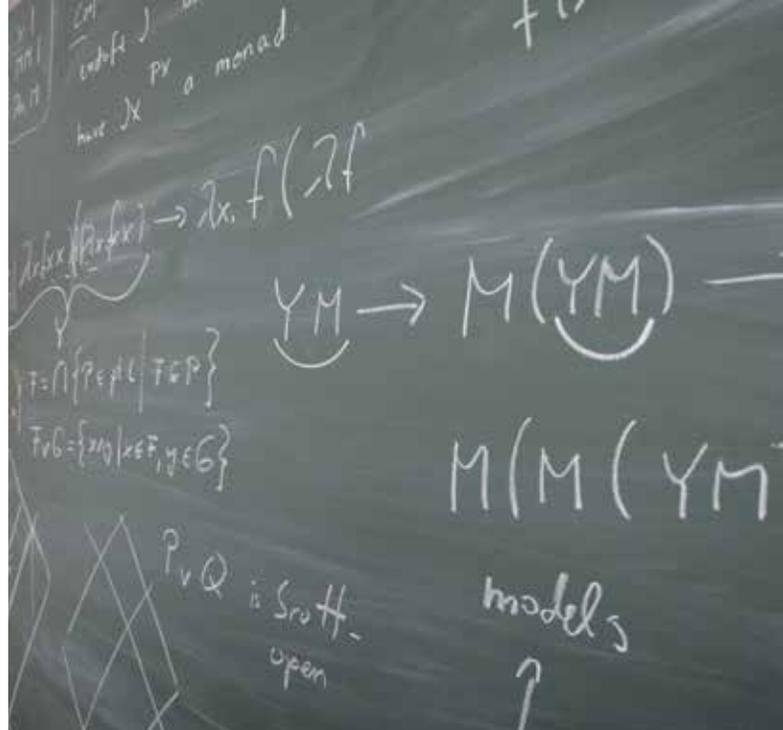
POSTGRADUATE STUDIES
IN COMPUTER SCIENCE

Introduction to Computer Science

TAKE ADVANTAGE OF STATE-OF-THE-ART FACILITIES, FIRST-CLASS TEACHING AND RESEARCH THAT MAKES A DIFFERENCE TO OUR WORLD.

'I am delighted that you are considering postgraduate study at Birmingham. Birmingham is a research-led university, and postgraduate students are central to our learning community. Our wide portfolio of research makes Birmingham one of the most popular universities for postgraduate study in the UK, and we hope that you will find this brochure of use when making your decision on where to study.'

Professor Andrew Howes
Head of School
Computer Science

The School of Computer Science was established in the late 1950s and became one of the first academic departments in the UK to undertake research and teaching in this area. Some 60 years later, we now provide specialist teaching and conduct world-leading research in fundamental and applied computer science, artificial intelligence, optimisation, computer security, medical imaging, software engineering, human computer interaction and robotics.

Birmingham is one of the leading universities in the country for postgraduate study in computer science, and we are proud to deliver outstanding programmes that offer a range of exciting career opportunities for students from around the world.

Why choose Birmingham?

- State-of-the-art, multi-million-pound facilities include dedicated laboratories for Computer Science students, a teaching laboratory for Robotics, and research laboratories for Security, Medical Imaging and Intelligent Robotics
- Our Security and Privacy Group is recognised as an EPSRC/GCHQ Academic Centre of Excellence in Cyber Security Research and we have a strong collaboration with the Centre for Computational Biology (CCB)
- The University is home to the Centre of Excellence for Research in Computational Intelligence and Applications (CERCIA), The Human-Computer Interaction Centre (HCI), and the Centre for Computational Neuroscience and Cognitive Robotics (CNCR)
- Our teaching is consistently ranked highly in all reputable league tables and guides and we have the highest possible rating from the Quality Assurance Agency for Higher Education
- We are ranked 8th in the UK for research, as measured by the combined volume and quality of our research (research intensity)

Award-winning development

At the School of Computer Science we are not just renowned for teaching and research excellence. We also produce novel solutions for real-world applications, including:

- Working with Jaguar Land Rover to make their vehicles more secure
- Contributing to the development of the Trusted Platform Module which makes many of our computers capable of secure cryptographic operations
- Deploying autonomous, intelligent robots in security and health support facilities
- Developing a revolutionary, award-winning method for diagnosing skin cancer

CONTENTS

Your future in computer science

A dynamic, fast-moving sector that offers exciting careers and excellent rewards.

The term computing covers every kind of digital technology that we use to create, store, communicate, exchange and use information. This makes it the foundation for small and large businesses to build their strategies and grow. It is also the key to making our personal lives easier and more fun: mobile phones, online shopping, social media – we owe them all and a lot more to computer science.

What can I do with a postgraduate degree in Computer Science?

Our graduates find themselves in a variety of environments within academia, research, industry, government and private organisations. The following is a short list of research and vocational areas:

- **Software Engineering:** developing methods for producing software systems on time, within budget and with few or no defects
- **Software Applications:** applying computing and technology to solving problems outside the computer field, eg, in education or medicine
- **Computer/Cyber Security:** covers all the processes and mechanisms by which computer-based equipment, information and services are protected from unintended and unauthorised access, change or destruction
- **Artificial Intelligence:** developing computers that simulate human learning and reasoning ability
- **Information Technology:** developing and managing information systems that support a business or organisation
- **Theoretical Computer Science:** investigating the fundamental theories of how computers solve problems and applying the results to other areas of computer science
- **Operating Systems and Networks:** developing the basic software computers use to organise themselves or to communicate with other computers

Where can I work?

You could join a technology consultancy firm like Accenture, PwC, CHP Consulting, LogicaCMG, BAE Systems, PA Consulting or Capgemini, or one of the global IT giants, such as Microsoft, Google, Oracle, Hewlett Packard, IBM, Cisco Systems and Apple, amongst many others.

There are a huge number of IT-focused UK companies, not to mention opportunities in investment, retail banking and financial computing and analytics (such as Goldman Sachs, Deloitte, J.P. Morgan, Morgan Stanley, Bank of England, Bank of America, HSBC, Barclays, RBS); telecommunications companies (such as BT, Vodafone, Orange, AT&T); IT for retail businesses (such as eBay, Amazon, Tesco, Argos, Expedia) and public sector organisations (such as NHS, GCHQ, Home Office).

Some students choose careers in teaching, research or technology development at universities both in the UK and overseas. There is a great deal of potential for postgraduates looking to put their computing skills to good use.

What skills will I develop?

We will broaden your knowledge of selected areas of computing by a combination of taught modules and individual project work, supervised by research active members of staff who will help you to develop appropriate investigation and study skills. Your course will give you a disciplined approach to analysing problems and the ability to design creative solutions, whilst critically evaluating the results. You will also develop management skills such as communication, teamwork, time management and report writing.

Through further study at an advanced level, you will get into the habit of questioning and conceptualising, and these practices transfer well into the workplace. Your prospective employers will be interested in both the technical skills (eg, programming) you develop and your transferable skills (eg, report writing, preparing and giving presentations).

What does the future hold?

Your career prospects are great and computing graduates with a good degree are in demand. Plus, with the number of computer science graduates from the UK diminishing at the same time as jobs are increasing, students with a postgraduate degree have an excellent chance of securing employment.
See page 14 for more information.

School of Computer Science

The School of Computer Science

Library, School of Computer Science

Student area, School of Computer Science

Atrium, School of Computer Science

SCHOOL FACILITIES

As a student in the School of Computer Science you will be based within a purpose built multi-million pound building, which offers 24-hour swipe card access to an impressive range of state-of-the-art facilities.
These include:

- Dedicated exclusive computing labs for Computer Science students only
- Teaching labs for Robotics
- Research labs for Medical Imaging, Intelligent Robotics and Security
- Full wireless network
- Bookable seminar and meeting rooms
- Student areas (with power access)
- New Computer Science reference library
- New collaborative student/staff teaching space
- New student areas (with power access and presentation screens)

RESEARCH CENTRES

We are home to the Centre of Excellence for Research in Computational Intelligence and Applications (CERCIA), The Human-Computer Interaction Centre (HCI), and the Centre for Computational Neuroscience and Cognitive Robotics (CNCR). Our Security and Privacy Group is also recognised as an EPSRC/GCHQ Academic Centre of Excellence in Cybersecurity Research and we have a strong collaboration with the Centre for Computational Biology (CCB).

The Sloman Lounge, School of Computer Science

Advanced Computer Science
MSc

Broaden your knowledge of cutting-edge areas in computing. This programme is designed for graduates with a degree in Computer Science or a related discipline, and a solid foundation in programming.

FACT FILE

Start Date: September
Duration: 1 year full-time
Fees for 2018/19: UK/EU – £9,000 full-time; International – £21,330 full-time
Entry requirements: 2:1 Honours in a relevant subject (eg, computing or a closely related discipline); plus a solid foundation in programming

Drawing on the School's international research reputation, you will have the opportunity to select from a broad range of advanced modules to reflect your own interests. You will also undertake your own software-development or summer project (which may be research-focused) to deepen your knowledge even further. It is essential preparation for a career in academic or industrial research.

Course content
In the first eight months of the course you study your choice of taught modules to a total of 120 credits, which may include a mini-project. In the final four months, you will work on your summer project and dissertation, individually supervised by a member of the research-active staff in the school.

Core modules
- Summer Project – 60 credits

Optional modules
- Advanced Aspects of Nature Inspired Search and Optimisation (Extended) – 20 credits
- Advanced Human Computer Interaction – 10 credits
- Advanced Topics in Functional Programming (Extended) – 10 credits
- Compilers and Languages (Extended) – 10 credits
- Computer-Aided Verification (Extended) – 10 credits
- Cryptography – 10 credits
- Distributed and Parallel Computing (Extended) – 10 credits
- Evaluation Methods and Statistics – 10 credits
- Individual Study 2 – 10 credits
- Intelligent Data Analysis (Extended) – 10 credits
- Intelligent Robotics (Extended) – 20 credits
- Introduction to Neural Computation – 10 credits
- Machine Learning (Extended) – 10 credits
- Mobile and Ubiquitous Computing (Extended) – 20 credits
- Nature Inspired Search and Optimisation (Extended) – 10 credits
- Network Security – 10 credits
- Networks (Extended) – 20 credits
- Operating Systems (Extended) – 20 credits
- Principles of Programming Languages (Extended) – 10 credits
- Research Skills – 10 credits
- Secure Programming – 10 credits
- Security Research Seminar – 10 credits
- Teaching Computer Science in Schools (Extended) – 10 credits

More about the course
In previous years, students have surprised themselves by their achievement, regularly producing project work at the level expected of a very good first year research student. Your project supervisors are able to draw on their research experience to help you develop your ability to work confidently on difficult tasks.

World-class learning and teaching
Each project is assessed by the supervisor and a moderator. Taught modules are assessed in a variety of ways: summer written examination, practical assessment during the semester, or a mixture of both.

In addition to the opportunity to learn from staff who are experts in their fields and working at the cutting edge of computer science research, we also support you by providing training in transferable skills relevant to your project work and in your future career. Our extensive computing facilities are available 24 hours a day (including a wireless network) to allow you to link in to our services from your own machine. We also offer many information resources (specialist library, information retrieval databases, electronic journals, etc) to support your project and course work.

CAREERS

Enhance your professional prospects
The importance of project work, together with a very wide range of options, makes this MSc unusually suited as a preparation for a research career in computer science. Students graduating from this programme have usually developed a taste for working on difficult problems and look for a career where they will be able to apply their enhanced analytical and technical skills. Some students go on to a PhD, either at Birmingham, elsewhere in the UK or abroad. Other graduates move into industry, typically taking technically demanding jobs.

LEARN MORE

For full module information and an online application form, please visit our dedicated web pages, or contact our programme staff with your questions.

Tel: +44 (0)121 415 8742
Email: msc-admissions@cs.bham.ac.uk
www.birmingham.ac.uk/ adv-computer-science

Computer Science
MSc

A 'conversion' Masters to open up career prospects for graduates new to computing.

FACT FILE

Start Date: September
Duration: 1 year full-time
Fees for 2018/19: UK/EU – £9,270 full-time; International – £21,330 full-time
Entry requirements: 2:2 Honours degree in any subject other than computing

This programme is designed for students with a first degree in a subject other than computing, but a certain amount of background in mathematics and scientific subjects would make your studies easier. Established in 1969, it is now the longest-running conversion programme to computing in the UK. It is designed to give you a grounding in both the fundamentals of computer science and practical software development skills, and opens the door to exciting new career opportunities in computer science and information technology.

Course content
The course consists of 180 credits. As well as your core modules, you will choose two optional modules. The mixture of core computing modules and a range of flexible options reflecting your interests and first degree provide a solid foundation for a career in computing or for further study.

Core modules
- MSc Software Workshop – 40 credits
- Fundamentals Data Structures – 10 credits
- Fundamentals Databases – 10 credits
- Fundamentals Intro to Computer Science – 10 credits
- Introduction to Human Computer Interaction – 10 credits
- Introduction to Artificial Intelligence – 10 credits
- Operating Systems and Networks – 10 credits
- Research Project – 60 credits

Optional modules may include
- Fundamentals Software Engineering – 10 credits
- Software Engineering 1 (Extended) – 10 credits
- Software Engineering 2 (Extended) – 10 credits
- Cryptography – 10 credits
- Evaluation Methods and Statistics – 10 credits
- Intelligent Data Analysis (Extended) – 10 credits
- Introduction to Neural Computation – 10 credits
- Machine Learning (Extended) – 10 credits
- Nature Inspired Search and Optimisation (Extended) – 10 credits

More about the course
The four summer months are spent working on your project. Projects vary from applied software engineering through to work that is linked to our research groups. The common factor is that almost all projects involve the development of a large software system. Usually, projects are selected from a list of topics proposed by the teaching staff (possibly on behalf of an external customer) or you can suggest your own project, providing it is appropriate.

The Software Workshop module is currently assessed by assignments in the practical sessions, team project and a final examination. Taught modules are assessed in a variety of ways: summer written examination, practical assessment or a mixture of both. The project is assessed by a report, supported by a practical demonstration.

CAREERS

Enhance your professional prospects
Many students graduating from this programme move into a wide variety of roles within industry and commerce. Others use their new computing skills to start their own companies, enhance their employment prospects in work related to their first degree or decide to pursue further study in the field.

LEARN MORE

For full module information and an online application form, please visit our dedicated web pages, or contact our programme staff with your questions.

Tel: +44 (0)121 415 8742
Email: msc-admissions@cs.bham.ac.uk
**www.birmingham.ac.uk/
msc-computer-science**

Cyber Security
MSc

Develop skills to evaluate, design and build secure computer systems.

FACT FILE

Start Date: September
Duration: 1 year full-time
Fees for 2018/19: UK/EU – £9,000 full-time; International – £21,330 full-time
Entry requirements: 2:1 Honours degree in computer science or a closely related discipline; plus object-oriented programming and data structures and algorithms

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Computing infrastructure is now vital for communication, government, commerce, and control of our physical environment, and is a potential target of terrorist and criminal attacks. Graduates who understand the technologies and practices that underpin secure computer systems are in great and ever-growing demand. This programme will give you the skills you need to deal with current and future cyber security threats. It provides a solid foundation for graduates to pursue a career in the software industry or research.

Course content

All students study our compulsory core modules (60 credits) and can choose from a variety of optional modules (60 credits). You will also undertake a large, personally supervised project (60 credits) in the final months of the course.

Core modules
- Secure System Management – 10 credits
- Designing Secure Systems – 10 credits
- Network Security (Extended) – 10 credits
- Cryptography – 10 credits
- Secure Programming – 10 credits
- Research Project – 60 credits
- Forensics and Malware Analysis – 10 credits

Optional modules may include
- Advanced Cryptography – 10 credits
- Penetration Testing – 10 credits
- Hardware and Embedded Systems Security – 10 credits
- Compilers and Languages (Extended) – 10 credits

- Individual Study 2 – 10 credits
- Networks (Extended) – 20 credits
- Operating Systems (Extended) – 20 credits
- Intelligent Data Analysis (Extended) – 10 credits
- Mobile and Ubiquitous Computing (Extended) – 20 credits
- Security Research Seminar – 10 credits
- Computer-Aided Verification (Extended) – 10 credits

More about the course

This programme covers all security layers, from low-level security attacks on software implementations, through to more abstract design principles underlying secure systems, to strategies for management of processes and people.

You will build the knowledge and expertise to evaluate, design and build secure processes for people that are involved in cyber security. You will cover the theory and practice of designing and building secure systems, and gain a firm grounding in cryptography, network security and secure programming. The programme also gives you practical experience with technologies and toolkits for building internet-based software.

World-class learning and teaching

The programme has received full certification by GCHQ and the University has been officially recognised by NCSC-EPSRC as an 'Academic Centre of Excellence in Cyber Security Research' (ACE-CSR) by the UK government; an accolade that is a testament to the School's first rate research and work.

Our curriculum has been developed with the involvement of key individuals in the cyber security industry.

As well as advising us on the skills they seek when recruiting graduates, they also contribute directly through guest lectures and project supervision. Companies including Microsoft, Vodafone, Siemens, IBM and Hewlett Packard come onto campus to talk directly to our students.

CAREERS

Enhance your professional prospects
The MSc in Cyber Security is a new programme, but graduates of the MSc in Computer Security have gone on to work for companies including Accenture, IBM, PriceWaterhouseCoopers, BT and Delcam. Our students gain the knowledge to become leaders in the field of cyber security and to shape the technologies that will be developed in the future. They are equipped to work on secure software development within the software and IT industry, or to become cyber security consultants. They may also choose to move on to PhD research.

LEARN MORE

For full module information and an online application form, please visit our dedicated web pages, or contact our programme staff with your questions.

Tel: +44 (0)121 415 8742
Email: msc-admissions@cs.bham.ac.uk
www.birmingham.ac.uk/ msc-cyber-security

Human Computer Interaction
MSc

Prepare for a successful commercial or research career in HCI design and development.

FACT FILE

Start Date: September
Duration: 1 year full-time
Fees for 2018/19: UK/EU – £9,000 full-time; International – £21,330 full-time
Entry requirements: 2:1 Honours degree in computer science or computer engineering, however other disciplines such as psychology or design are also considered

Human Computer Interaction (HCI) is probably the single most important area for the success of a computer system and also provides great opportunities for innovation and creativity. In this course you will cover the underpinning theories, methodologies and practice of the discipline. You will also have the opportunity to broaden your studies through optional modules in areas such as Robotics, Nature Inspired Computing or Security. The course builds upon the world-class research of the HCI Centre through project work and is designed to prepare you for a career in research or in industry or commerce.

Course content
This programme comprises 180 credits. In the first 8 months you will spend most of your time studying core compulsory modules (90 credits) and optional modules (30 credits). The final four months will be spent working on your research project (60 credits), with expert one-to-one supervision.

Core modules
- Advanced Human Computer Interaction and Practice – 20 credits
- Evaluation Methods and Statistics – 10 credits
- Mobile & Ubiquitous Computing (Extended) – 20 credits
- Research Skills – 10 credits
- Research Topics in HCI – 10 credits
- Mini-project – 30 credits
- Research Project – 60 credits

Optional modules may include
Optional modules can be chosen from the wide selection offered as part of other Masters' programmes in the School (subject to timetabling constraints), including:
- Advanced Aspects of Nature Inspired Search and Optimisation (Extended) – 20 credits
- Cryptography – 10 credits
- Individual Study 2 – 10 credits
- Intelligent Data Analysis (Extended) – 10 credits
- Intelligent Robotics (Extended) – 20 credits
- Introduction to Neural Computation – 10 credits
- Machine Learning (Extended) – 10 credits
- Nature Inspired Search and Optimisation (Extended) – 10 credits
- Secure Programming – 10 credits
- Security Research Seminar – 10 credits
- Teaching Computer Science in Schools (Extended) – 10 credits
- Distributed Parallel Computing (Extended) – 10 credits
- Networks (Extended) – 20 credits
- Network Security (Extended) – 10 credits

More about the course
Mini projects are a chance to work one-to-one with one of our research-active staff to explore an area of interest in greater depth.

Throughout the course you will not only become a specialist in HCI but will also develop your skills in analysis, research, technology and presenting and explaining your work clearly and effectively.

In your final semester you will undertake a piece of research work, that may be based on your mini-project, in collaboration with one of our active researchers. You will need to demonstrate an ability to define aims, objectives and plans, manage your project and time, use the results of systematic literature searches and communicate in writing and verbally. The project may also involve the development of software. It is through the mini-project and the final project that you can really develop your skills and expertise.

Project content can be varied. They can be design focused; concentrating on building skills for design and building of real-world systems or focusing on the experimental evaluation of systems, or could be research oriented; trying to develop novel techniques or understanding fundamental principles.

World-class learning and teaching
Learning is via lecture classes, problem-based workshops and one-to-one supervision. There will be some group work as part of the taught modules and there may be opportunities for industry-based project work. Most importantly, you will be part of a small, highly qualified group of students working closely with researchers within the HCI centre.

Assessment is by both practical and written coursework and examination. The project is assessed on the basis of a practical demonstration and a written report.

CAREERS

Enhance your professional prospects
The application of HCI is relevant to a number of industries including health care, games and entertainment and mobile communication. Graduates will have the skills to undertake a wide range of roles, such as user experience, user research, interactive design or information architecture. In addition, graduates of this programme are well prepared to continue their studies through research for a PhD.

LEARN MORE

For full module information and an online application form, please visit our dedicated web pages, or contact our programme staff with your questions.

Tel: +44 (0)121 415 8742
Email: msc-admissions@cs.bham.ac.uk
www.birmingham.ac.uk/mschci

Robotics

MSc

Explore the theoretical and practical underpinnings of robotics science and technology.

FACT FILE

Start Date: September
Duration: 1 year full-time
Fees for 2018/19: UK/EU – £9,540 full-time; International – £21,150 full-time
Entry requirements: 2:1 Honours degree in a relevant subject, such as computer science, electronic engineering, physics, mathematics or mechanical engineering, or another science or engineering subject with a significant computing content

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This programme is designed for graduates of numerate disciplines who also have experience of programming. You will explore theories of intelligent robotic control and software tools required to implement standard algorithms in mobile robots and robot manipulators. This, along with the chance to learn from world leaders in their field and to develop research and transferable skills, will effectively prepare you to either work in industry or pursue a research degree in robotics.

Course content
This course comprises 180 credits. In your first two semesters you will study the core compulsory modules (90 credits), and select from a wide range of optional modules (30 credits). In your final semester you will work on a research project (60 credits)

Core modules
- Advanced Robotics – 20 credits
- Intelligent Robotics (Extended) – 20 credits
- Robot Vision – 20 credits
- Mini-project – 30 credits
- Research Project – 60 credits

Optional modules may include
- Advanced Aspects of Nature Inspired Search and Optimisation (Extended) – 20 credits
- Computational Vision – 10 credits
- Computer-Aided Verification (Extended) – 10 credits
- Distributed and Parallel Computing (Extended) – 10 credits
- Intelligent Data Analysis (Extended) – 10 credits
- Introduction to Neural Computation – 10 credits
- Machine Learning (Extended) – 10 credits
- Nature Inspired Search and Optimisation (Extended) – 10 credits
- Teaching Computer Science in Schools (Extended) – 10 credits

More about the course
Mini projects are a chance to work one-to-one with one of our research-active staff to explore an area in great depth – analysing the problem and existing solutions, developing new ideas and building or evaluating prototype systems.

You will develop your skills in analysis, research, technology and also in presenting and explaining your work clearly and effectively.

In your third semester you will work on a research project, again with expert one-to-one supervision. This allows you to demonstrate professional competence in a substantial robotics-related project and to apply material learned in other components of the degree programme. Projects are chosen from staff suggestions or developed from your own original idea. The project may be completed in industry in the form of a work placement under the lead supervision of an academic member of staff from the School.

World-class learning and teaching
Learning is via small lecture classes, problem-based workshops and one-to-one supervision. There will be some group work as part of the taught modules and there may be opportunities for some industry-based project work. Most importantly, you will be part of a small, highly qualified group of students working closely with researchers within the Robotics lab. Assessment is by both practical and written coursework and examination. Projects are assessed on the basis of a practical demonstration and a written report.

CAREERS

Enhance your professional prospects
Through the course you will become a specialist in robotics. Our graduates are well equipped for software development roles in the robotics industry or research and development roles, and many go on to pursue a research degree in robotics.

LEARN MORE

For full module information and an online application form, please visit our dedicated web pages, or contact our programme staff with your questions.

Tel: +44 (0)121 415 8742
Email: msc-admissions@cs.bham.ac.uk

Natural Computation
MRes

Build your research skills and contribute to the development of new knowledge in this emerging field.

FACT FILE

Start Date: September
Duration: 1 year full-time
Fees for 2018/19: UK/EU – £4,270 full-time; £2,135 part-time; International – £20,280 full-time
Entry requirements: 2:1 Honours degree in computer science, computer engineering or another science or engineering subject with a significant computing content

This multidisciplinary area is the study of computational systems that use ideas and gain inspiration from natural systems. The MRes programme explores current topics in natural computation, such as evolutionary algorithms, co-evolution, evolutionary design, nature-inspired optimisation techniques, evolutionary games, novel learning algorithms, artificial neural networks and theory of natural computation. There is an increasing need from industry for professionals with knowledge of natural computation techniques. Our graduates develop a solid foundation to pursue a research and development career in industry or further studies.

Course content
The course consists of a mini-project, and a research thesis, which will be two-thirds of the entire programme. You will also study essential Research Skills and a further 20 credits of optional modules.

Core modules
- Research Skills – 10 credits
- Mini-project – 30 credits
- MRes Thesis – 120 credits

Optional modules may include
- Advanced Aspects of Nature Inspired Search and Optimisation (Extended) – 20 credits
- Introduction to Neural Computation – 10 credits
- Intelligent Robotics (Extended) – 20 credits
- Intelligent Data Analysis (Extended) – 10 credits
- Nature Inspired Search and Optimisation (Extended) – 10 credits

More about the course
The MRes is a Masters degree by research. This means that you are taught core principles and then develop skills by doing interesting, innovative research, supported by academic staff and peers. This is structured so that you learn how to plan, organise and manage your time; you learn what it is to be a scientific researcher; you help contribute to the development of new knowledge; you learn intellectual skills such as argumentation, exposition and reasoning; and you develop as an individual by improving your communication skills, writing, collaborative working and creativity.

The mini project module consists of a research project on the in-depth investigation of a chosen topic coming from industry (strongly encouraged) or academia.

The compulsory Research Skills module provides you with the basis of transferable knowledge and skills necessary for a successful research-oriented career in industry or academia, with a particular orientation to computing-based disciplines.

Your research thesis project consists of solving a substantial problem using natural computation techniques (including hybrid techniques). Industrial co-supervisors are used whenever appropriate, and you will be required to apply the knowledge and skills you have acquired to solve a difficult problem.

World-class learning and teaching
This innovative programme is led and run primarily by the world-leading Natural Computation Group and CERCIA in the School of Computer Science. The group has over 40 full-time researchers, including teaching staff, research fellows and associates, PhD students, and academic visitors.

Taught modules are assessed by a mixture of written examinations and continuous assessment. The first semester mini-project is assessed by a written report. Your thesis will be examined by an internal and an external examiner.

CAREERS

Enhance your professional prospects
We have strong links with industry, especially through CERCIA, including Honda, BT, Thales, Unilever, GSK, Rolls Royce, etc. We encourage MRes students to carry out their research projects in collaboration with our industrial partners, and opportunities also exist for students to do their project work within a company.

LEARN MORE

For full module information and an online application form, please visit our dedicated web pages, or contact our programme staff with your questions.

Tel: +44 (0)121 415 8742
Email: msc-admissions@cs.bham.ac.uk
www.birmingham.ac.uk/ mres-natural-computation

Computer Science
PhD

An outstanding and internationally respected place to complete your research degree.

FACT FILE

Start Date: September
Duration: 3 years full-time
Entry requirements: 2:1 Honours degree in computer science or a subject relevant to the research topic (eg, mathematics or physics)

The School of Computer Science welcomes highly motivated and well qualified graduates to join us to work towards a doctorate. Our work is regularly presented in international conferences and journals, indicating the high standards we achieve in research. At Birmingham, we work closely in small teams of researchers embedded within a broad and lively research culture. This combination means you get the necessary focus, while keeping an eye on the bigger picture in which your work is placed.

Course details
The School's staff and research students are loosely organised into informal research themes. Researchers are free to contribute to one or more themes and each theme organises its own activities. Cross-disciplinary research is a major feature of the school, and links exist with, for example, psychology, medicine, language studies and electronic engineering.

Supervision is arranged on an individual basis in order to closely match the interests of the student with those of the supervisor. We can only offer supervision in the areas in which we have academic expertise, including:

Artificial Intelligence
- **Reasoning and Cognition** covers research on architectures for accounting for human mental states and processes as well as recreating them in computer programs.
- **Robotics** research focuses on intelligent robotics and related areas, including cognitive robotics, learning robots, fault diagnosis, machine learning and sequential decision-making.
- **Natural Language Processing** includes metaphor understanding; emotion detection; temporal information analysis and corpus analysis.

Nature-inspired Computation
Covers both basic and applied research in areas including evolutionary computation, neural computation, artificial life, self-organising systems, emergent behaviours, machine perception, evolutionary robotics, complex adaptive systems, swarm intelligence and real-world applications.

Medical Imaging and Image Interpretation
Draws upon multidisciplinary research on computational techniques for image interpretation. The core activities relate to medical imaging and aim to develop diagnostic aids, which quantitatively characterise the properties of body tissues and organs.

Security and Privacy
Covers all aspects of computing security and privacy, tackling problems that are important to society, including government and industry. We are recognised as an EPSRC/GCHQ Academic Centre of Excellence in Cyber Security Research.

Human Computer Interaction
Promotes research and development in theories, designs, methodologies, and systems to support people in whatever they want to achieve. Work includes visualisation, intelligent interaction, data mining, ubiquitous and mobile computing. The group acts as a focal point for research, development and expertise in anything that has the user at the core.

Software Engineering
Focuses on methods and techniques for the development of large and complex software and systems, especially in the areas of: cloud, service orientated architectures, software tools and automated code generation. Our research spans theoretical as well as practical aspects and has resulted in a number of popular software products.

Theory of Computation Sciences
Explores fundamental concepts in computation and programming language semantics. This often involves profound and surprising connections between different areas of computer science and mathematics. From category theory to λ-calculus and computational effects, topology to constructive mathematics, game semantics to program compilation, our research is diverse and continues to provide new insight and underlying structure.

World-class learning and teaching
Most of our students are full-time, but a small number are part-time, usually working for UK companies. The supervision process usually takes the form of weekly meetings, (although the frequency will vary according to need), where ideas are exchanged, help is offered and written work is discussed.

LEARN MORE

For details of PhD opportunities/supervisor information and an online application form, please visit our dedicated web pages, or contact our programme staff with your questions.

Tel: +44 (0)121 414 2653
Email: phd-admissions@cs.bham.ac.uk
**www.birmingham.ac.uk/
phd-computer-science**

Scholarships and bursaries

Supporting you to achieve your potential.

Funding for taught degrees

Both the University and the School of Computer Science offer annual scholarships and bursaries for both UK/EU and International students wishing to study for a Masters degree in a Computer Science subject. Scholarships are awarded to students who have achieved, or expect to achieve, excellent academic results.

Paul and Yuanbi Ramsay MSc Bursary

For UK/EU students there are two MSc bursaries which cover the full current UK/EU tuition fee. Applicants must be from a low income background or in receipt of benefits. Applications should be made through the Student Funding Office using the form available from the scholarships web page. For more information visit www.birmingham.ac.uk/ postgraduate/funding/Ramsay-msc-bursary.aspx

International Student Masters Scholarships

A £3,000 scholarship will be awarded to a number of privately funded, full fee paying, international masters students. Applicants must have accepted an unconditional offer on one of the School's MSc programmes. Scholarships are open to students from outside the EU. Nomination is by the School of Computer Science only. Please indicate that you wish to be considered when completing your application to study an MSc.

For more information visit www.cs.bham.ac.uk/ admissions/postgraduate-taught/scholarships

Funding for research degrees

Our research students are funded from a variety of sources, and we have a number of School scholarships available. All of our scholarships are by nomination only, and no separate application is required. Other studentships may be available from funding sources under the control of the supervisor, and applicants should discuss this with potential supervisors. To find out about the latest opportunities, please contact: phd-admissions@cs.bham.ac.uk

School of Computer Science Teaching Assistantships

For UK and EU students, financial support from the School is normally conditional on the student contributing to the School's teaching as a teaching assistant. Our teaching assistants are registered for a part-time research degree, working 75% of their time on their research and 25% of their time on teaching duties – which can vary from demonstrating to tutoring and organising schedules. Maintenance payments are based on the EPSRC minimum annual rate. For more information visit www.epsrc.ac.uk or visit www.cs.bham.ac.uk/admissions/ postgraduate-research/scholarships

Careers support and employability

Supporting you to develop as a person, boost your career prospects and even change direction in your career.

Postgraduate study at the University of Birmingham is a chance to learn from world leaders in their fields. This guarantees you a first-class learning and teaching experience, leading to a qualification that is respected and highly regarded the world over, and making you an extremely attractive prospect in a very competitive job market.

Supporting you to achieve a challenging and rewarding career

As a postgraduate student you are likely to have specific requirements when it comes to planning for your next career step. To support you we offer a wide range of careers and employability services. The Careers Database features over 2,000 graduate job vacancies and internship opportunities targeted at our students. You will also be supported by specialist college internship officers, careers and industrial liaison tutors and advisors for advice on finding jobs and placements, writing CVs and application forms and succeeding in interviews.

Recruitment fairs, presentations, workshops and orientation sessions

In addition to the University recruitment fairs which attract a large number of national and international employers to campus, the School of Computer Science organises its own specialist fairs. These are aimed at careers in software, systems, emerging technologies, consultancy, social, cloud and financial computing.

We host some of the top national and international firms including Microsoft, IBM, Cisco, Oracle, BAE Systems, PwC, BT, Deloitte, IBM, Goldman Sachs, Morgan Stanley, Facebook, J.P. Morgan, Bank of America, Bank of England, NHS, UBS, Capgemini, Credit Suisse and many others.

We have also initiated the 'Employers in Residence' scheme, where high profile employers set up a recruitment desk in the School providing assistance and guidance on the application process. Employers use this opportunity to promote a vacancy or scheme, recruit on the spot for certain openings, 'headhunt' the best students, collect details of interested students and even sometimes to interview candidates from our School.

International students from China and India returning home also benefit from events where they have the opportunity to meet representatives from high-profile companies and learn about the latest labour market trends.

We take an active role in a number of community and grand challenge events, such as the Capgemini and University of Birmingham 'Apprentice' style challenge community project; the Televised Capgemini India and University of Birmingham Super Techies Show; and the College of Engineering and Physical Sciences Grand Challenge.

Employers of our graduates include

Microsoft, IBM, Google, Cisco, Oracle, Apple, HP, Accenture, BT, Cisco, BUPA, European Space Agency, Expedia.com, Goldman Sachs, Logica, Honda, Rolls Royce, QinetiQ, Siemens, Deloitte, Sony, Citi, UBS, PwC, GCHQ, Credit Suisse, BAE Systems, Morgan Stanley, J.P. Morgan, Bank of America and Bank of England, among others.
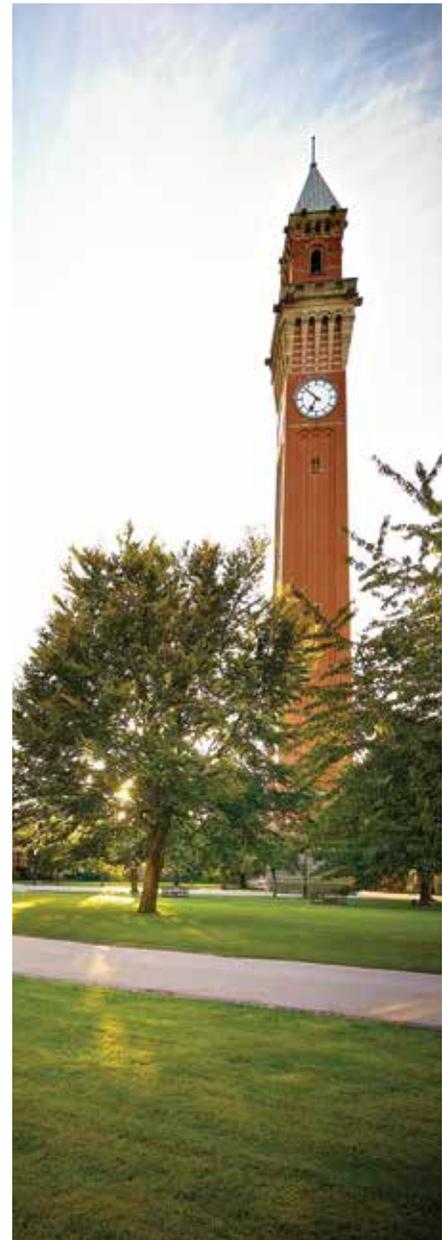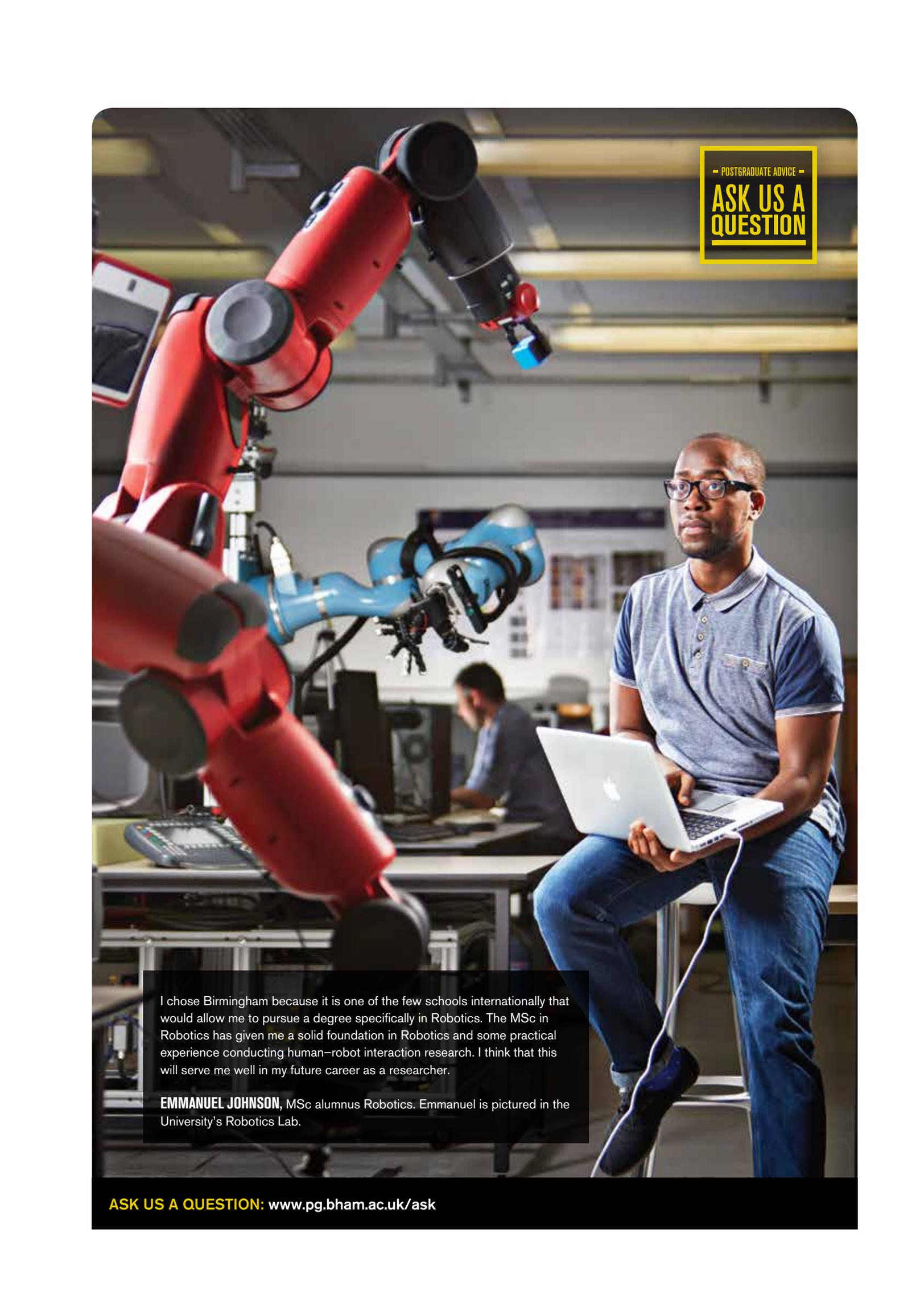
I chose Birmingham because it is one of the few schools internationally that would allow me to pursue a degree specifically in Robotics. The MSc in Robotics has given me a solid foundation in Robotics and some practical experience conducting human–robot interaction research. I think that this will serve me well in my future career as a researcher.

EMMANUEL JOHNSON, MSc alumnus Robotics. Emmanuel is pictured in the University's Robotics Lab.

ASK US A QUESTION: www.pg.bham.ac.uk/ask

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