School of Computer Science Handbook

Contents

Computing Programmes at Bangor
Computer Science and Related Degrees

Welcome to the School of Computer Science of the College of Physical & Applied Sciences. This document is intended to describe the computer science degree programme and related degrees in computing. Read it in conjunction with the formal programme specifications, available on the School's Web site.

Introduction

Computing courses have been running here in Bangor since 1986, and we have structured our computing degrees around a themed programme for Computer Science covering all the key areas in this exciting subject. As well as the fundamentals of computer science, we benefit from teaching that relates to the research interests of the academic staff, and particular specialities include computer graphics, artificial intelligence and data communications. Other computing related degrees share material with the Computer Science programme but allow you to combine computing with other specialisms. The main programmes that we offer are:

- Computer Science (UCAS Code G400)
- Computer Systems with Business Studies (UCAS Code H6N1)
- Computer Systems with Psychology (UCAS Code H6C8)

Our computing programmes are accredited by the British Computer Society (BCS) which is a professional body (which you can join) overseeing computing degree courses in the UK. Accreditation means that the team of experts from the BCS who reviewed our courses thought they were of comparable quality as those at any other British University, and the practical upshot of your having studied an accredited course is that you do not subsequently need to sit any professional exam to join the BCS, and any prospective employer would recognise the value of your degree qualification.

Although you will register for a single degree programme, there are mechanisms to transfer from one to another at the end of first year. We recognise that students do not always know what career route they want to follow when they start a degree so we have tried to build-in as much flexibility as we can. The description below of the programme and module contents will help you choose a programme and options where applicable.

Educational Aims

Our aims are fairly simple - we want to help you become a computing professional with the ability to keep yourself up-to-date with the rapid pace of developments in computer science. We would hope that after graduating with one of our computing degrees you would be able to:

- Obtain a good job in the computing industry either here in Wales, elsewhere in the UK or indeed with any of the International computing firms;

Or

- Take up study for a higher degree such as a Masters degree or PhD (we offer both here at Bangor, but we would expect you to be admissible at any UK University).

Computing is a rapidly growing and broadening field. It's important to realise what being a Computing Professional means.

Many people (both graduates and non-specialists) confuse Information Technology (IT) with Computer Science. IT is prolific in society now and no matter what career you pursue you will need basic IT skills. The ability to operate a computer and use common packages like: word processing; spreadsheets; email; web browsing; data analysis and presentation tools is very important. We aim to teach you all that – but a lot more too!

Since computing technologies move on at such a pace we aim to teach you the general principles behind computing so that not only will you be able to use computers to good effect now, but you will be able to keep yourself up to date and be ahead of the game even when you are in your 50's!

Computer Science covers all aspects of what makes computers tick and how to understand them. We hope that you will find our degree programmes useful whether you go on to be: a computer designer; a computational scientist; a software engineer; a systems administrator; a network engineer or a manager leading a team of other computing professionals.

To help you make the most of your time at University we have built as many options into our programmes as possible. This allows you to study other applied disciplines such as business or accounting in combination with computing modules.

In addition to the so called "body of detailed knowledge" that constitutes computer science, we also aim to help you develop other skills and pick up other knowledge. The hardest ability we try to help you develop is that of thinking and critical analysis. The ability to solve problems is hard to define but is generally developed from trying examples and scrutinising how previous generations of scientists tackled other problems.

So called "transferable skills" is a bit of educational jargon that means all the useful skills you pick up regardless of what degree specialism you are studying. We aim to help you build up your abilities to: write reports; give spoken presentations; read and

absorb technical information from books, manuals and Web pages; search for the information you might need for a project from libraries and the Web; work with project plans and schedules both individually and as part of a team.

Another general ability we hope to impart is that of appreciating how science and engineering work and how scientists and engineers work as professionals. Individual lecturers (who are themselves professional scientists or engineers) will try to impart their own experiences to you through the teaching programmes. In the project work components in the 3rd year you will have the chance to work closely with project supervisors who will also help guide you towards an appreciation of their "craft".

Computer science progresses by computing professionals: experimenting with computer systems hardware and software; building new systems; tinkering with and taking apart existing systems; playing with algorithms and programming tools; designing, building and testing programs; comparing ideas with other professionals; and above all thinking and playing with ideas.

Computing is an incredibly useful tool for many other applied science and engineering disciplines. It draws on many ideas that developed from discrete mathematics and turns those ideas into programs and tools that can provide a lifetime of entertainment and employment. Enjoy!

Programme Outcomes

The formal programme specifications give the programme outcomes wrapped up in educational jargon. In summary they are:

- Knowledge and Understanding (specific technical areas like programming languages)
- Cognitive Abilities and Skills (thinking ☺)
- Practical Skills (such as writing programs)
- Transferable Skills (writing reports, giving presentations, reading manuals…)

These outcomes spread across all the modules. We do not offer a specific module on "Thinking" but rather we expect you will develop your cognitive abilities from study of several of our modules.

More details of what you will be able to do after following a particular degree scheme are given in the program specifications. It is the body of technical knowledge that our programmes are designed to impart which makes them unique. This body of knowledge is organised into various strands or themes, which are described below.

Building Blocks

Algorithms are the recipes or sets of instructions that we as humans formulate to help us solve problems and to help us tell computers what we want them to do. We have several discrete mathematics and algorithms modules in the 1st, 2nd and 3rd years to help you understand what this is all about and to help you use existing algorithms and even develop your own.

Computer *programming* is how we put algorithms into practice and implement actual programs that the computer can read and execute for us. We teach several different sorts of computer programming languages including some you might be familiar with from school and some more specialist sorts. In the first year, we teach you how to program using the Java programming language. You get a chance to use several other languages during the course of the degrees and we expect that once you graduate after we have taught you the key concepts, you will be able to teach yourself from the manual most other programming languages that you might encounter.

Software Engineering

You will get a chance to write quite a few small to medium sized programs during your studies but if you go on to work in the computing industry you may well be involved in writing and maintaining very large and complex software programs. We have several software engineering modules to teach you how to cope with very large and complex programs and to impart some of the methodologies and tricks of the trade. We have an active research group in the School working on new software engineering methods.

Communications

This theme provides an introduction to the concept of data and communications, including the operation of local and wide area data networks. Some of the concepts will be illustrated through self-guided "hands-on" sessions. You have probably heard of and used the Internet and World Wide Web to access email and web pages. There is a lot of interesting technology to allow computers to communicate with one another on our behalf and to make the Internet and Web work. We cover distributed computing ideas to construct Web browsers and servers and a lot of the network engineering to help you understand how the Web works.

Visualization

The use of computer graphics is a dynamic field in computer science. Applications include games, the film industry, the WWW, scientific visualization, and many more. One of our main research groups in the School is active in this area and has an international reputation for medical uses of graphics and virtual environments. You will have the opportunity to learn the basics of computer graphics in the 1st year, and then to build on this knowledge with more advanced modules in the 2nd and 3rd years. Initially you will be taught about scene graphs and how they can be deployed to create graphics for the Web. Programming of core graphics algorithms will be taught using

Java3D, and you will be introduced to advanced techniques and the use of OpenGL. There will also be the opportunity to undertake a 3rd year project in the computer graphics area, and to have access to the sophisticated technology in our graphics laboratories.

Artificial Intelligence and Agents

Artificial Intelligence (AI) concerns deep questions such as whether machines can or will ever be able to think and more practical matters on how we can use programming methods to make it look like they can think and help us in day-to-day human activities. We run modules in 1st, 2nd and 3rd year on AI and also have a very up to date module on Agent Computing where we use computational agents to carry out tasks – including some thinking – for us. This is a very exciting area, which includes building smart and expert systems and artificially intelligent robots. You may have seen the growing popularity of robotics on TV. We have our own robotics lab in the School.

Knowledge Management

It is important to know how modern *databases* work even if you just use a simple one on your desktop. We run modules in 1st and 2nd year that unlock the secrets of databases and will help you should you want a job as a database administrator for a bank or if you simply want to organise your contact address book. In the 3rd year, we cover the fast growing topics of knowledge engineering and data mining.

Systems Software

In this theme you will be introduced to the basic organization and functionality of an operating system and compilers, the software environment that enables a computer to function. In the 1st year you will also become familiar with a Unix operating system such as LINUX. The 2nd year module will introduce key ideas in concurrency and its role and application in operating systems and middleware. Real time systems are covered in the 3rd year. These are systems that interact with their environment and whose behaviour is determined by events occurring in the physical environment.

Computing Systems

This theme focuses on computer architectures, and in the 1st and 2nd year will introduce you to using the C Programming language. There are many special techniques for making computers work really fast and for designing and building supercomputers. You might have seen supercomputers with lots of flashing lights on the front in films like Jurassic Park or in TV programmes like Horizon. The designers of machines like that often spend a bit extra making them look good – after all, these machines can cost 20 million pounds or more so a bit of advertising is sometimes necessary. The third year module covers parallel programming and advanced programming ideas for supercomputers. We do have one or two parallel computers and computer clusters in the School. You will get a chance to work with these on projects in the final year.

Finally……

When we designed the Computer Science programme we tried to cover the key areas that have been recognized by international computing bodies like the Association for Computing Machinery (ACM). We believe our curriculum coverage is not just to British standards but is in fact to an International level.

Methods for Teaching and Learning

There are various techniques we employ to help you learn and understand the topics covered by the modules. You can read about these in depth from the formal programme specifications, but the key methods we use are:

- Lectures – Class sizes vary for different modules but usually the format here is a bit like the school class room – a lecturer presents material sometimes from slides or overheads or just reads or uses the blackboard. Sometimes we use handouts sometimes we expect you to take your own notes. It is important to stay awake and listen.

- Tutorials – Usually a smaller and more interactive session where the lecturer or assistant helps you work through some example problems to reinforce lectures.

- Independent Reading – we often suggest you read particular handouts or books or sometimes research articles from the professional literature. It is often helpful if you make yourself some notes and sometimes it is a good idea to do this in pairs or small groups with your friends.

- Supervised Lab Sessions – We have a number of computing laboratories with computer terminals that can run Windows or Unix based operating systems. Some modules have a designated lab session during which there will be lab demonstrators present to help you. You can get a lot of help from these individuals if you ask!

- Web browsing and Searching – A huge body of material is now available on the Web and lecturers may suggest you look up particular sites or search for particular keywords in researching material for a practical or essay. You can use computers in Informatics or elsewhere in the University for this work, as all you need is access to a Web browser.

- Individual Project – In the final year of the computing programmes, we help you carry out an individual project. This will typically involve an agreed project topic between you and one of the academic staff who will act as your supervisor. Usually the projects are great fun and we often try to set project topics that are affiliated in some way with the research groups in the school. Some computing topics in recent years have included: building distributed Web and network applications; experimenting with virtual reality and advanced graphics systems; building programmable remote control systems; building wireless access protocol mobile phone applications; programming personal digital assistants to interact

with wireless networks; a chatterbox that holds conversations with you in Welsh and English.

Many students enjoyed their final year projects so much they have stayed on with the research group to study for PhD degrees (the cool degree after which you get to call yourself Doctor ☺).

- Small Group Project – In the 2nd year we run small group projects as part of the software engineering modules. This is usually a very worthwhile experience as you get to work in a realistic team environment (something employers like to see on your CV). Generally teams are between 4 and 5 students and you get to design, build and test software as part of the project.

Assessment Methods

We would like to think you come to study computer science because you love the subject ☺ but we know in fact it is important to assess your performance and set grades so you can get a degree. We use several methods of assessment depending upon the particular module. Some typical methods are:

- Unseen exam – This is probably familiar to you as it is like a school test. Many of our modules will have a mix of exam and continuous assessment exercises. Often the exam is worth between 50 and 80 percent of the marks for a particular module. Generally the exam will have specific instructions like "answer three out of five questions" (if they are longish questions) or "answer all ten questions" if they are shorter, easier questions. Usually we make available past years' exam papers and solutions so you can practise your exam technique and get the hang of the sorts of questions that may be set. There is usually no substitute for attending lectures (and staying awake) for getting a feel for what will be in the exam ☺

- Laboratory report – Some modules have a formal lab session and you may be asked to submit a written report on an experiment or exercise. The structure of these varies between labs. You will usually be expected to submit a word-processed report, perhaps with graphs or tables of experimental data.

- Assessed assignment – Many modules have some programming practical exercises or essays to hand in. Generally you get several weeks to do these and they are usually easy if you have paid attention in lectures. ☺

- Oral presentation – As part of project work we ask you to make a short presentation to the rest of the class. We realise many people get terrified doing this (How do you think we feel having to lecture every day?☺) so there are not too many marks involved but it is in fact a very useful experience to give a short talk. We help you sort out what you want to say and how to prepare the material. This experience is often something employers are interested in too.

- Project thesis/dissertation – As part of the reporting of work carried out during your final year project we ask you to write a fairly substantial thesis or project

report. We help you figure out what should be in this and how it should be structured. You can read previous years' student reports in the library. This may be the largest document you will ever have written and again is a valuable experience from employers' perspectives. It is also important as writing articles and publishing material is how science in general proceeds. We try to help you work on a final year project that will be near state of the art and possibly at actual research level. Some past project reports have been published in the scientific literature and some have also won prizes.

Above all, don't stress out over the assessments. If you are finding any of them particularly difficult don't suffer in silence. Your tutor or project supervisor will be happy to talk over difficulties you might have and perhaps give you a fresh perspective on the problem.

Professional Development and What Next?

Once you have graduated we hope you will know a lot about the state-of-the-art in computer science, but you need to take steps to stay up-to-date. Computing is moving ahead very rapidly and even during the three years of your degree you will probably see great changes.

You can reasonably expect your future employer to help you stay abreast of development whether you end up working in industry or academia but you may also wish to join one or more of the Computing Professional Societies. Some of these are:

- British Computer Society (BCS) is the official accreditation body for computing degrees in the UK. As a society it is also a useful source of contacts for employment. It produces a monthly magazine (Computer Bulletin) but is perhaps more oriented to IT and applied computing jobs than the ACM is for example, but the BCS is much better oriented for the UK job market. You can read the BCS web pages at www.bcs.org.uk or see the notice board for which academic staff member is the local contact. Generally, as a graduate of an accredited degree programme, all you need to do to join the BCS is pay them some money. The BCS also sponsor a prize for the best computer science graduate each year.

- Association for Computing Machinery (ACM) is one of the oldest computing societies in the world. It is based in the USA and is a very good source of computing contacts and news on an international scale. The ACM publishes a series of very high quality research level journals and also produces a monthly magazine called Communications of the ACM which usually gives good insights into what major developments are happening. The ACM also operates one of the best digital libraries - you have automatic access to this as a student at Bangor. See a librarian for details. You do not need any special qualification to join the ACM – you just have to sign something to the effect that you believe in the ACM's mission and that you will be a good and ethical computer professional – and of course pay them some money. See the ACM web page at www.acm.org for details. The ACM has many special interest groups, such as SIGGRAPH for computer graphics. It is possible to be just a member of ACM SIGGRAPH, which is cheaper than being a member of the parent ACM.

- Institute of Electrical and Electronic Engineers (IEEE) Computer Society – The IEEE Comp Soc is a part of the larger IEEE which is quite a prestigious organisation to belong to. Generally you need two referees to be admitted to the IEEE but once you are in you just pay a bit extra to belong to the Computing Society. The IEEE publishes the magazine "Spectrum" monthly which is good for keeping abreast of general engineering developments, and also publishes a worthwhile monthly magazine called "Computer" for the Computer Society. Like ACM, IEEE Comp Soc also publishes several very high quality research journals which you get cheaper as a member, and a digital library. The IEEE Comp Soc has Web pages at www.computer.org and the IEEE itself is at www.ieee.org .

- The Eurographics Association www.eg.org is for those of you who want to specialise in the computer graphics industry. Eurographics is the only truly Europe-wide professional Computer Graphics association. The association supports its members in advancing the state of the art in Computer Graphics and related fields such as Multimedia, Scientific Visualization and Human Computer Interfaces. Through a world-wide membership, EG maintains close links with developments in the US, Japan and other countries, promoting the exchange of scientific and technical information and skills on a global scale.

Summary

Each of our programmes has a designated Programme Leader. Contact the Programme Leader if you are confused by any aspect of the degree structure or if your tutor is unable to help.

The Programme Leaders are:

For "Computer Science"
- Dr Saad Mansoor
- Dr Jane Rudall

For "Computer Systems with Business Studies"
- Dr Bill Teahan

For "Computer Systems with Psychology"
- Dr Bill Teahan

We hope you enjoy the computing programmes here at Bangor and that you will go on to do great things after you have graduated.