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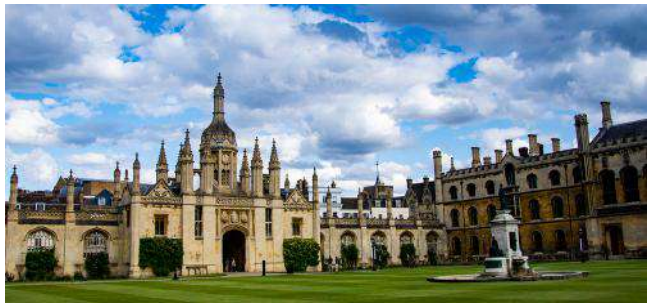


Computer Science

SYLLABUS OVERVIEW
13-15 YEARS OLDS

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About Immerse

Immerse Education is an award-winning academic summer school provider offering programmes for 13-15 year olds in Cambridge University colleges.

The aim of these introductory programmes is to provide participants with academically challenging content in a classroom environment based on the university style of learning. Through 40 hours of academic sessions, the programmes also offer young students unique and valuable insights into what it would be like to study their chosen subject at an advanced level.

This Syllabus Overview provides a summary of the topics and subject areas that participants can encounter during their studies with Immerse. It has been carefully created by our expert tutors who are current members of world-leading universities, and who have experience in teaching undergraduate students.

Academic Sessions

The academic sessions at Immerse are arranged into modules to enable participants to explore a broad range of topics over the course of two weeks. The modules included in this syllabus overview are indicative but not prescriptive.

Tutors are encouraged to include their own specialisms and also focus on any particular areas of interest expressed by participants within the class. They may choose to provide further detail on a specific topic, or they may include new material and information that builds on the knowledge already developed during the programme.

Personal Project

Each programme includes an element of individual work, generally termed the 'Personal Project'. This can take many forms but is commonly an essay or presentation delivered on the final day of the programme. Participants will receive feedback on this work which may also be mentioned in the participant evaluation which is provided in writing by the tutor once the programmes have ended.

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Preparatory work

Some tutors may ask participants to complete some preparatory work, such as reading or a series of exercises in advance of the programme. Participants are strongly encouraged to complete this work since it will be included in the opening sessions of the programme. Any preparatory tasks will be provided in advance of the programme directly to the participant.

Academic Difficulty

As all of our programmes are designed to provide a unique introduction to advanced material, the syllabus will be academically challenging at times.

This is something to be excited about and all of our tutors will encourage and support participants throughout the programme. Immerse Education aims to develop every participant regardless of ability, and our tutors will adapt their teaching to individual needs.

Aim of the Computer Science Programme

Computer science is a broad, interdisciplinary subject combining creativity with attention to detail, mathematical precision with novel means of expression. Knowledge of this field is also highly prized in industries all over the world and new opportunities are constantly emerging as technology continues to be driven forwards by the latest innovation. The aim of the Immerse Education Computer Science programme is to introduce participants to the foundations of this subject and highlight the pathways that are available to those who would like to pursue computer science further in the future. Participants will get to grips with a variety of practical skills as they explore both the theory and practice of computer science.

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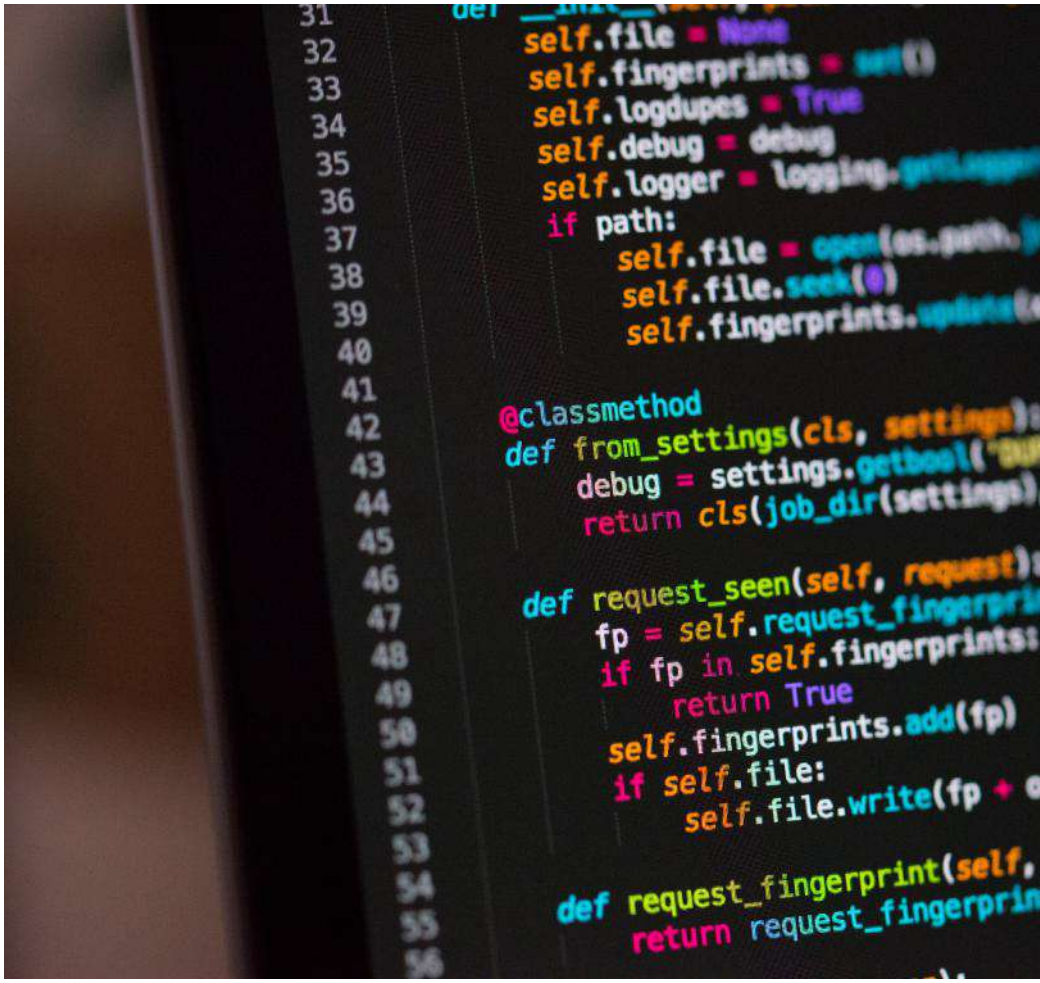
Introduction to Programming

We dive into the exciting world of programming. While there are ~7,099 spoken languages, according to HOPL there are over 8,900 programming languages. That may sound overwhelming but while most programming languages differ (as with spoken languages), the underlying principles are similar. Python is one of the most popular programming languages in the 21st century, which is both easy to learn and highly functional. We will look at Python basics, syntax and semantics through a series of tasks that become progressively more challenging, particularly for those already familiar with Python.



Introduction to Models of Computation

A model of computation describes how an ‘input’ is computed via a mathematical function to produce an ‘output’. In this session we introduce computability theory, and complexity, and show how the building blocks of computer science are based on very simple models, which in turn are very powerful. We will explore automaton examples, such as combinatorial logic and the Turing machine. We will briefly discuss the mathematical syntax for these automaton examples and demonstrate how they can also be interpreted graphically. Understanding computability theory sets the foundations for further study in computer science.

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Introduction to the Internet

The internet and World Wide Web has been one of the most disruptive technologies of recent times. With its background as a research platform, the World Wide Web has transformed how we interact with each other and services. In this topic we will discuss the origins of the internet and World Wide Web, and take a first look at HTML, CSS, and JavaScript. Moving on we discuss the internet of things (IoT), and how connectivity is changing our everyday life, exploring some of the latest and most impressive advances in connective technology.

Web Development

Developing a website from a blank page and bringing style to your website hasn't been easier. After developing the structure of the website using HTML, we experiment with different styling options and how best to incorporate them over entire websites using CSS. While the name may suggest that JavaScript is like Java, they are completely different – it is one of the main programming languages for the Web. We will explore how we can bring our site to life with a touch of JavaScript, as it allows us to create more responsive sites that allow you to add action and responses when the user interacts with your website.

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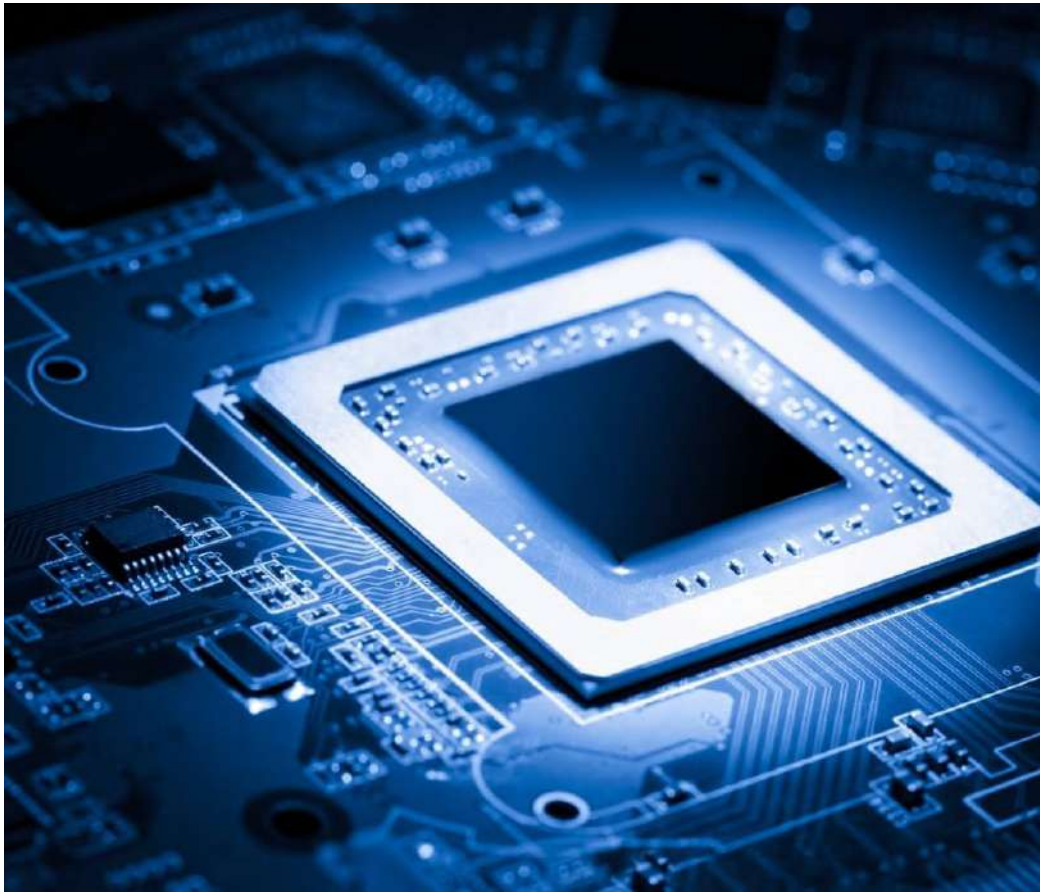
Computer Architecture

Whilst computers differ in specifications, abilities, processing speed and additional specs, most computers follow the same architecture of a typical stored program computer. From the smallest industrial controller to the largest supercomputer. What differentiates them is the multiple processor and memory modules as well as how they are coordinated to communicate and work cooperatively on a problem. We will look at the standard computer architecture and explore how information is passed from component to component. We conclude with a lesson on binary.



Introduction to Robotics and AI

Artificial intelligence and machine learning are some of the most interesting fields within computer science and engineering. Robotics is an intersection between the two and there have been a lot of interesting advances in robotics recently. We will look at programming robots using Raspberry Pi and Python. We will design challenges, programme the robots and test them. The functions can be combined differently to achieve different results. The robots have several sensors that can be utilised for input from the environment to make them more aware of their surroundings and thus more responsive in their task.

Sequence, Control, Selection Techniques and Iteration

A python program is made of a combination of different methods of enforcing sequence, control, selection and iteration. Depending on the order used, they can be combined to achieve a specific goal. We look at 'if' statements that execute a command only if a condition is true, 'while' statements that continue to execute a block of code while a condition remains true, and 'for' loops that are used to iterate over a set and carry out an action for each member of the set. We will learn how to use and combine them to achieve specific tasks.

Databases and Big Data

It is estimated that we produce 2.5 quintillion bytes per day, or 2,500 million gigabytes per day. In a world where we produce so much data, how do we make sense of it? How can we leverage it to our advantage, and how can we manage it? In this topic we will take a look at relational databases, a powerful tool that is used almost everywhere in computer science to efficiently store data. We will discuss normalisation and how we best store data, so that we can understand and infer from it.

Personal Project

Throughout the fortnight, participants will be working on their own personal project. Having been provided with a brief, participants should research and prepare a presentation for their peers. This will build upon an aspect of the theory that they have learnt over the course of the programme and is also an opportunity to showcase the practical skills they have developed. The presentation is followed by questions from the audience and wider class discussion of particular points of interest. The tutor may also include feedback about the presentation in the written evaluation which is sent to participants after the programme has ended.

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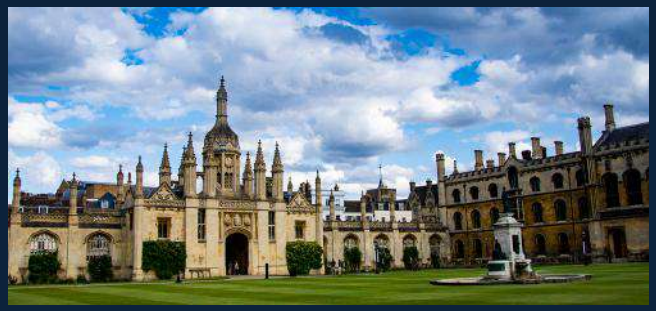


OUR AWARDS AND ACCREDITATIONS

THE QUEEN'S AWARDS FOR ENTERPRISE 2018

BAC ACCREDITED

COBIS SUPPORTING MEMBER | COUNCIL OF BRITISH INTERNATIONAL SCHOOLS

RoSPA Member

BETA British Educational Travel Association