



## COMPUTER SCIENCE

### **Why is the study of Computer Science important?**

Computer Science is the study of the principles and use of computers. Its study will make you question how the systems that you use in a modern day society work and encourage you to explore the concepts behind the technology you use and develop skills to become a creator of technology yourself. From Year 7 you will have the exciting opportunity to develop and consolidate basic ICT skills that will allow you to access more complex Computer Science concepts. From there you will study the four cornerstones of Computational Thinking; these are crucial as they can be applied to any computer science context and will provide firm foundations for other topics within the subject. From this, key programming constructs can be learnt, allowing you to develop programming skills in more than one environment. This will help you to understand key similarities between different programming environments and develop key skills in problem solving and debugging. These skills will be further consolidated and mastered in text based programming languages throughout your study, applying the cornerstones of Computational Thinking in a wealth of scenarios to develop your problem solving skills. Computer Science theory is also explored, looking 'under the bonnet' of the computer systems that you use on a day-to-day basis. Key systems hardware are investigated, including how networks are formed, the inherent security risks that networked devices produce and how to mitigate against these risks. Computer Security is currently one of the biggest risks to national security, is relevant, interesting, and provides you with knowledge that can help you become a responsible e-citizen. Your study of Computer Science will encourage you to think deeply and help you more effectively to become a resilient problem solver that understands the technological world in which we live – a great life skill that all universities and employers will appreciate.

Across your study you will explore fundamental principles and concepts of Computer Science, including abstraction, decomposition, logic, algorithms, and data representation. You will analyse problems in computational terms through practical experience of solving such problems, including designing, writing and debugging programs. Furthermore, the subject will teach you to think creatively, innovatively, analytically, logically and critically and understand the impacts of digital technology to the individual and to wider society. Lessons will provide a wide range of opportunities for practical application of key concepts through a chosen programming language as well as plentiful opportunities for you to investigate how computers work. In addition, there will be opportunities for extended discussion about the ethical, moral and social implications of technology in society. Computer Science offers significant challenges; this is because it is a subject that encourages technological progress and breaking new ground, but this is what makes it exciting! Can you apply the concepts, knowledge and skills you have learnt in a creative way that others haven't thought of before? Can you identify an area of computer science that provides further technological development? Seems challenging – but you are going to love it! Computer Science will expand your mind!

*Big Questions will be explored, such as are the developments in artificial intelligence affecting job prospects and opportunity? Is technology creating a digital divide that further disadvantages people in developing countries? Can you create a program for a specific scenario to solve a problem? What opportunities and issues does the internet develop? All of these questions are key and can be explored by understanding key computer science concepts both through theory and practical application. I bet you can't wait to get started!*

### **What skills will the study of Computer Science teach you?**

You are a citizen in this world and you need to know how to solve problems using technology and the key concepts involved in the technology that we have become so dependent on. It will teach you to...

- Apply computational thinking techniques (abstraction, decomposition, pattern recognition, algorithms) in a range of scenarios to solve problems.
- Develop resilience by not being afraid of challenges when solving problems, but to break them down and keep trying.
- Be creative in a subject that may not be renowned for it – there is no limit to creativity when you create the solution.
- How to act responsibly online to ensure that you and others stay safe online.
- Identify the key programming constructs (sequence, selection, iteration) required to solve a problem.
- Apply the key programming constructs (sequence, selection, iteration) to any programming language.
- Work independently and part of a team to solve complex problems.
- Construct reasoned arguments to ethical, social and moral problems that have arisen due to technology and communicate these in an effective way.
- Identify links between different elements of computer science.
- Evaluate different methods of representing data and decide on the most suitable method for presentation/storage.

### **What will you know and understand from your study of Computer Science?**

- How computers process data, the architecture of a CPU (von Neumann) and the characteristics that affect the performance of computer systems
- Different types of computer system and how embedded systems are used in society
- Methods of storage within a computer system, including primary and secondary storage
- How to calculate storage requirements for a range of different types of file
- The suitability of different storage devices based on capacity, cost, speed, portability, durability and reliability
- Different types of networks and factors that affect the performance of networks
- Hardware required to create a network and the different responsibilities of the different type of hardware
- How the internet is used for access to the WWW and online storage
- How the TCP/IP (the rules used to send data across a network) stack works, the different protocols related to each layer and their roles
- Threats to network and system security and how to prevent/overcome these problems
- Different types of software (operating systems and utility software) and their roles within a computer system
- Ethical, cultural and environmental issues that have arisen due to technology
- Different legislation that relates to computers and technology

- Different searching and sorting algorithms and how they are used
- The key programming constructs (sequence, selection and iteration) and how these can be written in a text based programming language
- The use of file handling in a programming language
- How SQL (structured query language) can be used to query and interrogate data
- The use of data types, arithmetic, Boolean and string manipulation when creating programs
- Different defensive design considerations for creating robust programs and how to implement these in programming
- How to generate test plans for a range of different scenarios
- Applying computational logic to generate truth tables for logic circuits
- How translators are used to deal with different types of programming language
- How data is represented in computers, including binary, hexadecimal, characters, images and sound
- How compression is used in computer systems
- How to select and combine multiple applications to achieve challenging goals, including collecting and analysing data and meeting the needs of a given scenario

### **How does your study of Computer Science support your study in other subjects?**

Study of any subject in our curriculum takes full advantage of links with other subject areas- we term these as interdisciplinary links and we make the most of them because we know that deep learning requires the transference of knowledge and skills from one topic of learning to another. Once you can transfer your learning across topics and subject areas then you are really mastering what you know and how to apply your understanding and skills.

Computer Science touches on so many other subjects such as mathematics as you develop skills in problem solving, including decomposition (breaking down problems), abstraction (removing unnecessary detail from a problem) and pattern recognition. All of these skills will support your teaching in Mathematics as these are very important in being able to solve mathematics problems in a range of contexts. There are also links with Science as binary logic can be applied to electrical circuits in Physics and much of the technology from Computer Science can be mapped back to core principles of Science. For example, how sensors are used to monitor motion, force and/or pressure. You will learn methods of thinking and research that are widely applicable to other subject areas helping your thinking in all subjects.

### **How can you deepen your understanding of Computer Science?**

The Computer Science department offers a great variety of opportunities for you to engage with this fabulous subject. In Year 7, 8 & 9 we engage with an external program called iDEA (Inspiring Digital Enterprise Award). This is an online program that students can complete in addition to their lessons to develop digital and enterprise skills. It is an initiative from the Duke of York and is the digital equivalent of the Duke of Edinburgh programme. Why not complete the iDEA programme to complete your bronze award, see if you can complete all the badges, develop your digital literacy and enterprise skills and compete against other students in the trust.

We also run a Coding club to give you a chance to develop coding skills and compete in challenges set by the teachers.

Get involved! Become a Computer Scientist!

## **How are you assessed in Computer Science?**

Throughout the 7 year Computer Science course you are assessed using the following assessment objectives which ensure that you can cumulatively build your subject understanding in preparation for future GCSE and A Level study. There are half termly assessment points each year. In younger years we use our subject mapping of our curriculum's age related expectation to assess how students are currently performing against their age related expectations at this point in their study. At GCSE we make informed predictions informed by our holistic assessment of their progress against the key assessment objectives and their aspirational GCSE targets. These are also the basis for any appropriate support and intervention.

### **Key Assessment Objectives**

**AO1:** Demonstrate knowledge and understanding of the key concepts and principles of Computer Science.

**A02:** Apply knowledge and understanding of key concepts and principles of Computer Science.

**A03:** Analyse problems in computational terms:

- to make reasoned judgements
- to design, program, evaluate and refine solutions.

### **How can Computer Science support your future?**

Of course we offer the study of GCSE and A Level Computer Science and we encourage your continued study in this fantastic subject. Yet we know that choice and personal interest are important aspects of worthy study. Whether you have continued your study of Computer Science into GCSE or A level or not you will have gained access to this enriching subject and its study will have taught you to think differently and deeply.

Computer Science is offered at most prestigious universities either as a single honours or a joint honours subject studied alongside other disciplines e.g. Computer Systems Engineering, Computer Games Design, Computer Science & Artificial Intelligence, Mathematics & Computer Science and Computer Forensics. The very fact that you have been able to study Computer Science e.g. computational thinking will help your future application be it for colleges, universities, apprenticeships or employment.

Careers that the study of Computer Science supports include:

- Secondary School Teacher
- Database administrator
- Software Developer
- Web Application Developer
- Computer Systems Analyst
- Mobile App Developers
- Information Security Analyst
- Computer Network Architect
- Software Tester
- Network Manager

**CURRICULUM PROGRESSION PATHWAY FOR COMPUTER SCIENCE AT OUTWOOD ACADEMY EASINGWOLD**

	<b>YEAR 9</b>	<b>YEAR 10 (GCSE Computer Science)</b>	<b>YEAR 11 (GCSE Computer Science)</b>	<b>YEAR 12 (A-Level Computer Science)</b>	<b>YEAR 13 (A-Level Computer Science)</b>
<b>Autumn 1</b>	Python Programming - Learning the Python programming language to solve real world problems through Procedural Programming techniques.	Practical Programming skills - students develop skills in designing, writing, testing and refining code.	<p>Networks - students learning about computer networks, connections and protocols</p> <p>Network security - students learn about the threats to computer systems and networks. Students also learn how to identify and prevent network vulnerabilities.</p>	<p>Structure and function of the processor</p> <p>Operating Systems</p> <p>Applications Generation</p> <p>Programming</p>	<p>Structure and Function of the Processor (Advanced)</p> <p>Programming Project</p>
<b>Autumn 2</b>	Databases: Learning how to build a database and extract data and to present it as meaningful information for an end user.	Algorithms - students learn about the principles of computational thinking: abstraction, decomposition and algorithmic thinking. Students also learn about how to design, create and refine algorithms.	<p>Operating systems - students learn about the purpose and functionality of operating systems.</p> <p>Utility software - students learn about the purpose and functionality of utility software in maintaining a computer system.</p>	<p>Databases</p> <p>Networks</p> <p>Web Technologies</p> <p>Data Types</p>	<p>Programming Project</p>

<b>Spring 1</b>	Digital Forensics - Learning about how digital artefacts can be explored and analysed to reveal information about a person.	Producing robust programs - students will learn about producing robust programs through defensive design.	Ethical, legal, cultural and environmental impacts of digital technology - students learn about the impacts of digital technology on wider society and about the legislation relevant to Computer Science.	Data Structures Boolean Algebra Computing related Legislation & Ethical, Moral and Cultural Issues Thinking Abstractly Thinking Ahead	Compression, Encryption and Hashing  Programming Project
<b>Spring 2</b>	Computer Hardware & Networks - Learning how to determine what hardware is needed to build a school network.	Boolean logic - students will learn about creating logic diagrams using the operators AND, OR and NOT and applying logical operators in truth tables to solve problems	Algorithms - students will learn about searching and sorting algorithms.  Languages - students will learn about the Characteristics and purpose of different levels of programming language, the purpose of translators and the characteristics of a compiler and an interpreter.	Thinking Procedurally Thinking Logically	Programming Project  Thinking Concurrently
<b>Summer 1</b>	AI & Data Science: Learning how data science and artificial intelligence be used to solve real-world problems.	Systems architecture - students will learn about the architecture of the CPU, CPU internal components, CPU performance and embedded systems.	Final Exam Prep	Software Development Algorithms	Revision
<b>Summer 2</b>	Sonic Pi - learning how to create sound with code in a live coding environment	Memory and storage - students will learn about primary and secondary storage, data storage and compression.	Final Exam Prep	Programming Project	