WORCESTER
SIXTH FORM COLLEGE

Progression -
Computer Science

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1. Thinking of studying A Level Computer Science at Worcester Sixth Form College?

We teach the **OCR** specification.

Here is a brief summary of the topics we cover over the two-year course.

- **Components of a computer and their uses** – processor components, processor performance, types of processor, input, output and storage devices
- **Systems software and applications generation** – OS functions, types of OS, nature of applications and programming language translators
- **Software development** – systems analysis methods, writing and following algorithms and programming paradigms
- **Exchanging data** – compression, encryption, database concepts, relational databases and normalisation, SQL and transaction processing
- **Networks and web technologies** – structure of the internet, internet communication, network security and threats, HTML, CSS, Javascript, search engine indexing client – server and peer - to - peer
- **Data types** – data types, binary, hexadecimal, ASCII, Unicode, binary arithmetic, floating point arithmetic, bitwise manipulation and masks
- **Data structures** – arrays, tuples, records, queues, linked lists, stacks, hash tables, graphs and trees
- **Boolean algebra** – logic gates, Boolean expressions, Karnaugh maps, Adders and D type flip flops
- **Legal, moral, ethical and cultural issues** – computing related legislation, ethical, moral and cultural issues, privacy and censorship
- **Computational thinking** – thinking abstractly, thinking ahead, thinking procedurally, thinking logically, thinking concurrently, problem recognition and problem solving
- **Programming techniques** – programming basics, selection, iteration, subroutines, recursion and object oriented programming
- **Algorithms** – analysis and design of algorithms, searching algorithms, sorting algorithms, graph traversal algorithms and optimisation algorithms

2. Tasks to complete before September

In order to prepare for the course, you need to complete the tasks on pages 4 - 10.

Before you begin, find a folder to store this Booklet and all the notes that you make on the tasks. **You need to bring in this folder at the start of the course.** Make sure that your notes are neat and well-organised!

2. Tasks to complete before September

Specification Review

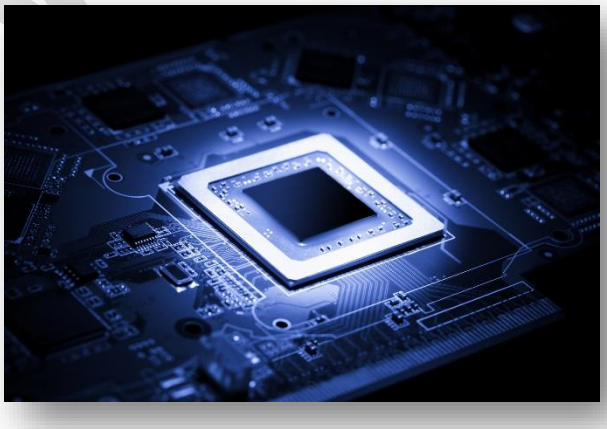
The exam board specification is a useful resource for helping you to understand the OCR A Level course you will be studying. Spend some time reading about the content of the course and how it will be assessed by using the link below:

https://www.ocr.org.uk/Images/170844-specification-accredited-a-level-gce-computer-science-h446.pdf

Vocabulary Research

Now that you have reviewed the specification you can start to get to grips with some of the new terminology and abbreviations you will be using. One of the first topics we will be learning about is the structure and function of the processor. Find out what the following abbreviations stand for and what they do:

- ALU
- CU
- PC
- ACC
- MAR
- MDR
- CIR



2. Tasks to complete before September

Quiz

1. How many external exams will you take as part of the A Level Computer Science course?
    a) 1
    b) 2
    c) 3
    d) 4
2. How much of your final grade is the programming project worth?
    a) 20%
    b) 25%
    c) 35%
    d) 50%
3. What are the 5 different types of computational thinking covered in Component 02?
    1) _____
    2) _____
    3) _____
    4) _____
    5) _____
4. What are the 4 pieces of computing related legislation covered in Component 01?
    1) _____
    2) _____
    3) _____
    4) _____
5. What does ALU stand for and what is its purpose?

    _____

    _____

6. What doe MAR stand for and what does it store?

    _____

    _____

2. Tasks to complete before September

Puzzles and Problem Solving

The following puzzles and problems require you to think logically and systematically.

1) A deduction puzzle

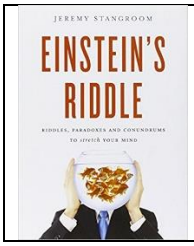
There are four programmers, Alice, Bob, Charlotte and Dave, each of whom codes in a different language and has their own reason for studying computer science. Can you use the clues provided to match each programmer to the correct programming language and motivation for studying computer science?

1. Of the one who likes puzzles and the one who loves maths, one is Alice and the other programs in C#.
2. The python programmer's name is alphabetically one more than the person who enjoys solving puzzles
3. Bob got into computer science through gaming
4. Of Dave and Bob, one wants to study computer science for the money, while the other codes in VB

Name	Language	Motivation
Alice		
Bob		
Charlotte		
Dave		

Lots more of this style of puzzle, including interactive solving tools, can be found here: http://www.logic-puzzles.org/index.php

For Einstein's riddle, allegedly one of the hardest of this type of puzzle, try this book:

	Einstein's Riddle Jeremy Stangroom Bloomsbury Publishing (18 May 2009) ISBN-10: 1408801493 ISBN-13: 978-1408801499	Contains the world's most famous logic puzzle

2) Knights, knaves and spies

On the fabled Island of Knights and Knaves, we meet three people, A, B, and C, one of whom is a knight, one a knave, and one a spy. The knight always tells the truth, the knave always lies, and the spy can either lie or tell the truth.

A says: "C is a knave."
B says: "A is a knight."
C says: "I am the spy."

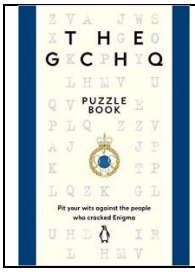
Who is the knight, who the knave and who the spy?

Knight _____

Knave _____

Spy _____

If you like logic puzzles, code breaking, or just really hard problems, try this:

	The GCHQ Puzzle Book GCHQ Michael Joseph (20 Oct. 2016) ISBN-10: 0718185544 ISBN-13: 978-0718185541	A proper work-out for the brain!

Each of the following puzzles requires you to design an algorithm. You may want to start by writing out some examples to help you understand the problem.

3) Light switches

This puzzle was an Oxford University interview question.

You are standing in a room with three light switches. Each switch controls exactly one light bulb in the next room. (This is a budget puzzle, so they are plain, cheap, basic light bulbs.) The door to the next room is closed, and there are no windows, so you cannot see the light bulbs. You may manipulate the switches as much as you like, then you may go through into the room with the lights. You must then say which switch controls which bulb. How do you do it?

_____

_____

_____

_____

4) Weighing and measuring

You have 10 bags of coins, each bag contains 100 coins. Nine of the bags contain real coins; each real coin weighs 1 gram. One bag contains fake coins; each fake coin weighs 0.9 grams.

If you have an accurate scale that will display the weight of an object placed on it, how can you identify the bag of forgeries using the scale only once?

_____
_____
_____
_____
_____
_____
_____
_____
_____

You have 12 coins, one of which is fake. The fake is either lighter or heavier than the real coins, but you do not know which. You have a balance that you can use to compare the weights of items.

How can you find the fake coin in just three uses of the balance? (You have no other weights or reference objects, just the balance and 12 coins.

_____
_____
_____
_____
_____
_____
_____
_____
_____

2. Tasks to complete before September

Research Topics

These questions require you to use your technical knowledge in context. You will need to do some research to extend your knowledge and provide relevant examples. Reference any sources that you use to help you – there is a guide to referencing at the bottom of the page.

You should complete the following tasks on paper and store them in your folder with this booklet.

1. Create a timeline showing the history of computing, including any key discoveries or inventions. Extend you timeline to show how you think computer science might develop over the next 50 years.

2. Compare the Xbox ONE, PS4 Pro and PC as gaming platforms. You must use as much technical detail as possible and reference any evidence presented. Choose how you will present your ideas.

3. Discuss the benefits and limitations of Virtual Reality
    a. In business contexts, such as medicine
    b. As a gaming tool
    c. As an extension to social media
    d. As a tool for education

A guide to the Harvard referencing style can be found here:

https://www2.le.ac.uk/library/help/referencing/author-date

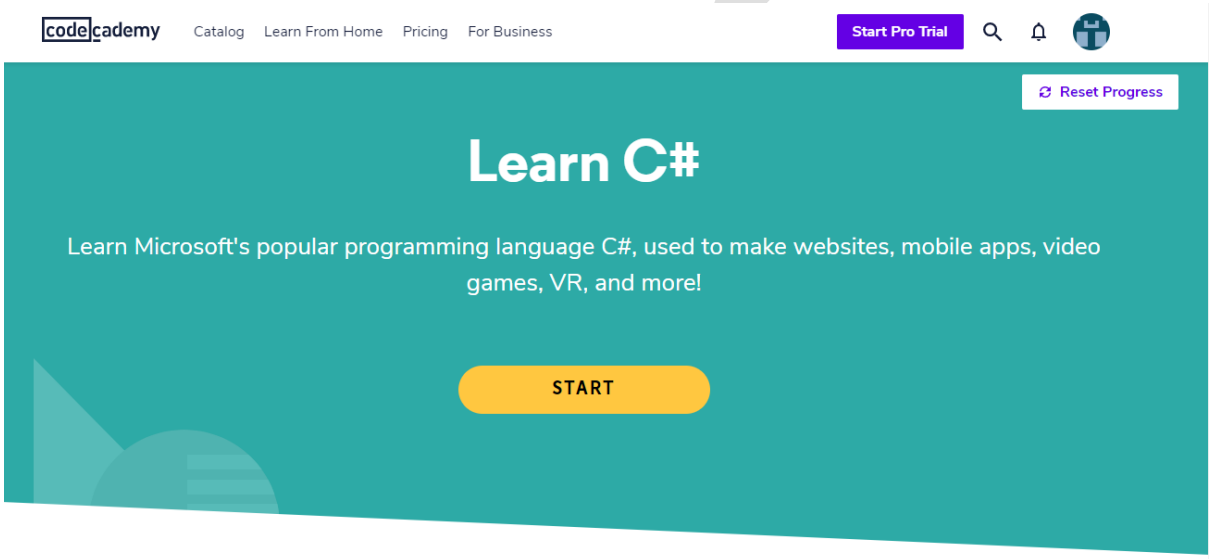
There are also many free tools online to help you create references. Make sure that you reference each source carefully and try to use a range of sources, including books and magazines, rather than just websites.

2. Tasks to complete before September

Coding in C#

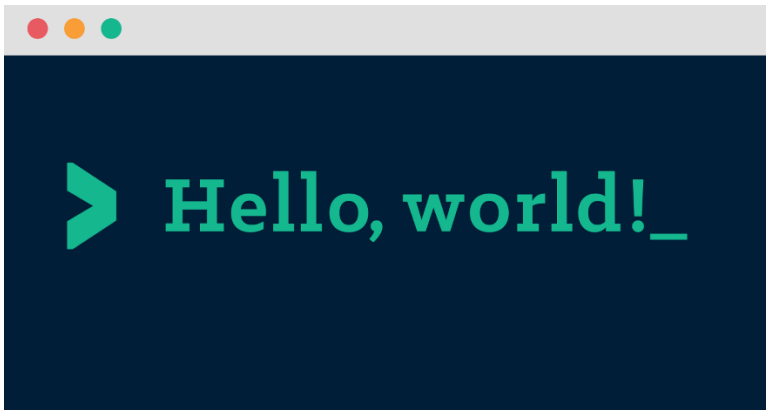
Throughout the A Level course you will be learning to program in a range of different languages. www.codecademy.com is a really useful website for helping you to learn the fundamentals of new programming languages.

In the first year you will complete many of your programming challenges in C#. Sign up for a free Codecademy account and choose the Learn C# course from the Catalog. https://www.codecademy.com/learn/learn-c-sharp



1. Complete the 'Hello World' interactive lesson to learn the basics of how to create your first program in C#.

2. When you have successfully completed your Hello World program move on to section 2 and complete the interactive lesson on Data Types and Variables.



3. Optional Tasks

i. Think like a Computer Scientist

Continue to develop your approach to problem solving by tackling the following problem:

Make 15

You and I are going to play a card game. The rules are as follows:

- 9 cards, numbered 1 – 9, a placed face up on the table between us
- You go first
- On your turn you may pick up any one card from the table
- We alternate turns, each picking up one card at a time
- The winner is the first player to get any three cards that add up to exactly 15 (You can have more than three cards in your hand as long as three of them add up to 15. For example, if I was holding 8, 6, 2 and I could pick up the 5 I would win with 8, 2, 5)

What strategy should you follow to always win at this game, or at least never lose?

3. Optional Tasks

ii. Mini Project

As part of your A Level you will need to complete a programming project where you design and create a computational solution to a problem. You can practice some of the skills involved by creating a program to showcase your programming skills. You should aim to demonstrate as many skills as you can, as appropriate to your prior knowledge and experience.

Some ideas for programs

- A game
  - A basic game could be text-based
  - More advanced games may have a GUI and/or an AI to play against
  - The "Make 15" game (above) could be a good starting point
- A program to encipher and/or decipher a text file
  - You may want to research well-known ciphers here: http://simonsingh.net/The_Black_Chamber/index.html
- A useful tool, such as a calculator or countdown timer

Demonstrate as many of the following skills as you can:

GCSE standard:

- Selection (if-elif-else and/or switch-case)
- Iteration
  - For loop
  - While loop
- Validation of user input
- Lists or arrays
- File reading/writing
- Functions

Extension skills:

- GUI
- OOP

Document your program carefully. You need to show the purpose of your program and evidence of testing your program.

If you are new to programming, you may want to follow an online tutorial. Some excellent C# tutorials are available at www.mooict.com.

If you have written code before, consider trying a new programming language. Perhaps write the same program in two different languages and compare your solutions.

3. Optional Tasks

iii. Computer Science in the News

Find a recent news story on each of the following topics:

- A legal issue in computing, such as a breach of the Data Protection Act
- An ethical issue in computing, such as the development of AI
- An environmental issue in computing, such as the disposal of waste equipment
- A technical development in computer science, such as the Internet of Things

Summarise each story (max. 100 words each), explaining any technical content for a student in year 10. Explain how the story affects you as a student of computer science.