Preparing for A-Level – Computer science

In this document, you will find a number of projects which you can try in order to develop your Computer Science skills. The key skills you should practice for September are –

Problem solving and computational thinking.	
Research skills.	
Coding skills	

I will use the above icons to signify when a project is developing one of these key skills.

Note – Due to the sheer amount of content I am creating, I have not yet been able to completely update every page on my website. If you see an error or something is not done, just drop me an email ☺

Revising programming – course

Coding skills	

Follow the video tutorials on the link below. I am uploading a load of python basic videos to help you remember and practice the basics. Also, I am creating interactive elements on my website for you as well. This is all things we covered in GCSE, but you may wish to revise some of them before starting the larger coding tasks.

http://www.ihaz.codes/UoB/learning-python/

Creating a simple pong game using pygame.

Step 1 – Install python and pygame	

Follow the video tutorials on the link below.
http://www.ihaz.codes/UoB/learning-python/pygame-tutorials/installing-pygame/

If you have issues installing pygame then email Mr Hamflett with screen shots of the error, you are getting AND a screenshot of where the python.exe is stored. You can find the file in file explorer and screen shot.

If you struggle to install it then you can use the editor on the pages to try the code out. Although this will work, it is not the best way to interact with pygame!
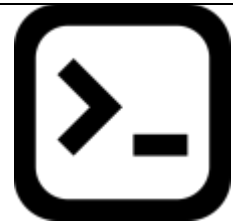
Step 2 – Learning the basics of pygame
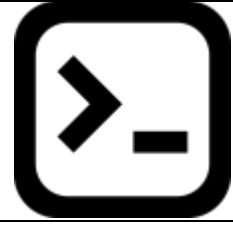
Before you start learning how to code a pong game you need to understand the basics of pygame. The link below will take you through a number of steps. Do make sure you do the tutorials in the order they are shown.

http://www.ihaz.codes/UoB/learning-python/pygame-tutorials/learning-the-basics-of-pygame/

Step 3 – Making pong

Now that you have looked at the basics of pygame, you can have a go at making pong. I have included the full code, however you should watch the videos and code it yourself. In order to develop your skills.

http://www.ihaz.codes/UoB/learning-python/pygame-tutorials/making-a-pong-game/

Extension topics

If you enjoyed pygame, then the following tutorials will help you delve even further into it. Please note that both of these are things we cover in a-level later so you may find them hard.

Learning how to solve hard problems using decomposition – space invaders.

http://www.ihaz.codes/UoB/learning-python/pygame-tutorials/space-invaders/

This tutorial is one you will be familiar with, making space invaders. The key behind this tutorial is to get you used to creating larger projects ready for the coursework at the end of year 12.

Keep your eyes peeled on my youtube channel and ihaz.codes. I will be adding new stuff soon!

Puzzles and algorithmic thinking

The following two sections were taken from the PixL resource – PiXL gateway progression.

Logic puzzles	

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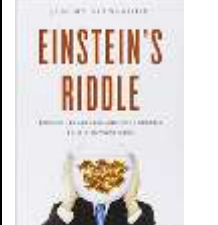
A deduction puzzle

There are four programmers, 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

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

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?

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!

Algorithmic thinking

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.

Weighing and measuring

1. 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?

2. 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.

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?

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?
Many more of these algorithmic puzzles can be found here:

	Algorithmic Puzzles Anany Levtin, Maria Levtin Oxford University Press, USA (14 Oct. 2011) ISBN-10: 0199740445 ISBN-13: 978-0199740444	A collection of puzzles designed to test and develop your algorithmic thinking and problem solving strategies. The book is well organised, with a discussion of each problem solving strategy and then several puzzles to practice.

Other areas of computer science

The following links are to areas of computer science you may find interesting.

Link	Description
https://www.youtube.com/watch?v=-OvRVlqKebI&list=PL2-dafEMk2A5_Fcpl3FHOjo2Gfios3b5o	Condensed computer science degree (USA major) – By Siraj. Siraj is an absolute legend BTW!
https://www.youtube.com/watch?v=vOppzHpvTiQ&list=PL2-dafEMk2A7YdKv4XfKpfbTH5z6rEEj3	Introduction to deep learning (machine learning)
https://isaaccomputerscience.org	A-level materials and course online.
https://www.youtube.com/watch?v=QuR969uMICM	Begineers guide to quantum computing
https://www.codecademy.com/learn/learn-alexa	Learning how to code an alexa skill
https://ai.google/education/	Getting started with google AI
https://docs.microsoft.com/en-gb/learn/paths/azure-fundamentals/	Azure fundamentals (Microsoft AI engine)
https://www.netacad.com/courses/os-it/ndg-linux-unhatched	Fundamentals of linux (course)
https://www.edx.org/course/subject/computer-science	Other free courses!
https://www.tutorialspoint.com/flask/index.htm	Learn how to make web apps in python
https://www.w3schools.com/html/	Learn how to make basic websites.