

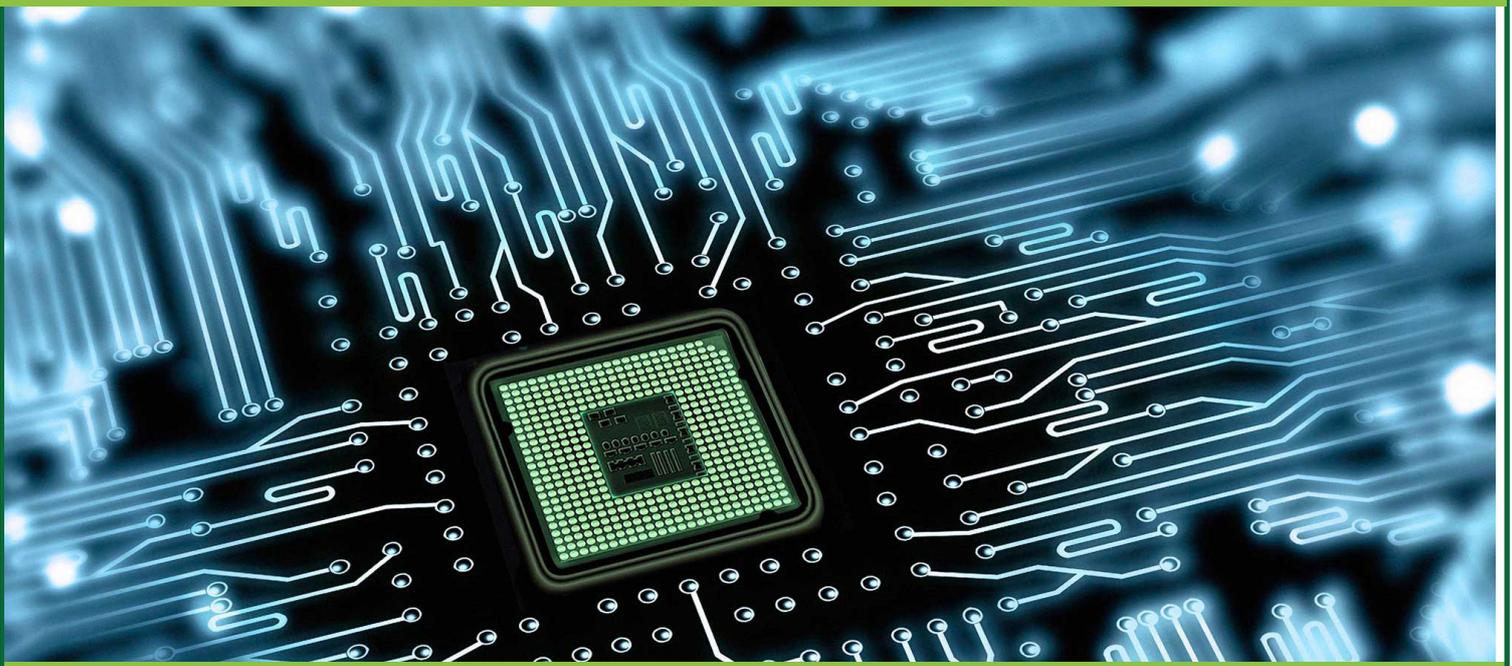


Bentley Wood

High School for Girls

Computer Science GCSE to A-level

Bridging Work
Year 11 into 12 for 2021/22

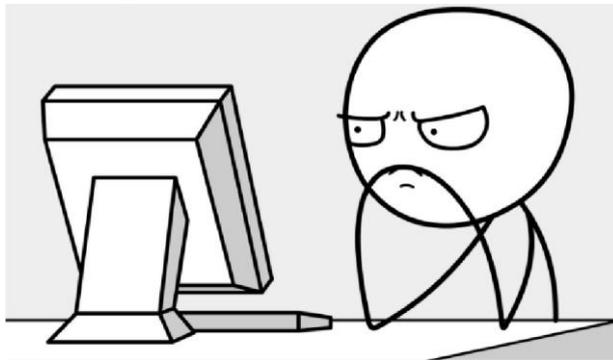


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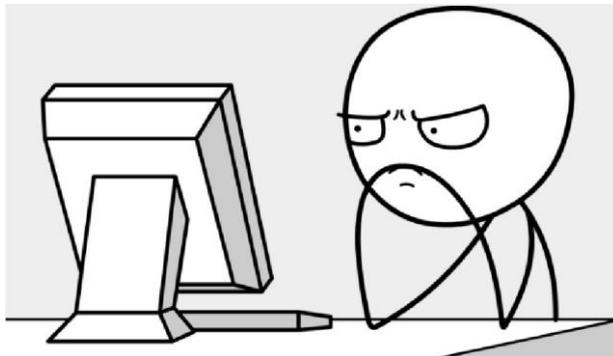
Tutor Group: _____

Teacher: _____

Programmers *at work*:



It doesn't work why?



It works why?

Contents

Using this pack

Computer Science Theory

Computational Thinking –

Theory

Algorithmic Thinking and Problem

Solving Writing Code

Intro

The transition from working at a GCSE standard to an A-Level is significant, including an increasing emphasis on technical content, extended answers and independent research. This pack is designed to allow you to practice some of these skills, building on the work that you may have covered at GCSE. Whether you have studied GCSE Computer Science or not, and whatever your grade, there will be something here to support your preparation for A-Level.

This transition pack is organised into three sections:

- Computer Science Theory
- Algorithmic Thinking and Problem Solving
- Writing Code

This broadly matches the examination and non-examination assessments of the new GCSEs and A-Levels. Within each section there will be practice questions to support both the content and style of writing required at A-Level, plus various links to books and other resources that you can use to study any topics that require attention. Each section is based on the GCSE specification, so that the content should be familiar if you have already studied GCSE Computer Science; if you are new to the subject, this should give you an overview of the main topic areas that you will study.

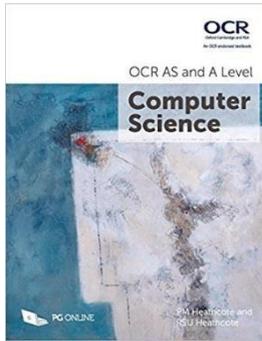
The questions are designed to go beyond GCSE standard and prepare you for A-Level study. Some questions are quite straightforward, and test core knowledge. Others are chosen to give you a chance to extend both your thinking and writing skills and to demonstrate your creativity in solving problems. There are also some genuinely hard extension questions if you want them!

Computer Science Theory

Recommended resources

http://student.craigndave.org/	By far, the best site you will find for this A-Level. Take a look at the videos section for videos on every topic of the course!
http://www.mrfraser.org/	You will have to create an account, but the resources here are excellent and well explained
http://www.advanced-ict.info/theory/NC/index.html	Although aimed at GCSE, there are some good resources on here, especially with programming, HTML and JavaScript
https://projecteuler.net/archives	Project Euler is a series of challenging mathematical/computer programming problems that will require more than just mathematical insights to solve. Although mathematics will help you arrive at elegant and efficient methods, the use of a computer and programming skills will be required to solve most problems
http://challenge.bebras.uk/	UK Bebras Challenge 2019 The 2020 challenges take place between 2nd and 13th November. The aim of the Challenges: Solve as many problems as you can in 40 minutes. You are not expected to finish!
https://en.wikibooks.org/wiki/A-level_Computing/AQA	This is an outstanding resource for all things Computer Science. It is based on the AQA spec but there is a lot of overlap
https://en.wikibooks.org/wiki/A-level_Computing/OCR	This is similar to the AQA website above, but there are a lot of unfinished parts.
https://robjonescowley.wordpress.com/resources/	Some Raspberry Pi resources for you to try
http://gcsecs.weebly.com	Although for GCSE and AQA AS, there are a lot of useful resources on this site
http://a2computing.as93.net/	Although for an older spec, there are a lot of relevant materials here
https://www.physicsandmathstutor.com/computer-science-revision/a-level-ocr/	A complete set of revision notes, questions and videos for the OCR AS and A-Level spec

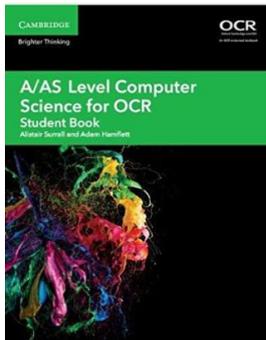
Recommended Books



OCR AS and A Level Computer Science Paperback – 12 Sep 2016

From https://www.amazon.co.uk/OCR-AS-Level-Computer-Science/dp/1910523054/ref=sr_1_8?ie=UTF8&qid=1499442116&sr=8-8&keywords=ocr+computer+science+a+level

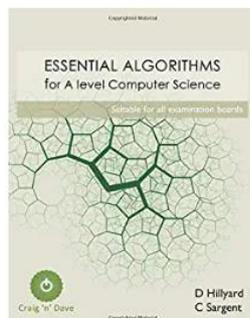
The best book for this course. It is very detailed and has all the information you will need for your AS and A Level exams. This is the core text book for the course and the one we will be referring to during teaching so it is recommended you purchase a copy of this book



A/AS Level Computer Science for OCR Student Book (A Level Comp 2 Computer Science OCR) Paperback – 5 Oct. 2017

From https://www.amazon.co.uk/Level-Computer-Science-Student-Book/dp/1108412718/ref=sr_1_12?dchild=1&keywords=a+level+computer+science&qid=1588246283&sr=8-12

Another very good book which covers both the AS and A Level course. Well written and with plenty of examples this is a good alternative to the core text book.

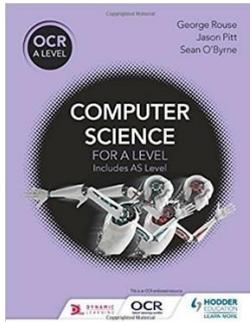


Essential algorithms for A Level Computer Science Paperback – 21 Feb. 2019

From https://www.amazon.co.uk/Essential-algorithms-Level-Computer-Science/dp/1794359427/ref=sr_1_7?dchild=1&keywords=a+level+computer+science&qid=1588256711&sr=8-7

This book focuses specifically on the algorithms aspect of the course and goes through some of

the most challenging algorithms you have to learn in great detail with clear explanations as well as coded examples in pseudocode, Python and Visual Basic. You will be given a free full .pdf version of this book but you can purchase a printed copy



OCR A Level Computer Science by George Rouse (24-Apr-2015) Paperback Paperback – 1600

From <https://www.amazon.co.uk/d/Books/Level-Computer-Science-George-Rouse-2015-Paperback/B011T7IG8K/ref=sr_1_1?ie=UTF8&qid=1499442048&sr=8-1&keywords=ocr+computer+science+a+level>

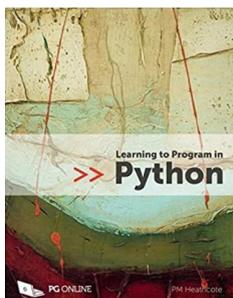
Not the best book to get. I would recommend against purchasing this but if you find a cheap version somewhere, it does have some useful bits



My Revision Notes OCR A level Computer Science Paperback – 25 Mar 2016

From <https://www.amazon.co.uk/Revision-Notes-level-Computer-Science/dp/1471865835/ref=tmm_pap_swatch_0?encoding=UTF8&qid=1499442116&sr=8-5>

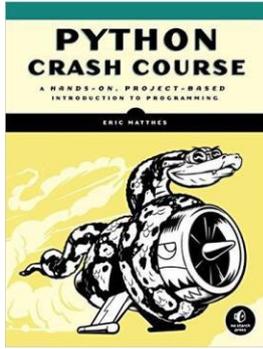
Good for condensed notes when it comes to revision



Learning to Program in Python 2017 Paperback – 23 Jun. 2017

From https://www.amazon.co.uk/Learning-Program-Python-2017-Heathcote/dp/1910523119/ref=sr_1_1?crid=11Y81GSH3V2K&dchild=1&keywords=python+heathcote&qid=1588257461&prefix=python+heat%2Caps%2C358&sr=8-1

A good Python programming book to get if you are new to Computer Science or need to get yourself up to speed for programming at AS level



Python Crash Course: A Hands-On, Project-Based Introduction to Programming

This book will teach you a little bit more than the Easy Steps book. We have a copy in the department if you would like to borrow it

TASK 1 – Benefits and limitations of VR

Choose one of the contexts below and discuss the benefits and limitations of Virtual Reality in this context (minimum 200 words)

- In business contexts, such as medicine
- As a gaming tool
- As an extension to social media

TASK 2 – Cyber Security

There have been many recent high-profile cyber-attacks across the world, including the attack on the NHS in May 2017. Some commentators have said that “we now rely too much on technology”. Write an essay explaining how far you agree with this statement and including descriptions of threats to IT systems and ways to reduce vulnerabilities (minimum 300 words)

TASK 3 - Ethical, Legal, Cultural and Environmental Concerns

Find a recent news story on one 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 the story in your own words (minimum 200 words)

TASK 4 - Computational Thinking – Theory Computational Logic and Calculations

- Complete the truth tables for the following expressions
 - A AND (B OR C)

A	B	C	B OR C	A AND (B OR C)
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

- (NOT A) OR (NOT B)
 - What single logic gate produces the same result as this expression?

A	B	NOT A	NOT B	(NOT A) OR (NOT B)

c. Draw a circuit to represent each expression

2. Convert the following into the units given

- a. 4 bytes = bits
- b. 1 TB = bytes
- c. 80 kB = GB
- d. 40 MB = nibbles

3. Complete the table, converting between binary, hexadecimal and denary as required

Binary	Hex	Denary
0010 1010		
	0B	
		255
0110 0111		
	F5	
		48
	CD	

4. Complete the following calculations

- a. $0110\ 0011 + 0011\ 0001$
- b. $1010\ 0110 + 1100\ 1111$
- c. $0110\ 0011 \ll 2$ (bit shift left two places)

TASK 5 - Programming Challenges

These challenges start off relatively easy then get notoriously difficult. Try to complete as many as you can

Section 1 (Grades 3-5)

Sing Along

Create a program that prints the lyrics to the song '10 green bottles' in as few lines of code as possible.

Extension:

1. Develop this program so that you can enter any starting number and it will count down from there

Name it

Have the programme ask for your name, age and form. Have it tell them the information back in the format: Your name is (blank), you are (blank) years old, and you are in form (blank).

Extension:

- Have the programme store this information in an external file

Arithmetic test

A primary school teacher wants a computer program to test the basic arithmetic skills of her students. Generate random questions (2 numbers only) consisting of addition, subtraction, multiplication and division.

The system should ask the student's name and then ask ten questions. The program should feedback if the answers are correct or not, and then generate a final score at the end.

Section 2 (Grades 5-7)

Tiler's mate

Tim has just launched his own company; Tim's Tiles and needs a program to work out the costs of jobs for his customers. Have the user enter the width and length of the floor and have the program calculate the total cost of tiles it would take to cover a floor plan using a cost entered by the user (per tile or metre).

Extension:

- Use functions within your program
- Have the program offer different types of tiles with different costs and tell the user the cost.
- Have the programme take into account the cost of grout and labour to give a customer a quote with and without VAT.
- Write the quote to a file

Section 3 (Grades 7-9)

R@nd0m P@ssw0rd generator

Have the programme create random strong passwords mixing upper and lower case, symbols and numbers. Passwords should be 15 characters long.

Extension:

- Have the password also use ASCII characters
- Have the passwords stored in an external file

Years in a Range

Write a program to count the number years in a range that has a repeated digit. For example, 2012 has a repeated digit, but 2013 does not.

Caesar Cipher

Implement a Caesar cipher, both encoding and decoding. The key is an integer from 1 to 25. This cipher rotates the letters of the alphabet (A to Z). The encoding replaces each letter with the 1st to 25th next letter in the alphabet (wrapping Z to A). So key 2 encrypts “HI” to “JK”, but key 20 encrypts “HI” to “BC”.

Extension tasks – these tasks are optional

Algorithmic Thinking and Problem Solving

The following puzzles will help you to develop your logical thinking skills. There are many good books of puzzles, plus countless online sources to test your skills. Some recommendations are given later.

The following puzzles are representative of classical problems and problem solving strategies. You can solve each one by trial and error, but you are encouraged to think about the strategy you employed to solve the problem. Note that there are discussions of each problem available online if you want to investigate them in more detail.

You should choose one of the problems and research the problem in depth. You are not necessarily expected to solve the problem, but you must describe your approach to solving it and how you have applied computational and algorithmic thinking to solving the problem. You do not have to do all of these, just one (unless you want to do more of course).

The Princess in the Castle

A princess lives in a long corridor in a castle. The corridor has 17 rooms, numbered 1 to 17 inclusive. Each night the princess sleeps in a different room according to the following rules:

- On the first night of the year she sleeps in a random room
- Each night she moves to an adjacent room; she never sleeps in the same room on two nights in a row and she always moves exactly one room left or right along the corridor
 - For example, if she is currently sleeping in room 12, then on the next night she will either be in room 11 or in room 13
 - If she is in room 1, then she must be in room 2 on the next night as she cannot move in any other direction (the same is true for room 17 – she must move to room 16 next)

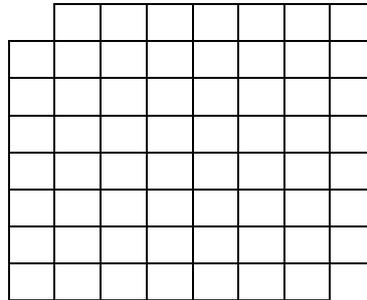
A prince wishes to marry the princess. To do this he must find her room in the castle. However, whenever he sneaks into the castle at night, the guards quickly find him and throw him out! Therefore he only has time to search one room each night.

The princess is unable to give the prince any clues to her location, and the prince has no knowledge of her location, other than whether or no she was in the room he last tried.

What strategy should the prince follow in order to find the princess in a finite time?

What is the maximum number of nights the prince needs to search before he can guarantee finding the princess?

Imagine a standard 8x8 chess board. Now cut off two diagonally opposite corners squares to get a shape like this:



I also have a pack of dominoes. Each domino is exactly the right size to cover two squares on the chess board, either horizontally or vertically. (The dominoes cannot be placed diagonally.)

Is it possible to cover the board with dominoes so that each domino covers exactly two squares, with no overlaps and without any dominoes “hanging off” the edge of the board? If so, how do you do it? If not, why not?

Einstein’s riddle (and related grid problems)

Grid puzzles have been in print for years.

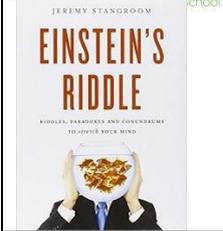
	Python	Java	VB	C	Puzzles	Maths	Gaming	Money
Alice								
Bob								
Charlie								
Dave								
Puzzles								
Maths								
Gaming								
Money								

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:

	<p>Einstein's Riddle Jeremy Stangroom Bloomsbury Publishing (18 May 2009) ISBN-10: 1408801493 ISBN-13: 978-1408801499</p>	<p>Contains the world's most famous logic puzzle</p>
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The torch and the bridge

I'm not sure where the original credit for this puzzle should lie – it is a common university interview question.

Three travellers wish to cross a rickety old rope bridge. Each person takes a different amount of time to cross the bridge.

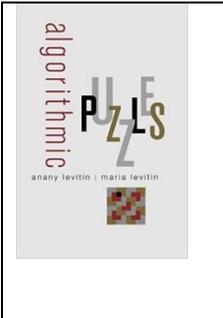
- Alice takes 1 minute
- Bob takes 2 minutes
- Charlie takes 5 minutes
- Dave takes 8 minutes

The bridge will only support two people at once (it is very old)

What's worse, we only have one torch between us... It is (of course) a very dark night and the bridge is too dangerous to cross without the torch. Oh, and the torch only has enough battery for 15 minutes...

How do we get across the bridge?

Many more of these algorithmic puzzles can be found here:

	<p>Algorithmic Puzzles Any Levitin, Maria Levitin Oxford University Press, USA (14 Oct. 2011) ISBN-10: 0199740445 ISBN-13: 978-0199740444</p>	<p>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.</p>
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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?

- 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.)

Make 15

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

- 9 cards, numbered 1 – 9, are 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 you could pick up the 5 you would win with 8, 2, 5)

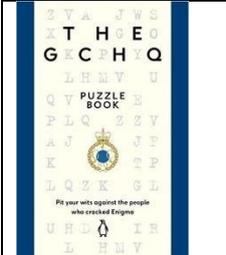
What strategy should you follow to always win at this game, or at least never lose?

Code breaking

Decrypt the following message

WYRAC WWDEE OBORI EIOWO NUILN UEKYL CPNRD HODLO HVEMF NHRIE OYIDA NEETW T

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

	<p>The GCHQ Puzzle Book GCHQ Michael Joseph (20 Oct. 2016) ISBN-10: 0718185544 ISBN-13: 978-0718185541</p>	<p>A proper work-out for the brain!</p>
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There are many more good logic, lateral and algorithmic puzzles available online if you are interested. Here is one starting point: <https://en.wikibooks.org/wiki/Puzzles>



Writing Code

There are many good resources for learning to write code and to practice your coding skills.

Here are some websites you might like to try.

http://pythonschool.net/category/basics.html	An outstanding resource that goes from the most basic in Python to some of the most complex parts.
http://interactivepython.org/courselib/static/thinkcspy/index.html	An extensive list of tutorials for Python with interactive activities and explanations
http://programarcadegames.com	Some tutorials to show you how to create graphics with Python with some examples that you can download
www.codecademy.com	You can sign up and complete the python 2 course for free – all other courses cost

Enrichment Activities

If you have time, these are excellent places to go and visit if you are interested in Computer Science

National Museum of Computing, Bletchley Park (Near Milton Keynes)

<http://www.tnmoc.org/>

<https://www.bletchleypark.org.uk/>

<http://www.codesandciphers.org.uk/bletchleypark/> (virtual tour)

The National Museum of Computing and the Bletchley Park code breaking exhibition are both on the same site, although each has a separate entrance fee. Huge range of technology to explore, including Colossus, the world's first electronic computer.

Museum of Science and Industry, Manchester

<http://msimanchester.org.uk/>

The museum has an exhibition covering the development of computers, and they have "Baby" the world's first stored program computer. (There is an interactive talk about Baby every day.)

Science Museum, London

<http://www.sciencemuseum.org.uk/>

A wide range of science and technology exhibitions. In particular, the museum is currently hosting an exhibition on robotics, charting our 500 year quest to make machines human.

Centre for Computing History, Cambridge

<http://www.computinghistory.org.uk/>

A large collection of vintage and retro computers, with an emphasis on how computers have developed over time and the social context and impact of technological change.