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COMPUTER SCIENCE: GCSE TO A-LEVEL TRANSITION

TOPICS TO EXPLORE TO PREPARE FOR A-LEVEL

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Contents

Introduction

The transition from GCSE to A-level standard is significant. In A-level courses you will see an increasing emphasis on technical content, extended answers and independent research. With Computer Science being a very complex discipline, developing a detailed technical understanding iscritical to success.

If you have studied GCSE Computer Science this will provide you with an excellent foundation onwhich to build; nevertheless, it is still important that you consolidate your knowledge and understanding of the GCSE material.

If you have not taken the subject at GCSE, do not worry, working through the material below willgive you an excellent background on which to start in September.

This pack of work is designed to help you through the transition from GCSE to A-level Computer Science and you should find something here to support your preparation regardless of whether youhave studied the GCSE course previously or the grade you gained at GCSE.

Some of this material is straightforward to complete, while other sections are more challenging. Do remember this is not a standalone "self-study" document it contains questions and prompts to start you on your journey towards studying these topics in preparation for the A-level course.

Exam board and syllabus

Examination board: AQA

Syllabus: A-level Computer Science 7517

AQA | AS and A-level | Computer Science | Specification at a glance

The Topics

Programming

Sign-up to our transition trinket course to make sure you have the correct programming ability before starting in September. Use the link below to start!

https://trinket.io/courses/join/vAqRFU

Systems Architecture

Create an annotated diagram showing how the CPU processes data.In your diagram include the following information:

1) The CPU and its components and their function
   a) Arithmetic and Logic Unit (ALU)
   b) Control Unit (CU)
   c) Cache
   d) Registers
      i) Memory Address Register (MAR)
      ii) Memory Data Register (MDR)
      iii) Program Counter
      iv) Accumulator
      v) Reference to the fetch-execute cycle

Remember to explain the purpose of the CPU and the components

1) Explain how the performance of a CPU is affected by the following:
   a) Increasing the clock speed
   b) Increasing the cache size
   c) Increasing the number of processing cores

2) Overclocking
   a) What does this term mean and how does overclocking improve the CPU's performance?
   b) What are the problems associated with overclocking a CPU?

Memory

1) How is memory of a computer used?
2) RAM and ROM are two types of memory found in virtually all systems. How are they usedand why are both needed by a system?
3) Explain how virtual memory is used in computer systems.
4) Describe the characteristics of flash memory. How does this work differently to RAM andROM? What is it used for?

Storage Devices

1) What is a storage device?
2) Why do most computer systems need at least one storage device in addition to memory?
3) Fill in the table below which compares the characteristics of various types of storage devices.

Type	Capacity	Speed	Portability	Durability	Reliability	Cost
Optical						
Magnetic						
Solid-state						

Networks

1) Network divide into two categories. Describe some of the similarities and differences between:
   a) A LAN and a WAN.
   b) Client-server and peer-to-peer networks.

2) What is the difference between the Internet and the World Wide Web?

3) Describe some of the factors that affect network performance and explain how Network performance can be improved. Things to think about include: connection media (e.g. CAT5, coaxial, etc.), bandwidth, error checking.

4) Draw diagrams which shows different network topologies: bus, star, ring and mesh. Remember to label each of the components in your diagrams.

   a) Explain the purpose of each of the following network components:
      i) Network Interface Cards
      ii) Wireless Access Point
      iii) Router
      iv) Switch
      v) Transmission media: cables/wireless.

5) 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 muchon technology”.

   Explain far you agree with this statement including descriptions of threats to systems andactions that can be taken to reduce vulnerabilities.

Wider computing issues and integrated questions

In answering these question, you should refer to your technical knowledge in context, referencing any sources that you use.

1) Find out about some of the key computer science pioneers. What have they contributed?You might want to investigate some of the names in the list below:

a. George Boole	b. Doris Hopper
c. Ada Lovelace	d. Alan Turing
e. John Von Neuman	f. Tim Berners-Lee
g. Bill Gates	h. Steve Woizniac and Steve Jobs
i. Jonathon Ives	j. Larry Page and Sergey Bryn
k. Mark Zuckerberg	l. Guido van Rossum
m. Brian Kernigan and Dennis Ritchie	n. Ted Codd
o. Thomas Watson Str	p. George Moore

1) Create a timeline showing the history of computers science, including any key discoveries or inventions.

3. How do you expect Computer Science to develop over the next 50 years?

4. Compare the gaming consoles: PlayStation and Xbox. Use your technical knowledge to explain your ideas.

5. Discuss the benefits and limitations of Virtual Reality in the following areas:
   a) Business
   b) Education
   c) gaming

Online ISAAC Computing exercise

First you will need to register an account with ISAAC Computing at the URL below:
https://isaaccomputerscience.org.

Next, try working through each of the following sections

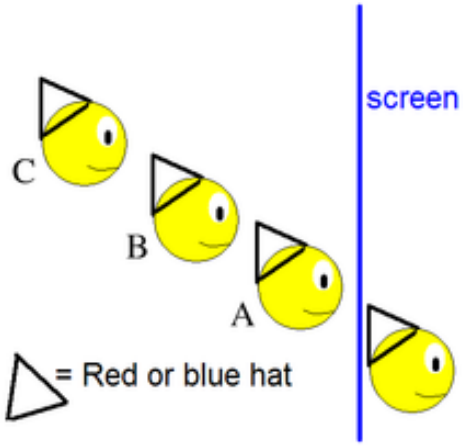
1.1 Programming concepts:
   a) Programming concepts — Isaac Computer Science
1.2 Data representation
   a) Representation of text — Isaac Computer Science
   b) Representation of images — Isaac Computer Science
   c) Representation of sound — Isaac Computer Science
1.3 Boolean logic
   a) Boolean logic — Isaac Computer Science
1.4 Systems
   a) Systems architecture — Isaac Computer Science
1.5 Networking
   a) Network fundamentals — Isaac Computer Science

Prisoners and Hats Problem

Four prisoners are arrested for a crime, but the jail is full and the jailer has nowhere to put them. He eventually comes up with the solution of giving them a puzzle. If they succeed, they can go free but if they fail, they are executed.

The jailer makes three of the men sit in a line. The fourth man is put behind a screen. All the men are given hats. The jailor explains that there are two red hats and two blue hats. The prisoners can see the hats in front of them but not on themselves or behind. The fourth man behind the screen cannot see or be seen by any other prisoner. No communication between the men is allowed.

If any prisoner can figure out and say out loud to the jailer what colour hat he has on his head all four prisoners go free. The puzzle is to find how the prisoners can escape.



Write down the steps you would take to solve this problem logically. Can you find a solution?

Starter problems

Here are some problems to get you thinking!

Problem 1: The monkey and bananas

A monkey is in a room. Suspended from the ceiling is a bunch of bananas, beyond the monkey's reach. In the corner of the room is a box. How can the monkey get the bananas?

When you have solved this, write down the steps the monkey must take.

Problem 2: Train in a tunnel

A 550 m long train, travelling at 50 kmph, enters a tunnel of 2 km in length. How much time will elapse between the moment the front of the train enters the tunnel and the moment the end of the train clears the tunnel?

Problem 3: Coins

A float contains £14. It is made up of four different denominations of coin and the largest denomination is £1. There is exactly the same number of each coin. How many of each coin is there and what are their values?

Problem 4: The fruit shop

Complete the blanks in the following sentence with two five letter words. The two words must contain the same five letters. What are the words?

At a fruit shop the lady picked up a _____ which was unusually _____.

Problem 5: Another train journey

A train covers an outward journey at 120 mph. It returns over exactly the same distance at 80mph. What is the train's average speed over the entire journey?

Problem 6: Customers in a supermarket

In a supermarket, the first 25 customers of the day purchased an average of two items each. After another 15 customers, the average number of items purchased by each customer rose to eight. What was the average number of items purchased by the last 15 customers?

Computational thinking

1) You need to make *n* pancakes for a number of people as quickly as possible. Your only frying pan is big enough to make two pancakes at a time. A pancake needs one minute's cooking on each side, regardless of whether there is one or two pancakes in the pan.

   What is the minimum time to fry 3 pancakes? Explain! What is the minimum time to fry n pancakes?

PG Online Computational Thinking

2) There are three children whose first names are Anne, Brian and Mary. Their surnames are Brown, Green and White, but not necessarily in that order. Given the following two clues, can you find each child's full name and age?

Tip: Use the grid to help you. Place an x in each box which you know to be wrong, and a tick in each box that you know to be right.

Clue 1: Miss Brown is three years older than Mary.
Clue 2: The child whose surname is White is 9 years old.

	Brown	Green	White	7	9	10
Anne						
Brian						
Mary						
7						
9						
10						

3) Write an algorithm to allow the user to enter an integer number for the number of paper bags, and a second integer (which must be greater than the first) for the number of sweets. The program then tells the user whether it is possible to put an odd number of sweets in each bag.

4) There are many way of solving a problem, including:

- Simulation
- enumeration – list all cases
- trial and error
- theoretical approach
- creative solution

i) Which of the methods listed above could you use to find the cube root of 729?
   (1) Write down the answer (what is the cube root of 729)?
   (2) Write down the steps you took to find the answer

ii) What method(s) could you use to estimate the probability of throwing a double six with two dice?

iii) Add up all the numbers between 1 and 50. What method of solution did you use?

iv) On a computer network, if two devices using the same line try to transmit at exactly the same time, a "collision" occurs. The network detects the collision and both transmissions are discarded. Can you think of a solution to this problem? Which of the problem-solving methods is applicable?

5) Scientists working at Bletchley Park on the Enigma code during WWII eventually managed to decode the secret messages sent by the Germans, even though the "key" was changed daily. What problem solving techniques do you think would be effective in cracking what was supposed to be an "uncrackable" code?

6) Environmental scientists want to study the effects on the rabbit population in a particular area if a cull of foxes is carried out. What problem-solving method could be applied?

7) This is an example of the *Decrease and Conquer* strategy. A group of 10 Venture Scouts are stranded on a small island, a short distance from the mainland. Two small boys are playing on the shore in a very small rowing boat, which is only big enough to hold either the two boys or one Venture Scout.

   How can all the Venture Scouts reach the mainland and leave the boys and their boat together on the island?

   How many trips does the boat make from one shore to the other?

   What is the answer in the general case of n Venture Scouts?

8) You are lost in a jungle, walking along a narrow path. You come to a T-junction, and you are aware that one way leads out of the jungle to safety, the other to a snake infested area and almost certain death. There are two tribesmen at the T junction, and you have been informed that one of these men will always answer a question truthfully, the other will always lie. What question will you ask?

(PG Online Worksheet 1 Computational thinking)