Algorithms and Programming

The coding challenges below will let you check your skills. Part of the transition to A-level is combining skills, and also ensuring that you plan and test your work thoroughly, so think about how you can re-use components and design your code for readability and robustness.

1. Write an program to:
    a. Ask the user to input
        i. Their first name
        ii. Their surname
        iii. A date, in the format DD/MM/YYYY
    b. The program should then output a customer ID as follows:
        i. The date in the format YYYYMMDD, then the first three letters of the surname, then the first initial, then the length of their first name. All letters should be in capitals
        ii. For example, John Smith, 27/05/2017 would give 20170527SMITHJ4
    c. The program should validate any inputs and keep asking for inputs until the user enters correct details or types “quit” at any point

- Plan your algorithm first, using a flowchart or pseudocode
- Code your algorithm, and provide evidence of both your code and the working output
- Create a test plan for your algorithm, including testing your validation with normal, boundary and erroneous data

2. Write a program to:
    a. Ask the user to input
        i. The name of a product
        ii. Its cost in pounds
        iii. The program should keep asking for inputs until the user types “None”
    b. The program should then output:
        i. The name and price of the most expensive item
        ii. The name and price of the least expensive item
        iii. The average price of the items
        iv. The total cost of the items
        1. Items over £50 get a 5% discount
        2. VAT is added at the end at 20%
    c. The program should validate any inputs

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Solve a famous algorithmic problem:

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?

Computer Systems

Systems Architecture

1. Produce an annotated diagram showing how the CPU processes data. This should include
    a. The purpose of the CPU
    b. Common CPU components and their function
        i. Arithmetic and Logic Unit (ALU)
        ii. Control Unit (CU)
        iii. Cache
        iv. Registers
            1. Memory Address Register (MAR)
            2. Memory Data Register (MDR)
            3. Program Counter
            4. Accumulator
    c. Reference to the fetch-execute cycle

2. Discuss, with examples, how the performance of a CPU can be improved, including:
    a. Increasing the clock speed
    b. Increasing the cache size
    c. Increasing the number of processing cores

Memory

1. Compare RAM and ROM
2. Explain the need for virtual memory in a computer system
3. Describe the characteristics of flash memory Storage

Storage

1. Complete the following table comparing optical, magnetic and solid state:

	Capacity	Speed	Portability	Durability	Reliability	Cost
Optical						
Magnetic						
Solid State						

2. Justify one use of each storage method

Networks

1. Explain the similarities and differences between
    a. A LAN and a WAN
    b. Client-server and peer-to-peer networks

2. Explain the difference between the Internet and the World Wide Web

3. Describe the factors that affect network performance, and explain how network performance can be improved

4. Draw three different network topologies
    a. Label all the components required to create each network
    b. Explain the purpose of each component in the network, including
        i. Wireless Access Points
        ii. Routers

iii. Switches
iv. Network Interface Cards
v. Transmission media, such as Ethernet Cables

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 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.

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, explaining any technical content for a student in year 10. Explain how the story affects you as a student of computer science.