

# A-Level Computer Science

## Bridging Task

### 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.

#### 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?

## 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

## Programming basics

Learning to "code" is a fun and essential part of A Level Computer Science. This task is ideal if you haven't done the GCSE in Computer Science or you simply want a nice refresher ahead of starting your A Level course.

1. Head over to the web site: <https://www.learnpython.org/>
2. Complete the following python tutorials under the heading:
  - Hello, World!
  - Variables and Types
  - Lists
  - Basic Operators
  - String Formatting
  - Basic String Operations
  - Conditions
  - Loops
  - Functions
3. Each section presents you with theory, code to run and exercises to try out.
4. If you want to practice writing your own python programs you can download and install a simple python development tool here: <https://www.python.org/downloads/> or alternatively set up an account at Replit

## Looking under the hood of the processor

The CPU “Central Processing Unit” is the central core of any computer system. You will study what it contains and how it works it in depth at A Level.

1. Start by watching the following 3 videos from Craig ‘n’ Dave
  - a) [https://www.youtube.com/watch?v=dVi2B7fGVm4&list=PLCiOXwirraUB7V2i0SJ4SSJFqRV\\_LtgzW&index=1](https://www.youtube.com/watch?v=dVi2B7fGVm4&list=PLCiOXwirraUB7V2i0SJ4SSJFqRV_LtgzW&index=1)
  - b) [https://www.youtube.com/watch?v=Y4O2-ilSw-o&list=PLCiOXwirraUB7V2i0SJ4SSJFqRV\\_LtgzW&index=2](https://www.youtube.com/watch?v=Y4O2-ilSw-o&list=PLCiOXwirraUB7V2i0SJ4SSJFqRV_LtgzW&index=2)
  - c) [https://www.youtube.com/watch?v=QtQBISOLkE&list=PLCiOXwirraUB7V2i0SJ4SSJFqRV\\_LtgzW&index=3](https://www.youtube.com/watch?v=QtQBISOLkE&list=PLCiOXwirraUB7V2i0SJ4SSJFqRV_LtgzW&index=3)
2. Produce a fully annotated diagram on a single sheet of A4 / A3 paper which shows how the CPU works.
3. Make sure the diagram includes and covers:
  - a) Major CPU components and what they are for:
    - i. Arithmetic Logic Unit (ALU)
    - ii. Control Unit (CU)
    - iii. Cache
  - b) The main registers
    - i. Program Counter (PC)
    - ii. Memory Address Register (MAR)
    - iii. Current Instruction Register (CIR)
    - iv. Memory Data/Buffer Register (MDR / MBR)
  - c) Fetch-decode-execute cycle
  - d) Include annotations which explain how the performance of a CPU can be improved by:
    - i. Increasing the clock speed
    - ii. Increasing the cache size
    - iii. Increasing the number of cores