AS and A LEVEL

Transition Guide

H046, H446

Accredited

COMPUTER SCIENCE

Theme: Problem solving and programming

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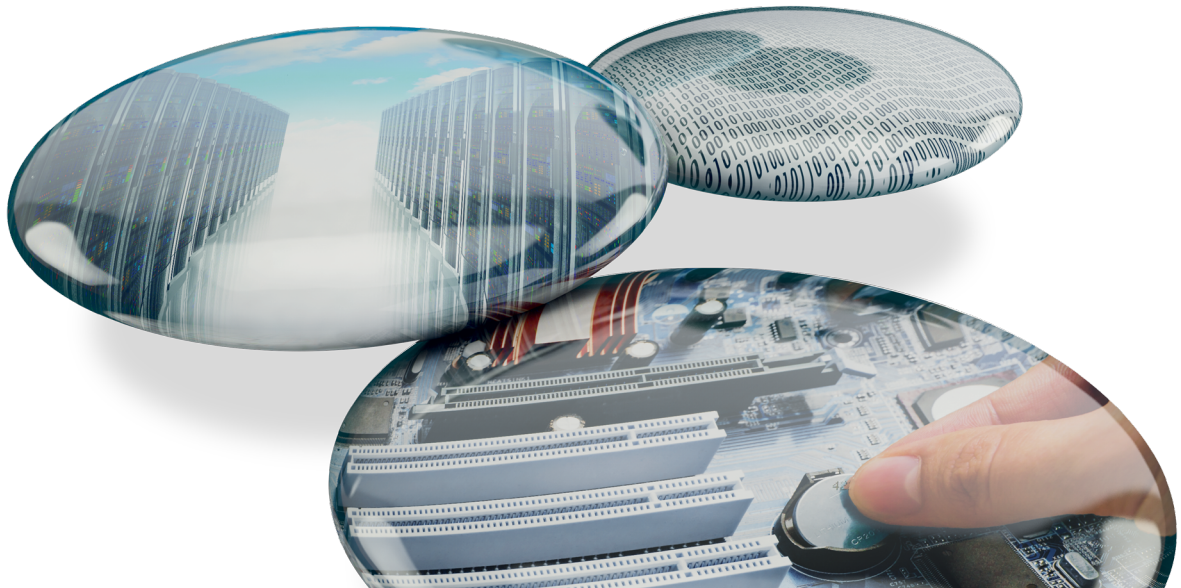

Key Stage 4 Content

Key Stage 4 GCSE Content

3.1 Programming techniques

Candidates should be able to:

a) identify and use variables, operators, inputs, outputs and assignments
b) understand and use the three basic programming constructs used to control the flow of a program: Sequence; Conditionals; Iteration
c) understand and use suitable loops including count and condition controlled loops
d) use different types of data including Boolean, string, integer and real appropriately in solutions to problems
e) understand and use basic string manipulation
f) understand and use basic file handling operations: open, read, write and close
g) define and use arrays as appropriate when solving problems.

Key Stage 5 Content

Key Stage 5 A Level Content

2.2 Problem solving and programming

How computers can be used to solve problems and programs can be written to solve them

(Learners will benefit from being able to program in a procedure/imperative language and object-oriented language.)

2.2.1 Programming techniques

a) Programming constructs: sequence, iteration, branching.
b) Recursion, how it can be used and compares to an iterative approach.
c) Global and local variables.
d) Modularity, functions and procedures, parameter passing by value and by reference.
e) Use of an IDE to develop/debug a program.
f) Use of object-oriented techniques.

2.2.2 Computational methods

a) Features that make a problem solvable by computational methods.
b) Problem recognition.
c) Problem decomposition.
d) Use of divide and conquer.
e) Use of abstraction.
f) Learners should apply their knowledge of:
backtracking
data mining
heuristics
performance modelling
pipelining
visualisation to solve problems.

COMMENT

The main differences in context for the sections in the A level related to problem-solving and programming are that of complexity and depth that students have to study and apply the subject matter. Both qualifications require this knowledge for the written part of the assessment, and of course, the programming element too.

Before covering programming techniques, it is important that they learn the basics of basic and complex data structures as these provide the basis for setting up and traversing algorithms. Some students may not have studied computer science before joining the subject at A level so this is important.

In the A level it will be the first time that many students have encountered recursion, and so it is important to give examples to be able to draw the line between both by using examples. Functional programming will need to have already been covered to achieve this. At GCSE, Iteration is covered but to a much lesser extent and may only consist of one-level loops rather than any nested loops.

This may also be the first time that students use global and local variables, and so again this will need to be covered in some sort of an illustrative way showing the pros and cons of each. Programming languages handle global and local variables differently, and so particularly when teaching a language such as Java at A level when a student has studied Python before, then private and public methods will have to be covered to help students fully understand what is going on.

It is likely that students at GCSE level have created functions before, but may not have created any that passed parameters via value or reference, and so these will definitely need to be covered.

It is also likely that students will not understand the full benefits of using an IDE, especially if they have only used Scratch or IDLE with Python in the past. It does, of course, depend on which language you are using as to what IDE you might use.

At GCSE, there is not a focus on Object Oriented techniques such as inheritance, encapsulation and polymorphism, whereas at A level there is a focus on this. Again, teaching this is a case of picking good analogies and sticking to some examples that increase in complexity, as if a student is coming to A level with no prior programming experience this could be quite bewildering.

Students at GCSE use computational methods to solve their programming problems using recognition, decomposition and may also use some abstraction, but will not use divide-and-conquer algorithms. Students at A level will need to have knowledge of backtracking, data mining, heuristics, performance modelling, pipelining and visualisation, but may not actually use any or all of this in their final solutions.

Teaching Activity (KS4 focus)

Chapter 4 – Guess the number

Students will look at import statements, conditions, Boolean/comparison operators and the 'break' keyword whilst making a 'guess the number' game. This is the typical kind of activity that you would want to introduce to build up to the controlled assessment element.

Resource: http://inventwithpython.com/chapter4.html

Checkpoint task

This task is a 'choose your own adventure' style activity where students develop a story application that changes depending on input from the user.

Teacher Instructions

http://www.ocr.org.uk/Images/253512-problem-solving-and-programming-checkpoint-task-teacher-instructions.pdf

Learner Activity

http://www.ocr.org.uk/Images/253510-problem-solving-and-programming-checkpoint-task-activity.doc

Teaching Activity (KS5 focus)

Codecademy – Python track

For students that are not confident with programming before the start of the course they could go away and work through the exercises at a website such as codecademy.

Codecademy covers topics such as:
- Variables and string manipulation
- Conditionals and functions
- Lists and dictionaries
- Looping
- Iterating over data structures
- Bitwise operators
- OOP
- File input/output

Resource: http://www.codecademy.com/en/tracks/python

Challenge and Extension Task

Introduction to Object-oriented programming

Covers how to create objects in Python 3 to do with crops, and incrementally builds a farm simulator.

Resource:
http://www.pythonschool.net/oop/introduction-to-object-oriented-programming/

The small print

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