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Knowledge Organiser - Algorithms

Key Terms & Definitions

1	Computational thinking	How computer scientists think about problems
2	Data type	The way in which a computer interprets some data
3	Boolean	A data type which can take two possible values: true or false
4	Boolean expression	An algebraic expression which has a Boolean value
5	Algorithm	A sequence of steps used by a human or computer to solve a problem or complete a task
6	Data compression	Reducing the amount of storage needed to represent a file
7	Lossy compression	Information is lost during the compression of a file
8	Lossless compression	No information is lost during the compression of the file
9	ASCII	American Standard Code for Information Interchange. A 7-bit character set used for representing English keyboard characters
10	Abstraction	The removal of unnecessary details from a problem in order to make the problem easier to solve
11	Decomposition	Breaking down a problem into smaller, more manageable parts in order to make the problem easier to solve

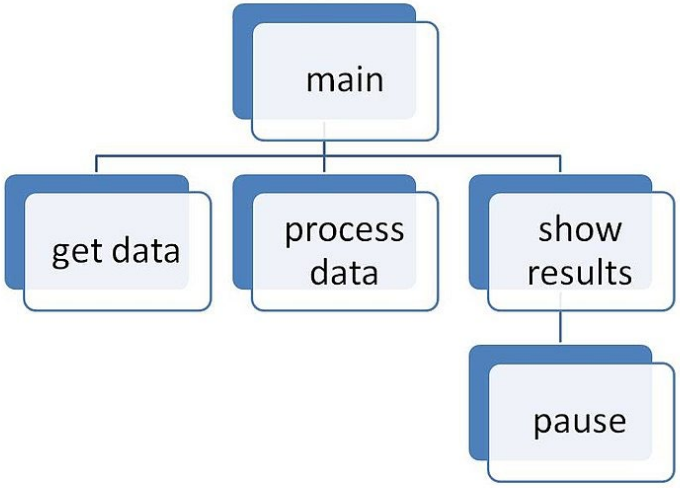
Computational Thinking

Computational thinking is how computer scientists think about problems.

Decomposition

Decomposition is the process of breaking down a large problem into individual smaller problems. Computer scientists use this technique to make larger problems easier to solve rather than having to tackle the whole problem in one go.

A hierarchy chart (sometimes also called a structure chart) can be used to aid the decomposition process. It shows how a problem is split into smaller problems. The smaller problems will then often form individual parts of a piece of software.



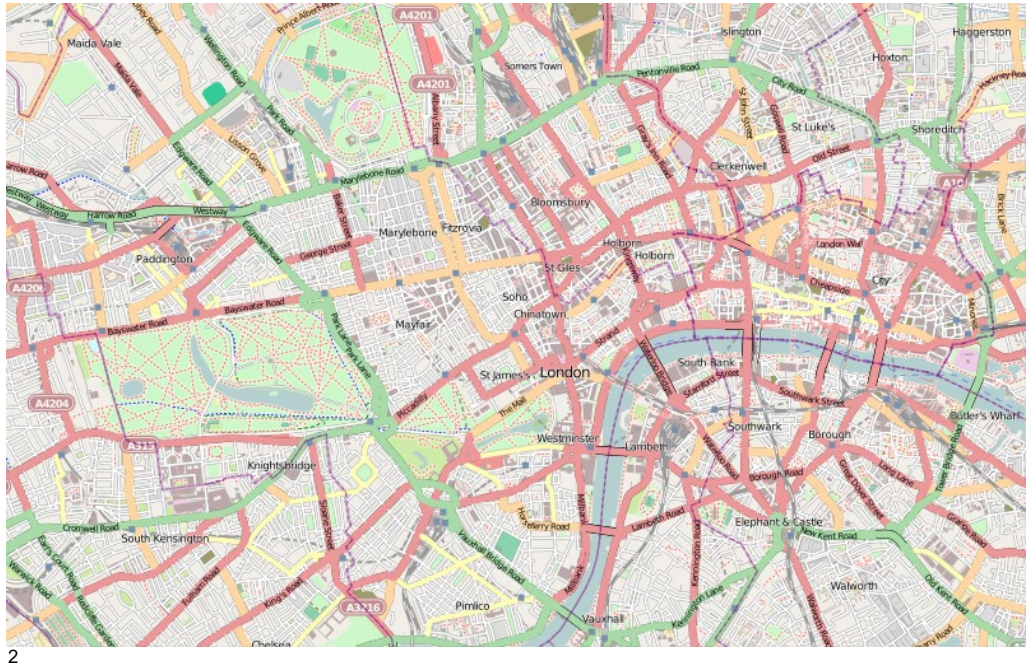
[1]

Example of a hierarchy chart

Abstraction

Abstraction means removing information from a problem which is not needed to solve the problem. This technique is used by computer scientists to reduce the amount of information they need to deal with when solving a problem, making the problem easier to solve.

Street maps are an example of abstraction. Street maps do not include every single detail of the area they're depicting. They only include the information that is required to allow the user of the map to work out how to get to their destination.



[2]

This map of London includes information which is useful for navigation such as road names but leaves out information which isn't required for navigation such as the location and height of different trees

[1] Software structure chart by Kenneth Leroy Busbee is licensed under CC BY 3.0

[2] Open street map central london by MRSC is licensed under CC BY-SA 2.0

Boolean expressions

George Boole lived in the 19th century and worked as a Mathematician. George Boole introduced Boolean Algebra, a way of describing logical operations.

The fundamental Boolean operators are:

- AND
- OR
- NOT

Example:

A boolean expression to describe Mr Nixon's job:

Computing & IT teacher **AND** Head of Computing

The **AND** operator has been used to describe the fact that Mr Nixon has two roles.

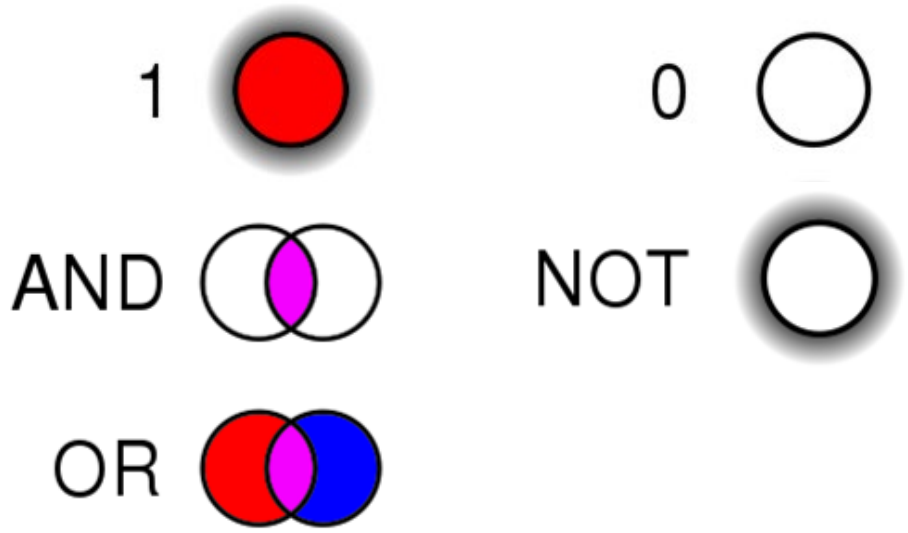
A boolean expression to describe the classrooms in which computing lessons take place:

N3 **OR** N4 **OR** L9 **OR** M8

The **OR** operator has been used to indicate that computing lessons happen in one of four different rooms.

Venn Diagrams

A Venn diagram can be used to show a Boolean expression graphically.



[3]

Drawing of George Boole

[3] Logic Gates by HereToHelp is licensed under CC BY-SA 4.0

Algorithms

Computer scientists can create software to complete a task as long as there exists an algorithm (set of steps to complete the task or solve the problem) for the task. They may sometimes be able to create new algorithms to complete tasks which computers have not solved yet.

Algorithms must provide the computer with precise instructions telling it exactly what to do. This is because computers have no 'common sense'.

Example:

Mr Nixon has brought a driverless car to travel to work. They program the car with the following algorithm:

- Drive to the M40.
- Travel south on the M40 and leave at the first exit.
- Drive into Wheatley.
- Continue through Wheatley to Wheatley Park School.

These instructions are not specific enough for an algorithm. Which route should the car take to get to the M40? Does the 'first exit' mean the first exit the car comes to or exit number 1? Which route should the car take to get the Wheatley? Which route should the car take to get to Wheatley Park School from Wheatley?

Mr Nixon would need to make the algorithm more detailed to make sure the car would definitely take them on the correct route.

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Lossy compression

Lossy compression is typically used on data such as images and video. This is because some data about an image of video is lost, although it will reduce the quality of the image or video the viewer can still see/view the image.

Lossless compression

Lossless compression is used when it is critical that, when the data is uncompressed, the original data can be reconstructed. This type of compression is often used to compress text so that all the letters in the text can be reconstructed and the text can be understood.

If lossy compression was used on a text file containing a program, the program would no longer work because characters would be removed by the compression algorithm.

```
plnets  ['Jpir', 'Sturn'
           'Uns', 'Nptne', 'Vnus',
           'Mas', 'Mry', 'Eah']
sies 110, 95, 00, 30, 95, 5, 8, 10]
fr i n rage(le(plnets)):
    prit(planes[i], sizei] % the se f Eth.")
```

This is what a Python program might look like if you tried to apply lossy compression to it