COMPUTER SCIENCE

Leaving Cert

Computer Science

Computer Science was introduced as a new Leaving Certificate subject in 2018.

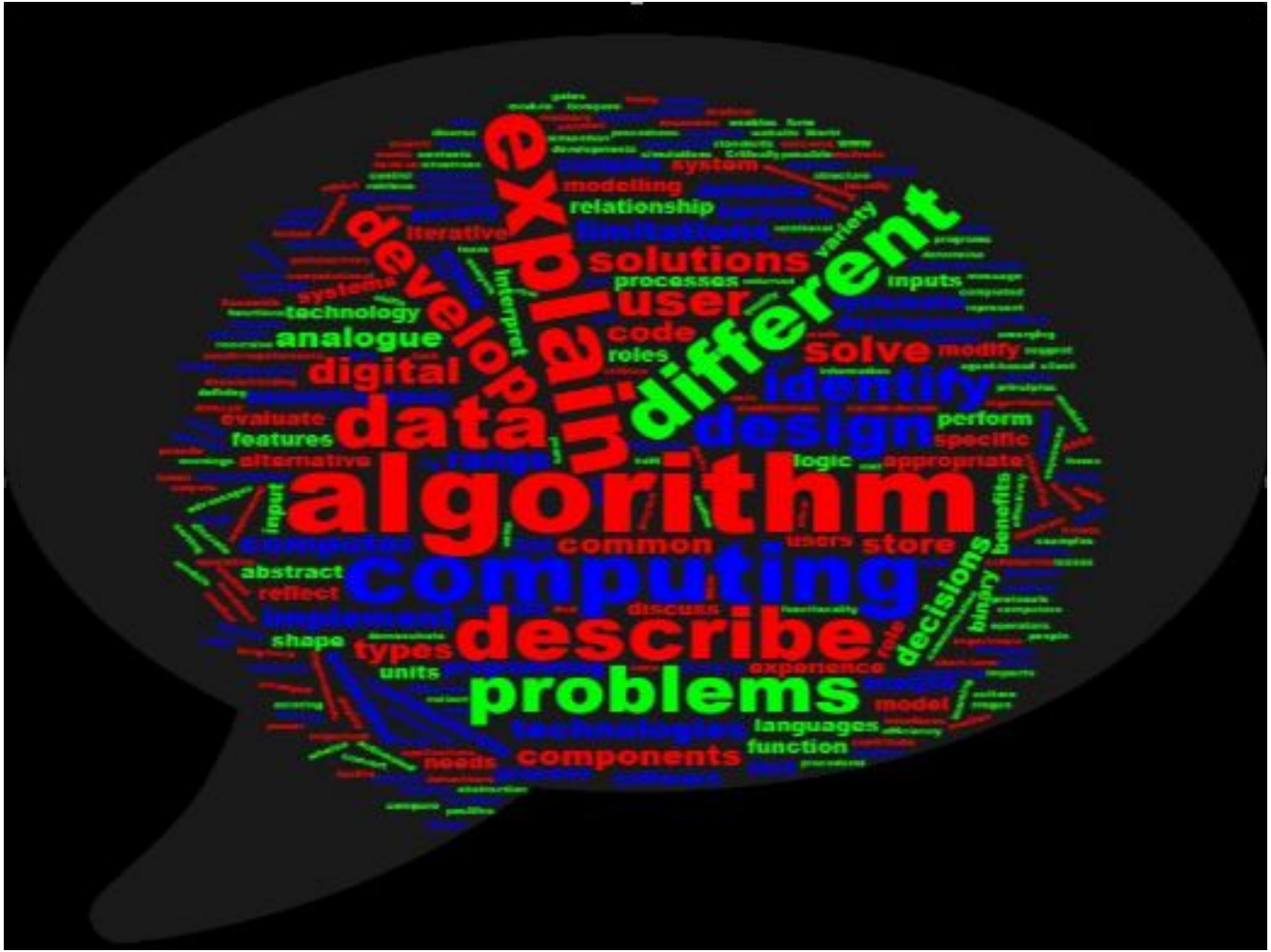
Adamstown CC was chosen as one of forty schools in Ireland to pilot the subject.

What is Computer Science?

- The study of algorithms and programming, and the impact of computers on society.

- Develops creative ways to solve problems and evaluate solutions.

- It is about finding automated solutions to almost any problem you can imagine.



The Computer Science specification defines the **Learning Outcomes** which students must achieve to complete the course.

These are contained in **3 strands.**


LCCS 2018
Interactive Information Systems
Analytics
Modelling & Simulation
Embedded Systems
Practices and Principles
Core Concepts
STRAND 3
4 APPLIED LEARNING TASKS
STRANDS 1 & 2
Practices and Principles
Core Concepts
NCCA
LEAVING CERTIFICATE COMPUTER SCIENCE

Strand 1: Practices and Principles

- Computational Thinking
- Computers and Society
- Computing Developments - Turing Machines, AI, The Internet
- Designing and Developing

Strand 2: Core Concepts

- Abstraction
- Algorithms
- Computer Systems
- Data
- Evaluation and Testing

Strand 3: Computer Science in Practice

Over the two years of the course, students will engage with **four** applied learning tasks.

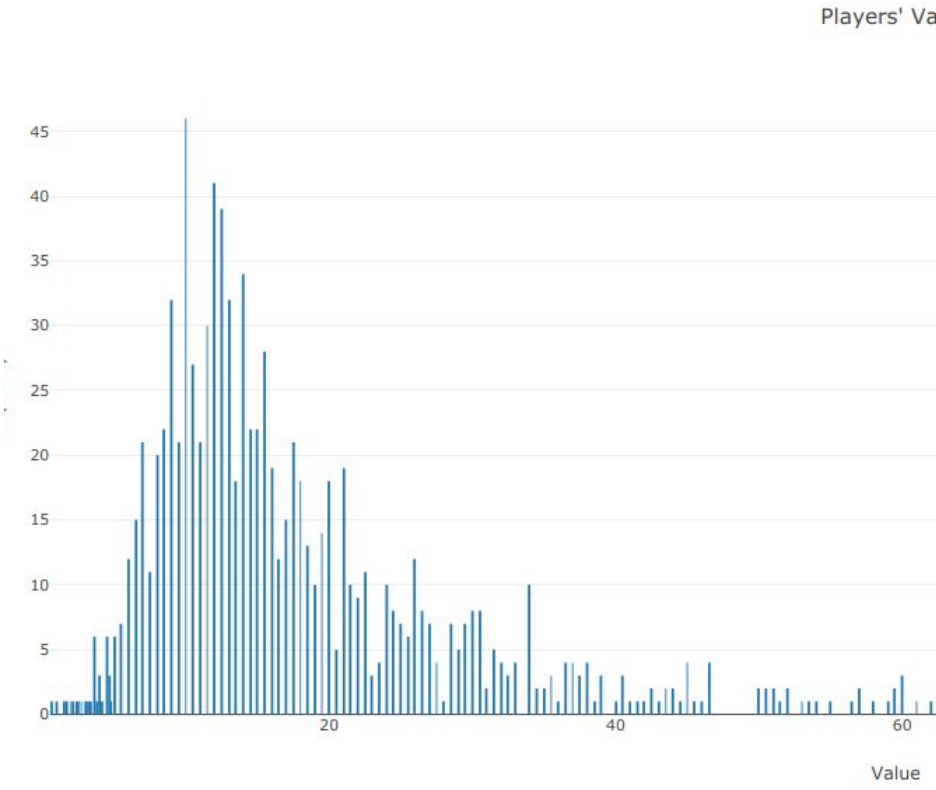
These will be **group tasks** in which groups plan, design and develop computational artefacts.

ALT2 - Data Analytics

This task involves finding a dataset (like a spreadsheet) and using Python to analyse it and create a graph.

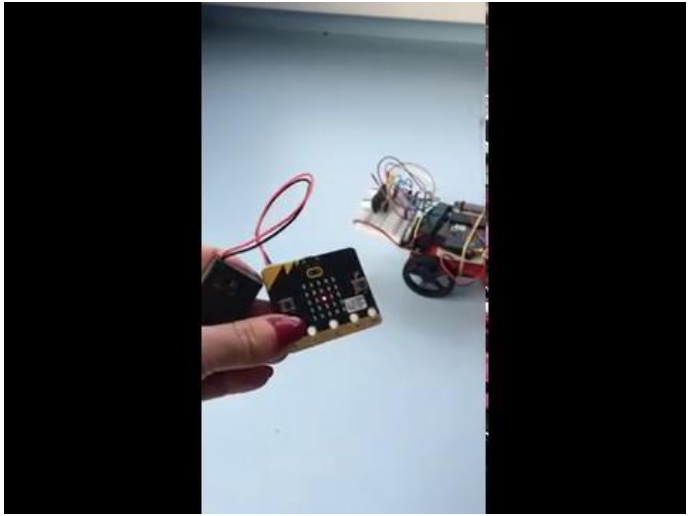
```
infile = open('data - data.csv')
reader = csv.reader(infile)
outfile = open("newfile.csv",'w', newline='')
writer = csv.writer(outfile)
player = []
player_count = []
value = []
value = [int(i) for i in value]
for row in reader:
  #these three lines of code takes out the euro signs (€), the
  letter M (for million) and the K (for thousands)
  newrow = [re.sub("€", "",item)for item in row]
  newrow = [re.sub("M", "",item)for item in newrow]
  newrow = [re.sub("K", "",item)for item in newrow]

  value.append(newrow[4])
value = [float(i) for i in value]
#this codes changes the numbers to integers
value.sort()
#this code sorts the values in ascending order
#the values are all in millions
print(value)
mean = statistics.mean(value)
print(round(mean,2))
median = statistics.median(value)
print(median)
mode = statistics.mode(value)
print(mode)
print("The highest paid footballer receives",max(value),
"million euro")
```



ALT 4

Embedded Systems



ALT 4 - Embedded Systems

This task involves planning, designing and coding an artefact using a microbit.

Our theme was security.

ALT 3: Modelling and Simulation

- Develop a model that will allow different scenarios to be tested.
- Analyse and interpret the outcome of simulations before and after modifications have been made.

```
def monthlyRepayment(principalAmount, interest, years):
    T = principalAmount * ((1+interest)** years)
    M = (T / (years * 12))
    return round(M,2)


testCase1 = monthlyRepayment(10000,0.032,6)
print("Principal: €1000\nInterest: 3.2%\nYears: 6 years")
print("Monthly repayments will be: ",testCase1)
```

```
Principal: €1000
Interest: 3.2%
Years: 6 years
Monthly repayments will be:  167.78
>
```

ALT 1: Interactive Information Systems

This task uses HTML, CSS and Javascript to create a website.

A database is created to store all the information which is then displayed on the website.

What EU country would you like to travel to?

Mention the country you would like to visit:

Please make sure you follow the following instructions:
-The first letter of the country has to be capital.
-No abbreviations or alternatives should be entered for "United Kingdom"
-The Netherlands should be only inputed as "Netherlands".
-There should not be a blank space after the last letter of the country.

Country: France

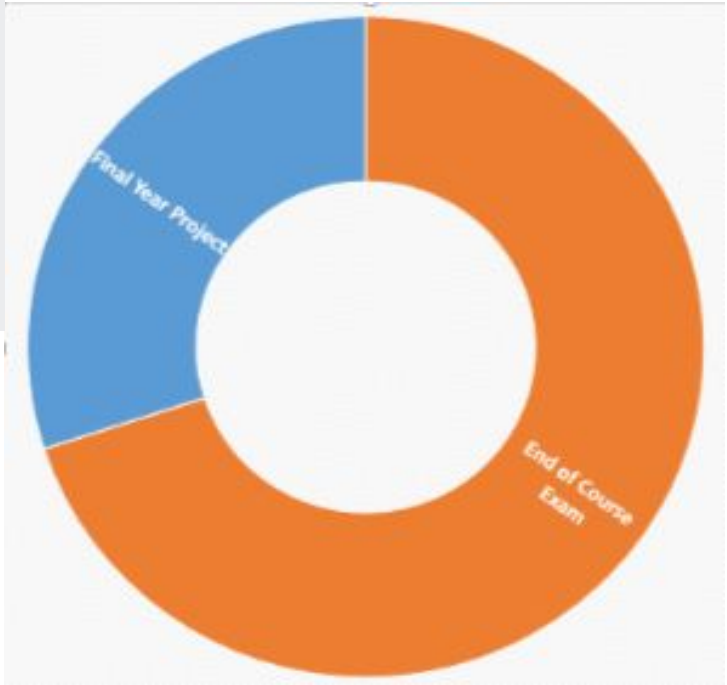
Submit

Search Complete

- France Paris Flight tickets cost €107 Hotel cost is €236 per night

Assessment

FINAL YEAR PROJECT (30%)



END OF COURSE EXAM (70%)

- The languages that will be tested are **Python** and HTML/CSS and Javascript
- We will use BBC Microbits as part of embedded systems
- There will be an individual 12 week coursework assignment beginning in December of 6th year.
- The Leaving Cert exam will be in May of 6th year.
- It will consist of a 1 hour Coding practical on a computer and a 1 ½ hours written exam.

Required Materials

Google Classroom Code: **l4agxji**

- Folder
- A4 copy
- Device to work on at home

Getting Started....

- Team Work

- Computational Thinking

The Puzzle

A school play has 2 spotlights for its stage: **RED** and **GREEN**.

The colour of the stage depends on which lights are turned on.

The table below shows the 4 possible combinations.

RED	GREEN	STAGE light
OFF (0)	OFF (0)	BLACK
OFF (0)	ON (1)	GREEN
ON (1)	OFF (0)	RED
ON (1)	ON (1)	YELLOW

The lights for the show will repeat the sequences below from the start:

RED Light sequence: 2 minutes ON, 2 minutes OFF, then repeat.

GREEN Light sequence : 1 minute OFF, 2 minutes ON, then repeat.

What will the stage colour be in the 6^{th} minute of the show?

The Puzzle

Jack is looking at Anne. Anne is looking at George.

Jack is married. George is not married.

Is a married person looking at an unmarried person?

	MARRIED	LOOKING at ...
JACK	√	ANNE
ANNE	?	GEORGE
GEORGE	X	?

Jack is married and looking at Anne.

But we do not know if Anne is married or not.

Let's see what happens if Anne is married.

	MARRIED	LOOKING at ...
JACK	√	ANNE
ANNE	√	GEORGE
GEORGE	X	?

Jack is married and looking at Anne who is now married. (NOT a solution)

But Anne is now married and looking at George who is unmarried. (BINGO! a solution)

And then what happens if Anne is unmarried.

	MARRIED	LOOKING at ...
JACK	√	ANNE
ANNE	**X**	GEORGE
GEORGE	X	?

Jack is married and looking at Anne who is now not married.

(Also a solution)

Another Puzzle (where a grid might help)

3 friends decide to go on a trip in their new electric cars.

Their batteries are empty and need to be re-charged.

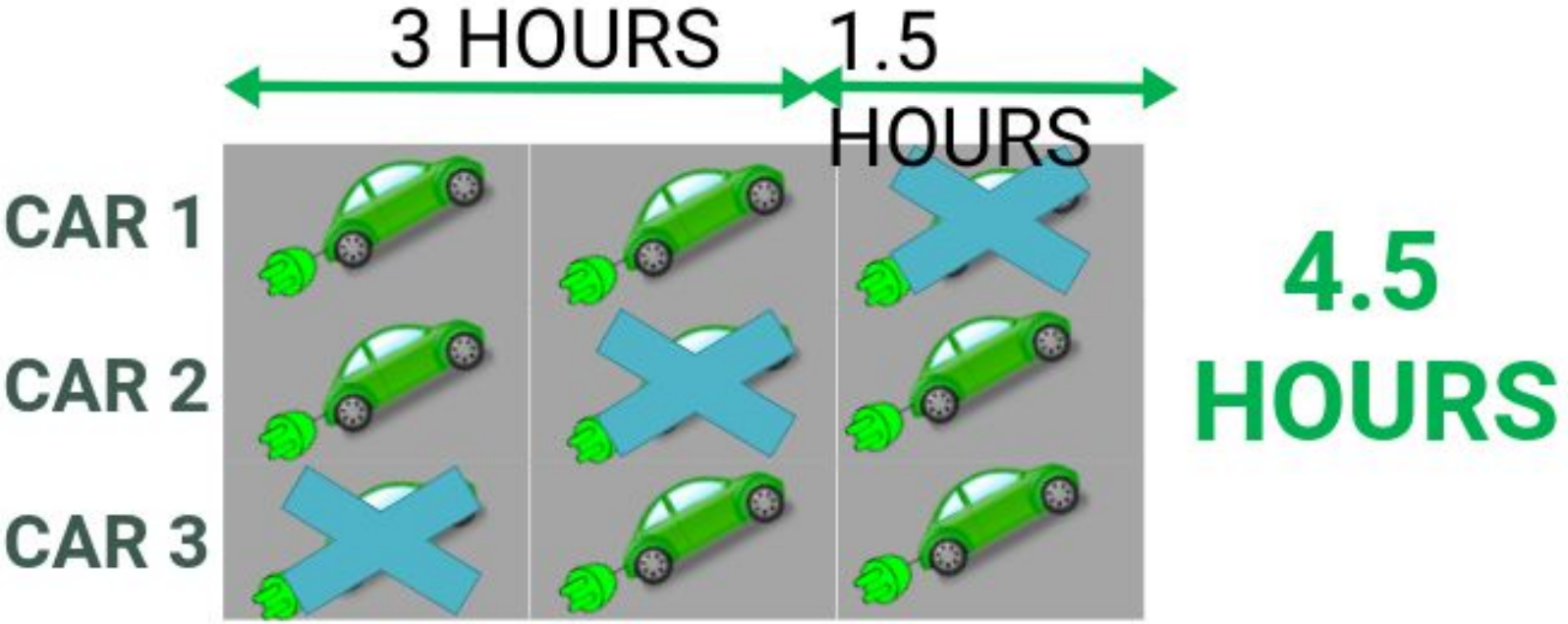
It takes 3 hours to fully charge the car battery.

The problem is there are only 2 charging points available.

The cars don't have to be charged all in one go.

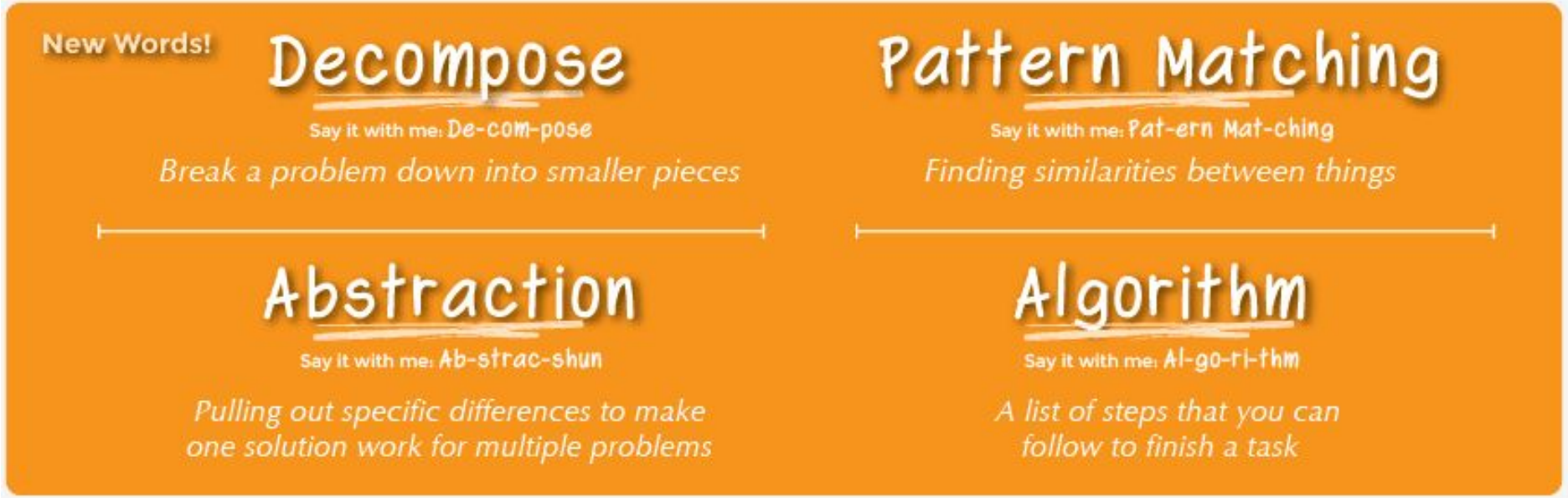
How soon can they leave with fully charged batteries?

Solution to 3 cars with 2 chargers ..Puzzle 2



The purpose of these puzzles is not necessarily to solve them fully!

The purpose is to practise the core elements of Computational Thinking.



For example :

Abstraction : See if you can figure out the vital information within the problem. Perhaps use variables to represent information. **(Puzzle 1 and 3)**

Decomposition : Break down the problem into smaller parts. Build information from the bottom up. **(Puzzle 2 and 4)**

Computational Thinking

Core Concepts

What is Computational Thinking?

Computational thinking is a way of understanding complex problems in order to form a solution that can be implemented by either a computer, a human or a combination of both.

There are four key elements to computational thinking:

Decomposition - breaking a problem down into smaller pieces

Abstraction - removing details that are not relevant to solving a problem

Algorithmic thinking - identifying logical steps/a set of instructions that can be used to solve a problem

Pattern Recognition - Finding patterns or similarities

New Words!

Decompose

Say it with me: De-com-pose

Break a problem down into smaller pieces

Pattern Matching

Say it with me: Pat-ern Mat-ching

Finding similarities between things

Abstraction

Say it with me: Ab-strac-shun

Pulling out specific differences to make one solution work for multiple problems

Algorithm

Say it with me: Al-go-ri-thm

A list of steps that you can follow to finish a task

Abstraction

Abstraction is a computational thinking technique that **simplifies a problem** by **removing unnecessary detail** so that you can **focus on the important parts** that are relevant to the problem.

For example, a school might want a computer system to store details about pupils and staff. Each pupil or staff member would be represented as a row in a database with fields for the most important information like their name, address, date of birth and so on (rather than what they had for breakfast or who their favourite actor is). Each entry in the database is an **abstraction** of the real-life person. It is a simplified form that represents the relevant details about them for this particular "problem".

Examples of abstraction

The London Underground map is a classic example of abstraction.

It focuses on the important details such as the station names and the routes from one to another along the various train lines.

The lines are **not** realistically representative of the actual paths taken by each train.

Image by Transport for London

Tube map abstraction vs real paths and distances

Tube map abstraction

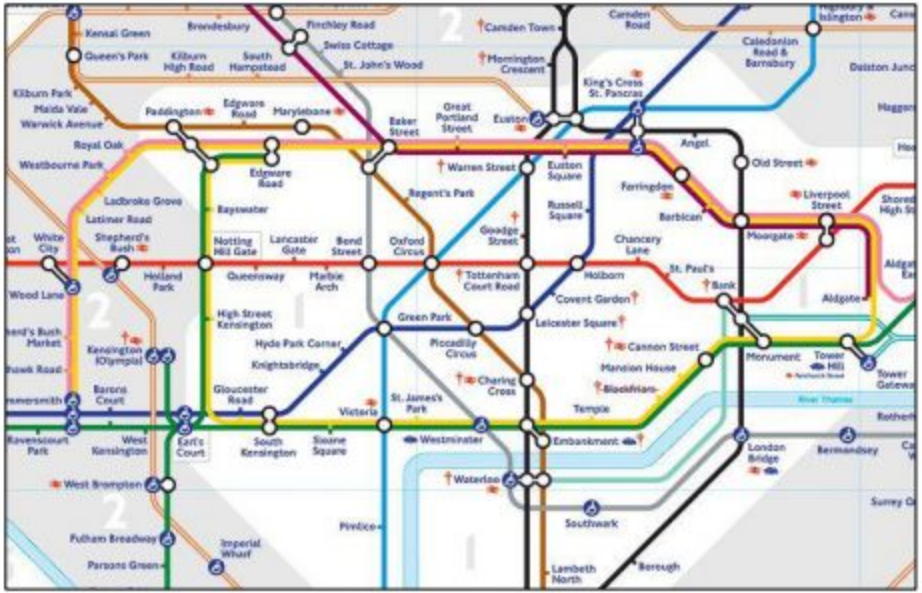


Image by Transport for London

Realistic distances and locations

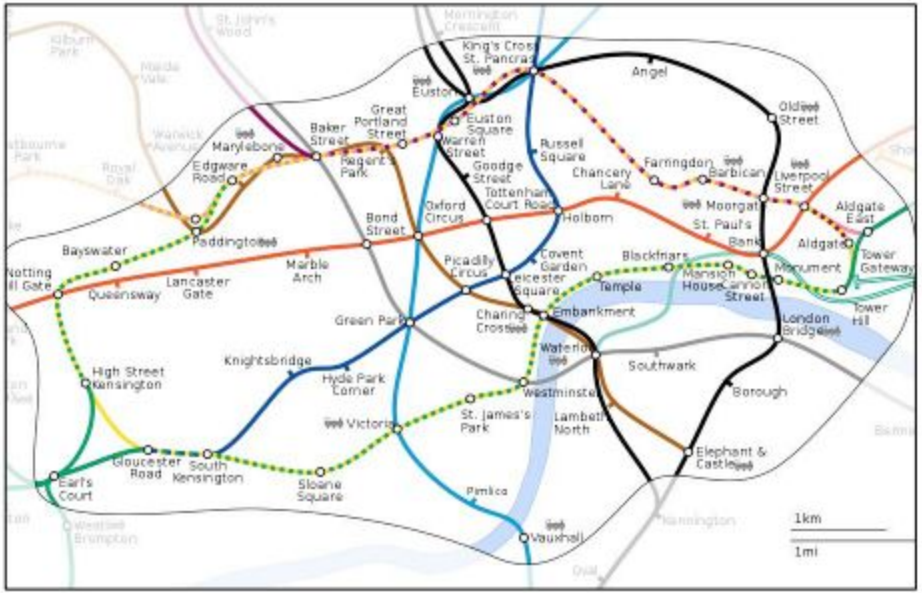


Image by Jc86035

All maps are examples of abstraction

- A map **represents something from the real world**
- It **removes unnecessary details** (plants, trees, colour of houses)
- It **represents** the **relevant information** that you need with symbols or shapes (such as buildings and roads)
- The purpose of the map will determine what information is left out. For example a map for climbers and hill walkers might include information about the relative height of the landscape, whereas a driving map may focus on showing roads more clearly.
- When planning a route from one location to another, a mapping app needs to know which roads connect those locations but it doesn't need to know every detail of the landscape between those locations.

Other examples of abstraction

In programming

- **Variables** in programs are used to represent real entities such as the name of a player or their score.
- A piece in a board game might be represented in a computerised version of that game as a **grid coordinate** whilst the board itself might be represented as a **2D array**.

In computer systems

- **Tables** in a database represent real-life entities (people, products, etc)

In the real world

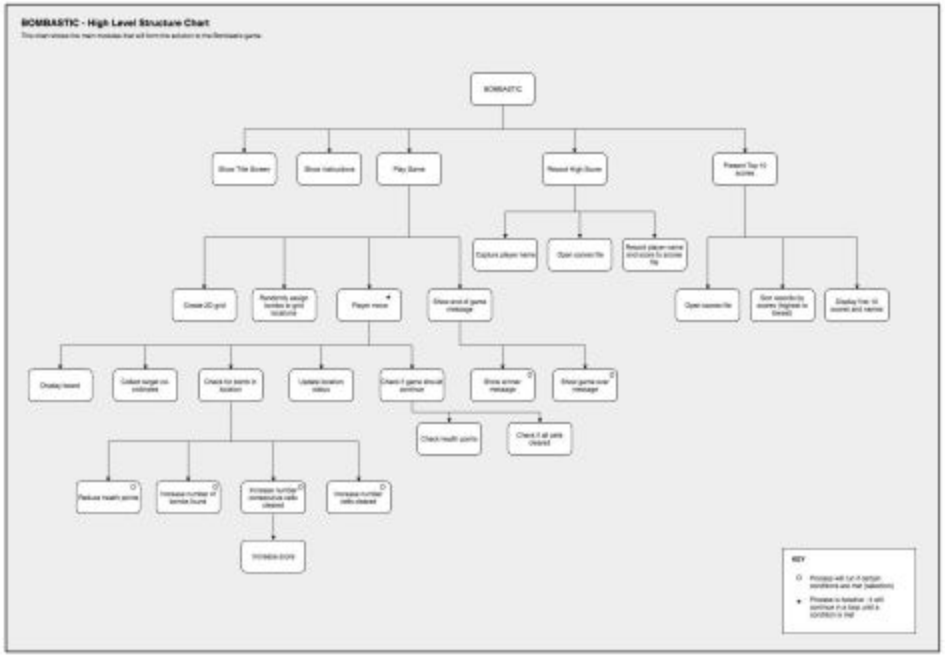
- **Money** has no real value (it's just paper, or maybe not even that!), but it represents the value of goods and services

Decomposition

- Decomposition means **breaking down** a **complex problem** into **smaller, more manageable parts**.
- Each smaller part can then be **solved individually**.
- Decomposition allows large teams to each take a part of a problem and work on it.

Structure charts

- Structure charts are used to break a large program down into the smaller parts that make it up.
- Each box represents a smaller problem to be solved. The lines show which bigger problem each box is a part of.
- Structure charts are a very useful tool when designing a solution to a big problem, such as a creating a computer game.



An example of a structure chart showing the parts that make up a computer game.

Algorithmic thinking

- Algorithmic thinking is a way of solving a problem by producing algorithms.
- An algorithm is a **reusable set of instructions** (or a series of steps or logical processes) **to solve a problem.**
- Algorithms can be written as a set of numbered steps to follow such as a cooking recipe or assembly instructions, however in computing they are presented as pseudocode or flow diagrams.

Algorithm building blocks

There are three main building blocks of all algorithms:

- **Sequence** - a series of steps that are to be completed one-by-one.
- **Selection** - steps that only occur if a certain condition is met.
- **Iteration** - steps that repeat, either for a fixed number of times or until a condition is met.

We use each of these algorithm structures when programming.

Drawing a grid or a graph or changing the form of the puzzle in some way, can often help solve problems in a systematic fashion.

If you get stuck on these puzzles, try drawing a GRID (or a two-way table) might help you get unstuck!!

Couples

Tomás, Davey, Hugh, and Fran are married to Ger, Jane, Sinéad and Bernie, though not necessarily in that order.

Jane, who is Davey's sister, has five children. Tomás and his partner want to wait a few more years before starting a family.

Tomás has never introduced his wife to Sinéad.

Sinéad works very closely with Davey. Ger is considering telling Davey's partner that they are working a bit too closely together these days.

Davey and Hugh, by the way, are twin brothers. Who is married to whom?

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Windows

Somebody has broken the window in the classroom. There are three suspects: Anne, Barbara and Clara.
Anne said that Barbara broke the window. Barbara and Clara also said something but nobody remembers what they said. It is known that exactly one of the girls broke the window and only this girl told the truth. Who broke the window?

Windows: Solution

If A broke the window then A told the truth. But A said B broke the window, not A. So A was lying. So A didn’t break the window. And B breaking the window was a lie. Hence C broke the window.

Computational Thinking

"Computational Thinking is a loose set of problem solving skills that mainly focus on the creation of algorithms."

(Curzon P, McOwan P. (2017) The Power of Computational Thinking)

Computational Thinking

The purpose of these puzzles is not necessarily to solve them fully!

The purpose is to practise the core elements of Computational Thinking.

Pattern Recognition: See if there is a pattern

Abstraction : See if you can figure out the vital information within the problem. Perhaps use variables to represent information.

Decomposition : Break down the problem into smaller parts. Build information from the bottom up.

Algorithm Design: Can you make a set of instructions to solve the problem

M&M’s

A shopkeeper receives three boxes of sweets from a supplier. One box contains peanut M&M’s, the second is filled with chocolate M&M’s and the third box is a mix of the two types. Unfortunately all the boxes are labelled incorrectly. If he can’t see into the box but can put his hand into take a sweet, what is the minimum number of sweets he needs to take out to figure out which box is which?

Explain!

M&M’s

If none of the labels are correct then by taking a single sweet from the box labelled ‘Mixed Box’ you should be able to solve it.

If the sweet you pick is a peanut M&M then that has to be all the peanut M&M’s.

That leaves chocolate and mixed M&M’s in either box labelled chocolate or peanut.

Because all the labels are wrong that means the chocolate M&M’s can’t be in the box labelled ‘Chocolate’ so must be in the box labelled ‘Peanut’, leaving mixed M&M’s in the box labelled ‘Chocolate’

Fishing Holes

Inuit children are sent out to find out about fishing holes and polar bears. They are only interested in polar bears that are at fishing holes, as their presence would frighten Inuit fisherman.

They communicate information using 2 dice, which serve also as fasteners for their coats.

Here's some results:

Dice 1	Dice 2	Meaning
4	3	1 fishing hole and 2 polar bears
2	5	1 fishing hole and 4 polar bears
2	2	no f.h. so no polar bears of interest
3	5	2 fishing holes and 6 polar bears
5	5	2 fishing holes and 8 polar bears

Question

What's the key to translating the dice data to useful information?

If the dice is odd (or has a centre dot) then it counts as a fishing hole so if we have the dice 3,2 that's 1 fishing hole but 3,3 or 1,3 is 2 fishing holes etc. Then the number of polar bears is the number of dots that surround any centre dots... So a 5 face would count as 4 polar bears, a 3 face as 2 bears and a 4 face is zero bears because there is no centre dot.