

MR GARVEY 2021

Learning Intentions

STRAND 1

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| 1.1 | Describe a systematic process for solving problems and making decisions |
| 1.2 | Solve problems by deconstructing them into smaller units using a systematic approach in an iterative fashion |
| 1.3 | Solve problems using skills of logic |

Computational thinking, Pattern Matching, Abstraction, Decomposition, Algorithms

What is Computational Thinking

Describe a systematic process for solving problems and making decisions

- Computational thinking is a method of studying a problem and formulating an effective solution that could be implemented using a computer.
- Computational thinking involves four techniques or 'pillars'.
 - Pattern matching - Identifying patterns.
 - Abstraction - Ignoring irrelevant details.
 - Decomposition - Breaking a complex task into smaller tasks.
 - Algorithms - Using a sequence of steps to solve a problem.

Task: 5 mins

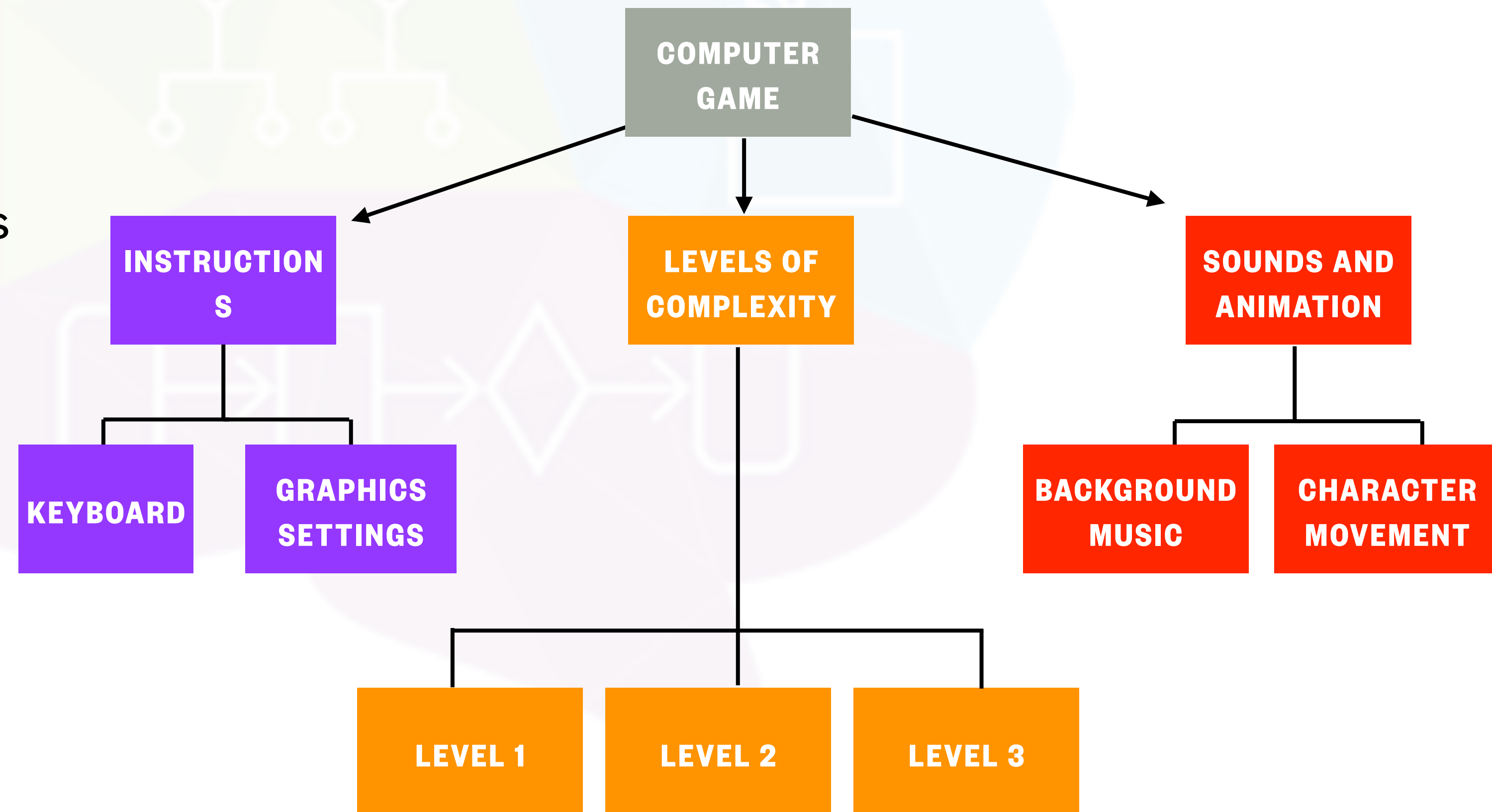
A human looking at a CCTV of an underground train platform can easily tell if the platform is over crowded, and no more people should be allowed on to the platform.

Can you think of any way a computer could figure out if a platform is overcrowded? What should the system take into consideration and what can it ignore?

Decomposition

Describe a systematic process for solving problems and making decisions

- Decomposition involves breaking down a large problem into a set of smaller tasks.
- Putting the solutions to these smaller problems together will give you a solution to the bigger problem.
- For example, think of the problem of developing a modern game for the Playstation. What smaller set of tasks could you break the development process down into?



Decomposition

Describe a systematic process for solving problems and making decisions

- Decomposition involves breaking down a large problem into a set of smaller tasks.
- Put the solutions to these smaller problems together will give you a solution to the bigger problem.

• Problem: I want to replant all the flowerbeds around my house. What kind of tasks can I break this large job up into?

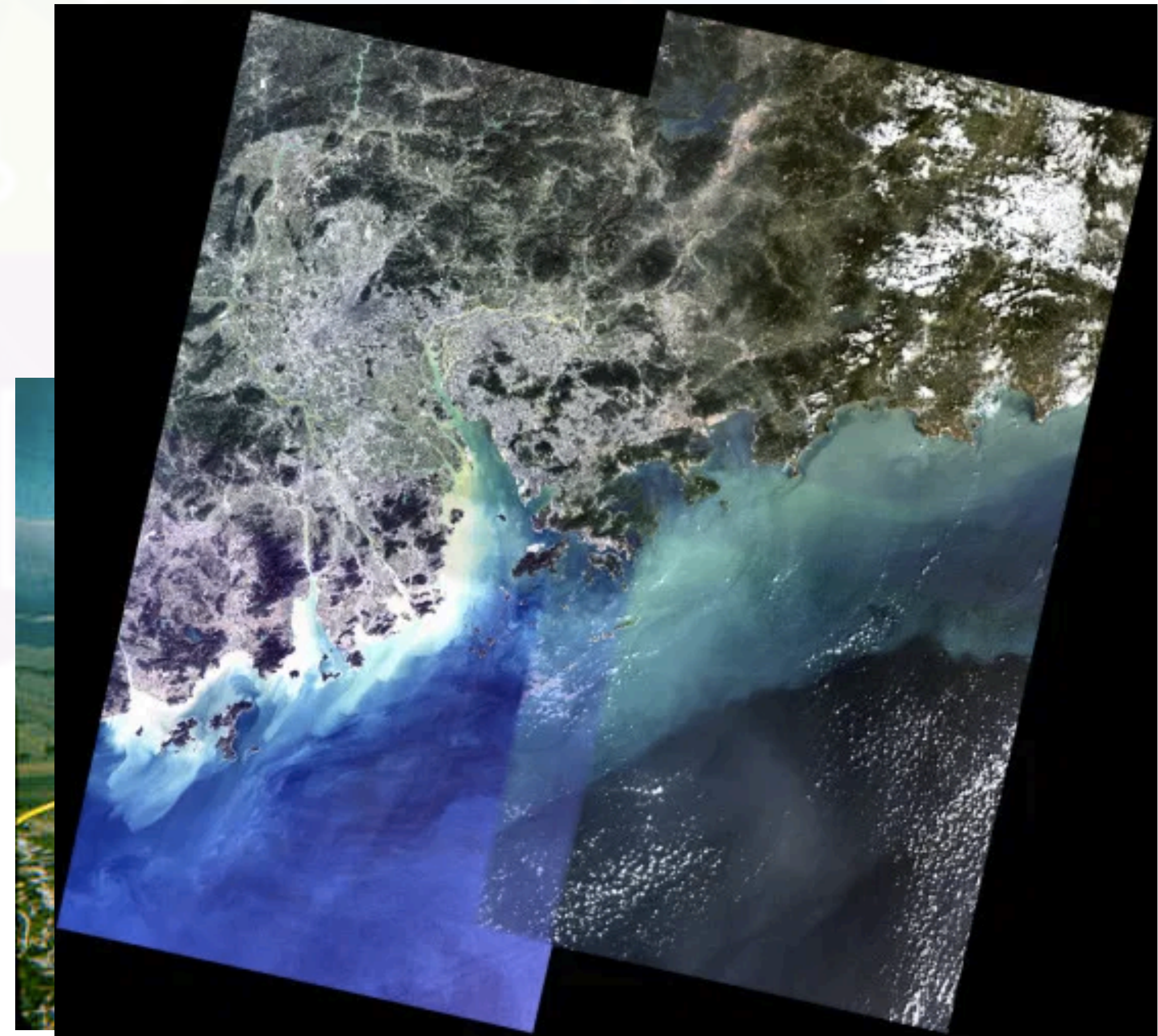


Decomposition

Describe a systematic process for solving problems and making decisions

When Google decided it wanted to create Google Earth and map the world, what smaller tasks may they have broken the larger task into?

- How will we collect the data?
- How will we bring the data together?
- What functionality will we give the data?



Decompositon Task

Solve problems using skills of logic

We have a list of randomly generated two character strings. Each one consists of a letter and a number.

D4, H2, W9, H4, F4

The problem requires that we sort the strings, first by letter and then by number. So all strings that begin with A appear before all strings beginning with B etc.

How could we decompose this task so we can solve it? What order will the strings be arranged in?

Solution:

- 1) Sort the strings so they are alphabetical order and ignore the numeric value.
- 2) Sort the strings again, but within each letter sub group sort them by numeric value.

D4, F4, H2, H4, W9

Pattern Matching

Describe a systematic process for solving problems and making decisions

- Identifying patterns in data or problems can often save time or lead to more efficient solutions.
- Patterns are similarities or characteristics that some problems share.
- Problems become easier to solve when they share patterns because we can use the same problem-solving solution wherever the pattern exists.

You are tasked with designing a brand new school for Pres, what are some characteristics or properties of schools you could use to help you design the new school?

How would finding a pattern help us with the design of more than one school?

We know that all schools need classrooms, canteens, principals office, sport hall, parking, science labs, computer labs.

If we didn't recognise any patterns, each time we design a school it would take longer as we would have to work out what a school looks like for each individual design. This is not efficient.

Pattern Matching - Task

Solve problems using skills of logic

You are asked to sum up all the numbers between 1 and 100 in your head in less than a minute.

Where/how would you start?

Try and work out the sum of a smaller subset of numbers e.g 1-10.

Write out the numbers 1 to 10 and add 10 and 1 together, now add 9 and 2 together, is there a pattern?

Does this pattern apply to the numbers between 1 and 100?

How can I use this pattern to work out the sum of numbers between 1 and 1000?

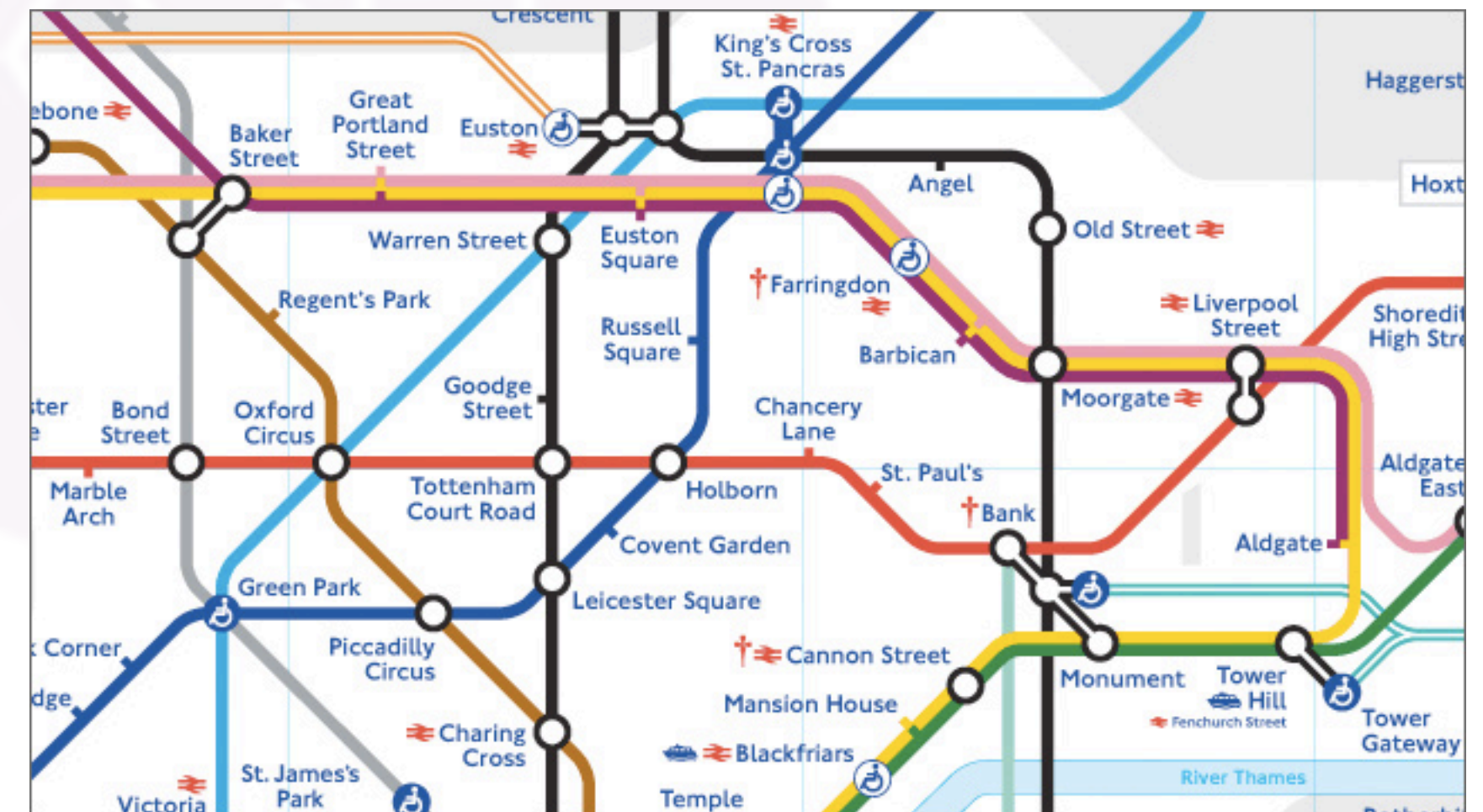
Abstraction

Describe a systematic process for solving problems and making decisions

- Abstraction involves the removing of unnecessary details from a problem in order to solve it, or identifying only the relevant information in a problem.

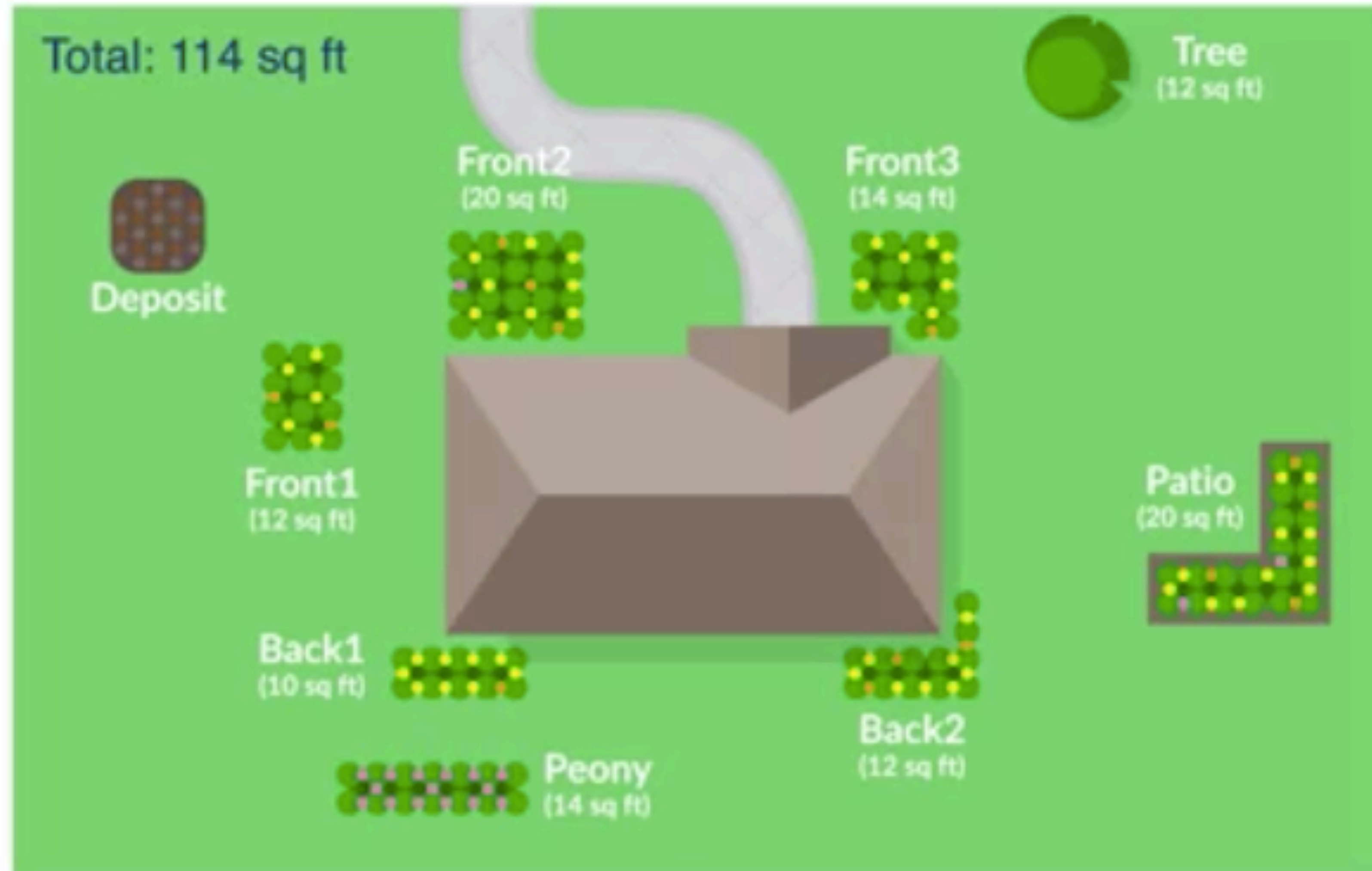
Think of our train platform problem earlier. What details about the people on the platform are not important when it comes to solving this problem?

- Abstraction encourages the development of simplified models that are suited to a specific purpose. e.g Climate change models.
- First step in abstraction is identifying the details of a problem that have a large effect on the solution and no effect on the solution.
- The London Underground map allows us identify the best route from A to B.
- Things like the direction or distance we travel are not relevant. So they are not represented on the map.



Abstraction

Describe a systematic process for solving problems and making decisions



- For putting down new soil in the flower beds. There are a number of characteristics we can ignore:
 - Is area shaded/full sun
 - What plants are there
- All we care about is the size of the flower bed

Abstraction - Task

Describe a systematic process for solving problems and making decisions

In the parking lot below, cars can be parked in parking spaces or in front of these parking spaces. If a car wants to leave its parking space, the cars that are parked in front of the parking spaces can be carefully moved forward or backwards in order to unblock the movement of the car that wants to leave.

Example:

Car A is not blocked and can leave its parking space.

Car L is blocked by car M.

Car M must move **backwards** before car L can leave its parking space.

Task:

Select the car that needs two other cars to move forward or backwards before it can leave its parking space.
(Don't forget to press Save.)

- Hint: Use pattern recognition to abstract away the irrelevant letters.







Abstraction - Task

Describe a systematic process for solving problems and making decisions

BeaverKingWay uses six types of fillings (A, B, C, D, E, and F) to make a burger.

The following table shows some examples of their burgers and fillings. The fillings are not listed in any particular order.

Burger				
Fillings	C, F	A, B, E	B, E, F	B, C, D

Question:
Which of the burgers below has fillings A, E, and F?



Task

Solve problems using skills of logic

An online store assigns passwords to its users to allow them to verify their purchases. You have been asked to create a program that validates each password entered. Each password must be:

Eight characters long

Include one upper case character

Include one lower case character

Include one number

Explain how you would use abstraction and decomposition to approach this task.

What programming concepts would you use if you had to develop this program in class?