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Computational Thinking

Activity: What is Computational Thinking?

In your work books, write down what you think Computational Thinking is.

Computational Thinking

Computational thinking allows us to take a complex problem, understand what the problem is and develop possible solutions. We can then present these solutions in a way that a computer, a human, or both, can understand. – Bitesize

So basically it is working out how to solve a problem and then writing the solution in a way so the computer can do the hard work for you.

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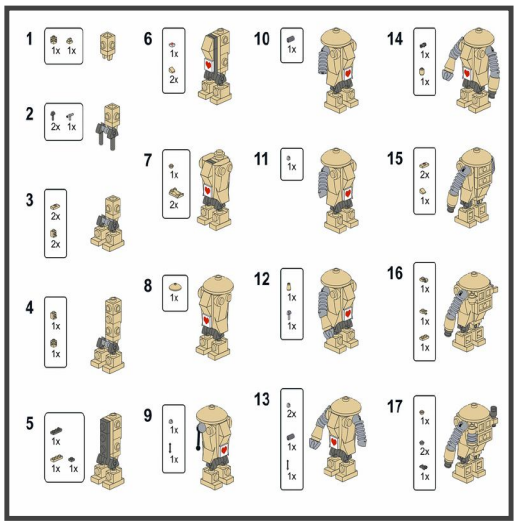
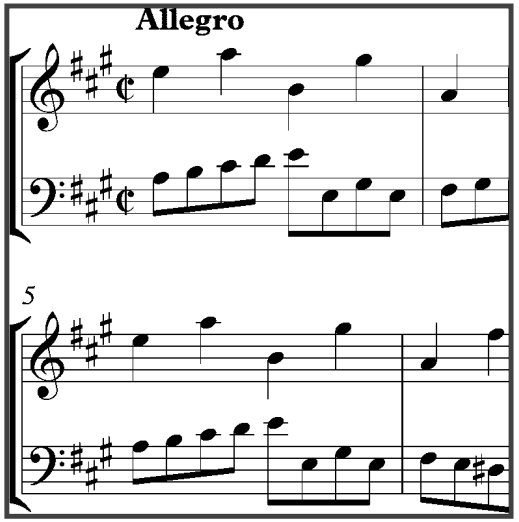
The Strands of Computational Thinking

Abstraction



Algorithms

Pattern Recognition



Decomposition

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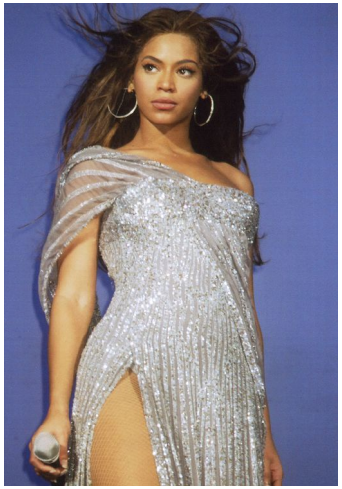
Activity: Guess Who

Cristiano Ronaldo

Beyoncé

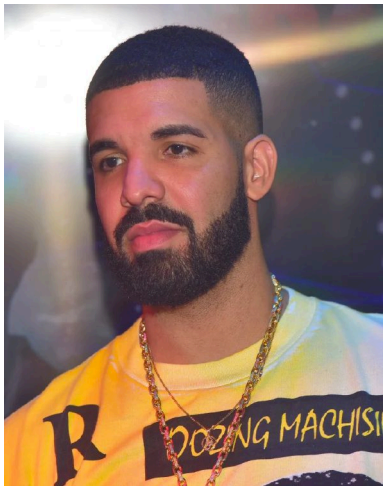


Lionel Messi

Rihanna

Serena Williams

Drake



Kylie Jenner

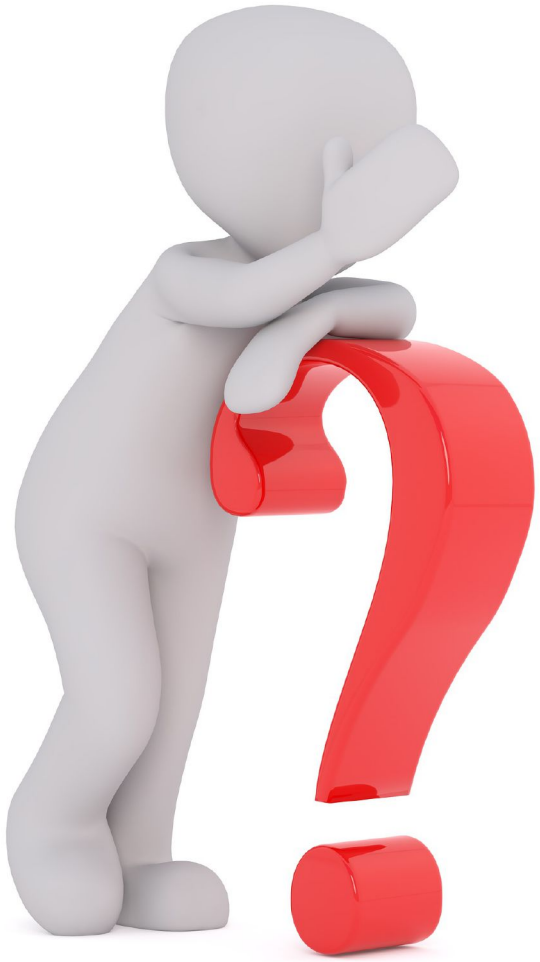
Robert Downey Jr.

Guess Who Reflection

How many questions were needed?

Which questions were useful or not useful?

Did your partner's answers influence your next question? In what way?



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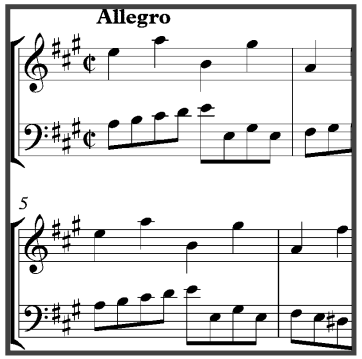
Activity: What is Decomposition?



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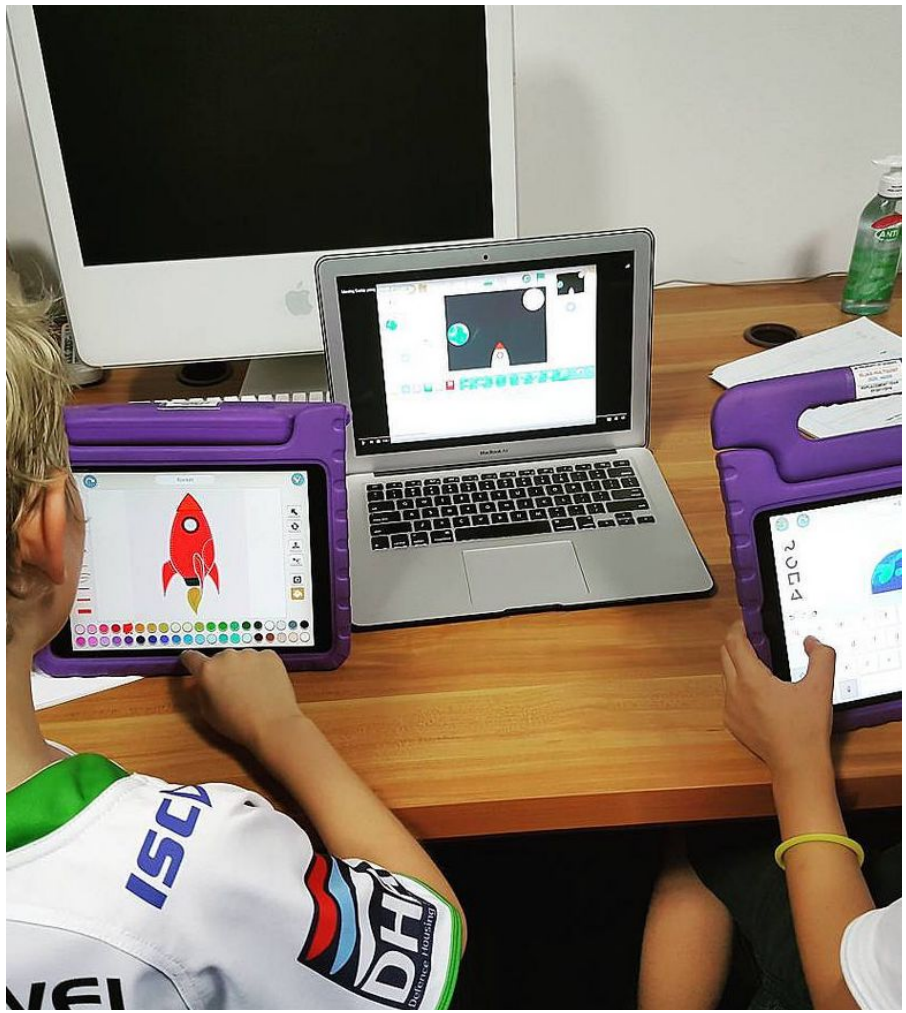
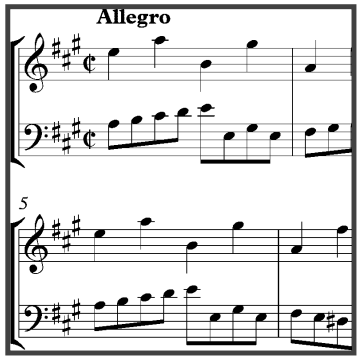
Decomposition

Decomposition is the process of breaking a complex problem into smaller component parts.

Real world examples of using decomposition:

- Complex Maths Problems.
- Cooking.
- Cleaning your room!
- Creating a Game.





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Activity: Decomposition of a Game

When creating a game, what would we need to think about?

Think of your favourite game. How could you break it down into the important features? For example:

- What is the objective of the game?
- Who are the characters?
- What is the world like?
- Is it single or multi player?
- How do the characters interact?

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Activity: LEGO Building

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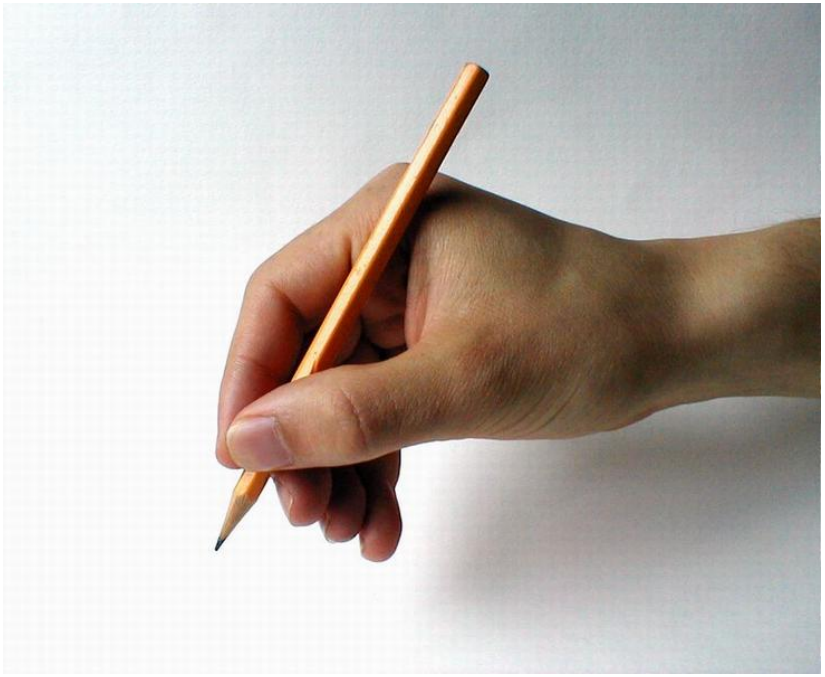
LEGO Reflection

Activity: Drawing Instructions

In your work books, make a small drawing/picture and try to give instructions to your partner on how to draw it. Remember, they are not allowed to see the drawing or ask questions.



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Activity: Get Arty!

Activity: Get Arty!

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Artist Reflection

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Abstraction

Abstraction is the process of removing unnecessary detail and simplifying. Abstraction is used to remove unnecessary detail from a real-world situation and to model the simplified result in an algorithm or program.

Real world examples of abstraction in action:

- In driving…
- In programming…
- In teaching…

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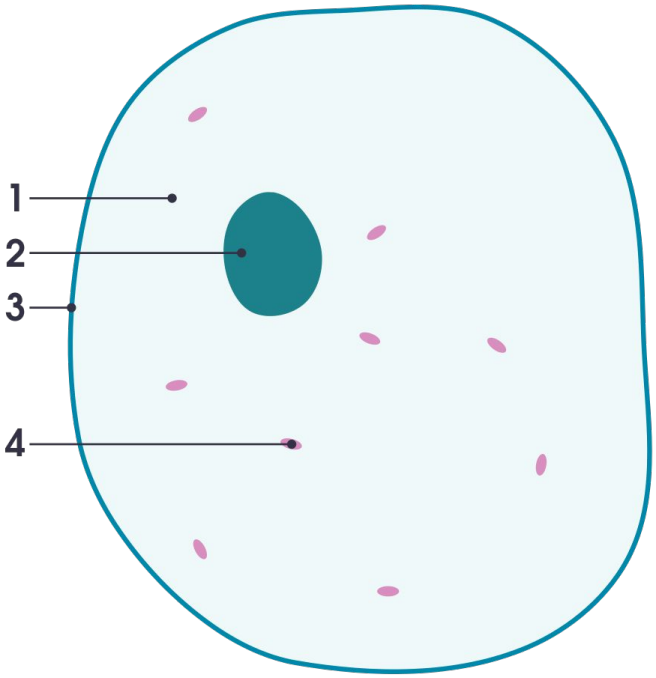
Teachers using Abstraction in Biology



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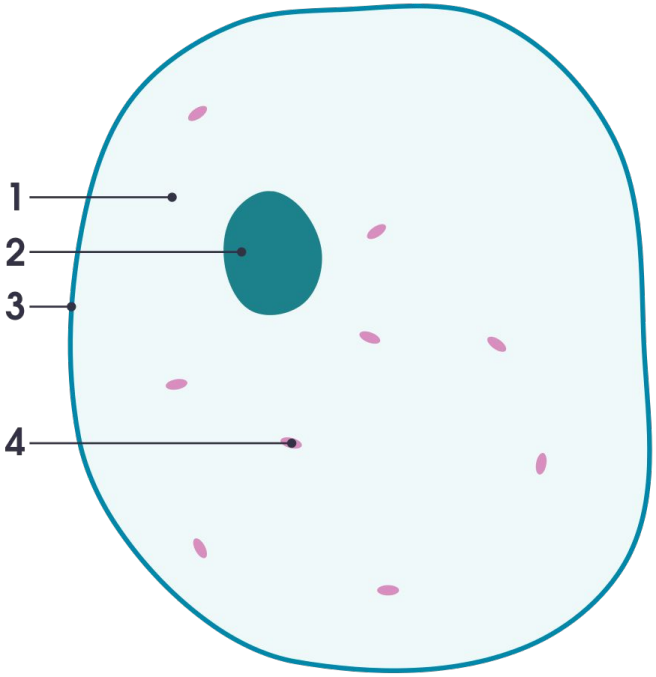
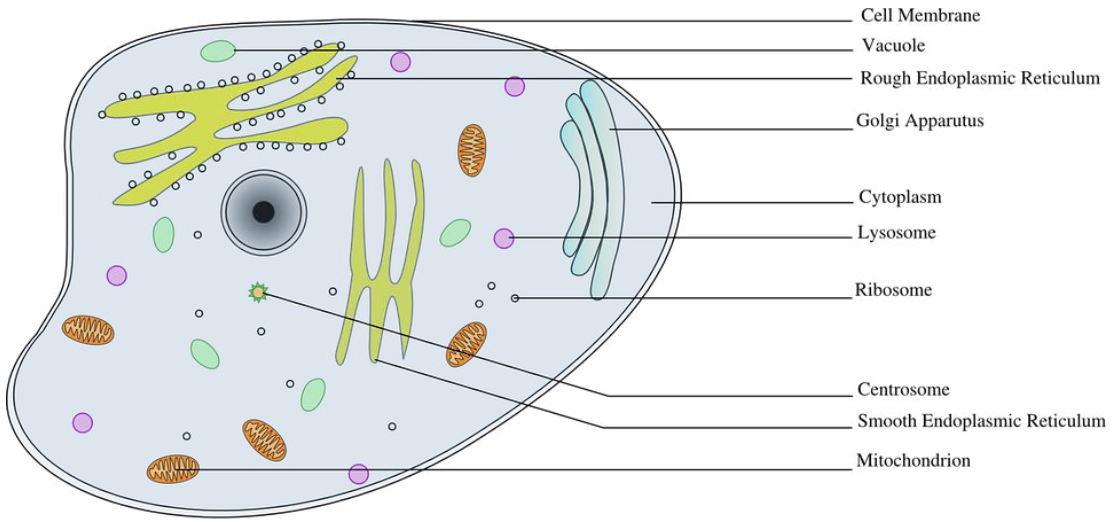
Teachers using Abstraction in Biology





Cross Section of an Animal Cell

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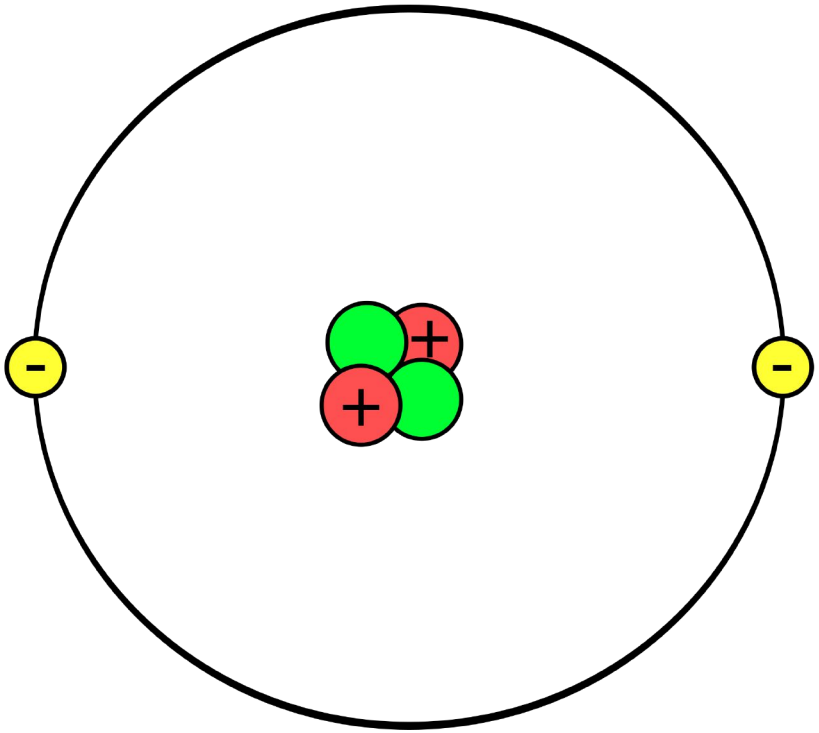
Teachers using Abstraction in Physics



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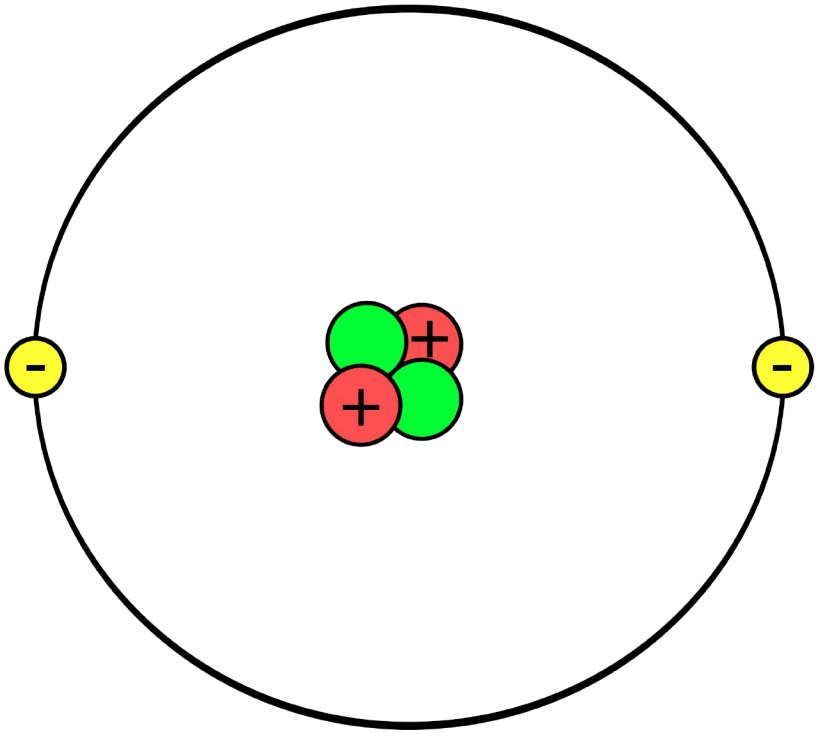
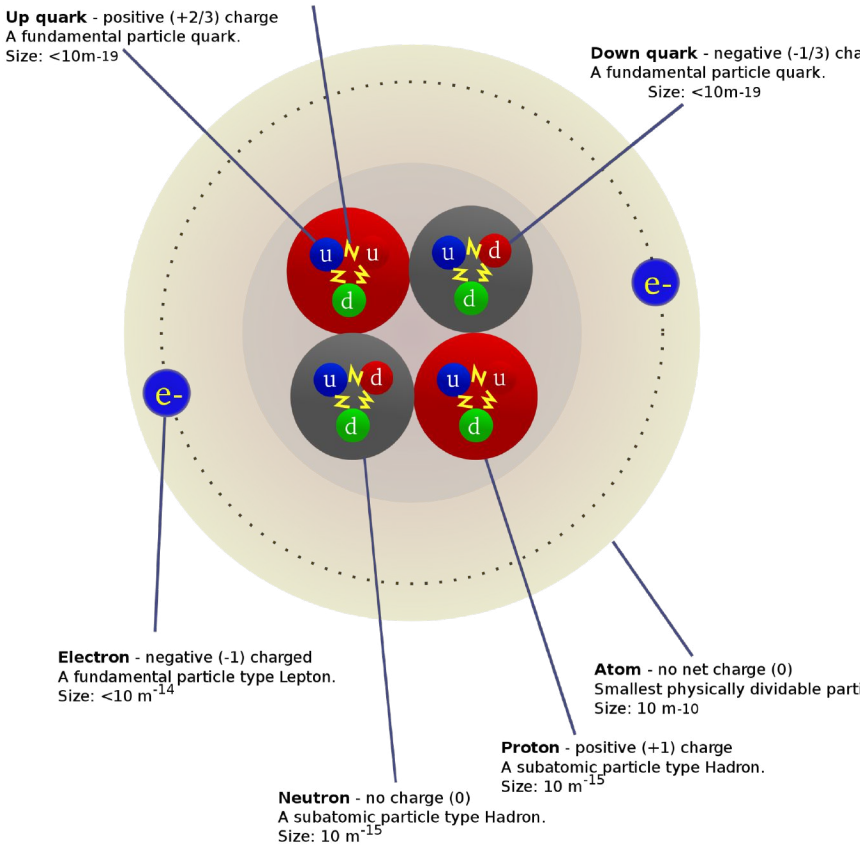
Teachers using Abstraction in Physics





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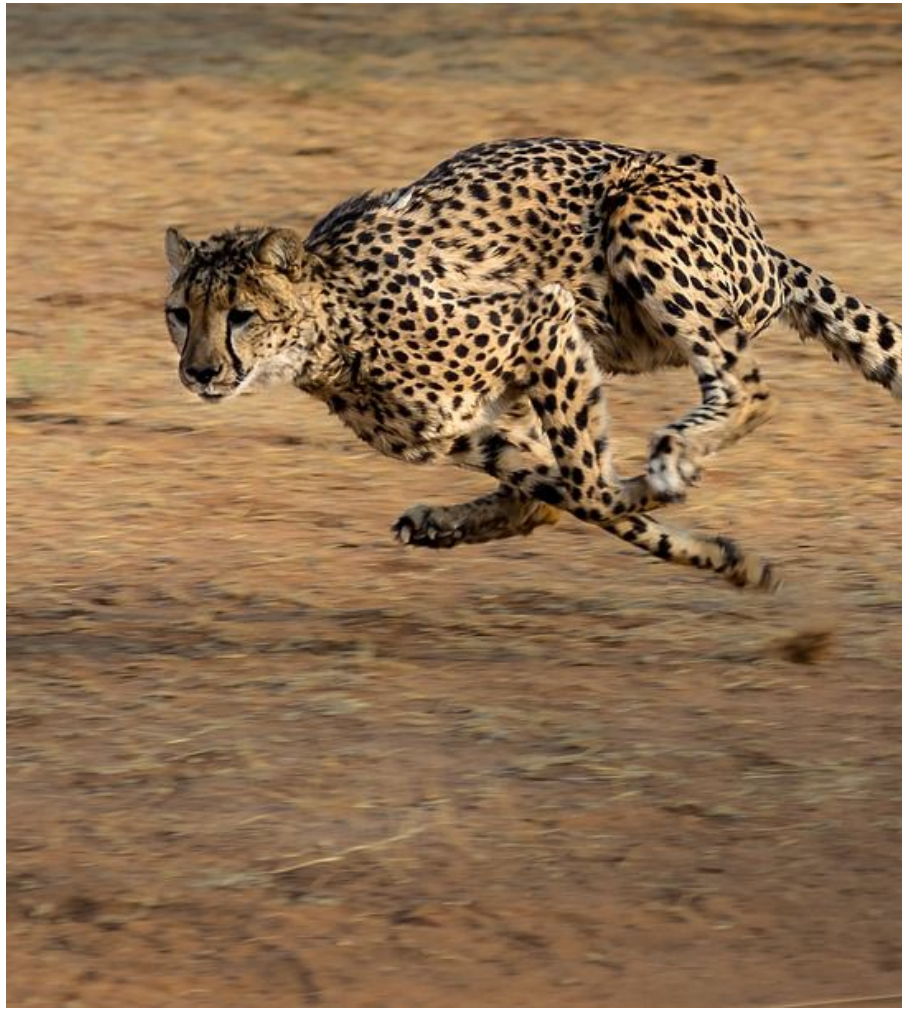
Abstraction in Robotics

When simulating or modelling things, we don't always need to include all of the details:

https://www.youtube.com/watch?v=_luhn7TLfWU



Activity: What is Abstraction?

Activity: What is Pattern Recognition?

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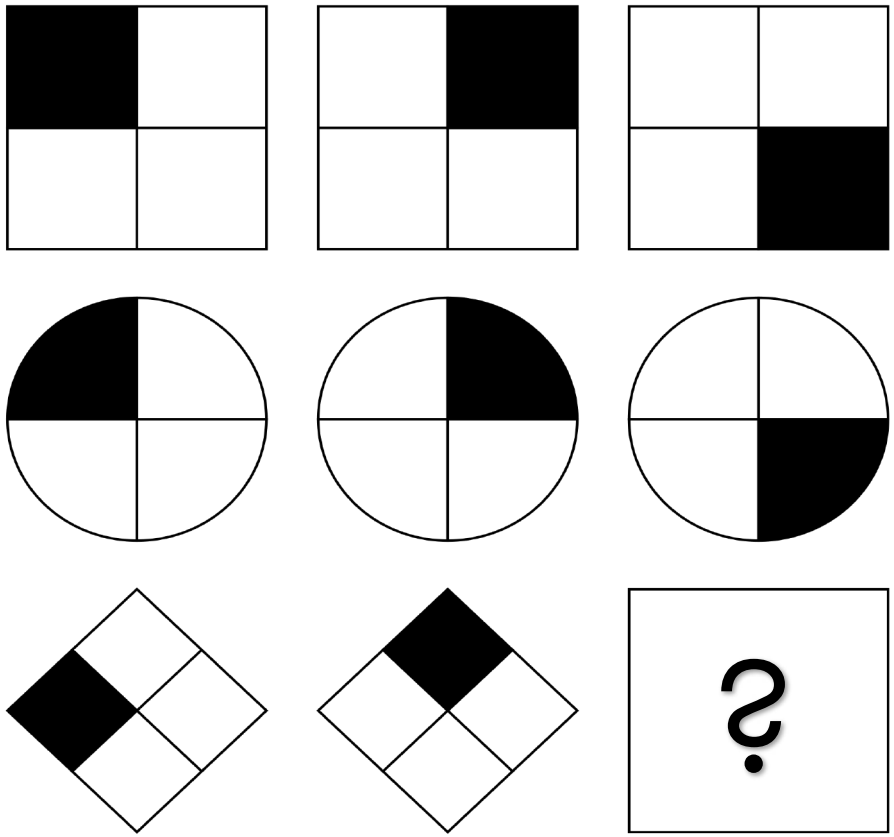
Activity: Complete the Pattern (1)

Can you see what should go in the final square?

Complete the pattern in your workbooks.



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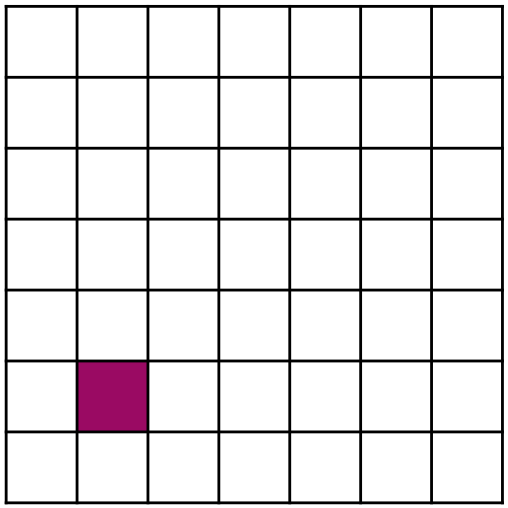
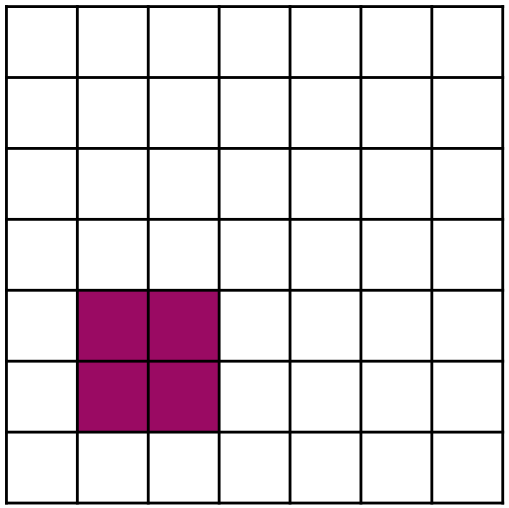
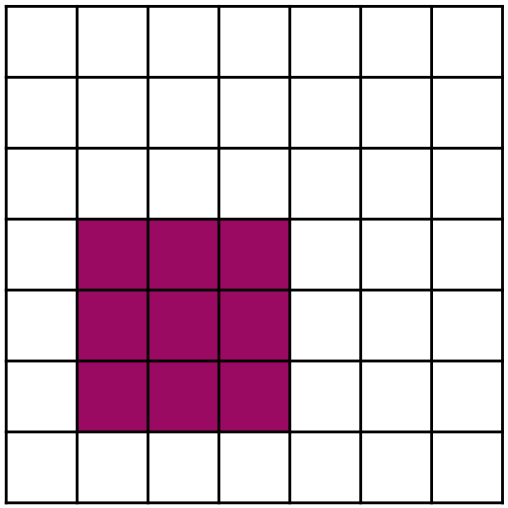
Activity: Complete the Pattern (2)

Complete the Pattern:







What would come next?

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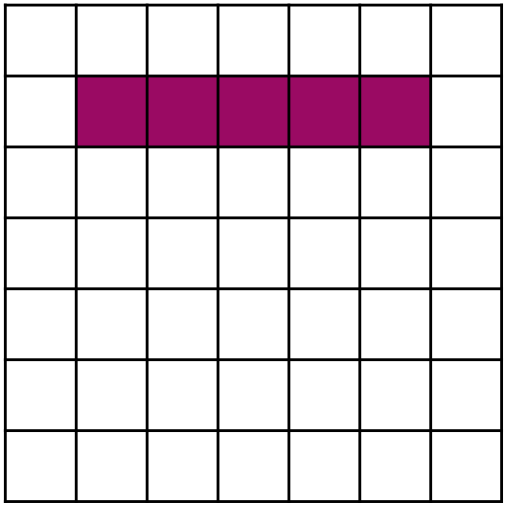
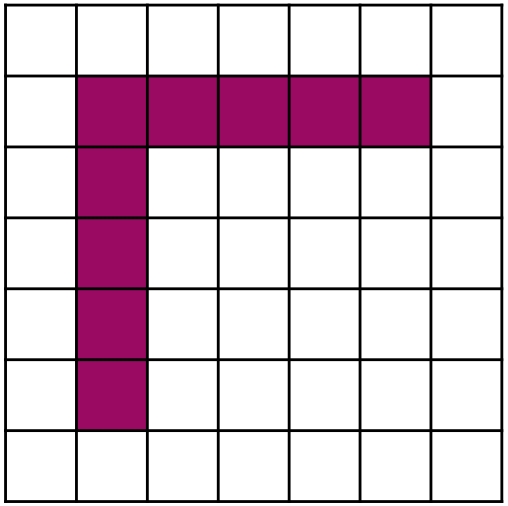
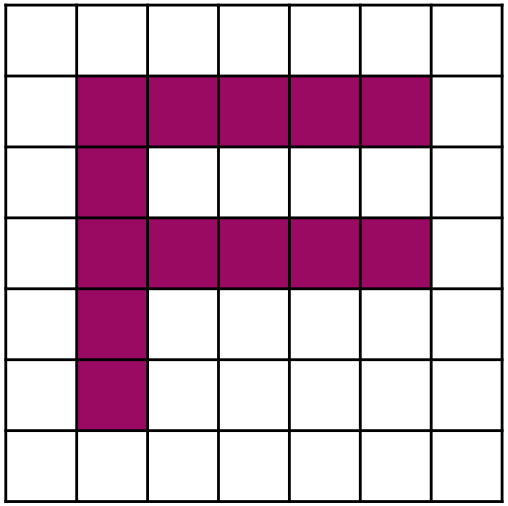
Activity: Complete the Pattern (3)

Complete the Pattern:







What would come next?

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Activity: Create Your Own Patterns

Using the grid provided, start a pattern and ask your partner to see if they can draw what will come next. Remember you'll need to leave enough space for them.

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Activity: Number Sequences

Can you spot the pattern in these sequences? Write the number that will come next:

1, 2, 3, 4, 5, ...

2, 4, 6, 8, 10, ...

8, 4, 0, -4, -8, ...

1, 2, 4, 7, 11, 16, 22, ...

1, 1, 2, 3, 5, 8, 13, 21, 34, ...

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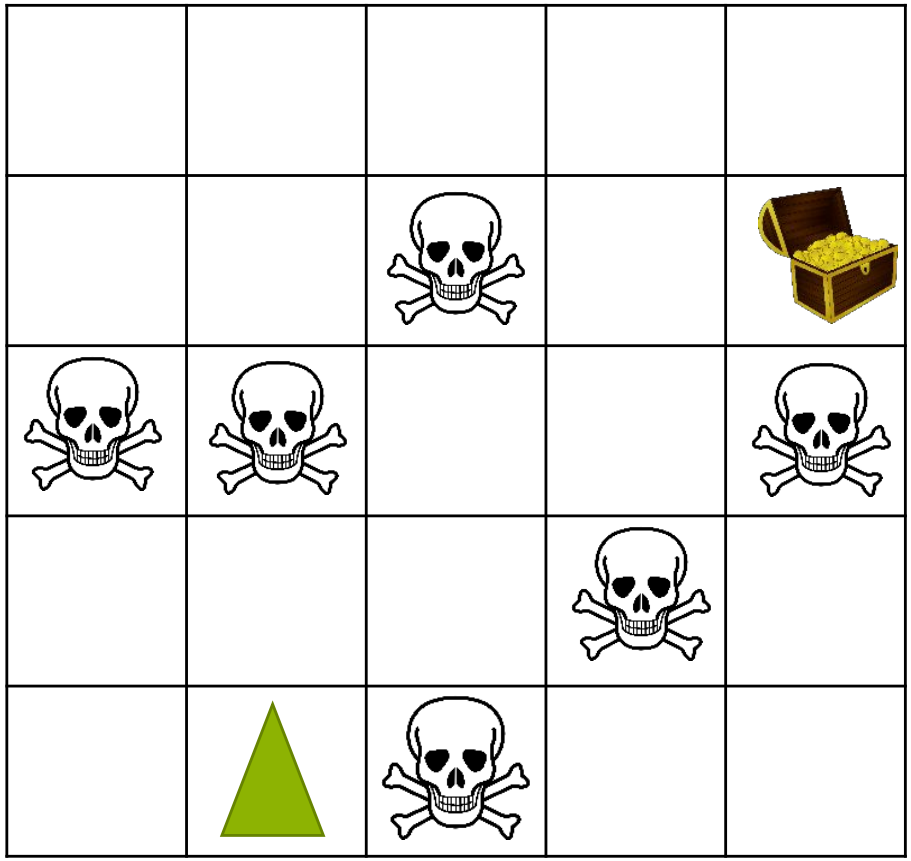
Activity: Buried Treasure (1)

Using the following commands, write step by step instructions to reach the treasure:

- Move forward
- Turn Left 90°
- Turn Right 90°

You can use the commands more than once.



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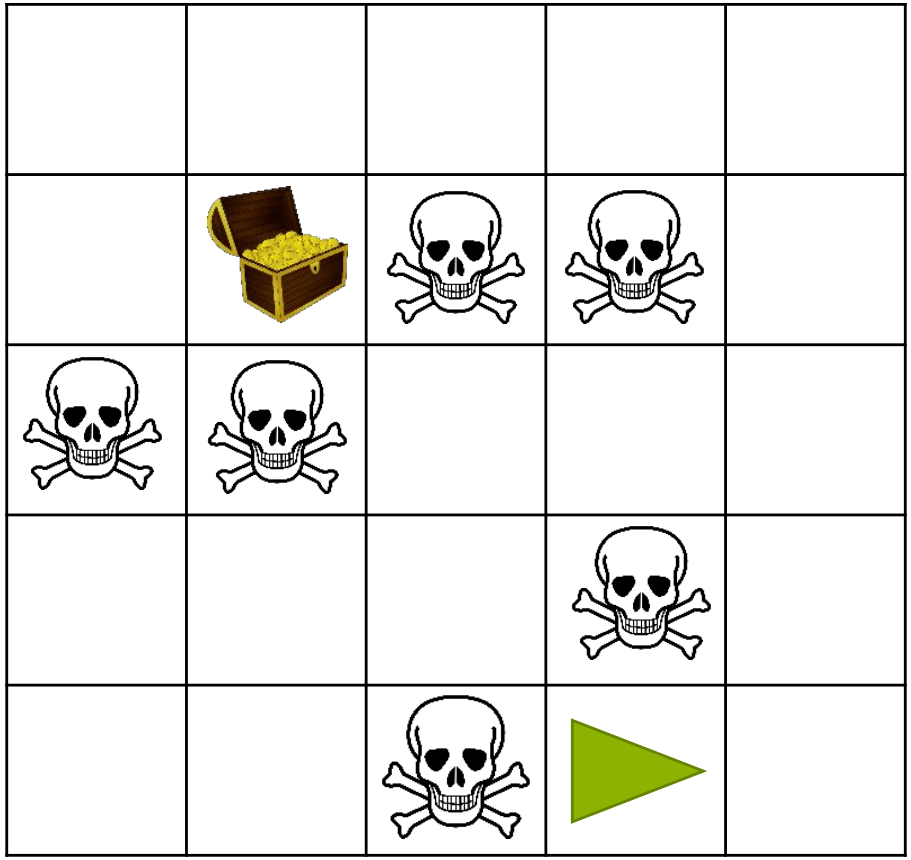
Activity: Buried Treasure (2)

Using the following commands, write step by step instructions to reach the treasure:

- Move forward
- Turn Left 90°
- Turn Right 90°

You can use the commands more than once.



Activity: Was There a Pattern?

Did you see a pattern in the solution? Were there any steps that we could repeat in order to shorten our list of instructions?

Try to rewrite your answers to the previous activity using repeat steps i.e.

Repeat steps 1-5

Move Forward x 3

And so on…

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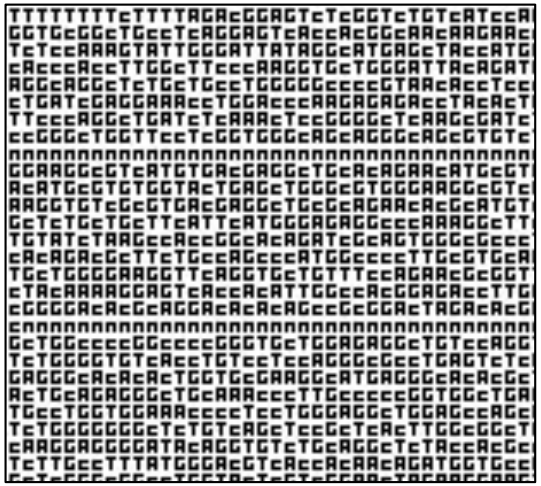
Everyday Patterns



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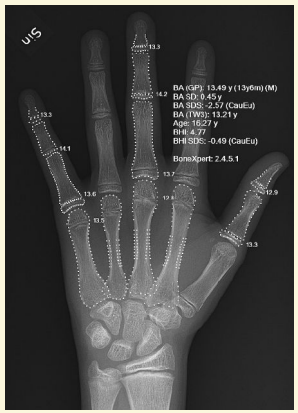
What Use is Pattern Recognition?

Name	Use	Image
Computer Aided Diagnosis	Helps doctors diagnose a patient.	
Speech Recognition	Recognises a person's voice	

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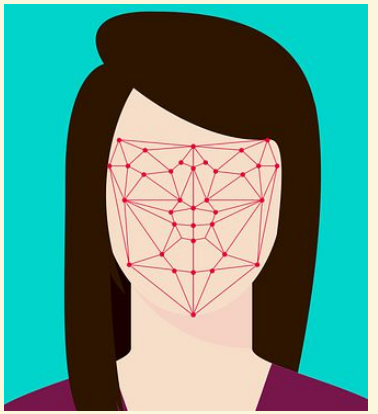
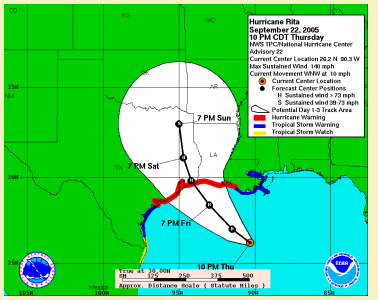
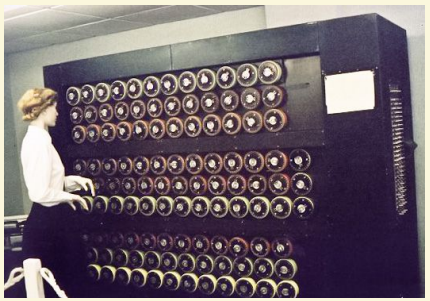
Name	Use	Image
Image Recognition	Recognising faces, Handwriting, Registration Plates	
Predicting Weather Patterns	Predict Extreme, life-threatening weather	
Codebreaking	Decrypting encrypted messages	

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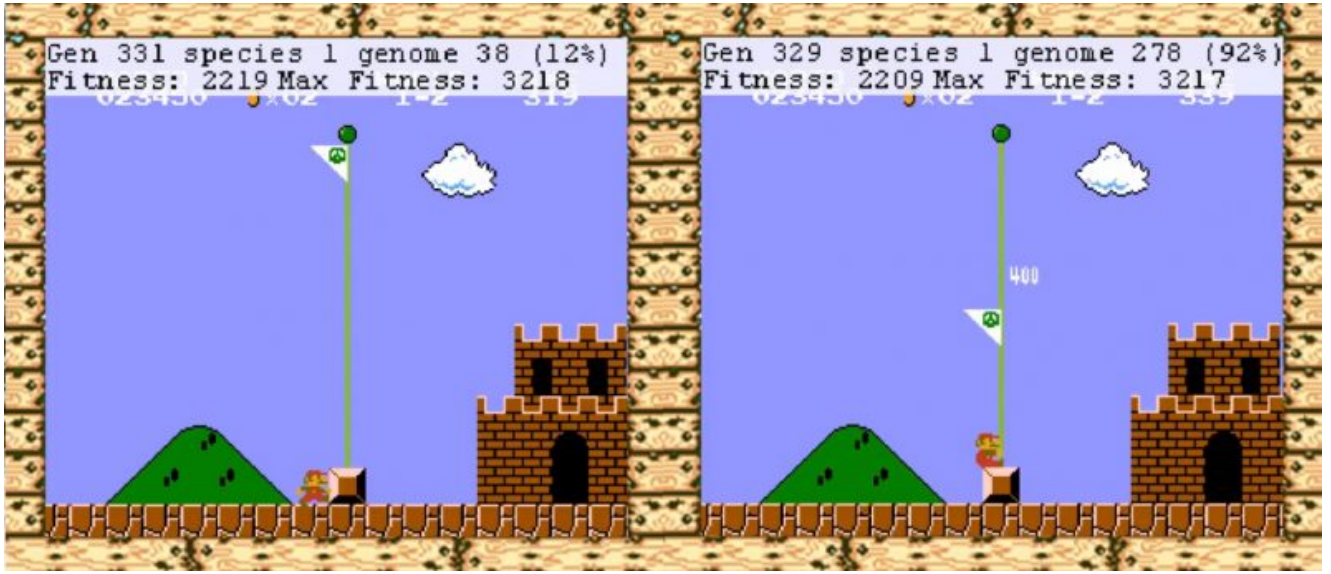
Machine Learning

Machine learning is the study of computers trying to learn patterns from data in order to carry out a task without being explicitly told how to do so.

Much like how a person can be trained to complete a task, computers can be trained to do tasks as well.



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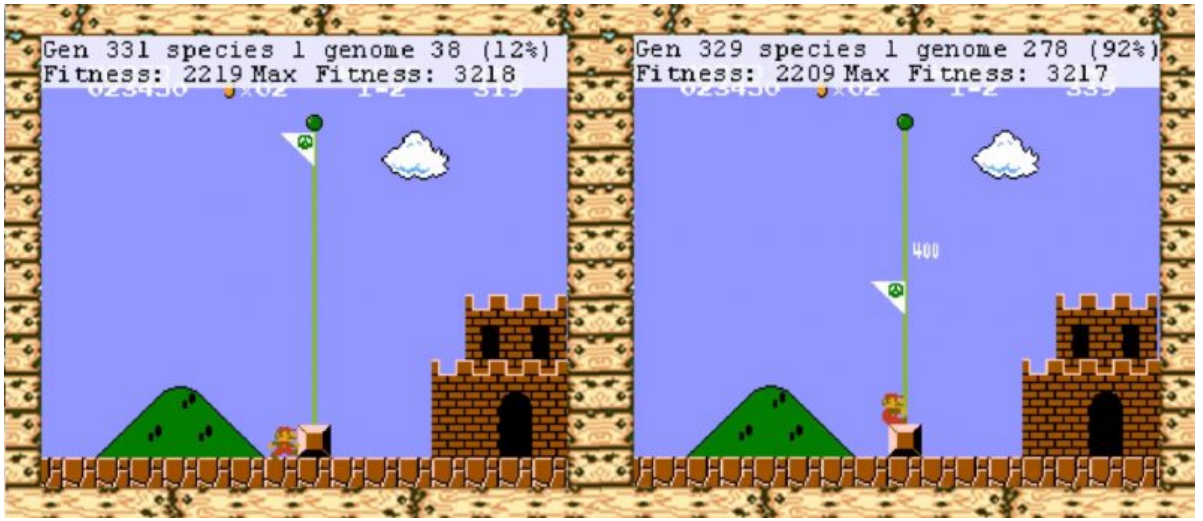
Machine Learning

For example a computer system, MarI/O, taught itself how to play the Nintendo game "Super Mario World" by watching footage of the world-record holder playing the game. It then played the game itself, over and over again as it learnt how to complete each level.

MarI/O has now taught itself how to play "Super Mario Brothers" and "MarioKart".



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Computational Thinking Puzzles

The River Crossing Conundrum

A Man needs to cross a river. There is no other way to cross safely other than the use of a rowing boat nearby. The Man cannot swim across. The Man has three things with him:

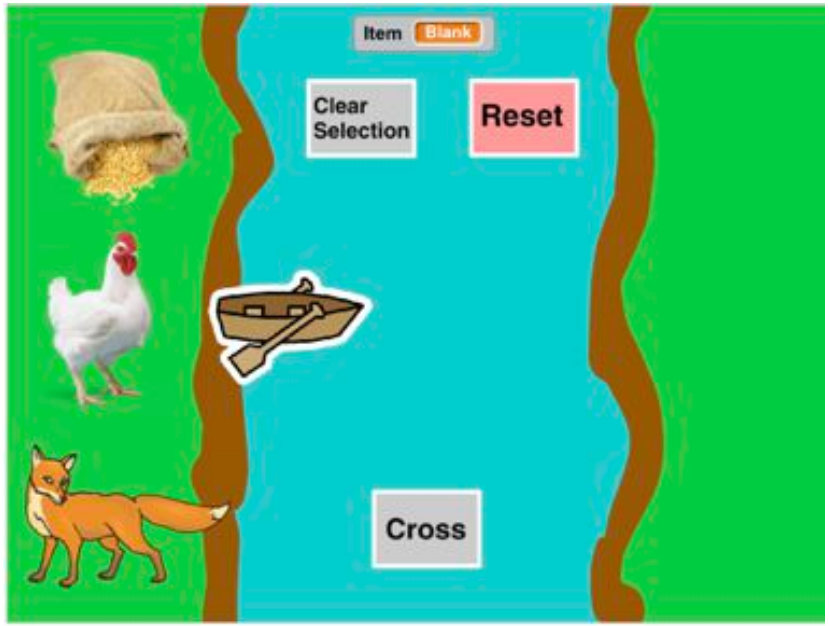
- a sack of corn
- a chicken
- a fox.

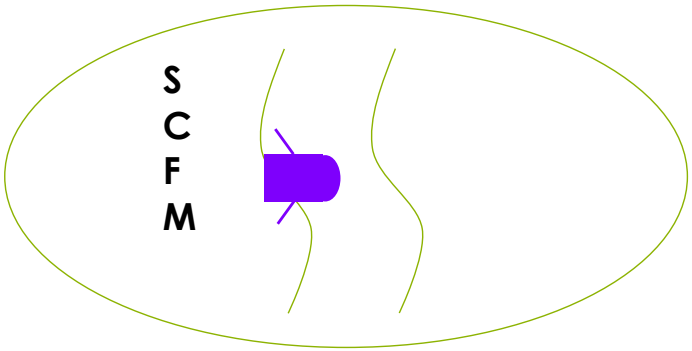
He must safely bring these across, however, the **boat can only carry the Man and one other object at a time e.g. The Man and the sack of corn.**

Another problem is that the **chicken cannot be left alone with the sack of corn**, and the **chicken can not be left alone with the fox**. How can the Man cross the river?

Visualising the Problem

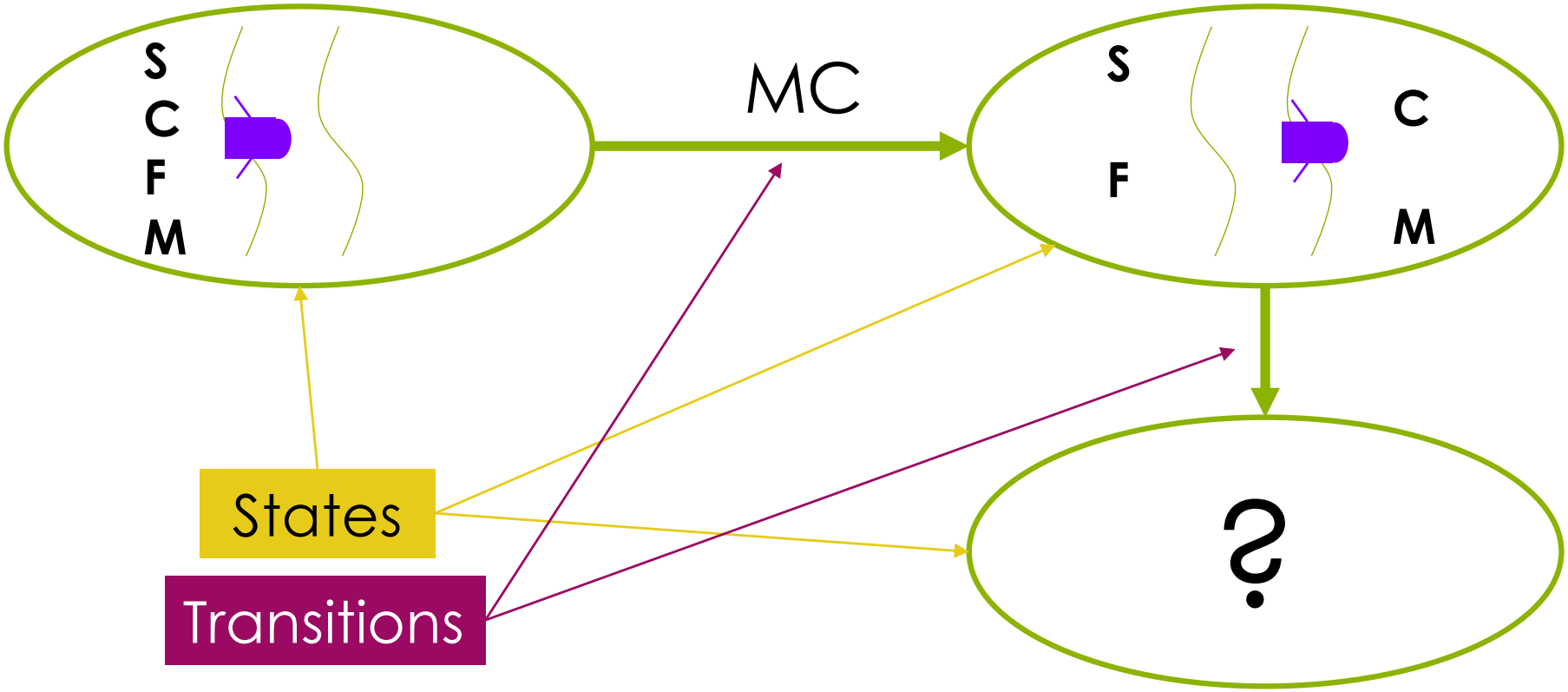
Using abstraction we can simplify the problem to only the necessary details.





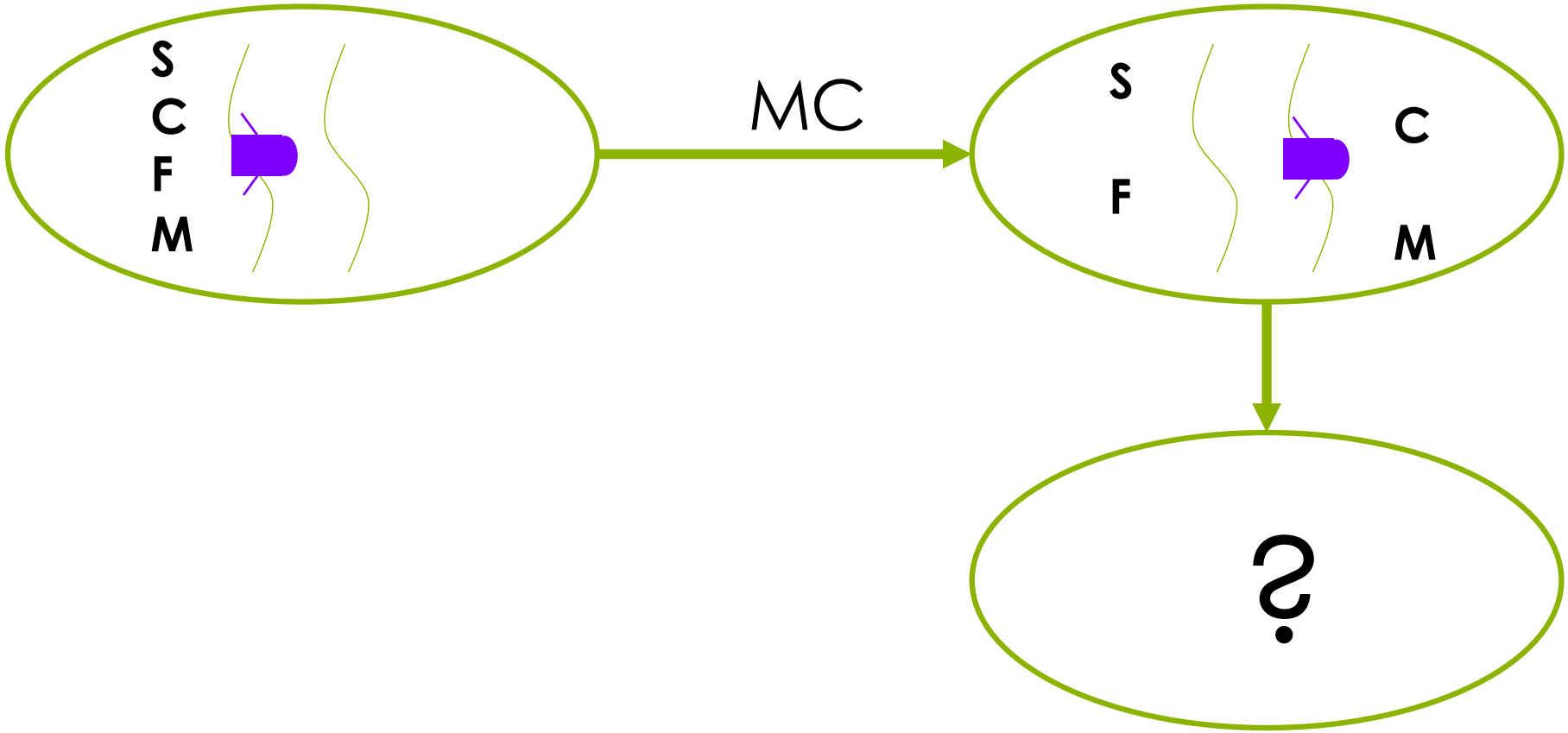
Labelled Transition System

Mapping out the steps of the puzzle using the different states is called a Labelled Transition System. It is made up of states and transitions.

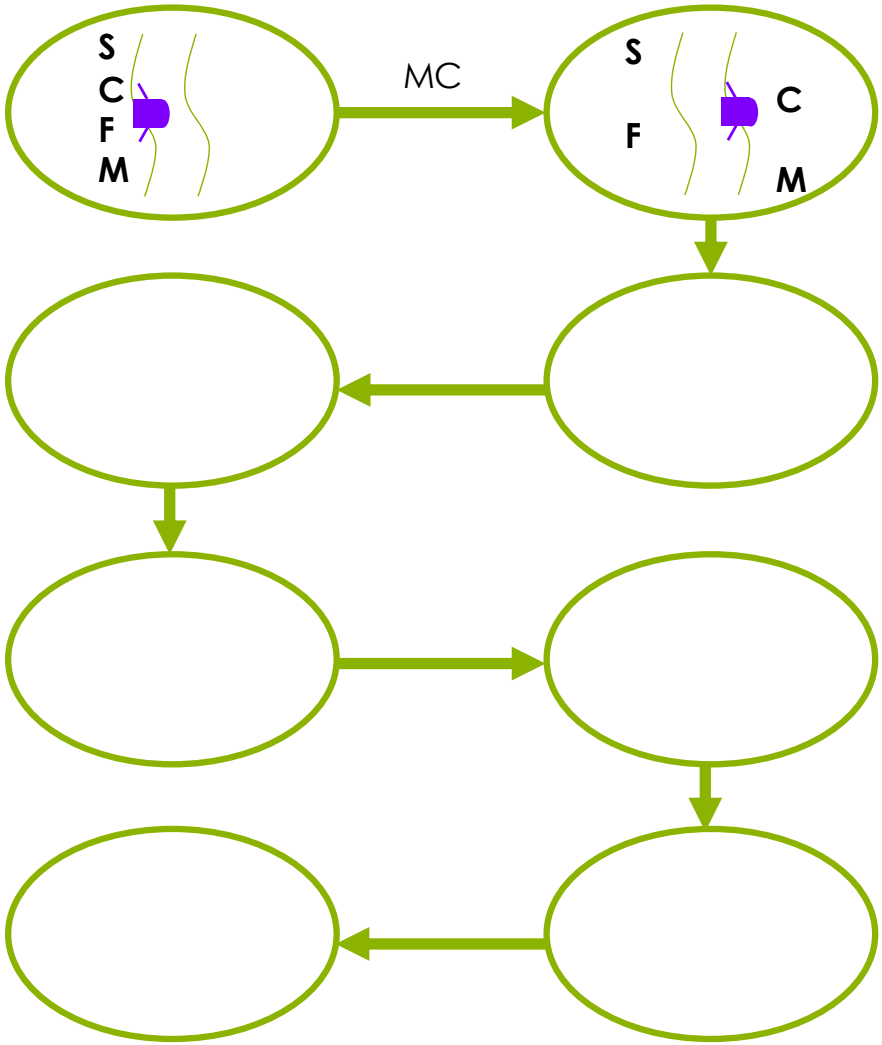


Activity: River Crossing LTS

In your workbooks complete the LTS diagram to solve the River Crossing Conundrum.

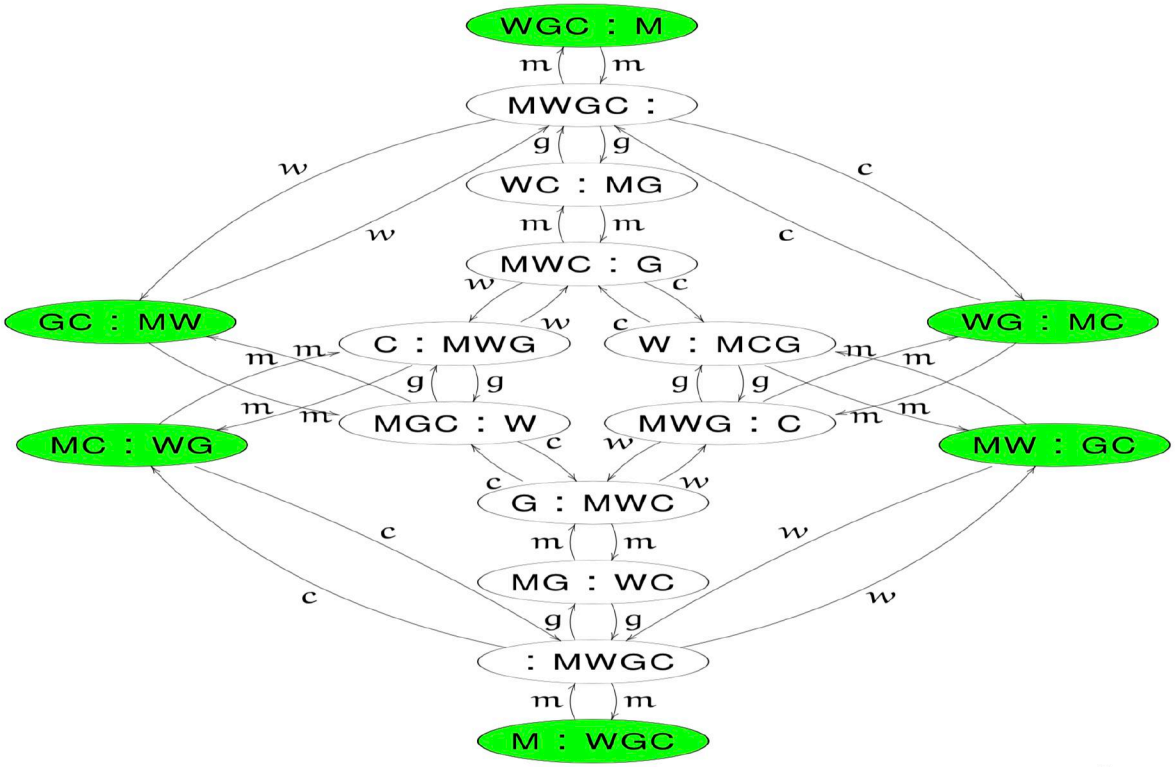


Activity: River Crossing LTS



Labelled Transition Systems

Labelled Transition Systems in reality show every possible state, even the ones that lead to losing the puzzle.



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Finding the Scratch Game

Use the following link to find the game:

http://bit.ly/Technothink

Choose your Language by clicking the English or Welsh Flag.

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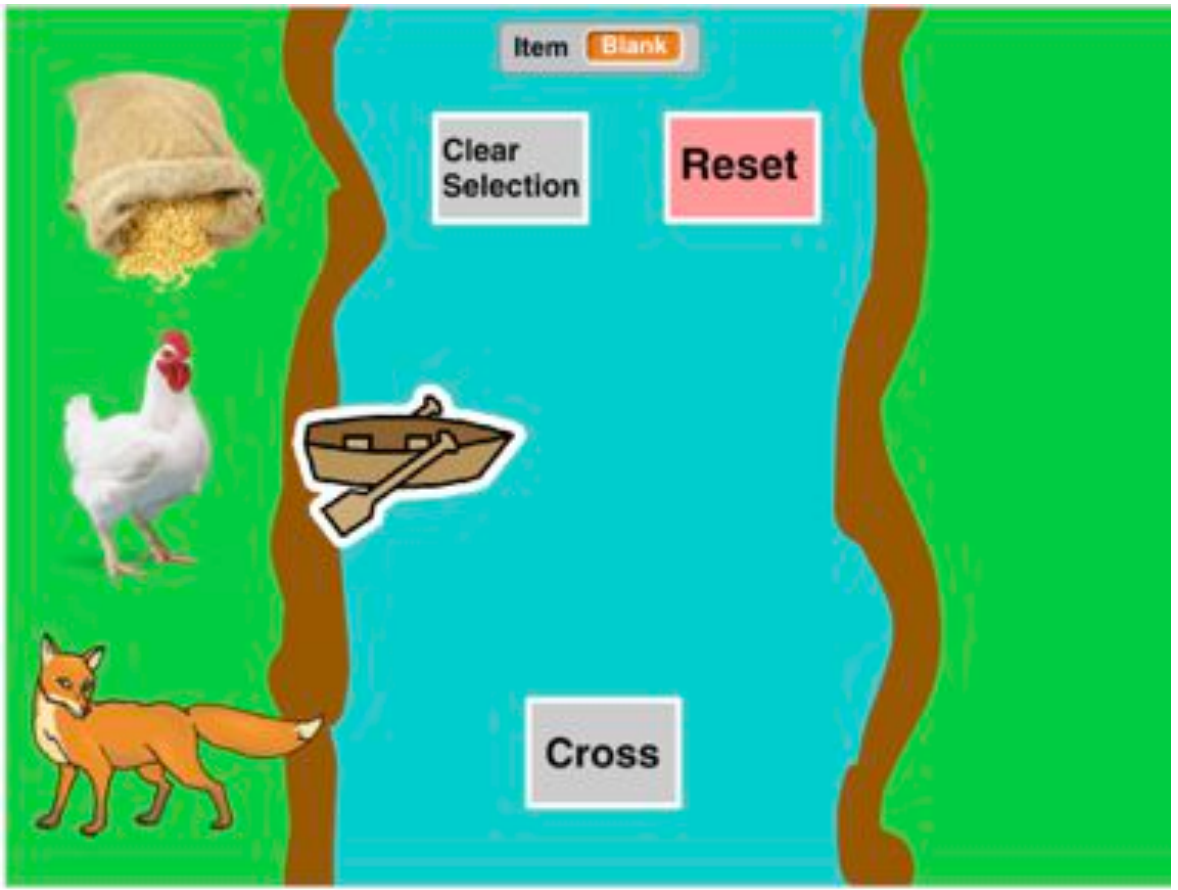
The River Crossing Conundrum

Complete the River Crossing Conundrum game.



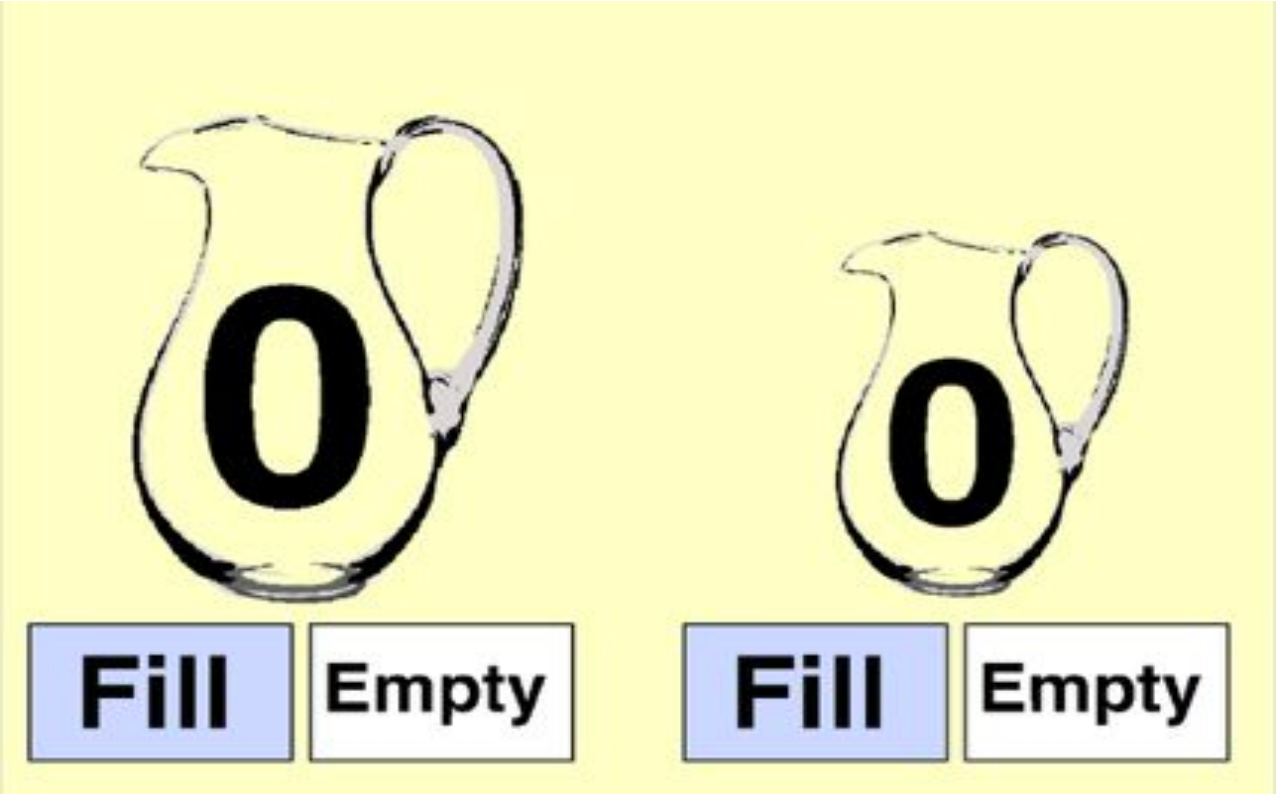
The Water Jug Challenge

There are two empty jugs: a 5 litre jug and a 3 litre jug. The jugs do not have any markings on them to help with measurements.

The only way to solve the puzzle is by filling the empty 5 litre jug with **precisely 4 litres of water**.

Activity: The Water Jug Challenge

Complete the Water Jug Challenge game. Write down the steps in your books.



The Bridge Crossing Conundrum

Alice, **Bob**, **Carol** and **Dave** have to cross a bridge in the dark of night. The bridge is rigged to explode in **17 minutes**.

Their walking speeds allow them to cross in **1**, **2**, **5** and **10** minutes, respectively.

They have one flashlight which must be used to cross the bridge, but the bridge can only hold two people at once.

Try to get them all across the bridge before the bridge explodes.

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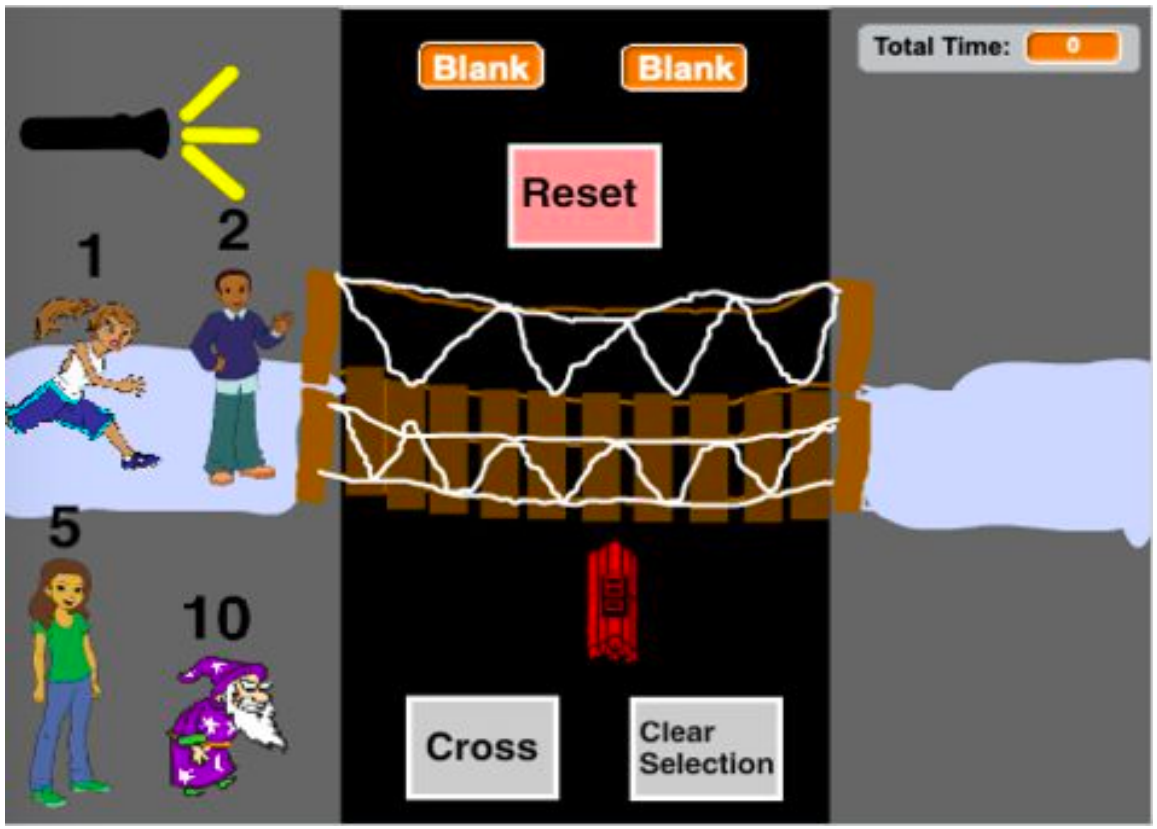
Activity: The Bridge Crossing Conundrum

Complete the Bridge Crossing Conundrum game. Write down the steps in your workbooks.



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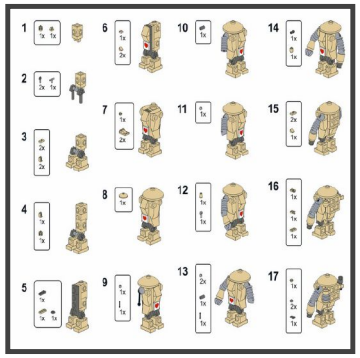
Activity: What is an Algorithm?



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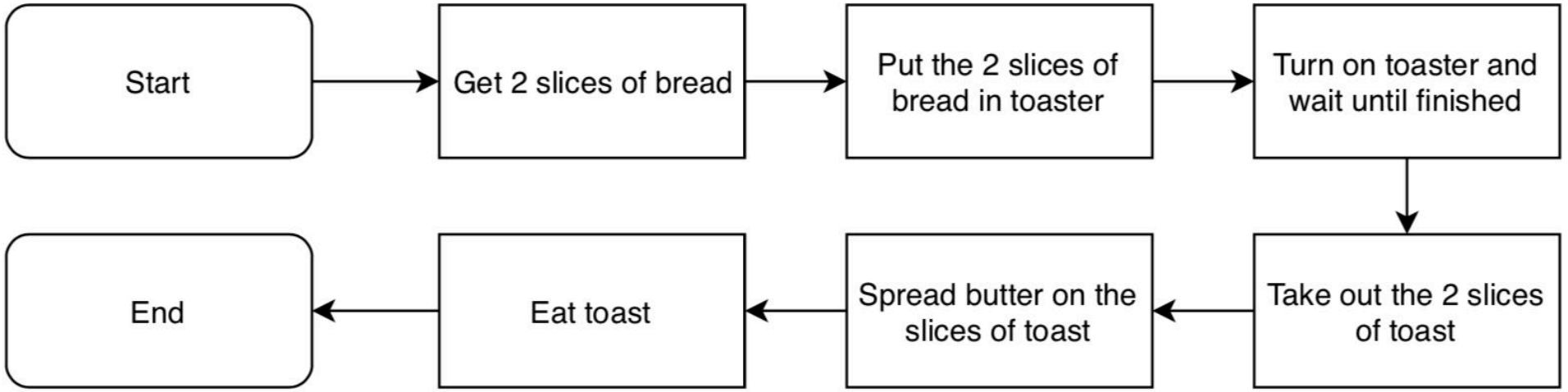
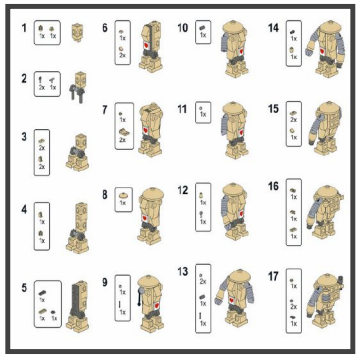
Algorithms

An **Algorithm** is a set of simple instructions that are done in a certain order to solve a problem.

Here's an example: Making and Eating Toast





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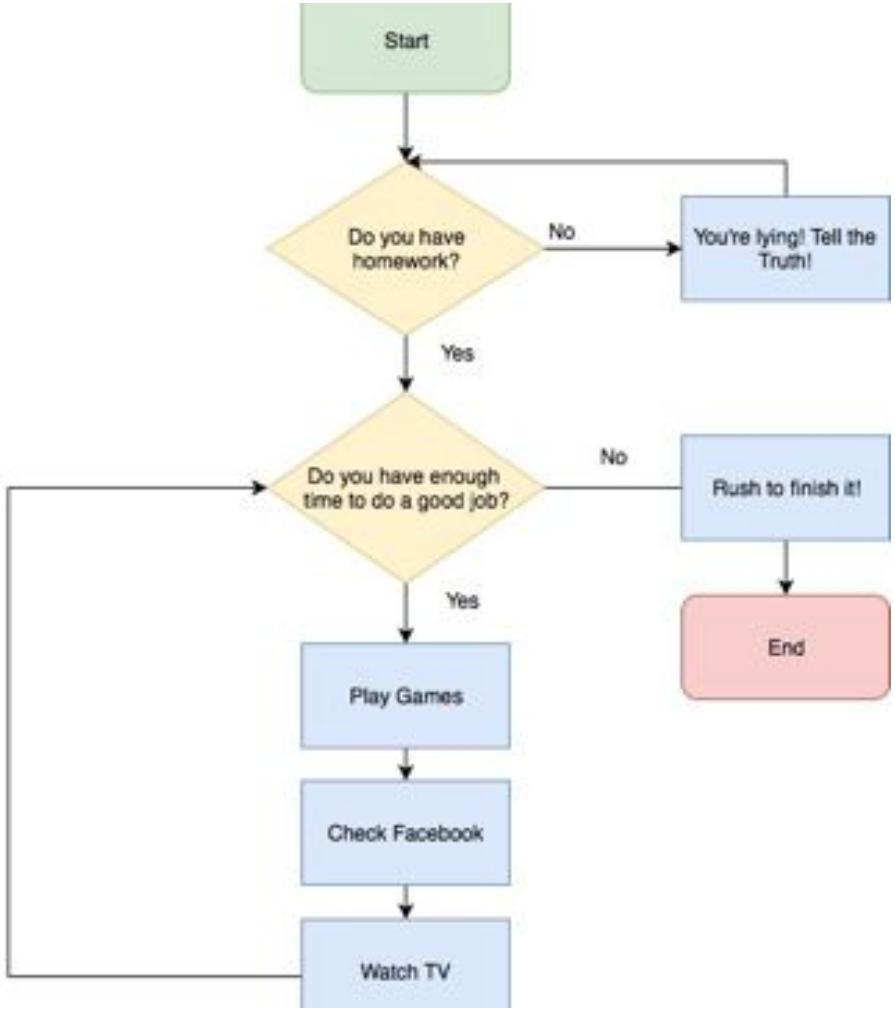
Algorithms

It is important to remember when writing an algorithm to keep instructions:

- simple
- in the correct order,
- unambiguous
- relevant to solving the problem

Where do we use algorithms in everyday life?



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Activity: Defining an Algorithm

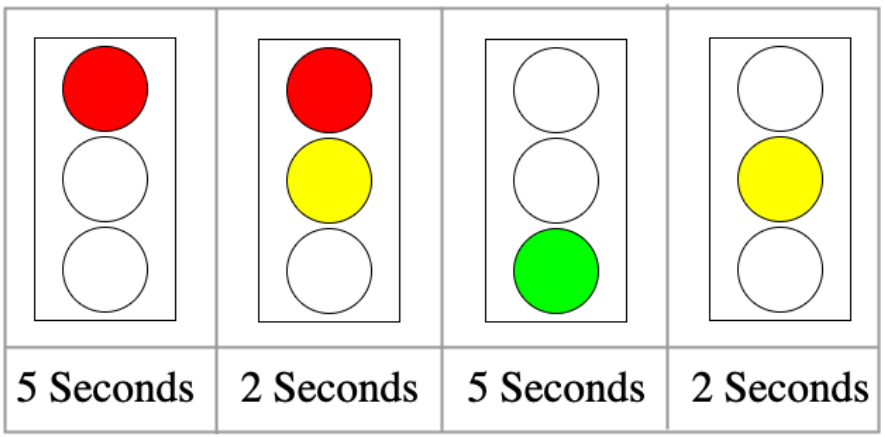
Iteration

An **iteration** is a single pass through a set of instructions. Most programs contain a set of instructions that are executed over and over again. The computer is said to be iterating through the loop.

Some processes include steps or a series of steps that are iterated.

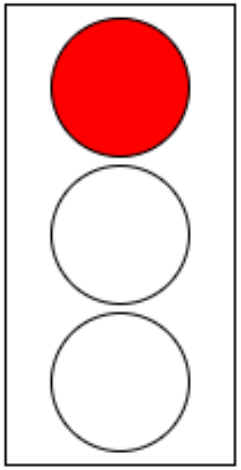
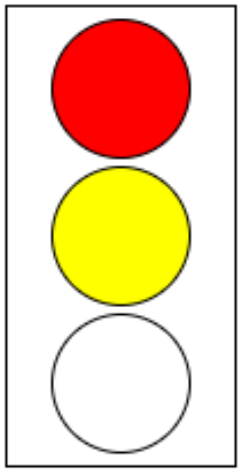
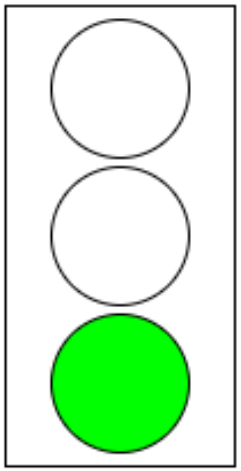
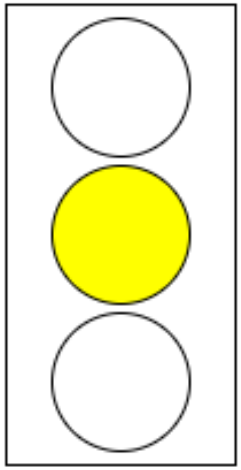
Example: Simple Traffic Lights

- What instructions would you use for this process?
- What needs to be iterated?
- Does this process ever end?



Activity: Traffic Lights Algorithm

Create a Scratch program which simulates the following traffic lights.

			
5 Seconds	2 Seconds	5 Seconds	2 Seconds

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Programming in Scratch

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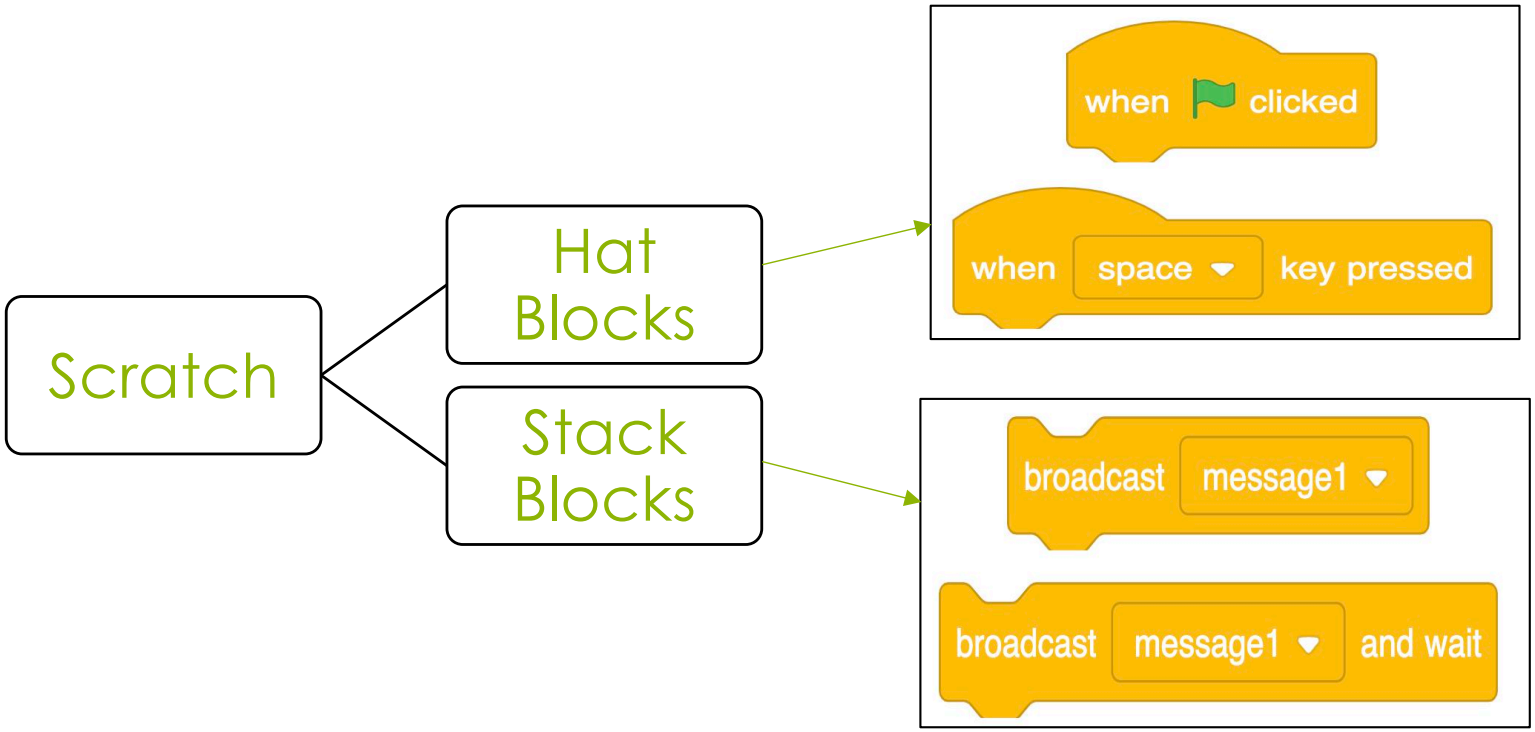
Scratch

- Drag and drop blocks to give instructions
- Easy to create and other useful programs
- User friendly



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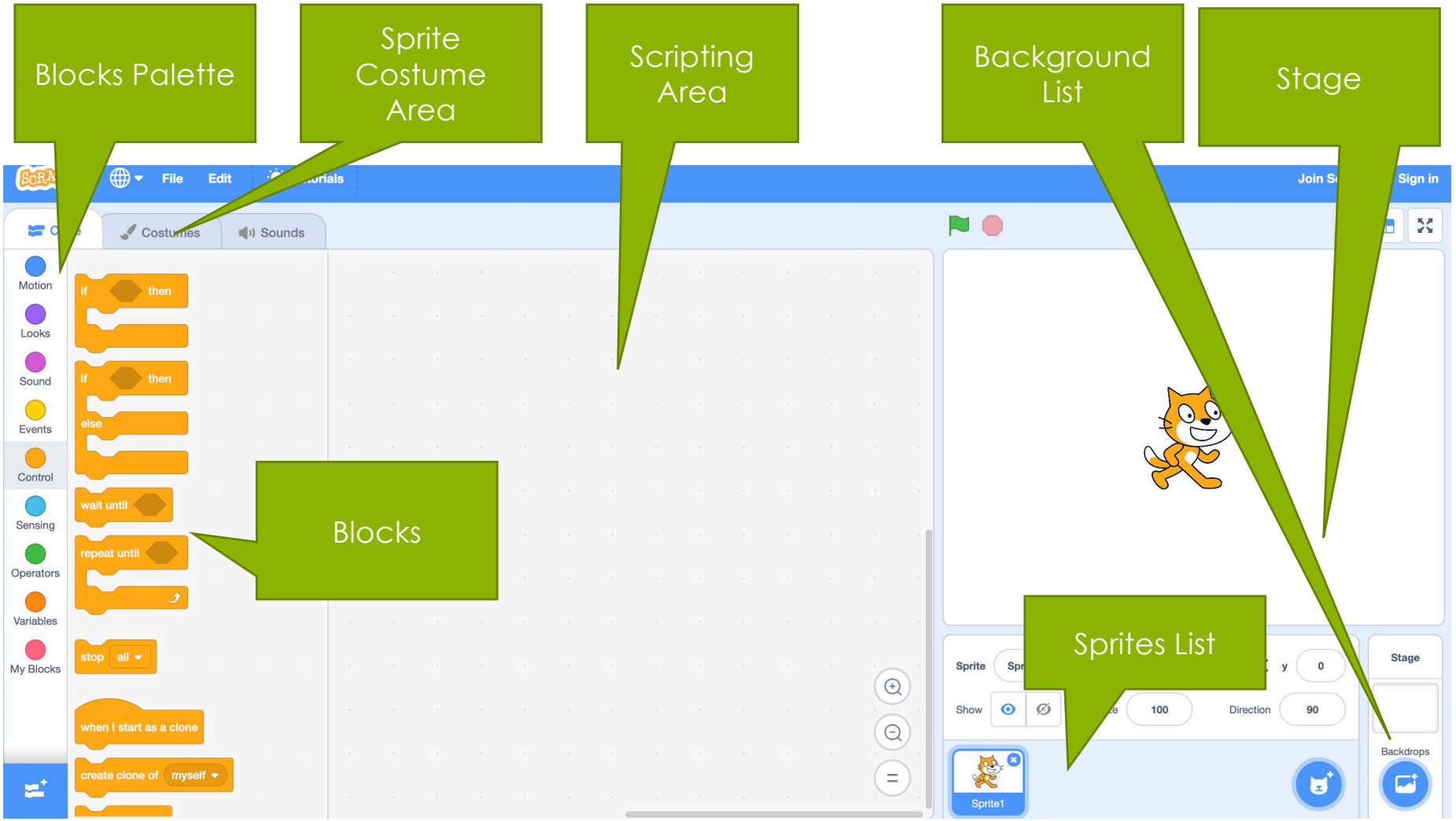
Scratch Basics



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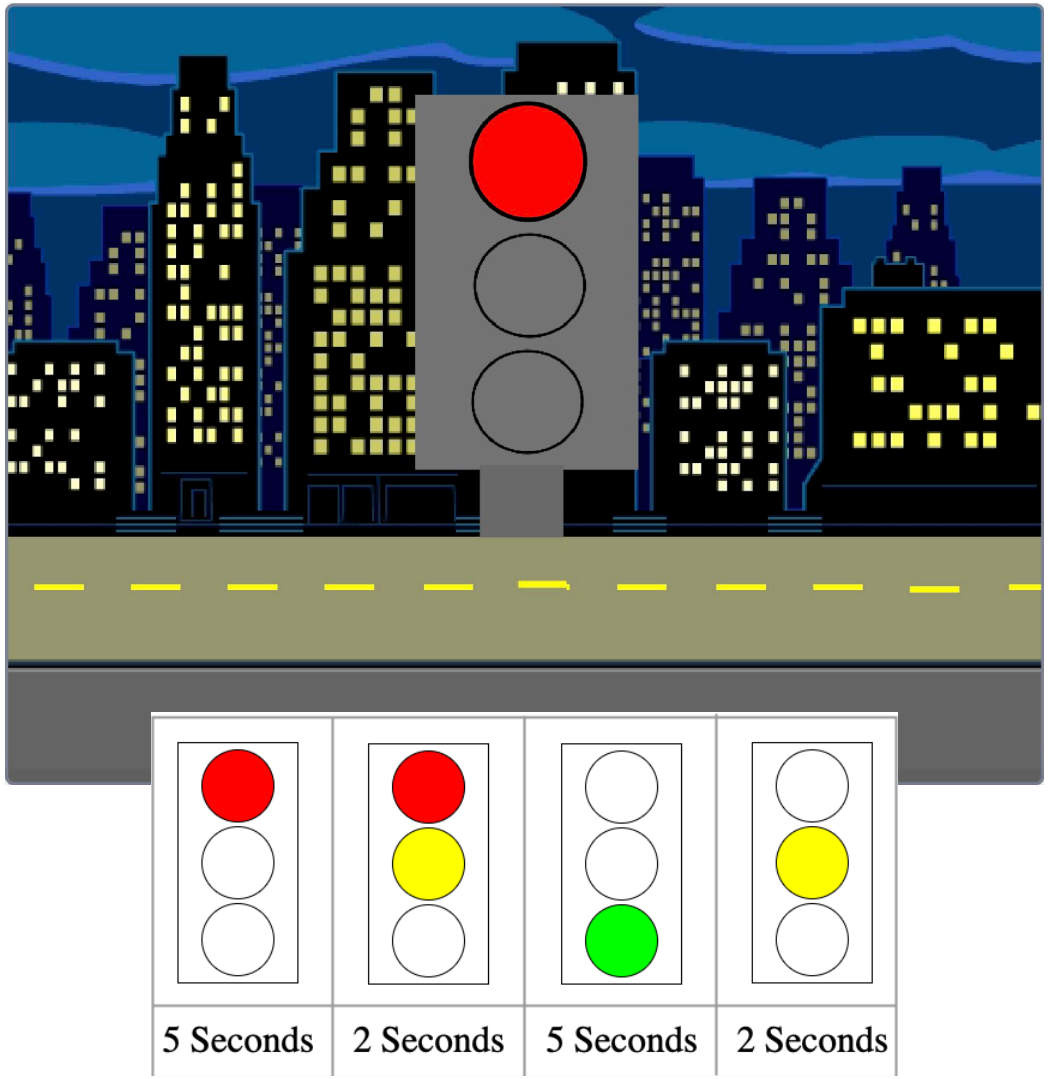
Traffic Lights Algorithm - How Could We Design It?



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Activity: Modifying Your Lights

Here are a few ways to extend your program:

1. **Add a Button** for pedestrians and modify the sequence so that it **stays green until the button is pressed.**
2. Add a crossing on the street and a **light to tell pedestrians when to cross**
3. Add a car which stops at the crossing if the light is red.
4. Add pedestrians who stop at the crossing until it is safe to cross.