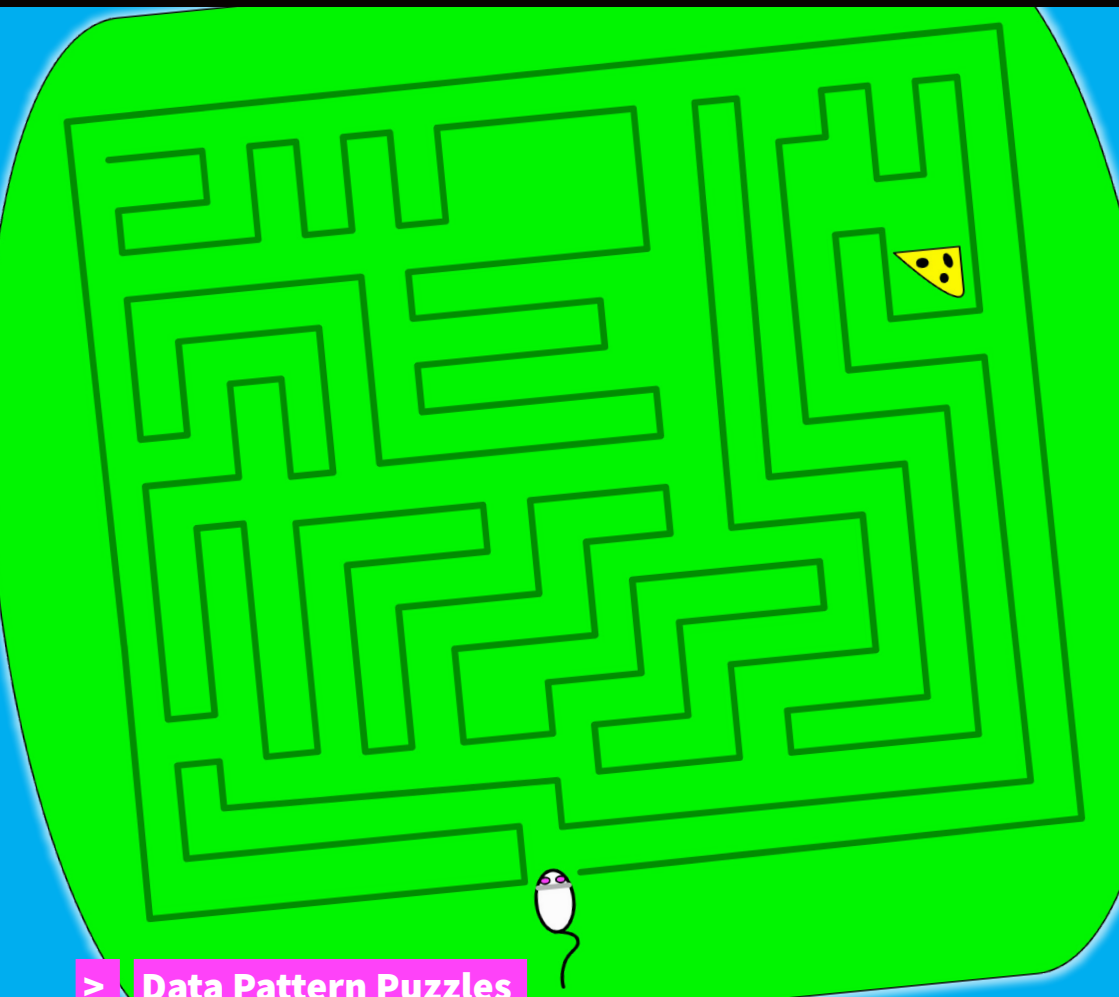
A BIT OF CS4FN
Computer Science for Fun

Primary Puzzles

Issue 1



- Data Pattern Puzzles
- Pixel Puzzles
- Logical Thinking Puzzles
- and more ...

Queen Mary University of London

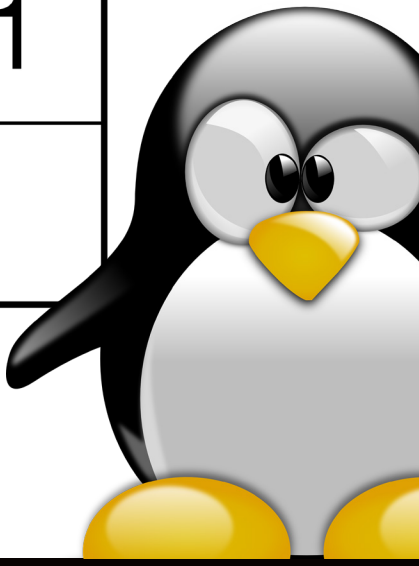
Being able to think clearly and logically is very important for programmers, engineers and scientists.

4x4 Sudoku

- Write a number in each square choosing from 1, 2, 3 and 4.
- Each row and column must contain each of 1, 2, 3 and 4 exactly once and so add up to 10.

		3	
		1	
			1
3		2	

HINT: If a row or column already has three numbers, there is only one thing the last number could be. Pencil in all 4 numbers in a square, then cross out the ones it can't be.



Tick the circle when you have attempted the puzzle and so practised the skill.

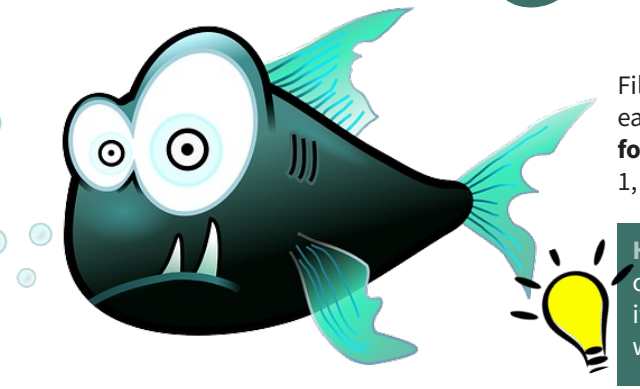
Skill: Logical Thinking

Penguin image by OpenClipart-Vectors from Pixabay

>>>>> Find the answers at cs4fn.blog/puzzles

Logical thinking helps programmers work out the instructions needed to make sure a program works.

4x4 Sudoku



Fill in the grid so that each row AND each column **AND each corner box of four squares** contains the numbers: 1, 2, 3 and 4 once and only once.

HINT: Find a row with more than one number already filled in. Check if numbers in the columns block what numbers could be in the gaps.

Tick the circle when you have attempted the puzzle and so practised the skill.

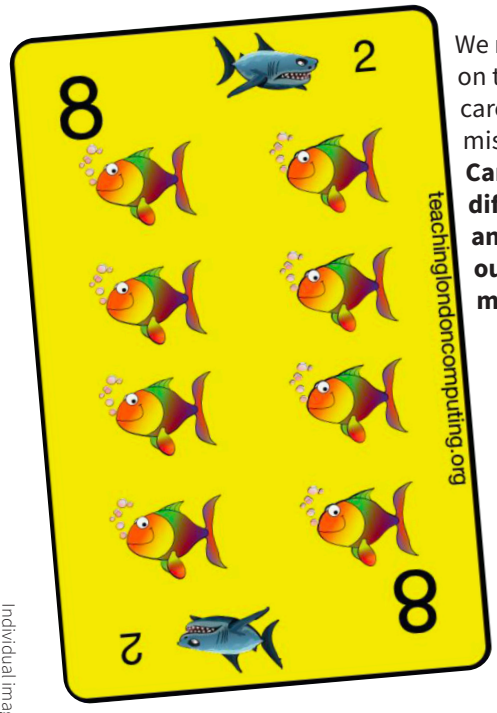
Skill: Logical Thinking

	2		
		4	
2			1
	3		

Fish image by Clker-Free-Vector-Images from Pixabay

Spotting differences needs attention to detail. So does finding mistakes in computer programs (called "bugs").

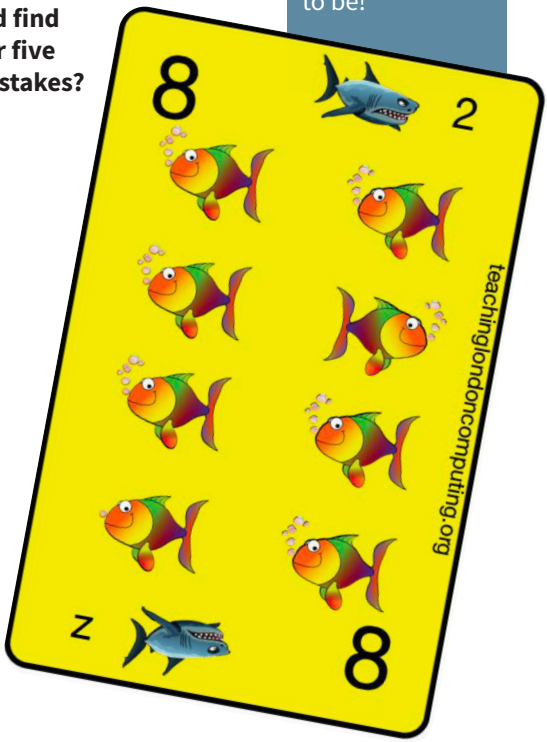
Spot the Difference



We made a copy of the card on the left but were a bit careless and made some mistakes.

Can you spot the differences and find our five mistakes?

HINT:
Differences can be small and not always where you expect them to be!



Tick the circle when you have attempted the puzzle and so practised the skill.

Skill: Attention to detail

Individual images on cards from Pixabay

>>>>> Find the answers at cs4fn.blog/puzzles

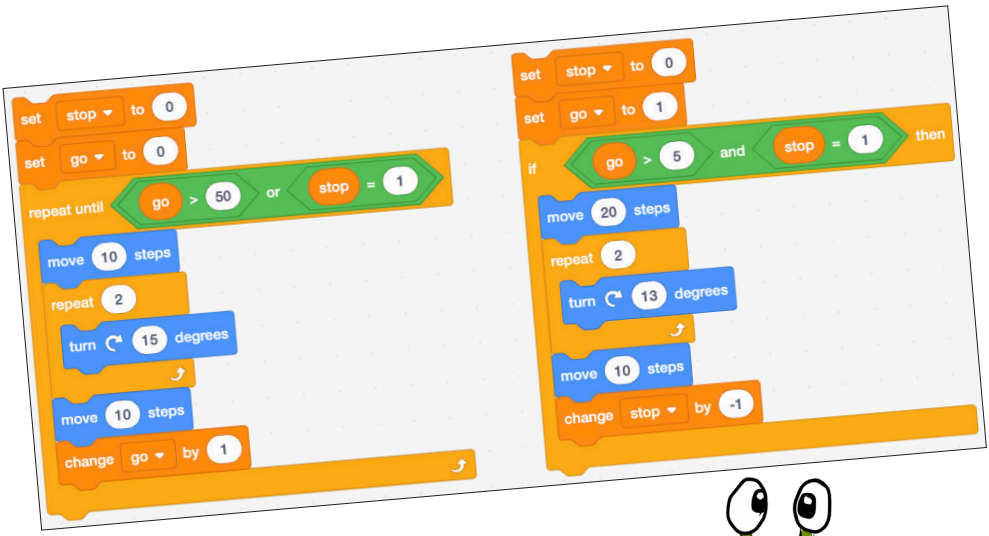
Programmers always check their programs to find bugs - spotting the difference to the code they meant to write.

Spot the Difference

Can you spot 10 differences between the two Scratch programs below?

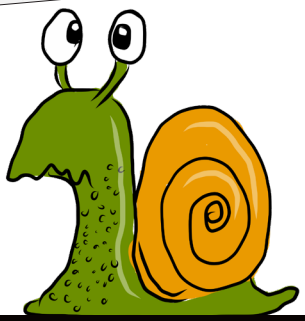
Scratch is a programming language. If you've not played with it yet, try it out at **scratch.mit.edu/** and learn to program.

When you understand what each part of a program does, differences, and bugs, are easier to spot.



Tick the circle when you have attempted the puzzle and so practised the skill.

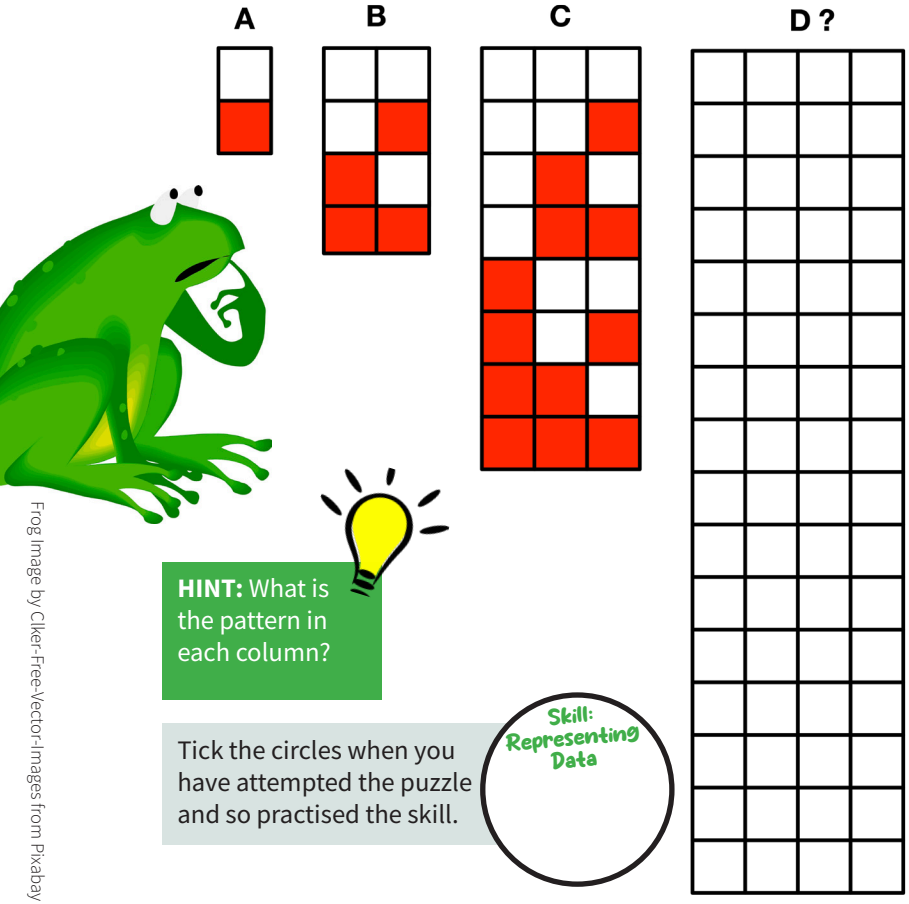
Skill: Attention to detail



Snail image by WALTER ANTONIO Boeger from Pixabay

Data Pattern Puzzle

Work out and complete the algorithmic pattern that goes in grid D.
This pattern is based on the way numbers are represented in a computer.



HINT: What is the pattern in each column?

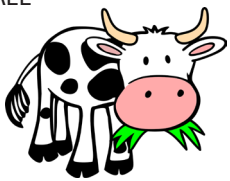
Tick the circles when you have attempted the puzzle and so practised the skill.

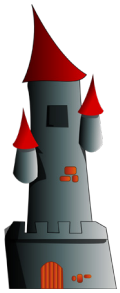
Skill: Representing Data

Frog Image by Clker-Free-Vector-Images from Pixabay

OW! Kriss Kross

Use logical thinking to fit ALL the words into the grid.





Tick the circle when you have attempted the puzzle and so practised the skill.

Skill: Logical Thinking

HINT: Cross out words as you place them.

HINT: If only one word of a given length is left, there is one place it goes.

3 letters	4 letters	5 letters		6 letters
cow	down	brown	sound	flower
now	loud	cloud	shout	
owl	town	mouse	tower	

Pictures can be stored in a computer as numbers. Each number gives the colour of one small area of the picture, called a pixel. This is the way digital images are stored in a camera.

Colour-by-Number Pixel Puzzle

Recreate this picture by colouring each pixel as given by its number. Look up the colour for each number in the key. For example, colour pixels marked 0 in black, and pixels marked 1 in red.

5	5	5	5	5	5	5	5	5	5	5	5	4	5	5	4
5	4	5	5	5	5	2	2	5	5	5	5	4	5	4	5
5	4	5	5	5	2	0	2	2	5	5	5	5	4	5	5
4	5	5	2	2	2	2	2	2	5	5	5	5	4	5	5
4	5	5	5	5	5	5	2	2	2	5	5	5	5	4	5
5	4	5	5	5	5	1	2	2	1	2	5	5	5	5	4
5	5	4	5	5	2	2	1	1	2	5	5	4	5	4	5
3	5	5	4	5	1	2	2	2	2	2	5	4	5	4	5
5	3	4	5	5	2	1	1	1	1	5	5	5	4	5	4
5	5	4	3	5	5	2	2	2	2	2	5	4	5	4	5
5	4	3	5	5	4	5	1	2	1	5	5	4	5	5	4
3	5	4	5	4	5	5	5	1	2	5	3	4	5	4	5
5	3	4	5	4	2	2	5	2	2	5	5	4	3	4	5
3	5	4	5	2	4	5	5	2	5	5	4	5	3	5	4
5	3	4	5	2	2	1	2	2	5	5	5	4	3	5	4
5	4	5	3	4	2	2	2	5	5	5	4	5	5	3	4

KEY

0
1
2
3
4
5

Why not create your own sea scene pixel puzzle picture?

Tick the circle when you have attempted the puzzle and so practised the skill.

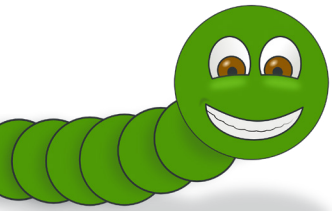
Skill: Representing Data

Sun image by rafdit24 from Pixabay

>>>>> Find the answers at cs4fn.blog/puzzles

Images are stored as lots of numbers and they take up lots of storage space. To save space image compression algorithms use patterns in the data to store a picture using fewer numbers.

Symmetrical Colour-by-Number Pixel Puzzle



This picture is symmetrical. Knowing that, we have only given half the numbers. Can you still complete the full picture?

7	0	7	7	7	7	5	5
7	0	7	7	6	7	7	5
7	0	7	7	7	6	6	4
7	7	0	7	3	3	4	4
7	7	7	0	3	4	4	8
7	7	7	7	7	4	4	8
7	7	0	0	4	8	2	4
7	0	7	8	4	4	8	2
7	0	7	8	4	4	8	1
0	7	7	8	4	4	4	8
0	7	7	8	4	4	4	8
7	7	0	4	8	4	4	8
7	0	7	4	8	4	4	8
7	0	7	7	8	4	8	8
7	0	7	7	7	4	4	0
7	0	7	7	7	7	7	7

KEY

0
1
2
3
4
5
6
7
8

Tick the circle when you have attempted the puzzle and so practised the skill.

Skill: Representing Data

Worm image by Clker-Free-Vector-Images from Pixabay

Text compression

Text compression algorithms replace messages with ones that use less space to store. One way is to swap words with numbers, then use the same number each time the word appears.

Compression puzzle

Here is a poem. To save space we have compressed it.
Use the codebook to recover the original poem.

The poem:

23 7 22 3 16 2 23 12 14 9 20 15 21 22

Answer:

Codebook:

1 = A	14 = MAKES
2 = ALOUD	15 = PROUD
3 = ALWAYS	16 = SINGS
4 = BE	17 = SWEET
5 = BLUE	18 = THE
6 = CLOUD	19 = TO
7 = EVERY	20 = VERY
8 = FLOATING	21 = 19 4 1
9 = HIM	22 = 13 6
10 = HOW	23 = 24 25
11 = IN	24 = 10 17 21 6
12 = IT	25 = 8 11 18 5
13 = LITTLE	

Tick the circle when you have attempted the puzzle and so practised the skill.

Skill: Algorithmic Thinking

HINT:
Replace numbers by their entry in the codebook. For example, 13 is replaced by LITTLE and 22 is replaced by 13 6. 13 and 6 are then replaced too.

Cloud image by PC

Images can also be represented by the commands to build them. An early use of Computer generated images (CGI) was to draw natural scenery, so trees and other plants.

Doodle Draw puzzle

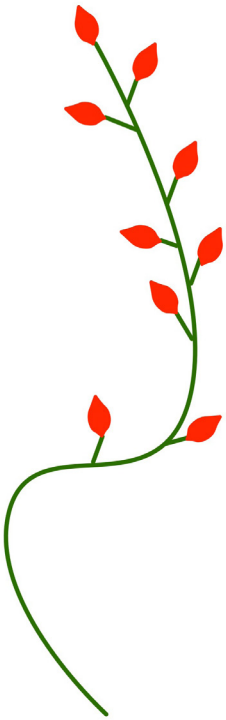
Next time you find yourself doodling, draw an algorithmic doodle and explore algorithms for drawing nature. Here is one example.

To Draw a Rose Bush with Buds:

1. Draw a wavy green line with small lines sticking out at angles from it on either side. Draw red buds from the end of every line. (We have done this first line for you).
2. DoodleDraw from that line as follows.

To DoodleDraw from a chosen line:

1. Draw a new similar wavy line from any point on the chosen line into any empty space. It should have similar lines sticking out and buds.
2. Choose a new existing line and DoodleDraw from that line



Rose Bush image by PC

Skill: Algorithmic Thinking

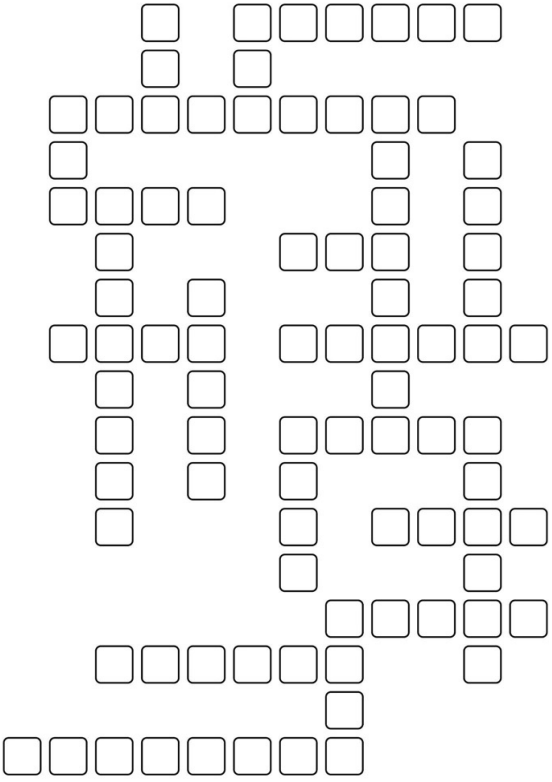
Tick the circle when you have attempted the puzzle and so practised the skill.

Computer Science Skills

With lots of practice you can get better at any skill, whether logical thinking, attention to detail or spotting patterns.

Kriss Kross puzzle

Use logical thinking to slot the words into the grid.



3 letters
ant
bee
bug
fly

4 letters
gnat
moth
slug
wasp
worm

5 letters
aphid
louse
midge
snail

6 letters
beetle
earwig
spider
weevil

8 letters
lacewing
ladybird
nematode

9 letters
butterfly

HINT:
If there is only one word of a given length left there is only one place it will go. Cross out words as you place them.

Tick the circle when you have attempted the puzzle and so practised the skill.

Skill: Logical Thinking

Insect image by Clker-Free-Vector-Images from Pixabay

Light bulb image, all pages. Image by OpenClipart-Vectors from Pixabay

Well done if you have solved all the puzzles! You have great thinking skills and are well on the way to building the skills to be a great Computer Scientist! If not, keep practising. You will get better.

Solutions: Find the answer booklet and copies of puzzle sheets to photocopy for class use at **cs4fn.blog/puzzles/** Thanks to support from EPSRC on grant EP/W033615/1. Design by Kelly Burrows (kellyburrows@gmail.com)

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