

Warm-up: rows

Clue = blanks, coloured, blanks, ... Shade the boxes with a pencil.

Name: _____

Date: _____

A Decode the rows

Example: 2, 7, 3 means 2 blank, 7 coloured, 3 blank.

2, 7, 3

--	--	--	--	--	--	--	--	--	--	--	--	--

Your turn. (0 first = starts coloured)

3, 5, 4

--	--	--	--	--	--	--	--	--	--	--	--	--

0, 4, 8

--	--	--	--	--	--	--	--	--	--	--	--	--

1, 2, 2, 2, 5

--	--	--	--	--	--	--	--	--	--	--	--	--

6, 6

--	--	--	--	--	--	--	--	--	--	--	--	--

0, 3, 3, 3, 3

--	--	--	--	--	--	--	--	--	--	--	--	--

B Squash it

Write each string as a clue: count each run, then the letter.

AAAABBBBCCCCD

→

4A 3B 4C 1D

WWWWBBW

→

XXXXXXXXXX

→

C Stretch it

4C 2A 5B

→

3X 1Y 2Z

→

1A 1B 1A 1B 1A

→

Decode it: Mystery picture 1

Shade the coloured pixels. Clue = blanks, coloured, blanks, ...

Name: _____

Date: _____

- 2, 7, 3
- 1, 10, 1
- 1, 8, 2, 1
- 1, 8, 2, 1
- 1, 10, 1
- 2, 6, 4
- 3, 4, 5
- 4, 3, 5
- 0, 12

Tip: a clue that starts with 0 means the row starts coloured. Every row's numbers add up to 12.

What is it? _____

How long did it take? _____ min

Decode it: Mystery pictures 2 and 3

Name: _____ Date: _____

Shade the coloured pixels. Clue = blanks, coloured, blanks, ... Each row adds up to 14.

Mystery picture 2 What is it? _____

14																			
7, 3, 4																			
6, 4, 4																			
6, 2, 6																			
3, 3, 2, 3, 3																			
2, 4, 2, 4, 2																			
1, 12, 1																			
1, 10, 3																			
1, 9, 4																			
1, 9, 4																			
1, 9, 4																			
1, 9, 4																			
1, 11, 2																			
1, 12, 1																			
2, 10, 2																			
4, 6, 4																			

Mystery picture 3 What is it? _____

14																			
5, 4, 5																			
4, 6, 4																			
3, 3, 2, 3, 3																			
3, 2, 4, 2, 3																			
3, 2, 4, 2, 3																			
3, 2, 4, 2, 3																			
2, 10, 2																			
2, 10, 2																			
2, 10, 2																			
2, 4, 2, 4, 2																			
2, 4, 2, 4, 2																			
2, 4, 2, 4, 2																			
2, 10, 2																			
2, 10, 2																			
2, 10, 2																			
2, 10, 2																			
14																			

Decode it: Mystery picture 4

Shade the coloured pixels. Clue = blanks, coloured, blanks, ...

Name: _____

Date: _____

14														
4, 6, 4														
3, 8, 3														
2, 10, 2														
1, 12, 1														
1, 12, 1														
1, 3, 1, 4, 1, 3, 1														
1, 12, 1														
1, 12, 1														
1, 12, 1														
1, 5, 2, 5, 1														
1, 4, 4, 4, 1														
14														
14														

? Spot the pattern

- 1 Which rows have the same clue? Rows _____ and _____
- 2 Which row is the widest (most coloured pixels)? Row _____
- 3 What do you notice about the left and right sides of the picture?

Be the computer

Follow the code one step at a time. Fill in every empty box.

Name: _____

Date: _____

Part 1 Trace `decode_row([2, 7, 3])`

Start: `row = []` `colour = 0` . Step 1 is done for you.

step	number	colour	what gets added	row so far
1	2	0	0, 0	[0, 0]
2	7			
3	3			

Part 2 A clue that starts with 0

Trace `decode_row([0, 4, 2])` . Fill in the rest.

step	number	colour	what gets added	row so far
1	0	0		
2	4			
3	2			

? What is different about the first step?

What does `colour = 1 - colour` **do**? Try `colour = 0` , then `colour = 1` .

Plan before you type

Write it in plain English first. No code yet!

Name: _____

Date: _____

Part 1 Steps for `decode_row`

Write the steps the function follows, one per line.

Word bank: start • for each number • add • swap colour • return

- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____
- 6 _____

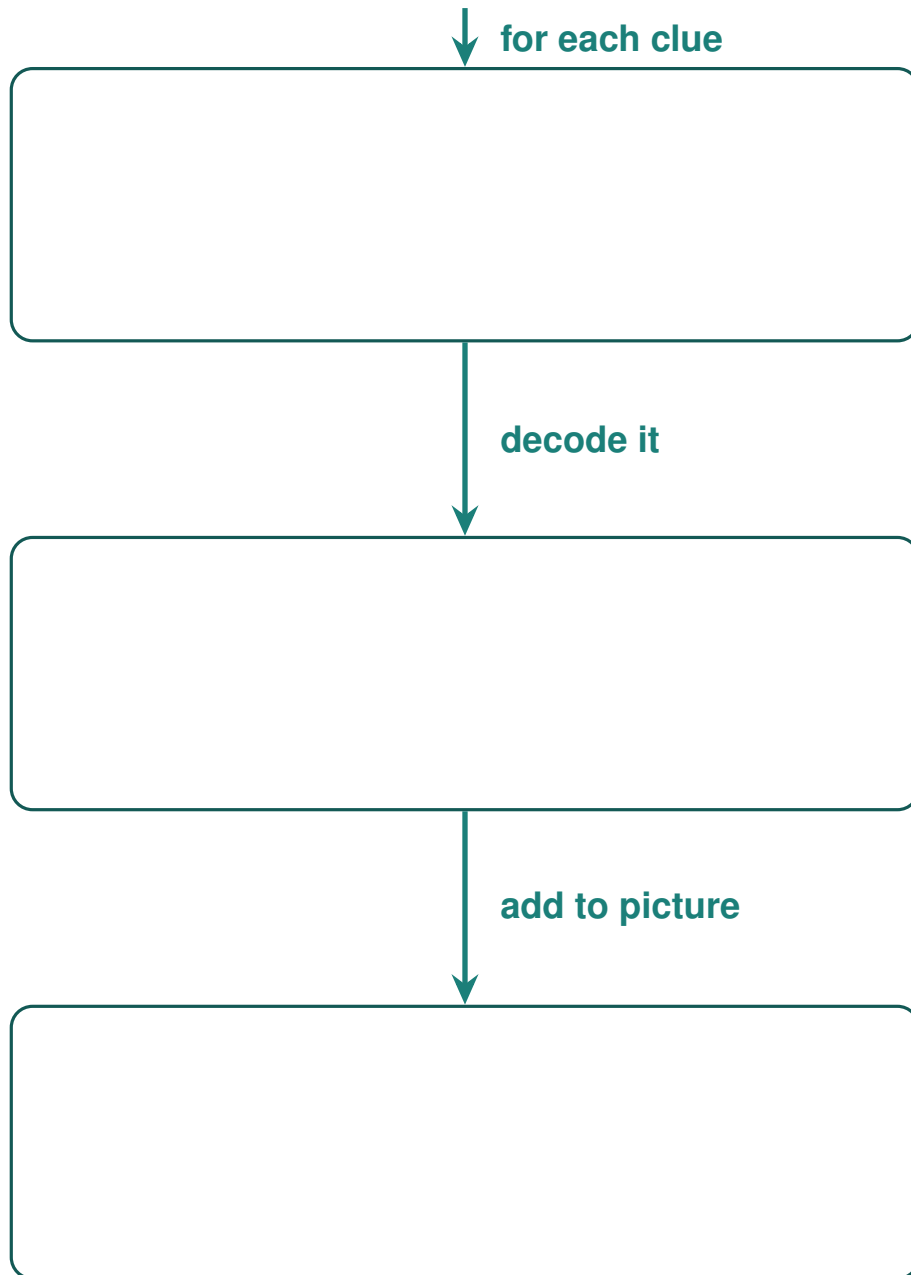
Part 2 Steps for `decode_picture`

Same again, for a whole picture.

- 1 _____
- 2 _____
- 3 _____
- 4 _____

Part 3 Boxes and arrows

Write what happens in each box.



Fill in the functions

Finish the code, run it, and check it.

Name: _____

Date: _____

Part 1 Decode one row

```
def decode_row(clue):  
    row = []          # the row we are building. It starts empty.  
    colour = 0        # we always start with blanks (0)  
  
    # go through each number in the clue (a for loop over the list)  
    for _____ in _____:
```

Write your code here

1. add that many copies of colour (hint: range, row.append)
2. swap the colour: 0 becomes 1, 1 becomes 0

```
    return _____    # what do we give back?
```

```
decode_row([2, 7, 3])  
expected: [0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0]
```

What did YOU get? _____

Did it match? ☐ yes ☐ no, I'll check my code

Part 2 Decode a whole picture

```
def decode_picture(clues):  
    picture = [] # the picture we are building. It starts empty.  
  
    # go through each clue in clues:  
    # 1. decode that clue into a row (use your function!)  
    # 2. add the row to the picture hint: picture.append(...)  
  
    return _____
```

Write your code here

Part 3 Check and time it

Debugging checklist

- ☐ Did I put `return` at the end?
- ☐ Are my indents right?
- ☐ Is colour swapped INSIDE the outer loop but AFTER the inner loop?
- ☐ Did I run the file?

Picture	rows	worked?	time by hand	time by computer
Mystery 1				
Mystery 5				
Mystery 6				
The big one				

Which was faster for the big mystery picture, you or Python? Why?

Stretch: go backwards! Write `encode_row(row)` : count pixels that match the colour, and `append` each count to `clue` . Swap colour when the pixel changes. Don't forget the last count! It should turn `[0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0]` into `[2, 7, 3]` .

The starter code

Your printed copy of `rle_starter.py`. Type it or open the file.

Name: _____

Date: _____

Set up: keep `rle_starter.py` and `pictures.py` in the *same folder*. Open `rle_starter.py` in Spyder and press **F5**. Pictures appear in the Plots pane.

Part 1 Given: do not change

```
5 import matplotlib.pyplot as plt
6 from pictures import MUG, DINOSAUR, MARIO, APPLE, LOCK, GHOST, UK_IRELAND
7 # ^ that line fetches the clues from the file pictures.py (keep it in the same folder)
8
9
10 # ----- GIVEN: you do not need to change this function -----
11 def show_picture(picture):
12     # picture = a list of rows. Each row is a list of 0s (blank) and 1s (coloured).
13     plt.imshow(picture, cmap="Greys", interpolation="nearest")
14     plt.axis("off")
15     plt.show()
16
17
18 # ----- TEST: a tiny picture made by hand -----
19 heart = [
20     [0, 1, 0, 1, 0],
21     [1, 1, 1, 1, 1],
22     [0, 1, 1, 1, 0],
23     [0, 0, 1, 0, 0],
24 ]
25 show_picture(heart)
```

Part 2 Your turn: fill in the TODOs

```
28 # ----- TODO 1: decode ONE row -----
29 def decode_row(clue):
30     row = []          # the row we are building. It starts empty.
31     colour = 0        # we always start with blanks (0)
32
33     # TODO: go through each number in the clue (a for loop over the list).
34     # 1. add that many copies of colour to the row
35     # hint: a loop inside a loop: for i in range(number), then row.append(colour)
36     # 2. then swap the colour: 0 becomes 1, and 1 becomes 0
37     # hint: an if / else, or the shortcut colour = 1 - colour
38
39     return row
40
41
42 # Test it. The answer should be [0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0]
43 print(decode_row([2, 7, 3]))
```

```

46 # ----- TODO 2: decode a WHOLE picture -----
47 def decode_picture(clues):
48     picture = []    # the picture we are building. It starts empty.
49
50     # TODO: go through each clue in clues.
51     #     1. decode that clue into a row (you already wrote a function for this!)
52     #     2. add the row to the picture    hint: picture.append(...)
53
54     return picture
55
56
57 # Test it on the mug, then look at the Plots pane
58 # show_picture(decode_picture(MUG))
59
60
61 # ----- TODO 3: try the bigger ones -----
62 # show_picture(decode_picture(DINOSAUR))
63 # show_picture(decode_picture(MARIO))
64 # show_picture(decode_picture(UK_IRELAND))    # the one that took ages by hand!

```

Part 3 Stretch: go backwards

```

67 # ----- STRETCH: go backwards (ENCODE) -----
68 def encode_row(row):
69     clue = []
70     # TODO: count how many pixels in a row are the same, and add each count to clue.
71     # hints: start by counting blanks (0). Keep a count variable.
72     #     if the pixel matches the colour we are counting, count += 1
73     #     otherwise, add count to clue, swap the colour, and start counting again.
74     #     Don't forget to add the last count when the loop ends!
75     return clue
76
77 # print(encode_row([0, 0, 1, 1, 1, 1, 1, 1, 1, 0, 0, 0]))    # should print [2, 7, 3]

```

Tick when done: ☐ heart shows ☐ decode_row works ☐ mug shows ☐ UK & Ireland shows
☐ encode_row

Decode it: Mystery picture 5

Name: _____ Date: _____

Shade the coloured pixels. Clue = blanks, coloured, blanks, ... Every row adds up to 47. Started: _____ Finished: _____

[illegible]

Decode it: Mystery picture 6

Name: _____ Date: _____

Shade the coloured pixels. Clue = blanks, coloured, blanks, . . . Every row adds up to 16.

6, 5, 5															
4, 7, 5															
3, 8, 5															
3, 11, 2															
3, 9, 4															
2, 12, 2															
2, 13, 1															
1, 14, 1															
1, 13, 2															
1, 13, 2															
3, 10, 3															
4, 7, 5															
4, 8, 4															
3, 10, 3															
2, 12, 2															
1, 14, 1															
1, 14, 1															
0, 16															
0, 16															
0, 16															
0, 16															
0, 16															
1, 14, 1															
1, 14, 1															
2, 12, 2															
1, 6, 2, 6, 1															
1, 5, 4, 5, 1															
1, 5, 4, 5, 1															
2, 4, 4, 4, 2															
2, 4, 4, 4, 2															
0, 6, 4, 6															
0, 6, 4, 6															

Decode it: The big mystery picture

Name: _____ Date: _____

Shade the coloured pixels. Clue = blanks, coloured, blanks, ... Every row adds up to 38.

[illegible]

Started: _____

Finished: _____

Total time: _____ min

Design your own

1. Shade a picture in the grid. 2. Write each row's clue in its box.

Name: _____

Date: _____

Tip: start with a simple shape. A row with no colour is just 14 . Each clue must add up to 14. A row that starts coloured begins with 0 .

Swap: decode their picture

Designer: copy ONLY your clues into the boxes (no picture!), then swap. **Partner:** shade the grid.

Name: _____

Date: _____

Designed by: _____

Decoded by: _____

Did it match the original picture? ☐ Yes ☐ Nearly ☐ No

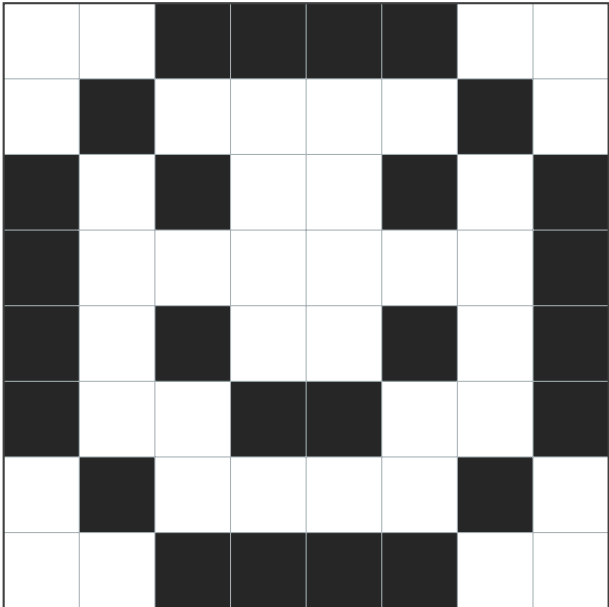
Encode it

Write each row's clue in the box. Blanks first, then coloured (start with 0 if the row starts coloured).

Name: _____

Date: _____

Picture 1



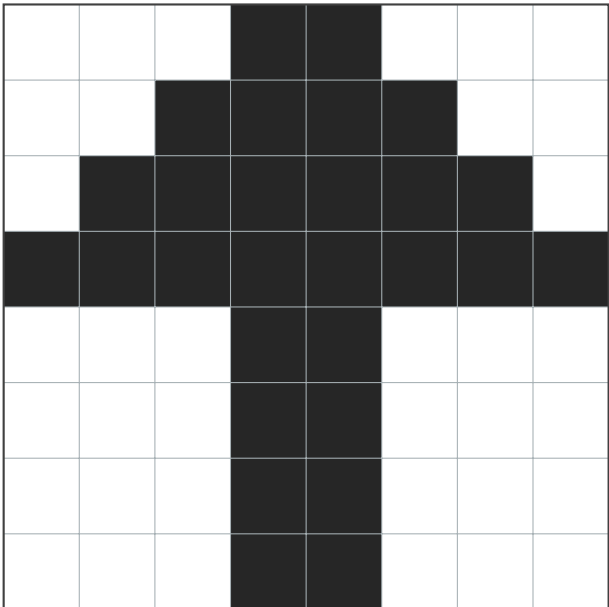
Pixels in picture: 64

Numbers in all my clues: _____

Fewer numbers than pixels?

☐ Y ☐ N

Picture 2



Pixels in picture: 64

Numbers in all my clues: _____

Fewer numbers than pixels?

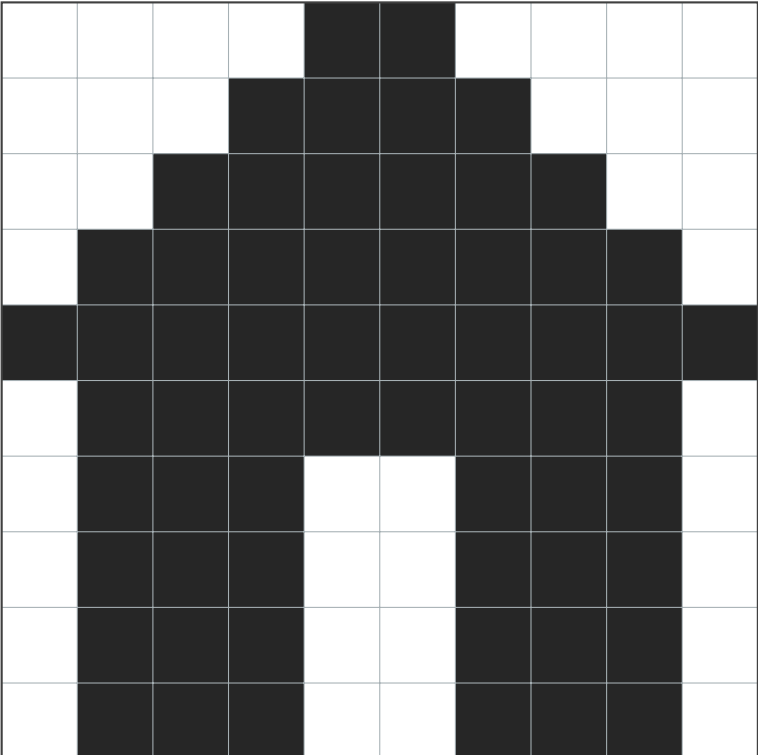
☐ Y ☐ N

Encode it (2)

Name: _____ Date: _____

Write each row's clue in the box.

Picture 3



Pixels in picture: 100

Numbers in all my clues: _____

Fewer numbers than pixels?

☐ Y ☐ N

? Think about it

- 1 Which picture had the biggest saving from using clues? _____
- 2 Would clues save more space on a picture with lots of single dots, or big solid blocks?