Computing

Lesson 4: It’s only Logical

Computer Systems

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Task 1 - Boolean logic - part 1

A digital sensor returns a reading that is either true or false.

You have a digital light sensor and you name its reading **light**. This reading is true when the light level exceeds a certain threshold and false otherwise.

The table on the next slide contains the different possible values for the **light** sensor reading. For each of these values, fill in the table with the corresponding values for the logical expression **not light**.

Task 1 - Boolean logic - part 1

light	**not** light
false	
true	

Task 1 - Boolean logic - part 2

The logical variable **fruit** is true when a diet includes fruit and false otherwise. The logical variable **veg** is true when a diet includes vegetables and false otherwise.

The expression below is a simplistic indicator of a healthy diet:

fruit or veg

The table below contains different combinations of the possible values for **fruit** and **veg**. For each of these combinations, fill in the table with the corresponding values for the logical expression **fruit or veg**.

Task 1 - Boolean logic - part 2

fruit	veg	fruit or veg
false	false	
false	true	
true	false	
false	true	

Task 1 - Boolean logic - part 3

You come across a strange machine. It has a red button, a green button, and a blue light.

You try pressing different combinations of the two buttons and make a table indicating which combinations result in the blue light being turned on.

Task 1 - Boolean logic - part 3

red button pressed **red**	green button pressed **green**	blue light is **on**
true	true	true
true	false	false
false	true	false
false	false	false

Task 1 - Boolean logic - part 3

Write a logical expression that describes when the blue light is on. The expression should involve the **red** and **green** logical variables and it should be true when the blue light is on.

The logical expression is: red **and** green, because the light is on only when **both** the red and green buttons are pressed.

Task 2 - Logic circuits - part 1

Part 1: A circuit with the AND logic gate

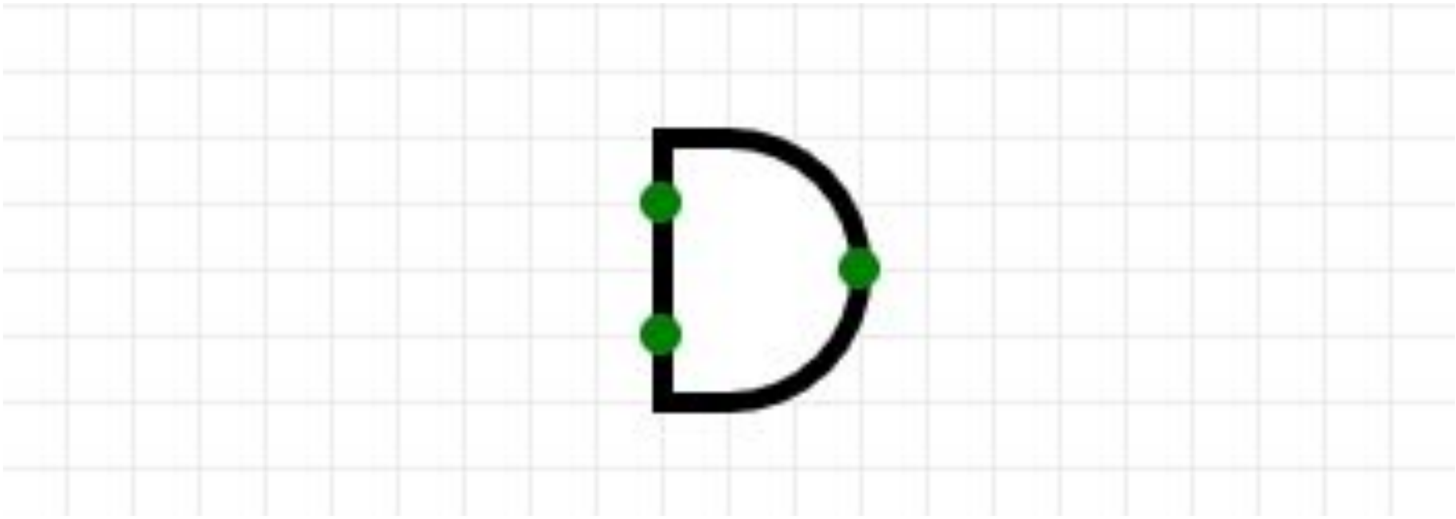
For the tasks below, you will need to open a browser window and visit:

oaknat.uk/comp-simulator

Task 2 - Logic circuits - part 1

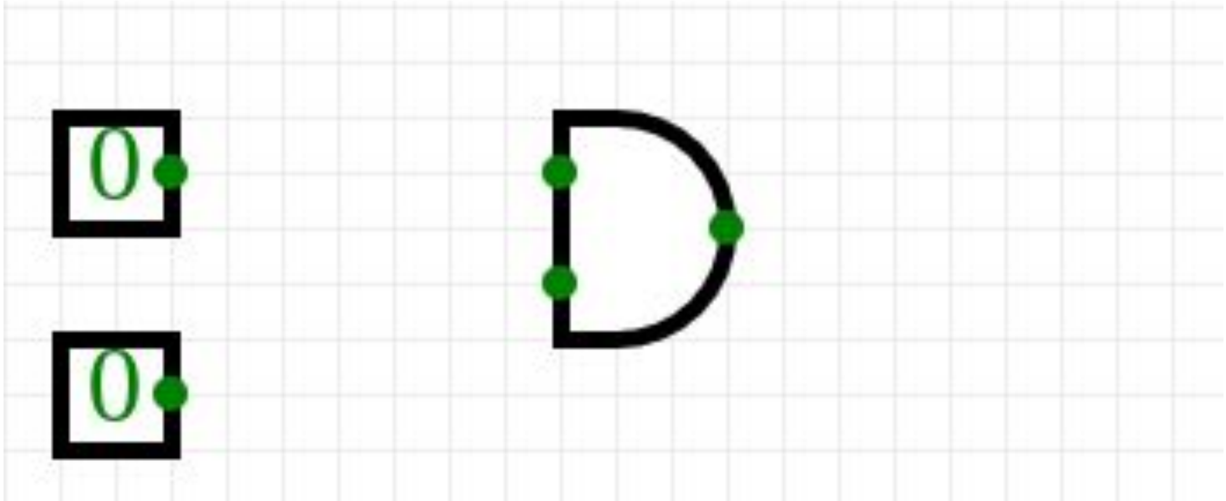
The AND gate

1. Go to ‘Circuit elements’ on the left.
2. Click on **Gates**.
3. Click on the AND gate.
4. Place an AND gate on the canvas.



Task 2 - Logic circuits - part 1

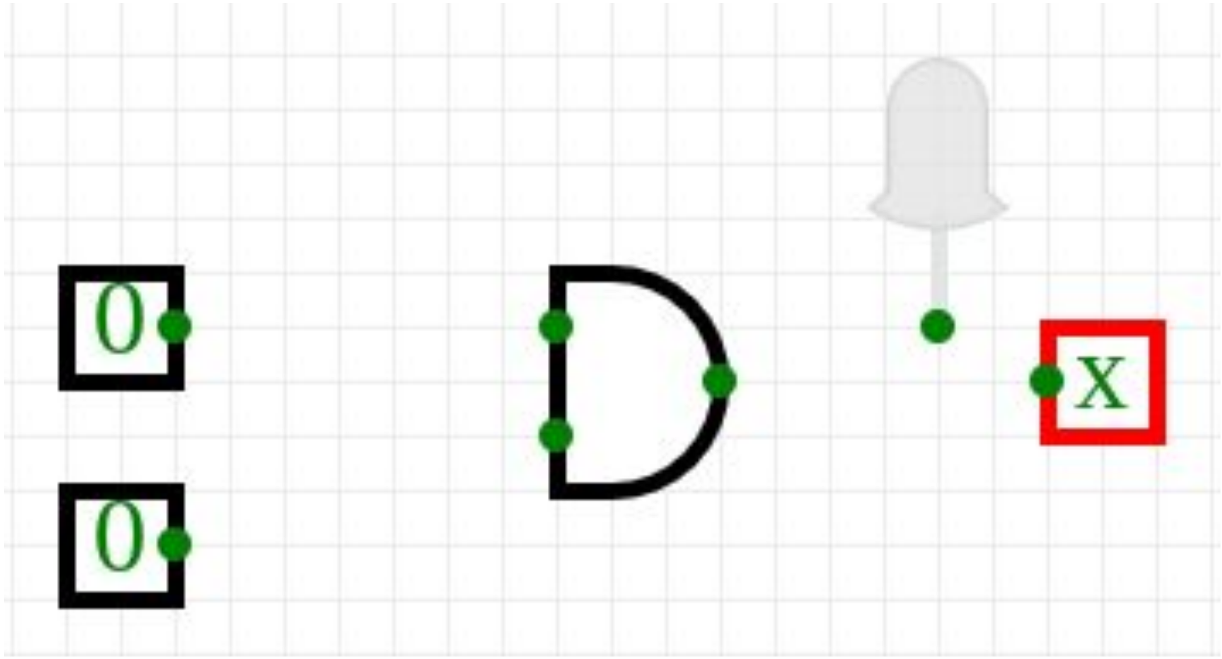
The inputs to the AND gate



5. Go to ‘Circuit elements’ on the left.
6. Click on Input.
7. Click on the **‘Input’** box.
8. Place an input box on the canvas, to the left of the AND gate.
9. Repeat steps 7–8 to add a second input.

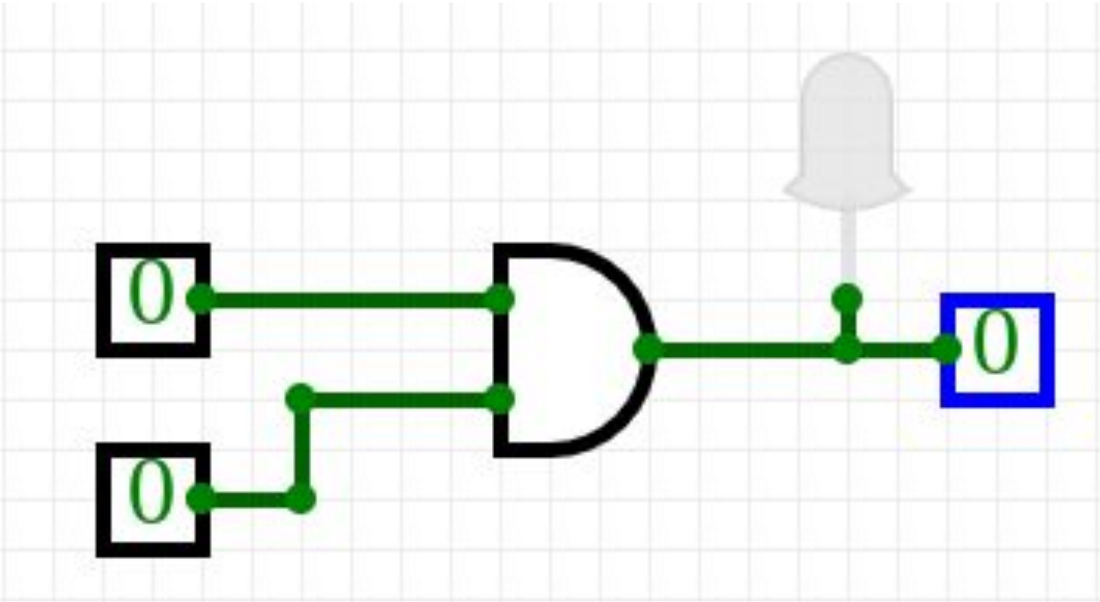
Task 2 - Logic circuits - part 1

The output of the AND gate



10. Go to ‘Circuit elements’ on the left.
11. Click on **Output**.
12. Click on the ‘Output’ box.
13. Place an output box on the canvas, to the right of the AND gate.
14. Click on the ‘Digital LED’.
15. Place an LED on the canvas, to the right of the AND gate.

Task 2 - Logic circuits - part 1



The output of the AND gate

16. Go to ‘Circuit elements’ on the left.
17. Connect the first input box to one of the inputs of the AND gate (by click-dragging on the connectors, i.e. the little green circles).
18. Connect the second input box to the other input of the AND gate.
19. Connect the output of the AND gate to the output box.
20. Connect the output of the AND gate to the digital LED.

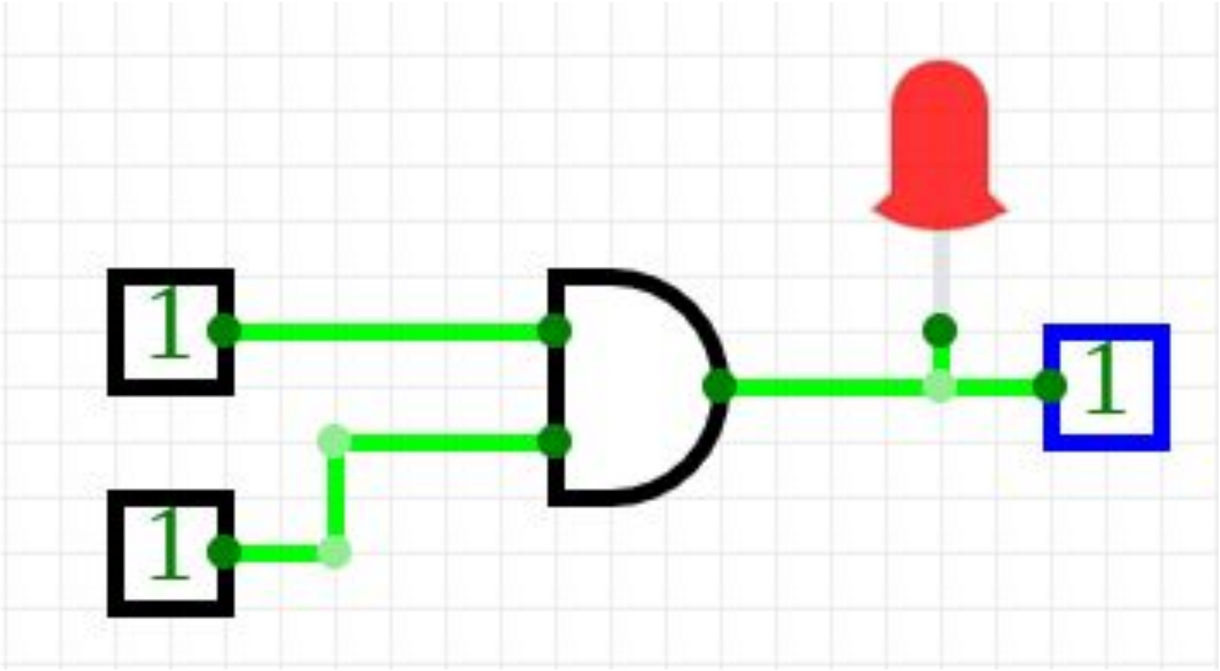
Task 2 - Logic circuits - part 1

You can flip an input from false (0) to true (1) and vice versa by clicking on the input box.

Verify that the output is true (1) and the light is turned on only when both of the inputs are true (1). The table on the next slide contains all the input combinations that you should try.

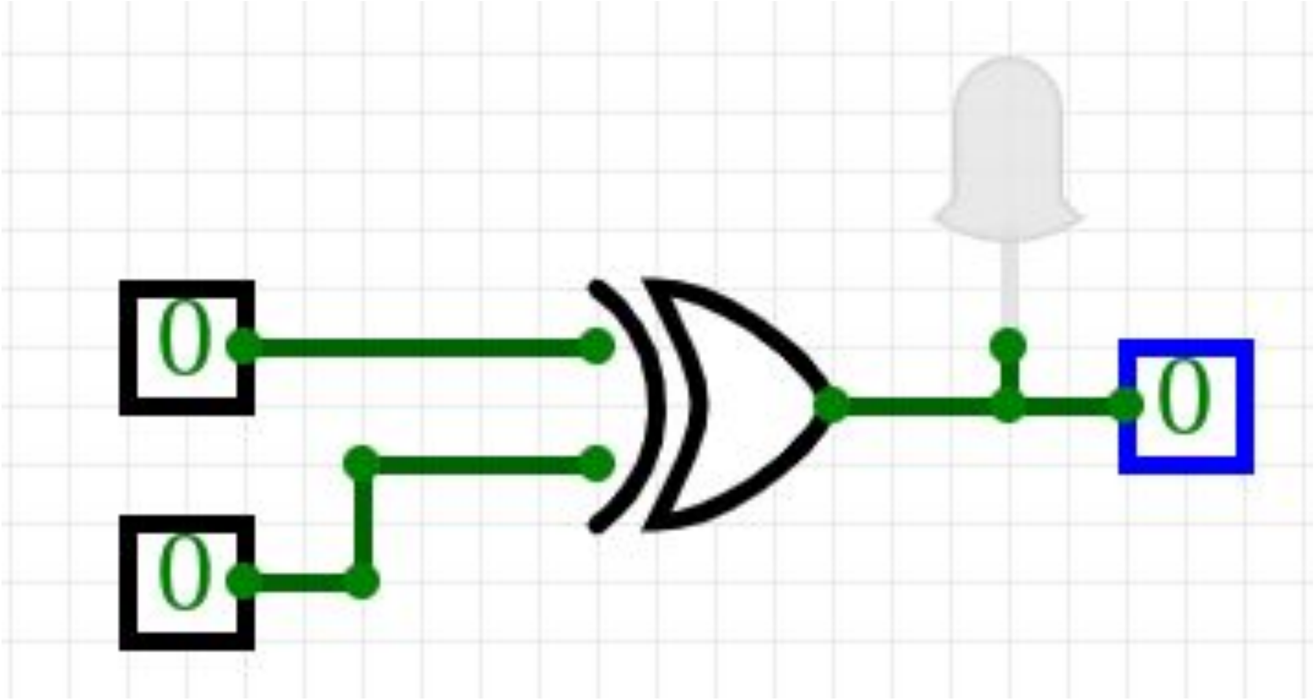
Task 2 - Logic circuits - part 1

First Input **A**	Second Input **B**	AND Output **A and B**
true	true	true
true	false	false
false	true	false
false	false	false



Task 2 - Logic circuits - part 2

Create the logic circuit below.



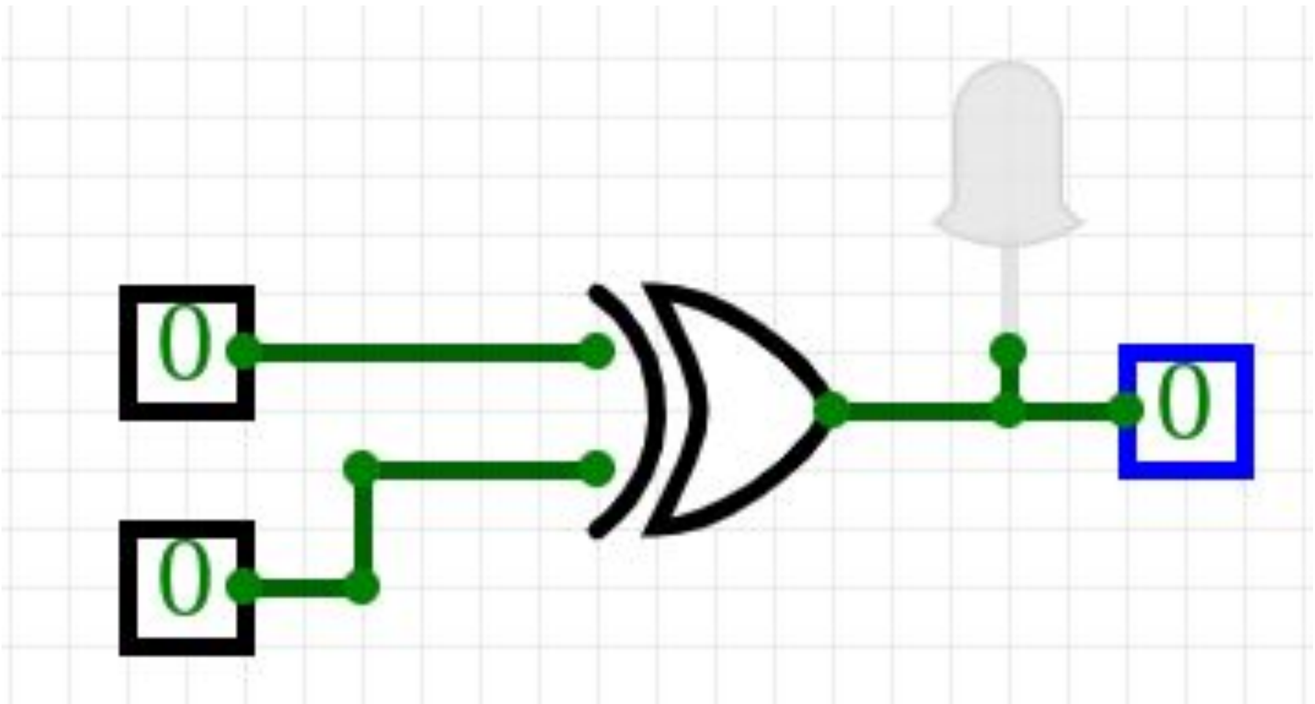
This is identical to the logic circuit that you created in the previous task, except that the **AND** logic gate has been replaced with an **XOR** logic gate. This is a new logic operation.

You can flip an input from false (0) to true (1) and vice versa by clicking on the input box.

Task 2 - Logic circuits - part 2

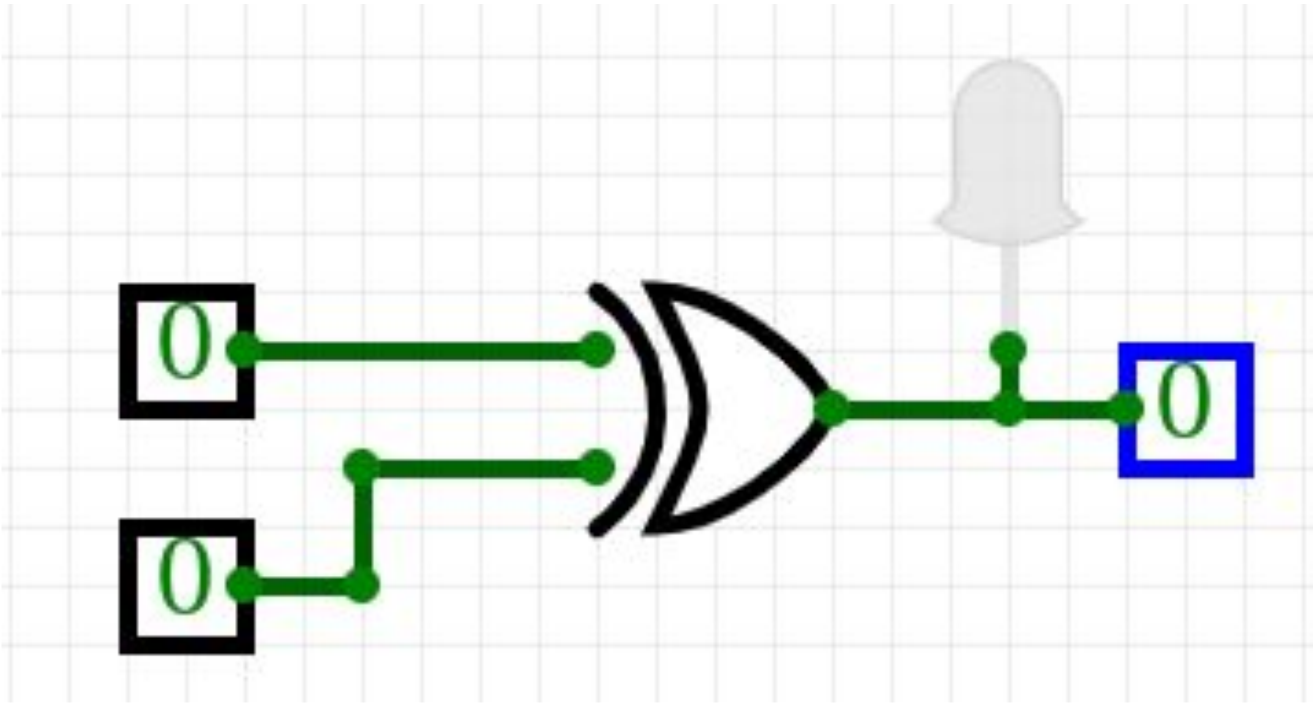
Try all the input combinations in the table below and fill in the table with the corresponding output.

First Input **A**	Second Input **B**	XOR Output **A XOR B**
true	true	
true	false	
false	true	
false	false	



Task 2 - Logic circuits - part 2

Before, we described how the result of the OR operator is true if at least one of its inputs is true. How would you describe the result of the XOR logic operator with words?



You can flip an input from false (0) to true (1) and vice versa by clicking on the input box.

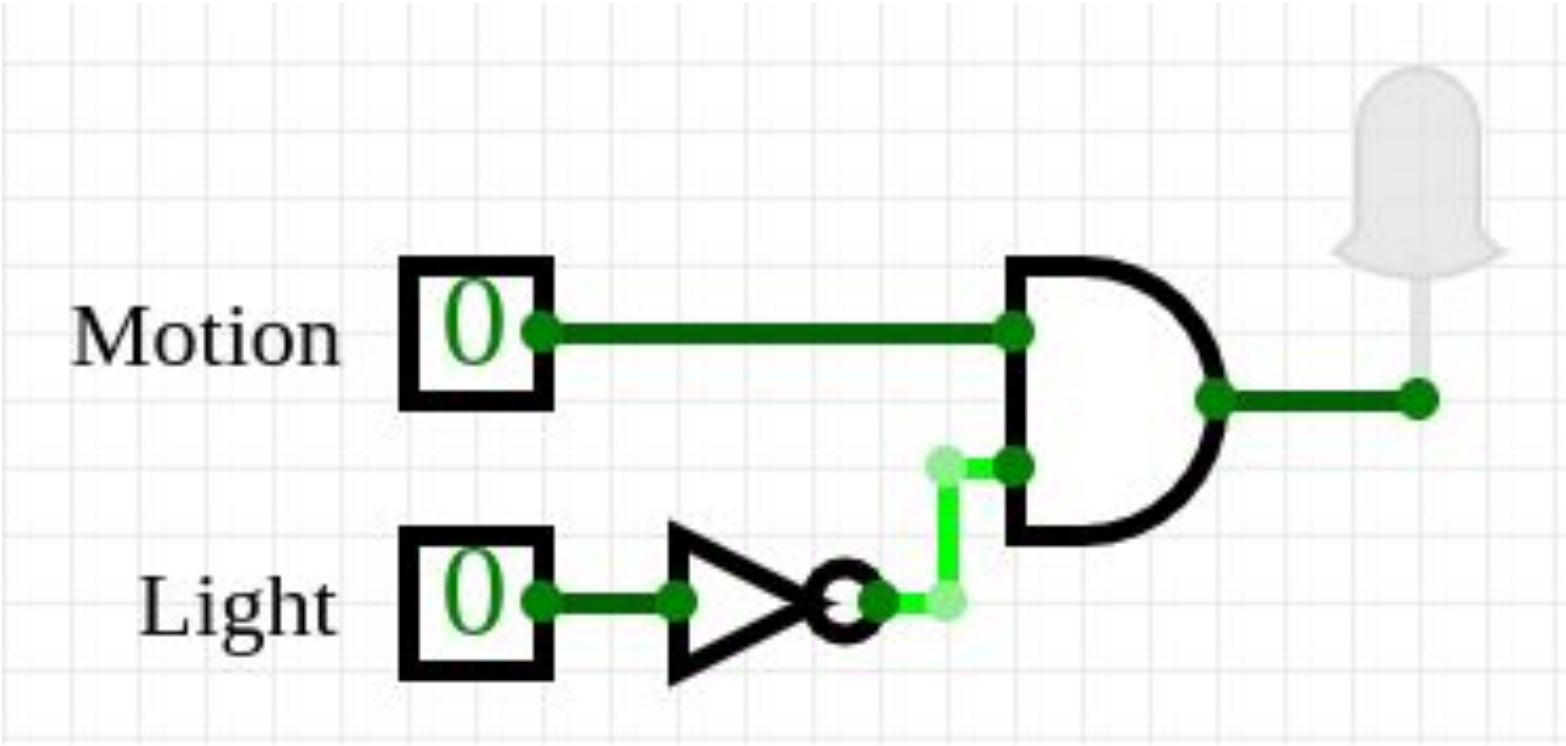
Task 2 - Logic circuits - part 2

Before, we described how the result of the OR operator is true if at least one of its inputs is true. How would you describe the result of the XOR logic operator with words?

Task 2 - Logic circuits - part 3

Part 3: Security light

For the logic circuit below, there is **a single combination of input values** that will turn on the output LED.



Task 2 - Logic circuits - part 2

You can use logical reasoning to deduce what this combination will be, or you can create the circuit and try out the different combinations of input values. Write your answer in the table below, and provide a brief explanation for your answer.

input **motion**	input **light**	output
		true