

Boolean Operators and Sensors

Ages: 11-14

Length: 1 hour

Equipment: PDF print out

Introduction

This lesson introduces the relevant words; ***Boolean operators*** and ***sensor*** through activities that link to student's lives to help them relate to the concepts introduced. This lesson will build upon prior learning relating to selection.

Curriculum Alignment	<ul style="list-style-type: none">• UK National Curriculum Computing Key Stage 3
Learning Objective	<ul style="list-style-type: none">• To describe what a sensor and Boolean operator are• To demonstrate the use of a Boolean operator and sensor
Keywords	<ul style="list-style-type: none">• Boolean operators• Sensor
Resources	<ul style="list-style-type: none">• Boolean Operators Worksheet and answers• Ball
Lesson Sections	<ul style="list-style-type: none">• Setting the Scene• Activity 1 – Sensors and Boolean Operators• Activity 2 – MiRo simulator• Summary

Setting the Scene

Can you decide what to do based on a sensor?

We can make a decision depending on what we sense around us.

Concept	How it is used
<p>A sensor can detect, for example, movement or light and depending on this individually or combined, an output can be activated.</p> <p><i>Can you think of when you have made a decision based on what you sense?</i></p>	<p>When you write code, parts of the code can be activated by a sensor and if more than one sensor, it can be activated with one or both.</p>

Boolean operators include 'AND' and 'OR' and can be used with, for example, variables or sensors.

First let us look at an example of what **Boolean Operators** and **Sensors** are.

Activity 1

Activity 1 is focused on getting students to think about what **Boolean operators** and **sensors** are and relate this to their everyday tasks.

Scenario 1	Scenario 2
<p>You are sitting in a restaurant and reading the menu, how do you choose?</p> <p>Do you have one or more factors that help you decide?</p> <ol style="list-style-type: none">1. The cost?2. The Image?3. The description4. The one you had before?	<p>You need to decide what shoes to wear for the day.</p> <p>Do you have one or more factors that help you decide?</p> <ol style="list-style-type: none">1. Is it cold?2. Is it raining?3. Is it sunny?4. Do you need specific footwear for an activity?

When making a decision you may need to answer one AND/OR another question.

Small Group Activity

Split the students into small groups and give them the Boolean operators worksheet.

In your group, I want you to read the scenario and decide which Boolean operator is needed; AND / OR

Encourage discussion within the group, looking at the keywords within the scenario of 'both' and 'either' to help determine which Boolean operator is used. Ask students to add two further scenarios and highlight the words that define the Boolean operator required within the scenario.

You use **sensors** and **Boolean operators** yourselves. Many computing devices use these to enable the system to work fully. An example: an automatic door can open when movement is sensed OR a button is pressed.

Differentiation

- If pupils need extra support to understand what a Boolean operator is, place a ball in front of them and ask them what will make it move? The ball will move if you push it OR the table moves.
- For higher ability pupils ask them to think of a computer system that uses sensors and what type of Boolean operator would be incorporated.

Additional Small Activity

The use of a boolean operator within programming can be within a conditional statement; an if statement.

Below is the code for a program asking the user to add a number between 1 and 10 and if the number is less than 10 and greater than 5 then the output will be 'condition met' otherwise it will be 'condition NOT met' The use of **'AND'** within the two conditional statements is the **Boolean Operator**.

Example python code:

```
number = int(input('Add a number between 1 and 10: '))
if number < 10 and number > 5:
    print('condition met')
else:
    print('condition NOT met')
```

What would the output be if the number added was 6?

= 'condition met'

What would the output be if the number added was 3?

= 'condition not met'

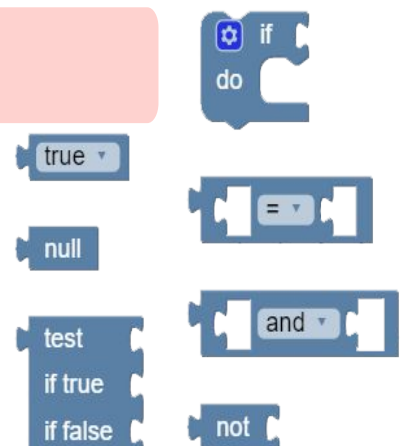
Can you write a similar python program that uses a boolean operator?

Activity 2 Part 1

What are the blocks available for ***Boolean operators***?

They are located within the 'logic' tab.

The default Boolean operator on the block is 'AND' but if you click the dropdown menu you can change to 'OR'.



Sensors on MiRo

- Front Left ▾ Light Sensor
- All Light Sensors
- Sonar Range
- Left ▾ Cliff Sensor
- Body Touch sensors
- Head Touch Sensors

We are going to use the 'Cliff Sensor' block to detect the edge of the table.

Why would we need to use this sensor and how would Boolean Logic come in?

How can we get MiRo to use the cliff sensors and stop falling off the table?

We are going to use an OR to allow MiRo to use both sensors to detect the edge.

What would happen if we used 'AND' instead?

Algorithm planning

1. IF the left OR right cliff sensor is false
 - a. Move forward
2. IF the left sensor is true
 - a. Stop moving
 - b. Turn right fast
3. IF the right sensor is true
 - a. Stop moving
 - b. Turn left fast

Which sensor is being used?

Which Boolean operator is being used?

Using the algorithm as your plan, can you create the program in the MiRo simulator?

Remember there is no fail in computing only debugging, fixing and learning!

Activity 2 - Program solution - Part 1 Create a block based program to utilise the sensors to stop MiRo falling off the table

NB. There can be more than one solution in programming, encourage experimentation and use solution below as a guide

Step 1-2

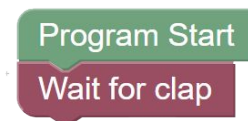
- Add 'program start' from 'Setup'
- Add 'wait for clap' from 'Control'
- Connect to 'Program Start'

** The use of the 'wait for clap' block will enable an event to occur to allow the program to continue. The clap can be a physical clap if you have the robot or can be simulated on the screen through the clap icon.

Step 3-7

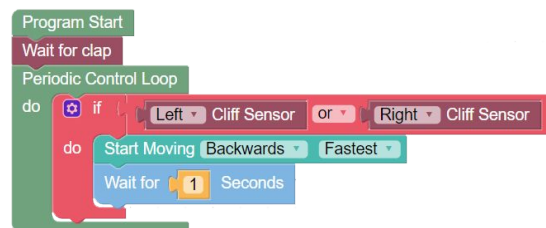
- Add 'Periodic Control do' block from 'Setup'.
- Connect to 'wait for clap'
- Add 'if do' block from 'Logic'.
- Add '(' and ')' block from 'Logic'.
- Connect together inside the 'periodic control loop' block.
- Change 'and' to 'or' in the dropdown menu.
- Add 2 'Left Cliff Sensor' blocks from 'Sensor'

** The error is that both blocks are set to 'up' so will not go up and down. Encourage students to try and debug the code and test it to find the error.



** opportunity to discuss how that is also the use of a boolean operator 'or'. The clap can be completed physically **or** on screen.

- Add one to either side of the 'or' section.
- Change one to 'right'
- Add 'start Moving forwards slow' from 'Simple Motion'
- Connect into the 'do' section
- Change to 'Backwards' and 'Fastest'
- Add 'wait for 1 seconds' block from 'Control'
- Connect under the 'start moving backwards' block.



Step 8

- Click Simulator Play OR
- Click Robot play

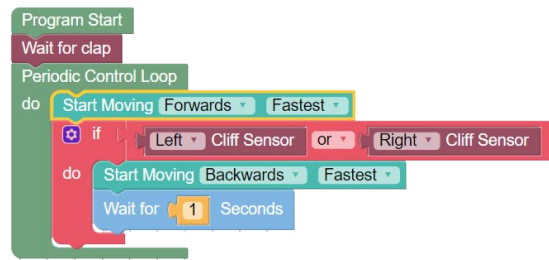
** If you are using the physical MiRO ensure the IP address is correctly added to the onscreen code to allow the code to be communicated to MiRO to action.

** If you are using the simulator remember to use the icon to simulate a clap taking place and start the program.



Step 9

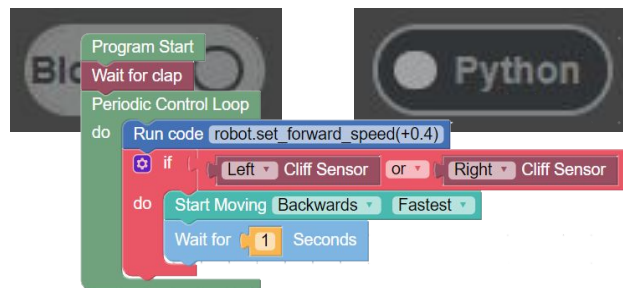
- Why isn't MiRo moving forward?
- Code has not been added to get miRo to move forwards first.
-
- Encourage students to look and see if they can find the error to debug and experiment with a solution.



Activity 2 - Program solution - Part 2 Moving into Python

Step 1

- To flip to look at the python code, click the 'blockly' button at the top of the white canvas.
- When the canvas is switched the button will have the word 'python' on it and is pressed again to return to block code.



Step 2-4

- Select and copy the line of code for moving forward
- Flip back to 'Blockly' view and add a 'run code' block in after the 'move forward' block.
- Paste the code into the 'run code' block.
- Delete the "move forwards' block.

Step 5

Experiment with the code and options are:

- Change the speed setting from 0.4 to 0.1
- Change the speed to minus the number added i.e. -0.4
- Can they add the code block elsewhere and remove the blocks?
- Can they edit the settings directly in python view?

Summary

Have a discussion with the class about what they have learnt in the lesson. Discuss the new words learnt: **Boolean operators** and **sensor** and talk through any difficulties they had.

Ask students to complete the self-assessment and can be done by thumbs up, down and centre or using the images; on the following 3 questions

Questions
Can you identify a sensor?
Can you describe what a Boolean operator is?
Can you create and use a Boolean operator and sensor in the MiRo simulator?

