

### Overview

This lesson requires 2 periods. In the first session, students will gain understanding of conditional statements and learn about AND logic gates. In the second session students will put into practice a system based on conditions and be introduced to the OR logic gate. Students will integrate and exhibit learning by creating a system which emits at different levels of alert, depending on conditions.

### Key Information

**Level 4:** (Ages 11-12) US Grades 5 or 6

**Time:** 45/90 minutes

<a href="#">Warm-Up</a>	10 minutes
<a href="#">Mini-lesson</a>	10 minutes
<a href="#">Worked Example</a>	25 minutes
<a href="#">Challenge 1</a>	25 minutes
<a href="#">Challenge 1 - Debug</a>	5 minutes
<a href="#">Challenge 2</a>	10 minutes
<a href="#">Tidy Up / Exit Ticket</a>	5 minutes

### Lesson Topics

- **Computing/Coding**
  - Inputs, outputs, modifiers, debugging, loops, logic gates, AND and OR, conditional statement, 'if', 'then', and 'else' and different functions within a system
- **History**
  - Understanding the history of the international distress signal 'SOS' as well as the legacy of Morse Code
- **English Language Arts**
  - Use information gained from the illustrations and words in a print or digital text

### Learning Objectives

- **As a result of this lesson, students will be able to:**
  - Understand the concepts of conditional statements
  - Understand the workings and use of Logic Gates (AND and OR)
  - Understand the importance of such knowledge in order to understand how computers work
  - Build, debug and calibrate a system to make different types of alert signal, including Morse code, when certain conditions are met

### Materials

- SAM Labs Kit
- SAM Labs Student Workbook

### Warm Up

10 minutes

*How do we make choices?*

**Objective:** Students explore the process of decision-making based on conditions

**Procedures:** Teachers asks the students to take a look at each pictures. *How many choices do you make each day? Each week? How many of these choice are based on conditions? What are the choices here? What are the conditions?*



**Sample picture ideas:** Choices based on weather, choices based on day of the week

**Link forward:** Teacher prepares to present the idea of conditional statements

### Mini-lesson

10 minutes

*Decisions, conditions and Morse code*

**Objective:** Understand conditional statements combined with the boolean operator 'AND'.

**Procedures:** Very often we make a decisions based on two (or more) conditions. The weather **and** the day or time of year affect our decisions. For example, we might think, *'If it's a weekday **and** it's cold, go to school wearing a thick coat'*.



## Lesson 4.4 - Morse Code Alert

At the end of the mini-lesson, students match or define keywords in their workbooks.

(2 minutes)

### Key Words

- Condition
- Morse Code
- Fulfil
- Decision

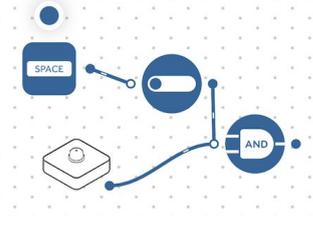
**Checks for understanding:** *Why it is important for us to understand how computers think? In your workbooks or with a partner, record, discuss or share how the way computers make decisions mirror what we do in real life.*

**Link forward:** Today we are going to build a Morse Code alarm system that will send different automatic alerts when certain conditions are met.

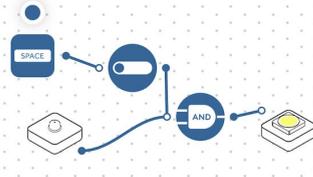
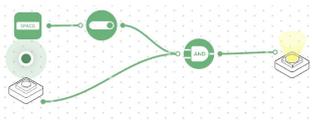
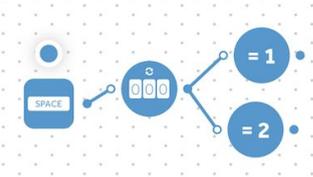
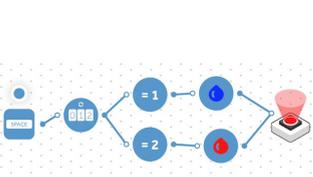
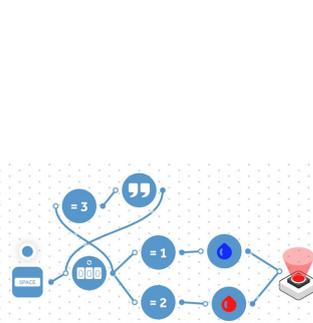
## Worked Example

25 minutes

Make SAM Labs systems that demonstrate Morse Code and conditions

Instructions	Workspace	Notes for Teachers
<p><b>Step 1.</b> Drag and connect the following blocks onto the Workspace:</p> <ul style="list-style-type: none"> <li>• Key Press block</li> <li>• Text block</li> <li>• Morse Code block</li> <li>• RGB LED block</li> </ul>		<p>First we are going to make a basic system to send Text to a Morse block with output to an RGB LED.</p>
<p><b>Step 2.</b> Open the Text block settings and enter a short message you want to send.</p>		<p>The text should be something that the students can easily check, eg:</p> <p>A: dot, dash   . _</p> <p>S: dash, dash, dash   _ _ _</p>
<p><b>Step 3.</b> Press the Key Press and check the flashing RGB LED.</p>		<p>Observe the flashing light to see if it corresponds to the Morse Code table.</p>
<p><b>Step 4.</b> Now we're going to make a new system! Drag and connect a Key Press block and a Toggle block to an 'AND' gate. Pair and connect a Light Sensor (as a Button) to the 'AND' gate.</p>		<p>Now we're going to look at another mechanism, using an AND block for two inputs.</p> <p>Sometimes we need to switch a system on before use so that an accidental press of a Button will not activate the system.</p> <p>The Light Sensor (as a Button) will activate the system once we have readied it using the Toggle.</p>

## Lesson 4.4 - Morse Code Alert

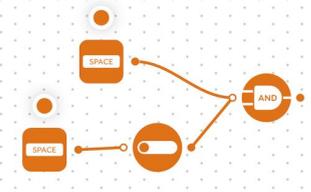
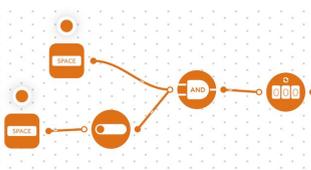
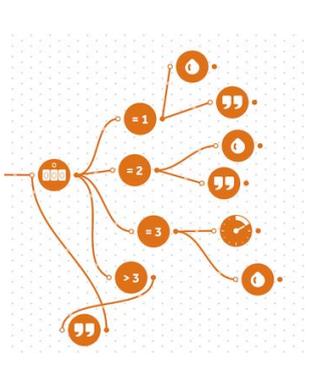
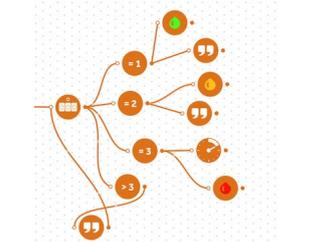
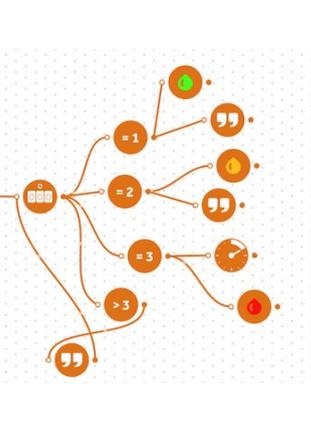
<p><b>Step 5.</b> Connect the 'AND' block to an RGB LED block and touch the Sensor Button.</p>		<p>The combination of the Toggle and the Sensor send 2 'True' messages to 'AND' gate, which sends 'True' to the Light and it illuminates. The light will not illuminate until the system has been readied.</p>
<p><b>Step 6.</b> Activate the Toggle and touch the Sensor again.</p>		<p>Students should observe how the Toggle flips from Left to right, Off to On or False to True. When the Toggle is 'True', and the Sensor is touched, both inputs to the AND gate are True and the AND gate will activate the light.</p>
<p><b>Step 7.</b> Time for a new system! Connect a Key Press block to a Counter block. Now connect the Count to 2 Compare blocks. Set these to '=1' and '=2'.</p>		<p>Finally, we're going to make one or another thing happen, depending on a condition with a new system. Let's make the light blue with one press and red with two presses.</p> <p>The 2 Compare blocks allow for two different outcomes, depending on the conditions.</p>
<p><b>Step 8.</b> Connect your Compare blocks to Color blocks. Make these Blue and Red. Connect the Color blocks to an RGB LED. Now try out your Key Press!</p>		<p>The Compare block containing a numeric variable is a favourite way in SAM Labs to make things happen, depending on the value. Watch the Counter and the Light carefully.</p> <p>If we press the Key Press once the light goes blue.</p> <p>If we press the Key Press twice the light goes red.</p>
<p><b>Step 9.</b> Don't forget to add a reset to your system! Drag and connect a Compare block and Text block onto the Workspace. Link together your Counter to your Compare and then onto your Text block. Edit the settings of your Compare block to '&gt;3' and your Text block to say 'reset'. Now try out your system!</p>		<p>This example resets the Counter after '3' but students should be encouraged to remember to set theirs to '&gt;2' in this case.</p> <p>In all cases, the important word is 'if'. 'if' statements are very powerful ways of writing programs and, as in this case can be extended to:</p> <ul style="list-style-type: none"> <li>• If the value is 1, then make the light blue, else (ie if not) make it red, else (ie if neither), reset the Counter.</li> <li>• Relate this to their work on Scratch, Python or whatever coding language they are using in Computing. How would this be written in those languages?</li> </ul>
<p><b>End of Session 1</b></p>		

**Checks for understanding:** How do you make the Counter increase by '1'? How can the Compare blocks register numbers in the Counter? What is the function of the AND gate?

## Challenge 1

25 minutes

Make a working resettable Morse code alert system that signals OK with a green light, SOS in Morse with an amber light and flashes red if things get really serious!

Instructions	Workspace	Notes for Teachers
<b>Session 2</b>		
<p><b>Step 1.</b> Connect one Key Press block directly to an 'AND' gate. Connect another Key Press to a Toggle block which then connects to the 'AND' gate.</p>		<p>This provides two separate inputs to the AND gate.</p> <p>One to <b>ready</b> the system One to <b>use</b> the system</p>
<p><b>Step 2.</b> Connect the output of the 'AND' block to the input of the Counter block.</p>		<p>The Counter will contain a numeric variable. We can use this changing value to make different things happen.</p>
<p><b>Step 3.</b> Connect the Counter block to the 4 Compare blocks and set them as:</p> <ul style="list-style-type: none"> <li>• = 1 and = 2 connected to a Text block and a Color block</li> <li>• = 3 connected to an Interval block and a Color block</li> <li>• &gt; 3 connected to a reset loop</li> </ul>		<p>Each Compare block will trigger a different behaviour</p>
<p><b>Step 4.</b> For Compare = 1</p> <ul style="list-style-type: none"> <li>• edit the Text block to 'OK'</li> <li>• set the connected colour block to 'Green'</li> </ul>		<p>When the Counter is at '1', it will send an 'OK' message and a green light.</p>
<p><b>Step 5.</b> For Compare = 2</p> <ul style="list-style-type: none"> <li>• Edit the Text box to 'SOS'</li> <li>• set connected colour block to 'Amber'</li> </ul> <p>For Compare = 3</p> <ul style="list-style-type: none"> <li>• set the connected Interval block to 10 milliseconds</li> <li>• edit the connected colour block to 'Red'</li> </ul> <p>For Compare &gt;3, make a 'reset loop' to the Counter.</p>		<p>When the Counter is at '2', it will send an 'SOS' message and an amber light.</p> <p>When the Counter is at '3', it will send an 'SOS' message and a red flashing light.</p> <p>When the Counter is at '&gt;3', reset the counter.</p>

## Lesson 4.4 - Morse Code Alert

<p><b>Step 6.</b> Connect the Text blocks following Compare blocks '=1' and '=2' to a Morse code block.</p>		<p>The Morse block automatically translates text into Morse, much in the same way that this website does:</p> <p><a href="https://morsecode.scphillips.com/translator.html">https://morsecode.scphillips.com/translator.html</a></p>
<p><b>Step 7.</b> The outputs into the Light and Buzzer are as follows:</p> <ul style="list-style-type: none"> <li>the 3 Color blocks input to the Light</li> <li>The Morse code blocks input to the Buzzer</li> <li>the Interval block inputs to the Light</li> </ul>		<p>The system is readied or switched on by activating the Toggle with the relevant Key Press.</p> <p>When the other Key Press is pressed once the signal is green and the Buzzer sounds 'OK'.</p> <p>When it is pressed twice the signal is amber and Buzzer sounds 'SOS'.</p> <p>When it is pressed 3 times the Light flashes red.</p> <p>The system resets after 3.</p>
<p><b>Step 8.</b> Well done on getting this far. This is a complicated system. Now it is finished, try it out!</p>		

**Checks for understanding:** What does each compare block do? Why is it useful to have the AND block to ready the system for use?

### Challenge 1 - Debug it

Is your Morse too fast to understand?

5 minutes

Instructions	Workspace	Notes for Teachers
<p><b>Step 1.</b> See how the speed of the Morse code sent to the Buzzer/Light can be changed by opening up the Morse Code settings.</p>	<p>Pick Morse code speed</p>	<p>Like many blocks, the Morse block has hidden Settings under the gear icon. Listening to, or watching Morse is difficult, especially at high speed. Encourage students to experiment with different speeds so the that the message is very clear.</p>

## Lesson 4.4 - Morse Code Alert

<p><b>Step 2.</b> Experiment to find the best speed and try your system again.</p>		<p>Students should choose a speed that anyone can understand.</p>
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### Challenge 2

10 minutes

Improve the system to allow a Light Sensor to be incorporated as an input

Instructions	Workspace	Notes for Teachers
<p><b>Step 1.</b> Connect an 'OR' gate between the 'AND' gate and the Counter block.</p>		<p>The 'OR' gate will send True if either input is True.</p>
<p><b>Step 2.</b> Connect a Light Sensor block to the input of the 'OR' block. Edit the Settings of the Light Sensor to be a button.</p>		<p>Now, if either the Light Sensor or the Key Press is activated then the OR block will send True to the 'AND' gate.</p>
<p><b>Step 3.</b> Test your improved system!</p>		<p>This system integrates:</p> <ul style="list-style-type: none"> <li>• 'AND' gates</li> <li>• 'OR' gates</li> <li>• Conditional statements</li> </ul> <p>... to send an automated Morse message once activated and when either the Key Press or Sensor is activated.</p>
<p><b>Extension Ideas:</b></p> <ul style="list-style-type: none"> <li>• Can logic gates be combined in other ways? What if an AND gate was an input into an OR gate?</li> <li>• <b>Science</b> <ul style="list-style-type: none"> <li>○ Electricity and logic gates, how is a gate represented within a circuit?</li> </ul> </li> <li>• <b>ICT</b> <ul style="list-style-type: none"> <li>○ search engines using boolean logic - AND and OR within advanced searching tools</li> </ul> </li> <li>• <b>English</b> <ul style="list-style-type: none"> <li>○ book 'Computational Fairy Tales' look at and discuss the 'Town of Bool'</li> </ul> </li> </ul>		

**Checks for understanding:** What do logic gates do? How do logic gates and conditional statements allow computers to 'think' like people do?

### Tidy Up / Exit Ticket:

5 minutes

Reinforcing the learning objectives of the lesson, students can reflect on key takeaways by completing and submitting an 'exit ticket' on the SAM Space App or in their workbooks.