

## Conditionals

### Overview

<b>Concept</b>	<b>Conditionals</b> - Make decisions in response to different conditions. Execute the action only if the conditional statement is true; otherwise, skip it or ignore it.
<b>Explanations</b>	Example: If it's raining, then you will use an umbrella.
<b>Learning Objectives</b>	1. Understand the concept of Conditionals; 2. Write programs using the conditional blocks to accomplish challenges and create projects.
<b>Teaching Preparation</b>	1. A box of conditionals (Step 3 - Lead-in Game) ; 2. A whiteboard and a whiteboard marker (or you can use a blackboard and chalks); 3. One Codey and a Bluetooth dongle (or the USB cable) per student but it's fine if 2 or 3 students share one set; 4. A computer per student, but it's fine if 2 or 3 students share a computer. And install mBlock 5 on each computer; 5. A self-review report per student.
<b>Time</b>	120-240 min

### Teaching Procedure

#### Step 1: Review — Loop

Review:

- What is a **Loop**?
- When will you need to run coding blocks repeatedly?
- How does the **Repeat** block help with your programs?

**Loop** means running one piece of programs over and over again. **Counting loops** refer to repeating specific times; **infinite loops** are to run one piece of programs endlessly. If we need to repeat one piece of programs specific times or endlessly, we can use the Repeat block to make our programs neat and effective.

#### Step 2: Explain New Knowledge - Conditionals

In today's lesson, we are to move on to a new concept, **Conditionals**. Conditional statements are common in everyday lives, and we often have to make decisions when we come

across them. For instance, if you want to buy a cup of tea, then you might walk out of your house first to see whether it's raining.

If it's raining, you will then take an umbrella to go; if it's not raining, you will go outside without an umbrella.

**Conditionals** refer to conditional statements. We make decisions in response to different situations. We execute the action only when the conditional statement is true; otherwise, skip it or ignore it. Ask students if they can think of any conditionals in daily lives.

We use conditionals blocks in programs to enable robots to make decisions in response to different situations. To get a Boolean value(true/false), we can drag a hexagon-shaped block to the hexagon dent in the **If/then** block. If the conditional statement is true, the computer will run the program; if the conditional statement is false, the computer will skip it and directly run the next piece of programs.



### **Step 3: Lead-in Game- Box of Conditionals**

The box is full of paper strips on which there are all kinds of conditional statements. Have students randomly pick papers from the box and read out what it says. Students should make decisions and take actions as requested by the papers they pick. Ask students to write down the conditionals in advance and leave the actions part to teachers. In this way, we can avoid occasions where students might write down actions that they can not finish, like walking out of the classroom to leave school or jumping down from the 2<sup>nd</sup> floor. The chart attached at the bottom of this document are available for reference. Teachers can modify the actions or add new actions. Print the chart and cut the paper into strips along the dashed lines. Fold the strips in half and put them all into the box of conditionals.

Remind students one thing: write down conditionals that are easy to identify. This is to ensure that the game can go on smoothly. For instance, write conditionals like the following ones: if you have long hair; if you wear glasses; if you are in a black shirt; if your name has a letter A in it; if you were born in June; if someone puts up his or her hand; if someone claps his or her hands. If the

conditional statement on a paper strip is hard to identify (for instance, “if it rains tomorrow” or “if the amount of your hair is an odd number”), ignore that paper strip.

Have students come to the podium to pick papers from the box, or they can pass around the box on their seats.

**Steps:**

1. Pick a paper strip from the box and open it;
2. Read aloud what the paper says and make decisions. If the conditional statement is true, take action correspondingly; if the conditional statement is false, ignore it;
3. Fold the paper in half and put it back into the box. Go back to your seat or hand the box to the next student.

**Suggestions:**

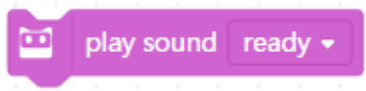
1. Teachers can join the students if there are not enough students;
2. If the paper strips outnumber students, then there is no need for students to put the conditionals papers they’ve used back into the box.

**Step 4: Tasks**

Have students accomplish the tasks in pairs or by themselves. Each step has a square box. **Tell them to tick the square box when they finish the step (The Tasks Cards are included at the bottom of this document. Print them).**

**Task 1: Start off when the flag is waving**

Introduce the story background and the task requirements to students. Then hand out the tasks cards.

<b>Task 1— Start off when the flag is waving</b>
<b>The game is starting now. If Codey Rocky sees the green flag waving, it will run forward at its top speed.</b>
<input type="checkbox"/> When <b>button A</b> is pressed, Codey Rocky is getting ready at the starting line (play the sound ready).


- **If** the color sensor detects **green**, **then** Codey Rocky will **move forward** at its **top** speed.



- After the computer assesses the conditional statement and make a decision, the RGB LED will light up with red color.



- **Challenge: Customize coding blocks to make Codey Rocky show expressions and make sounds when it is running.**

Teachers demonstrate how to write the following programs. Remind students:

1. The “**if/then**” block includes a dent, so we need to interlock a conditional block (for instance, “if it is green?”) to the dent;
2. Remind students to put the the block “**RGB LED lights on with color red**” outside the conditional block to help end the programs.



Students write programs as demonstrated by the teachers.

**Discussions:**

1. If we want Codey Rocky to move backward when detecting red, how to rewrite the programs?

**Task 2: Avoid the Obstacle**

Have students finish the task independently.

### Task 2—Avoid the Obstacle

**When meeting an obstacle, Codey Rocky will avoid it and keep moving forward.**

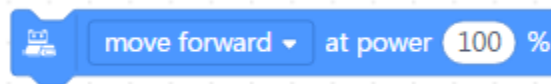
- Place an obstacle before Codey Rocky.



- When **the button A** is pressed, if it **detects an obstacle**, Codey Rocky will turn right by 90 degrees, move forward, turn left by 90 degrees and **move forward** at a rapid speed.



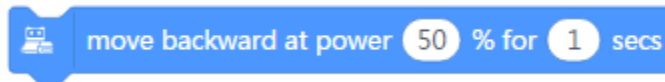
- If Codey Rocky doesn't detect any obstacles, it will move forward at its top speed.



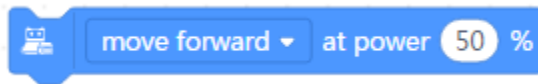
- **Challenges** 1. Take a detour to avoid the obstacle, that is to say, turn left and then turn right.  
2. Let Codey Rocky show expressions and make sounds when it's moving.

**Tips:**

1. Make sure you put the **“move forward”** block and the **“ turn left/right”** block including time limits in the conditional block.



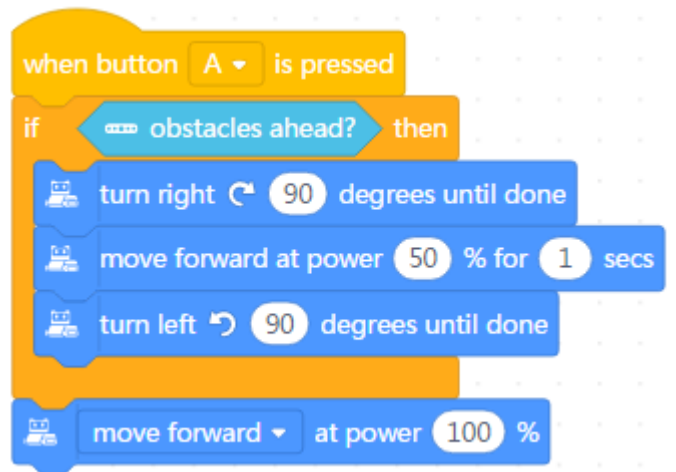
Don't use the following block.



The first two blocks will stop when the time is up and then move on to run the next block. However, the third block will keep running with other blocks unless you use another action block in the programs. In this case, Codey Rocky will keep moving forward at power 50% until someone powers it off.

2. Remind students to put the block “**move forward at power 100%**” outside the conditional block. After Codey Rocky turns left, the piece of programs surrounded by the conditional block will come to an end, and the outer block starts to run. The outer block has no time limits.

**Sample Programs:**



**Discussions:**

1. What will happen if you encircle all the programs with a **forever** block?
2. What will happen if you use a **move forward** block **without** time limits instead?
3. What will happen if you put a **move forward** block **including** time limits outside the conditional block instead?

**Task 3: Service Station**

Have students finish the task independently.

Teachers remind students: In some cases, we might use multiple conditional blocks to accomplish a task.

### Task 3— Service Station

**During the race, Codey Rocky needs to get fuel and repairs at service stations for plenty of times. However, the ways it pulls into the station might vary from time to time. Write programs to ensure that Codey Rocky is able to re-enter the racetrack whatsoever.**

- Use books or other objects to encircle your Codey Rocky as illustrated below. This is to simulate a scene where Codey Rocky stops at a service station. Codey Rocky pulls into the station

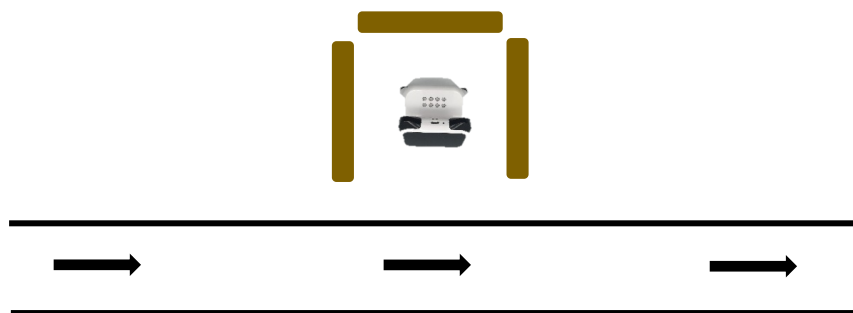


ending up in random positions as shown above.

- Write programs: when **the button A** is pressed, if Codey Rocky detects **an obstacle** ahead, then it will keep making turns until it finds the exit. You might use more than one conditional blocks.



- Use chalks or black sticky tapes to make a racetrack in front of the Exist.

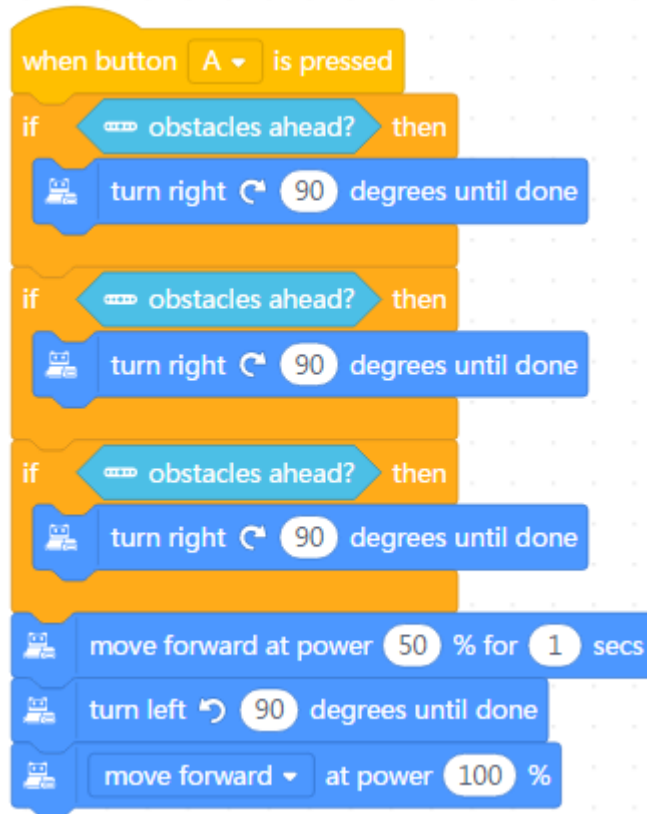


- When Codey Rocky finds the Exit, it will first **move forward** to leave the garage, **turn left** and then move forward **at its top speed**.
- **Challenge:** Add expressions, sounds, and lights.

**Tips:**

1. You might use more than one conditional blocks.
2. You can set the blocks to make Codey Rocky enter the tunnel at different powers under the drive of various events.

**Sample Programs:**

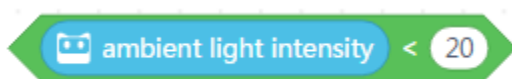


**Discussions :**

1. How to use the fewest blocks to make Codey Rocky find the Exit? Any repetitive blocks did I use?

**Task 4: Tunnel**

Instructions: The hexagon blocks we used in the previous tasks can directly judge whether the conditional statement is true or false, for instance, whether there is an obstacle or not, whether it is red or not. Besides, we use the comparative Operator block to evaluate two values. For example, the block “**when light intensity < 20**” helps us assess whether the light intensity exceeds 20. If the light intensity is below 20, then the result will be true. Otherwise, the result will be false.





The hexagon blocks return Boolean values (with only two possible values: true or false). A Boolean variable has only two values, 1 if true and 0 if false. If the conditional statement is satisfied, then it will return the value, true. Otherwise, it will return the value, false. Therefore, we also refer to the hexagon blocks as Boolean blocks.

**Teachers Demonstrate:**

1. Drag the following comparison block from the Operators category;



2. Drag the “**light intensity block**” into the left dent;
3. Input a value in the right dent of the comparison block;
4. Finish the following task.

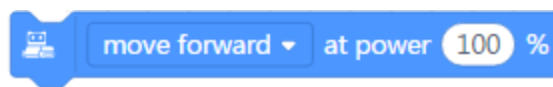
**Task 4— Tunnel**

**When entering a dark tunnel, Codey Rocky will turn on its light and slow its speed.**

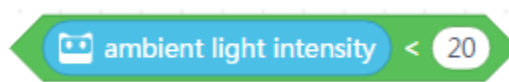
- Stick a black paper to the light sensor of Codey Rocky.

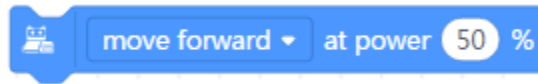


- When **the button A** is pressed, Codey Rocky will move forward at its top speed.



- If Codey** detects that the light intensity is **below 20**, Codey Rocky will turn on its **white RGB indicator** and drive at a lower speed.





**Tips:**

1. The light sensor is the black dot at the right bottom of Codey.

**Sample Programs:**



**Challenges for Students:**

1. By following the teachers, students write programs to let Codey make sounds and show expressions in a dark environment;
2. How to make Codey Rocky more sensitive to a dark environment? How to manipulate Codey Rocky to turn on the RGB indicator instantly the light intensity gets low?

**Task 5: Volume**

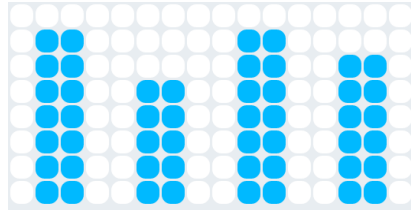
Students finish the task independently.

**Task 5—Volume**

**Codey Rocky wins the game and people are applauding. The volume bar on the screen will change in response to the applause loudness.**

- When Codey Rocky starts up, if the detected applause loudness exceeds 20, the volume bar will reach its top height.





- If the detected loudness falls between 10 and 20, the volume bar will go down. Now, we need to use the “**and**” block.



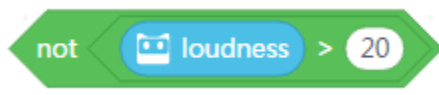
- If the applause loudness is below 10, the volume bar will fall to its lowest height.
- Encircle all the programs with a “**forever**” block to make Codey Rocky keep detecting loudness of sounds around it all the time.



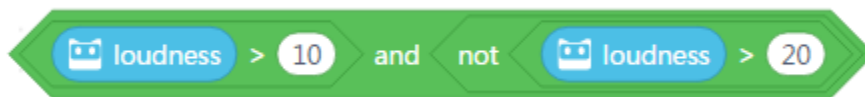
- **Challenge:** Control the RGB LED indicator to change its color in response to the loudness.

**Tips:**

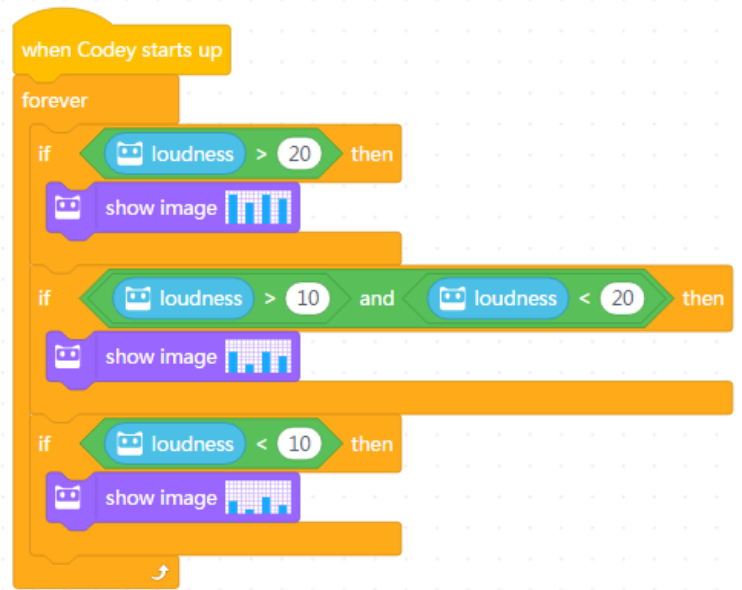
1. The “**and**” block means that both of the two conditional statements should be true;
2. And there is another occasion: if the loudness equals 20 or 10. We need to use the “**not**” block if we want to add this situation. If we want to make Codey Rocky assess whether the loudness is less than or equals 20, we will use the following combination of blocks:



If we want to evaluate whether the loudness falls among a range of  $10 < x \leq 20$ , write programs using the following combination of blocks:



**Sample Programs:**



**Discussion:**

1. How to define different ranges: 1)  $>20$  ; 2)  $10 < x \leq 20$ ; 3)  $\leq 10$ ;
2. How to subdivide the ranges to make the volume bar more sensitive to the loudness? When the music starts, the volume bar will react to the music.

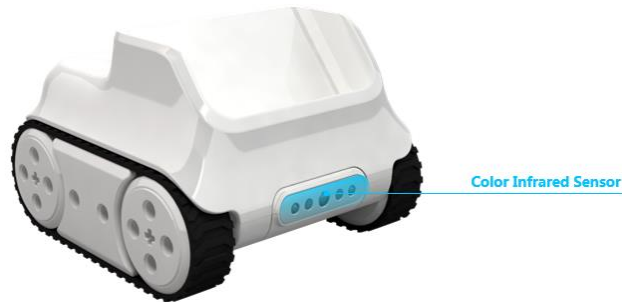
**Task 6: Follow**

Teachers give students more details about the “**if...then...else**” block. Then have students finish the task independently.

Task 6 — Follow

**Imagine Codey is a cute cat. When you approach, it will follow you; otherwise, it will stay there waiting for you.**

- The IR color sensor detects the intensity of reflected IR lights. The closer an object is to Codey Rocky, the stronger the light intensity will be.

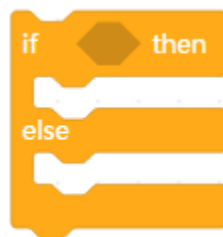


- When Codey Rocky starts up, the LED matrix will display the reflected infrared light intensity value.



- Surround the “**show**” block with a “**forever**” block to make Codey Rocky monitor light intensity in real time.

- In the “**forever**” block, programs first show the reflected infrared light intensity, then make assessments. If the intensity exceeds a specific value (Customized), then Codey Rocky moves forward at its top speed, otherwise it will stop there not moving. We need to use the “**if...then...else**” block and the Operators block.



- **Challenge:** If the loudness exceeds one specific value, then Codey Rocky moves forward or turns left at the greatest power.

**Tips:**

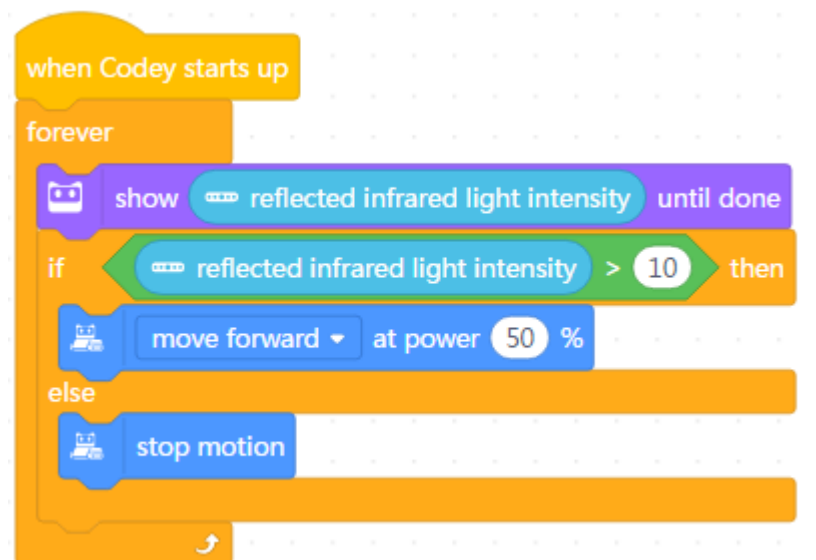
1. When using the “**show**” block to display variables changes on the LED matrix, we need to avoid using blocks including time limits, such as “**move forward for 1 sec**”, “**turn left until done**”, “**play sound until done**”. This is because these blocks will lead to the failure of Codey Rocky to monitor data in real time.

2. Through monitoring and showing the reflected infrared light intensity in real time, we can customize the conditionals. That is to say, only when the reflected infrared light intensity exceeds a certain value will Codey Rocky move forward.

3. Make sure all the programs are surrounded by the “**forever**” block;

4. Make the IR color sensor face forward to detect obstacles.

### Sample Programs:



### Discussion:

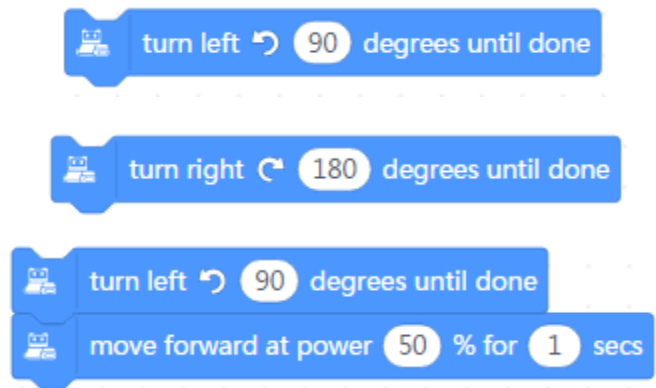
1. What will happen if I make the IR color sensor face down?
2. I want Codey Rocky (cat) to do the following things: keeps searching around until it finds its master and then follows the master. How to rewrite programs?

### Task 7: Find the Master

#### Task 7: Find the Master

**Rather than stay there waiting for the master, the cat (Codey Rocky) prefers to walk around searching.**

- If Codey Rocky finds its master (the reflected infrared light intensity exceeds a specific value), it will move forward.
- If Codey Rocky fails to find its master, it will first keep turning left, right and left, and then keep moving forward in the original direction to search.



- Encircle all the programs with the **forever** block.
- Challenge**: Write programs to make Codey Rocky show expressions and make sounds when it finds the master.

**Tips:**

1. To ensure that Codey Rocky accurately detects the master, we need to keep our hand or objects level with the IR color sensor;
2. Remember to make Codey Rocky move forward in the original direction after it finishes searching around for its master;
3. If Codey Rocky succeeds in finding its master (an obstacle), we should use the “**move forward**” block without time limits; otherwise, we need to use the blocks including time limits, such as “**turn left until done**”, “**turn right until done**” and “**move forward for 1 sec**”.
4. To finish the task, we have to use 3 “**if...then...else**” blocks. One block can just manipulate Codey Rocky to detect the master (an obstacle) only when it’s moving forward. However, what we need is that the cat (Codey Rocky) detects three times respectively when it turns left, turns right and moves forward.
5. We can shorten the time of moving forward in case the cat (Codey Rocky) misses its master (an obstacle).

**Sample Programs:**

```
when Codey starts up
  forever
    if (reflected infrared light intensity > 10) then
      show image [meow]
      move forward at power 100 %
      play sound [meow] until done
    else
      turn left 90 degrees until done
      show image [curious]
      play sound [curious] until done
    if (reflected infrared light intensity > 10) then
      show image [meow]
      move forward at power 100 %
      play sound [meow] until done
    else
      turn right 180 degrees until done
      show image [curious]
      play sound [curious] until done
    if (reflected infrared light intensity > 10) then
      show image [meow]
      move forward at power 100 %
      play sound [meow] until done
    else
      turn left 90 degrees until done
      move forward at power 50 % for 1 secs
      show image [curious]
      play sound [curious] until done
```



**Discussion:**

1. If the master (an obstacle) is dressed in black, is the cat (Codey Rocky) still able to detect it?

Why?

2. I want the cat to detect whether there is an obstacle ahead each time it turns by 10 degrees.

How to achieve this by adding the “repeat” blocks?

**Sample Solutions:**

```

when Codey starts up
  forever
    repeat 9
      if reflected infrared light intensity > 10 then
        move forward at power reflected infrared light intensity * 2 %
      else
        turn right 10 degrees until done
    repeat 18
      if reflected infrared light intensity > 10 then
        move forward at power reflected infrared light intensity * 2 %
      else
        turn left 10 degrees until done
    repeat 9
      if reflected infrared light intensity > 10 then
        move forward at power reflected infrared light intensity * 2 %
      else
        turn right 10 degrees until done
    keep straight towards move forward at power 50 % for 1 secs
  
```

### Self-review Report

**Name:**

**Age:**



- Answer the following questions to record your learning outcomes:

Describe what you've learned with one or two sentences.

Describe what you like most and least about this class session briefly.

What I like most

What I like least

Draw a conditional that happens in your life.

You can paint how you feel about this class session at the upper right corner of the self-review report.

If ( \_\_\_\_\_ ) ,  
then press the light button in the classroom.

If ( \_\_\_\_\_ ) ,  
then touch any green object in the classroom.

If ( \_\_\_\_\_ ) ,  
then squat jump three times.

If ( \_\_\_\_\_ ) ,  
then draw a fish on the blackboard.

If ( \_\_\_\_\_ ) ,  
then stretch one hand through underneath of the other hand to hold your nose and turn  
around three times with that posture.

If ( \_\_\_\_\_ ) ,  
then say “I m great.”

If ( \_\_\_\_\_ ) ,  
then cross arms over the chest and smiles at the teacher.

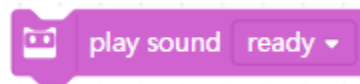
If ( \_\_\_\_\_ ) ,

then open a book and turn to page 20.

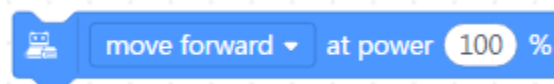
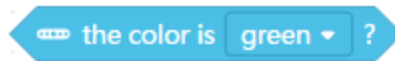
### Task 1— Start off when the flag is waving

**The game is starting now. If Codey Rocky sees the green flag waving, it will run forward at its top speed.**

- When **button A** is pressed, Codey Rocky is getting ready at the starting line (play the sound ready).



- If the color sensor detects **green**, then Codey Rocky will **move forward** at its **top** speed.



- After the computer assesses the conditional statement and make a decision, the RGB LED will light up with red color.



- **Challenge: Customize coding blocks to make Codey Rocky show expressions and make sounds when it is running.**

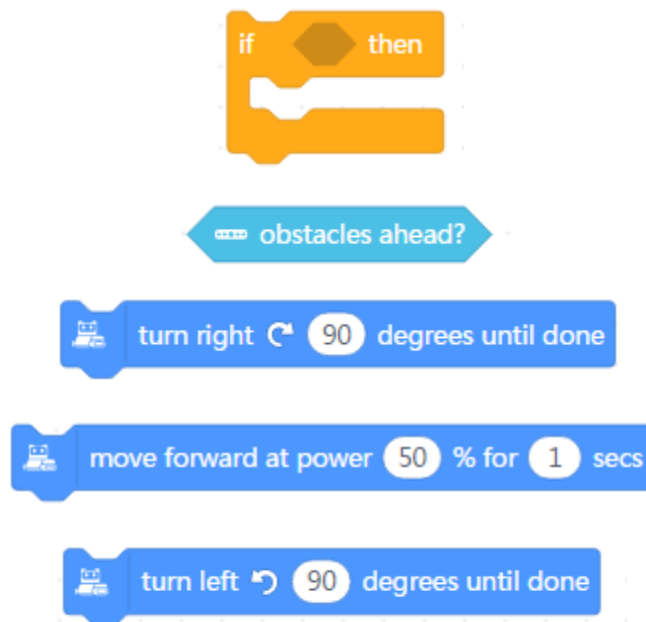
### Task 2—Avoid the Obstacle

**When meeting an obstacle, Codey Rocky will avoid it and keep moving forward.**

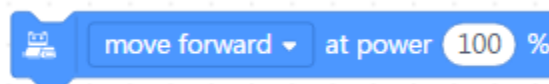
- Place an obstacle before Codey Rocky.



- When **the button A** is pressed, if it **detects an obstacle**, Codey Rocky will turn right by 90 degrees, move forward, turn left by 90 degrees and **move forward** at a rapid speed.



- If Codey Rocky doesn't detect any obstacles, it will move forward at its top speed.



- **Challenges** 1. Take a detour to avoid the obstacle, that is to say, turn left and then turn right.  
2. Let Codey Rocky show expressions and make sounds when it's moving.

### Task 3— Service Station

**During the race, Codey Rocky needs to get fuel and repairs at service stations for plenty of times. However, the ways it pulls into the station might vary from time to time. Write programs to ensure that Codey Rocky is able to re-enter the racetrack whatsoever.**

- Use books or other objects to encircle your Codey Rocky as illustrated below. This is to simulate a scene where Codey Rocky stops at a service station. Codey Rocky pulls into the station

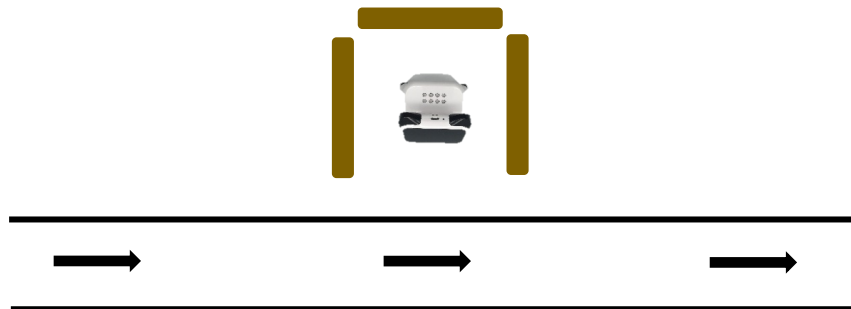


ending up in random positions as shown above.

- Write programs: when **the button A** is pressed, if Codey Rocky detects **an obstacle** ahead, then it will keep making turns until it finds the exit. You might use more than one conditional blocks.



- Use chalks or black sticky tapes to make a racetrack in front of the Exist.



- When Codey Rocky finds the Exit, it will first **move forward** to leave the garage, **turn left** and then move forward **at its top speed**.
- **Challenge:** Add expressions, sounds, and lights.

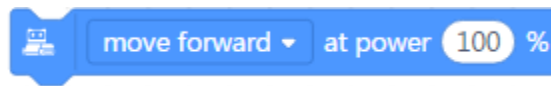
### Task 4— Tunnel

**When entering a dark tunnel, Codey Rocky will turn on its light and slow its speed.**

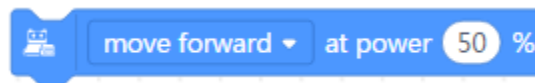
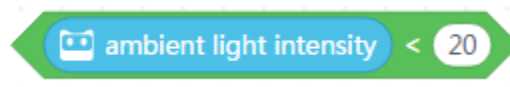
- Stick a black paper to the light sensor of Codey Rocky.



- When **the button A** is pressed, Codey Rocky will move forward at its top speed.



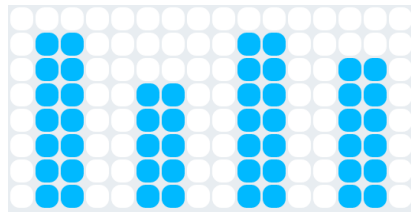
- **If Codey** detects that the light intensity is **below 20**, Codey Rocky will turn on its **white RGB indicator** and drive at a lower speed.



### Task 5—Volume

**Codey Rocky wins the game and people are applauding. The volume bar on the screen will change in response to the applause loudness.**

- When Codey Rocky starts up, if the detected applause loudness exceeds 20, the volume bar will reach its top height.



- If the detected loudness falls between 10 and 20, the volume bar will go down. Now, we need to use the “and” block.



- If the applause loudness is below 10, the volume bar will fall to its lowest height.
- Encircle all the programs with a “forever” block to make Codey Rocky keep detecting loudness of sounds around it all the time.



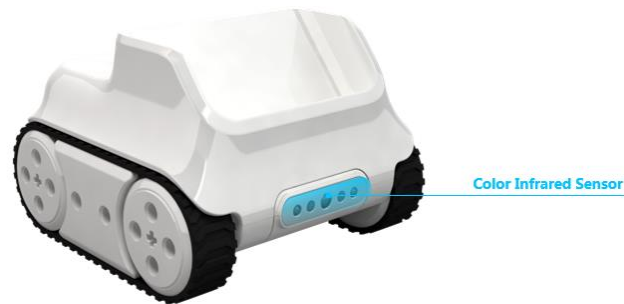
- Challenge:** Control the RGB LED indicator to change its color in response to the loudness.



Task 6 — Follow

**Imagine Codey is a cute cat. When you approach, it will follow you; otherwise, it will stay there waiting for you.**

- The IR color sensor detects the intensity of reflected IR lights. The closer an object is to Codey Rocky, the stronger the light intensity will be.

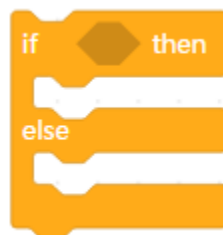


- When Codey Rocky starts up, the LED matrix will display the reflected infrared light intensity value.



- Surround the “**show**” block with a “**forever**” block to make Codey Rocky monitor light intensity in real time.

- In the “**forever**” block, programs first show the reflected infrared light intensity, then make assessments. If the intensity exceeds a specific value (Customized), then Codey Rocky moves forward at its top speed, otherwise it will stop there not moving. We need to use the “**if...then...else**” block and the Operators block.

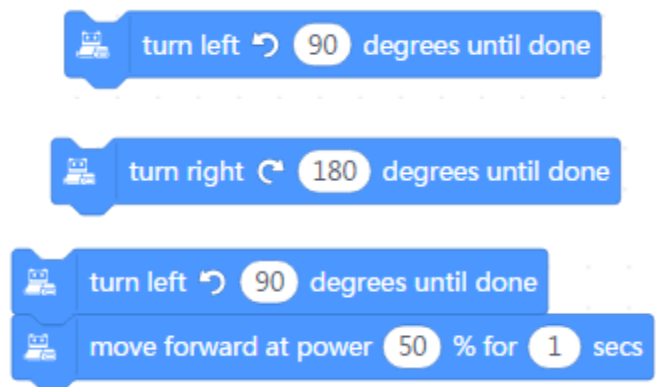


- **Challenge:** If the loudness exceeds one specific value, then Codey Rocky moves forward or turns left at the greatest power.

### Task 7: Find the Master

**Rather than stay there waiting for the master, the cat (Codey Rocky) prefers to walk around searching.**

- If Codey Rocky finds its master (the reflected infrared light intensity exceeds a specific value), it will move forward.
- If Codey Rocky fails to find its master, it will first keep turning left, right and left, and then keep moving forward in the original direction to search.



- Encircle all the programs with the **forever** block.
- Challenge**: Write programs to make Codey Rocky show expressions and make sounds when it finds the master.