Reaction Game

Paper Version

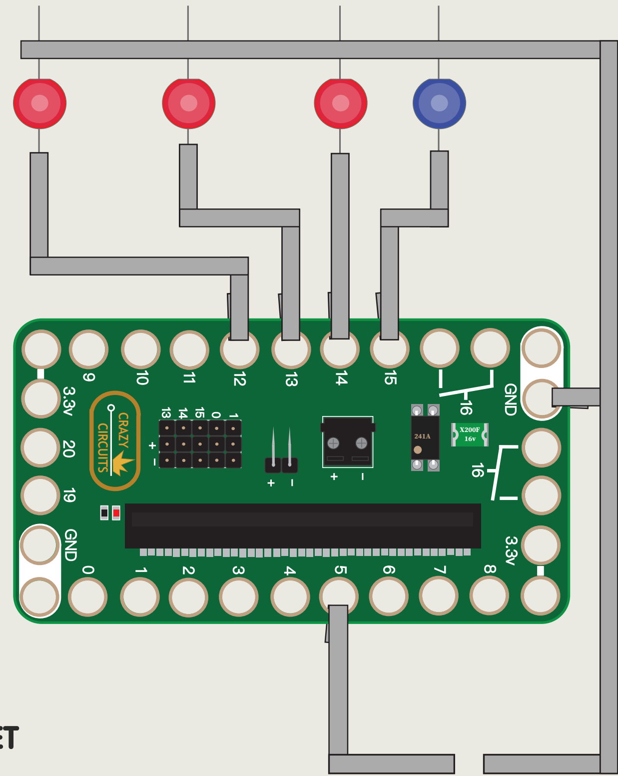
What You Need:

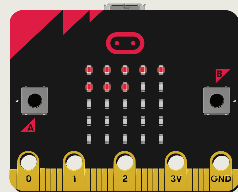
1 x Crazy Circuits Bit Board
1 x micro:bit V2
4 x LEDs
1/8" Maker Tape
Paper

Optional:
1/4" Maker Tape

You can build this project directly onto paper or cardboard using a Bit Board, Maker Tape, some standard LEDs and your own paper switch!

Note...
You can use any color LEDs you want. Try different colors to see if it affects the gameplay.





How it Works:

The LEDs will flash on and off in order (one at a time) and when the fourth LED is lit you should press the button. If you successfully press the button while the fourth LED is lit, you'll get a point, and the score will be shown on the LED matrix on the front of the micro:bit

If you press the button when LED one, two, or three is lit you will lose a point. (The default code will not go below zero, since there isn't an easy way to display a negative score on the LED display.)

Each time you press the button at the correct time the speed will increase, making it more difficult to get the timing right for the next time.

The piezo speaker will play two different tones, one when you successfully press the button, and one when you press it at the wrong time. It will also play a song when you win by scoring the determined amount of points.

If you want to abandon a game and start over you can press the reset button. (Button B on the micro:bit)

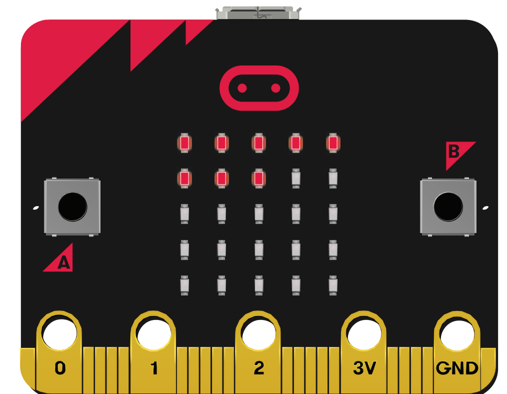
Note: For this version of the Reaction Game we're using a V2 micro:bit so we can take advantage of the on-board piezo speaker.

Scoreboard:

We're going to use the built-in LED matrix on the front of the micro:bit to display the score.

Each time you get a point it will light up another LED, and if you lose a point it will turn off an LED to indicate your score is lower.

With the code we provide you can then set your **winScore** to a maximum value of 25 if you want to use the entire matrix.



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Make Your Button/Switch:
This version of the Reaction Game requires you to make your own button (or "momentary switch") that you'll trigger to play the game.

Making an effective button is the additional challenge for this version. We've included two examples here from our Paper Circuits guides on switches to get you started.

You'll want a switch that only turns "on" when you press it, and then turns "off" when you release it.

Lever Button

1. Cut out button using scissors. Fold on dotted line.

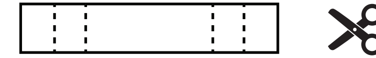
2. Place Maker Tape on top of switch. Leave enough extra tape to stick to switch down to paper and to wrap around the bottom of the switch.

3. Fold tape over long end of switch and attach securely.

4. Stick it down to the paper so it will close the gap in the circuit.

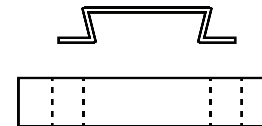
5. Press the switch down to make contact!

Push Button

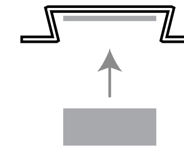


1. Cut out button using scissors.

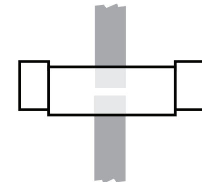
2. Fold paper as show below using dotted lines as a guide.



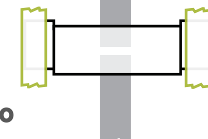
3. Attach Maker Tape to the bottom of the button.



4. Align your button (tape side down) over the gap in the circuit.



5. Use tape to hold the button in place.



6. Press the button down to make contact!

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The Code:
We've broken our program into seven sections. We'll start by looking at the smaller sections then move on to the **forever** loop, which is the most complex.

Don't worry if you don't understand all of the code! You can always build the circuit, load the code, try it out, and then make changes to the code to see how it affects the gameplay.

Our **lightLED** function allows us to call the function with a set of **parameters**.

When we call our function we "pass in" four numbers. Our numbers need to be either a 0 or a 1, which corresponds to setting each pin to 0 or 1, which is **off** or **on**. This allows us to turn on (and off) all four LEDs with a single command.

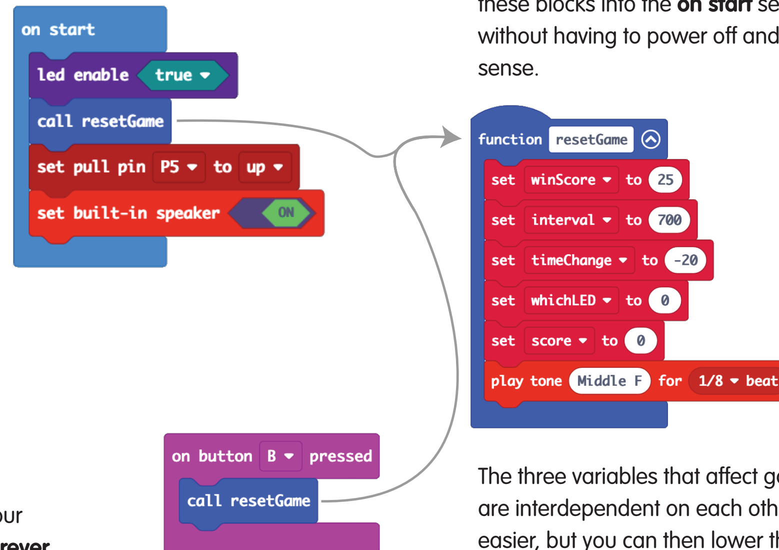
If we have a block like so:

It will turn on the first LED and turn off the rest of them. If we pass **0, 1, 0, 0** it will turn on the second LED and turn off the rest of them, etc.

The **on start** section always runs first in our program, and we used it to set things that only need to happen one time at the start.

For this program we start by enabling the built-in LED matrix, then calling the **resetGame** function (more on that later). We also set pin 5 to **up** so we can use it with the button connected to it, and enable the built-in speaker.

You'll notice our "event handler" for **button B** also contains the call to **resetGame**. This allows us to reset all our variables at any point while the game is running if we want to start over.



In our **resetGame** function we set the variables for the game.

If we did not have a special reset button we could probably have put all of these blocks into the **on start** section, but since we want to reset the game without having to power off and back on the micro:bit this method makes sense.

Here's what each of our variables does:

winScore sets the score you need to reach to win the game.

interval sets the amount of time each LED remains lit for.

timeChange sets the amount of time we subtract from **interval** after each successful button press.

The three variables that affect gameplay; **winScore, interval,** and **timeChange**, are interdependent on each other. If you lower the winScore the game will be easier, but you can then lower the interval to make it more challenging again.

If you adjust the timeChange to a much higher number, or set the interval to a much lower value it might make the game unplayable, or just more challenging! We've set what we think is a good balance as a starting point, but adjusting them and seeing what happens is part of the fun of game development!

A note about "event handlers"
Typically if we want to check for something happening in our program we need to use a conditional statement in our **forever** section. We would add in the code blocks and the logic and test for a specific condition (like a button press.)

Event Handlers are special "functions" that run all the time, and continually check for a specific thing, like **button B** being pressed.

In this case we use the special event handler to trigger the game to reset the variables and start over.

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Displaying the Score:
If you built the version of the Reaction Game that uses a 7 Segment Display you may remember that the code to show the score was just a single block of code. This time we need to do a bit more work to display the score.

We have two functions, **showScore** which deals with looping through all the LEDs and turning them on one at a time, and **clearScreen** which looks through all the LEDs and turns them off one at a time.

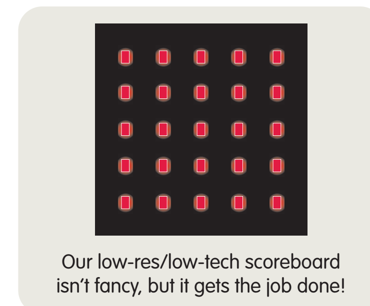
You might also notice that the first thing our showScore function does is call the clearScreen function. This is so we can always wipe the screen completely before displaying the score. Since the score could go down if you lose a point we had to make sure we didn't always just count up but also had the ability to count down.

If you want to make your own scorekeeping functions you can look at using the **show number** command in MakeCode or the **show leds** command.

We chose this method as a fun programming challenge! And since we created it as functions separate from our code we can easily use it in other programs that need a score keeping system.

```
function showScore
    call clearScreen
    set tempScore to score - 1
    set scoreX to 0
    set scoreY to 0
    set index to 0
    while index ≤ tempScore
    do
        plot x scoreX y scoreY
        change scoreX by 1
        if scoreX = 5 then
            set scoreX to 0
            change scoreY by 1
        change index by 1
```

```
function clearScreen
    set scoreX to 0
    set scoreY to 0
    set index to 0
    while index ≤ 25
    do
        unplot x scoreX y scoreY
        change scoreX by 1
        if scoreX = 5 then
            set scoreX to 0
            change scoreY by 1
        change index by 1
```



Our low-res/low-tech scoreboard isn't fancy, but it gets the job done!

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⚠ The **forever** section of our code has a lot going on, so we've broken it into four sections to explain it.

If you checked out our guide titled **Blink Without Pause** we showed that while it's common to cause an LED to blink on and off using the pause command if you want **non-blocking code** (that is, code that never "pauses" while running) you can implement a timer that checks if a certain number of milliseconds has passed and then turn on (or off) your LED.

We use that method in the first part of the forever section to change which LED is lit each time our **interval** is passed.

We also check if our **whichLED** variable has increased past 4 and set it back to 0 if it has.

```
forever
  set currentMillis to millis (ms)
  if currentMillis - previousMillis > interval then
    if myState = 0 then
      set myState to 1
    else
      set myState to 0
    set previousMillis to currentMillis
  if myState = 1 then
    change whichLED by 1
    if whichLED > 4 then
      set whichLED to 0
```

In our next section of code we check which LED is specified and then use our **lightLED** function to turn on one of the four LEDs.

Our **lightLED** function call passes four values to the function which means that with a single block of code we can control all four LEDs. This is much more efficient that using four blocks of code to individually control all four LEDs within each if/else statement.

```
if whichLED = 1 then
  call lightLED 1 0 0 0
  set myState to 0
else if whichLED = 2 then
  call lightLED 0 1 0 0
  set myState to 0
else if whichLED = 3 then
  call lightLED 0 0 1 0
  set myState to 0
else if whichLED = 4 then
  call lightLED 0 0 0 1
  set myState to 0
else
  call lightLED 0 0 0 0
```

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This section checks to see if the fourth LED is active, and also checks if the button is being pressed. If those conditions are met we increase the **score** by one. decrease the **interval** by the amount of time set for the **timeChange**, we play a tone, and we pause for half a second.

But what if the fourth LED is not active, and the button is pressed? Then we subtract one from the score, play a different tone, and again pause for half a second.

```
if whichLED = 4 and digital read pin P5 = 0 then
    change score by 1
    change interval by timeChange
    play tone High B for 1/8 beat
    pause (ms) 500
else if whichLED ≠ 4 and digital read pin P5 = 0 then
    change score by -1
    play tone Low C for 1/8 beat
    pause (ms) 500
else
```

Lastly, we have a check if the score is less than one and if it is, we set it to zero. If we remove this check then our score could keep decreasing to negative numbers, which might make the gameplay even more challenging! Feel free to remove this section or adjust it in some other way.

The **call showScore** block handles calling the function to display the score on the LED matrix.

And finally, we check to see if our score is equal to the winScore, and if it is, you won the game! We then turn on all the LEDs, play a victory song, wait for two and a half seconds, then reset the game so we can try again.

```
if score < 1 then
    set score to 0
call showScore
if score = winScore then
    call lightLED 1 1 1 1
    start melody power up repeating once
    pause (ms) 2500
    call resetGame
```