



Binary Hero

Introduction

Make a game in which you play the notes of a song as they scroll down the stage.

What you will make

Click the green flag to play. Use **z**, **x**, **c** and **v** to play the correct notes when they reach the bottom of the stage. You'll score ten points for every correct note you play.

What you will learn

This project covers elements from the following strands of the Raspberry Pi Digital Making Curriculum (<http://rpf.io/curriculum>):

- Combine programming constructs to solve a problem.
(<https://www.raspberrypi.org/curriculum/programming/builder/>)

What you will need

Hardware

- Computer capable of running Scratch 2.0

Software

- Scratch 2.0 (either online (<https://scratch.mit.edu/projects/editor/>) or offline (<https://scratch.mit.edu/scratch2download/>))

Binary notes

How many notes can you play with four keys? It might be more than you think!

- Open the starter project.

I'm using Scratch online

Open the 'Binary Hero' Scratch starter project at jumpto.cc/binary-go
(<http://jumpto.cc/binary-go>).

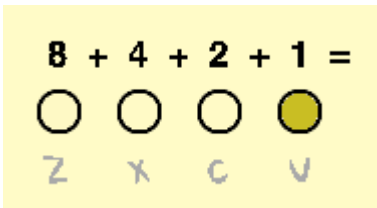
I'm using Scratch offline

Download the binary-hero.sb2 (<https://projects-static.raspberrypi.org/projects/binary-hero/0a21d51b84d874ab1f3b710b5a0dc295c9442efa/en/resources/binary-hero.sb2>) Scratch starter project and open it using the offline editor.

If you have a Scratch account, you can click on **Remix** in the top right-hand corner to save a copy of the project to your account.

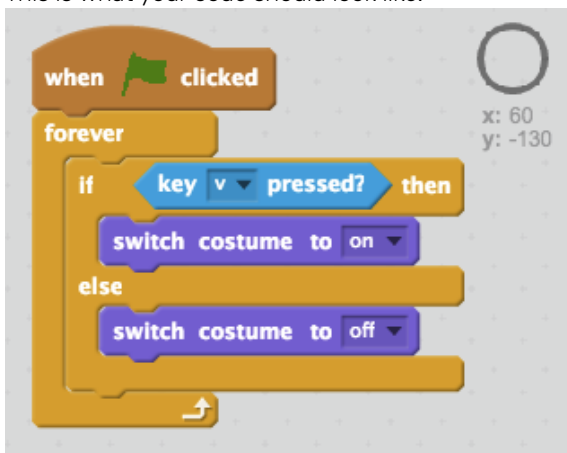
- Let's start by showing which keys have been pressed. Click on the sprite called '1'; and add code to change its costume when the v key is pressed.

When you test your sprite by pressing the v key, the sprite should light up.



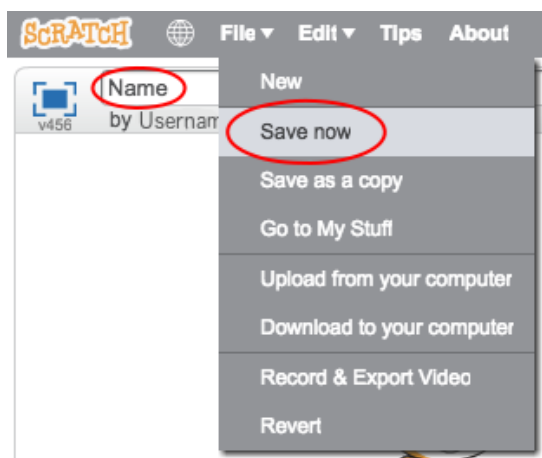
? I need a hint

This is what your code should look like:



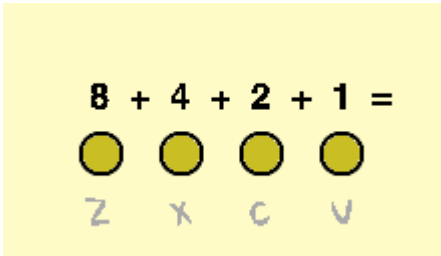
i Saving a Scratch project

- Give your program a name by typing into the text box in the top-left corner.
- You can click **File** and then **Save now** to save your project.



- Note:** if you're using Scratch online but don't have a Scratch account, you can save a copy of your project by clicking **Download to your computer** instead.

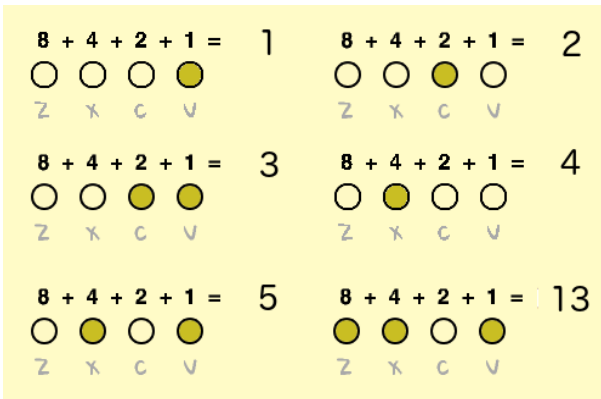
- Do the same for the other three sprites, so that they light up when the c, x, and z keys are pressed.



Binary numbers

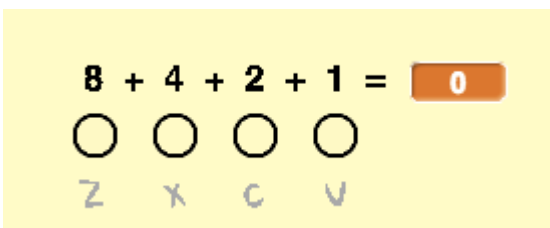
In this project you'll be using combinations of the four different keys to play different notes. You can think of each of the keys as either on (pressed) or off (not pressed). This means that you can think of each combination of keys as a **binary number**.

Moving from right to left the keys double in value, and are 1, 2, 4, and 8. By adding up the numbers above each key you can work out the value of the note.



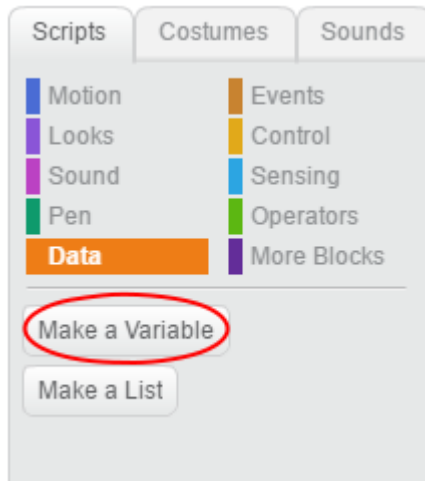
There are $2^4 = 16$ **combinations** that can be made with the four keys. This means that we can play 15 different notes, as 0 will mean that no note is played.

- Create a new variable called **note**, and drag it next to the 4 note sprites.

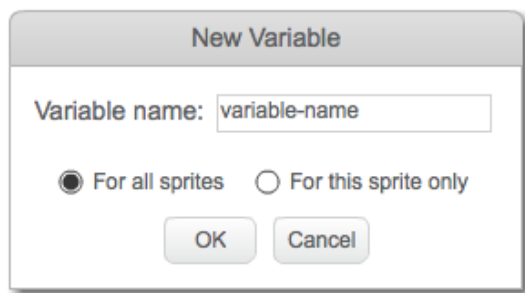


i Add a variable in Scratch

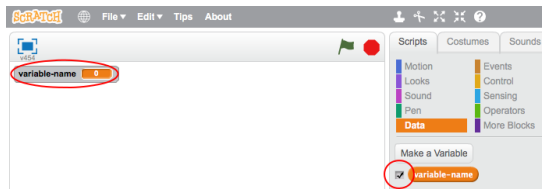
- Click on **Data** in the Scripts tab, then click on **Make a Variable**.



- Type in the name of your variable. You can choose whether you would like your variable to be available to all sprites, or to only this sprite. Press **OK**.



- Once you have created the variable, it will be displayed on the Stage, or you can untick the variable in the Scripts tab to hide it.

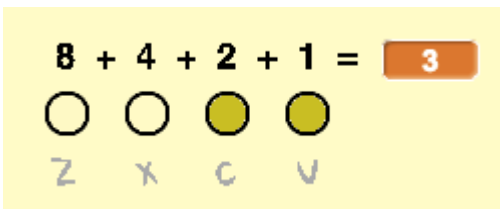


- New blocks will appear and allow you to change the value of the variable.



- Add code to the Stage to use the keys pressed to calculate the value of the note to be played.

For example, when **c** and **v** are pressed, the value of **note** should be 3.



? I need a hint

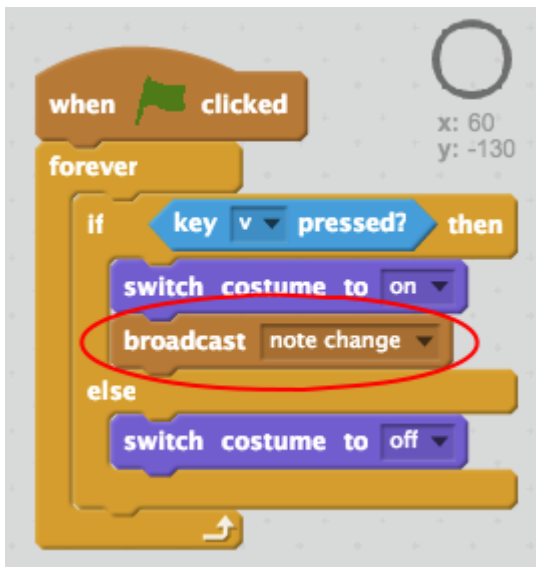
This is what your code should look like:



Playing notes

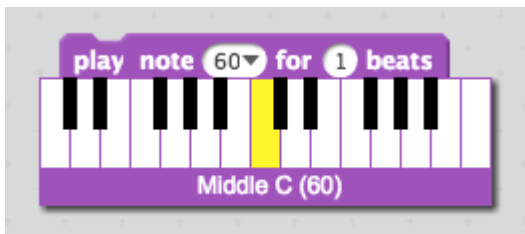
Let's play notes when keys are pressed.

- Broadcast a 'note change' message whenever each of the four keys is pressed.



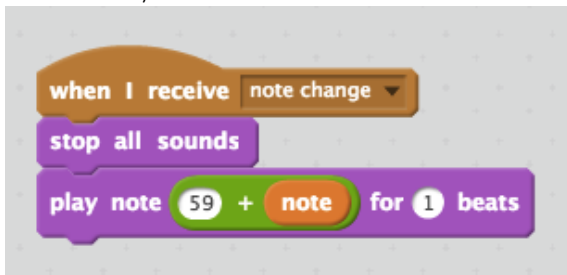
- Add code to the Stage to play a note when a combination of keys is pressed.

Your notes should start at middle C, which is note 60.



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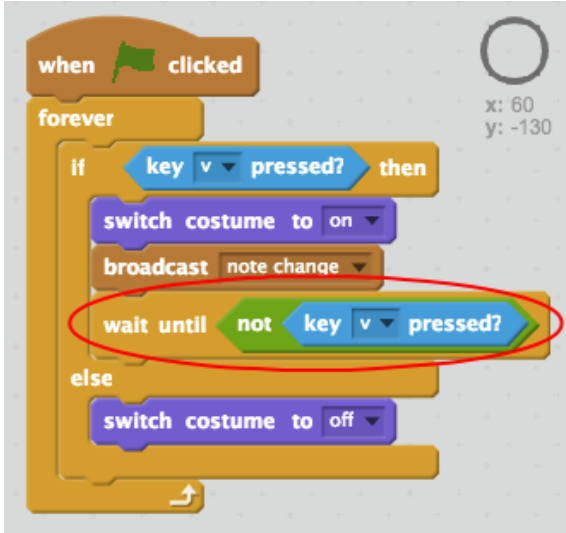
This is what your code should look like:



- Test your code. You'll notice that the note is repeatedly played when a key is held down.
- Can you add code so that the key sprites only play a note **once** when a key is held down?

? I need a hint

This is what your code should look like:



Scrolling notes

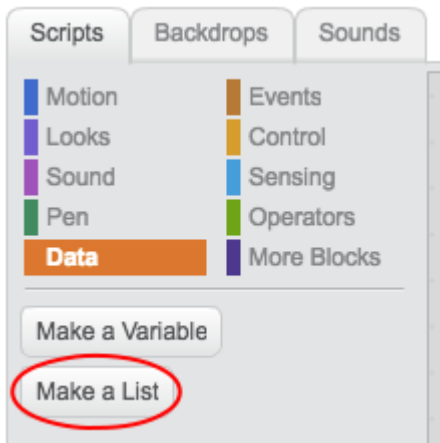
Scroll notes down the stage so that the player knows which keys to press.

- Create two lists called **notes** and **times**.

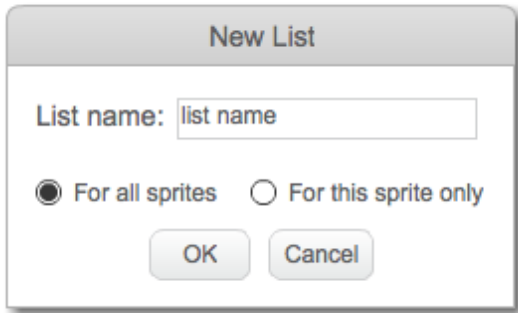
Make a list

Make a list

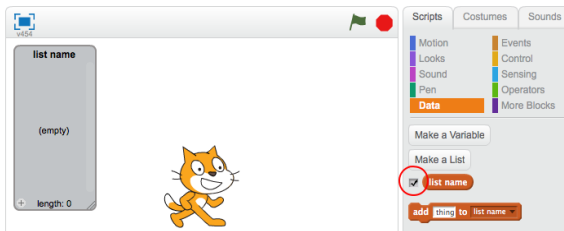
- Click on **Data** in the Scripts tab, then click on **Make a List**.



- Type in the name of your list. You can choose whether you would like your list to be available to all sprites, or to only a specific sprite. Press **OK**.



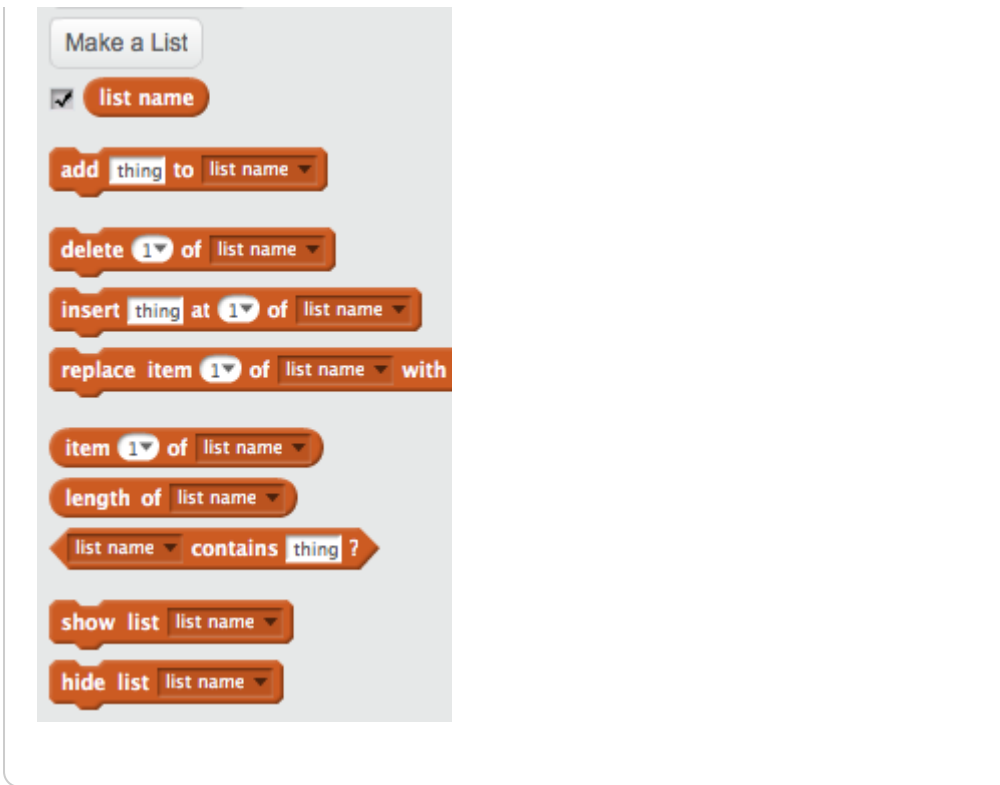
- Once you have created the list, it will be displayed on the stage, or you can untick the list in the Scripts tab to hide it.



- Click the + at the bottom of the list to add items, and click the cross next to an item to delete it.



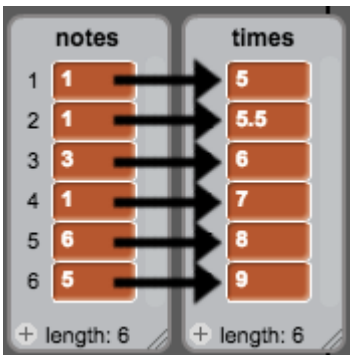
- New blocks will appear and allow you to use your new list in your project.



- Add the following numbers to your **notes** and **times** lists. Note: make sure to add these exact numbers in the right order.

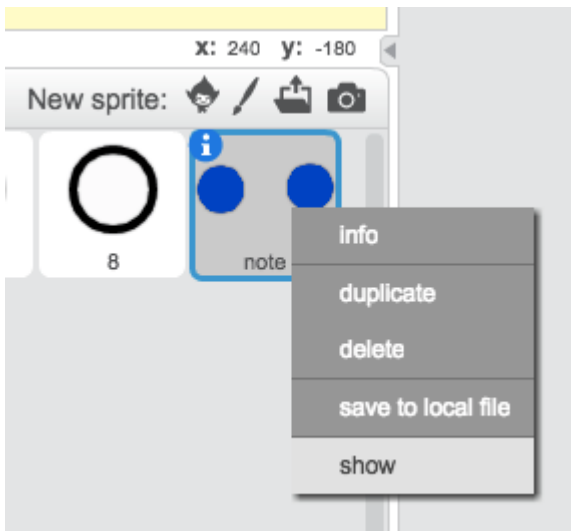


- Here's how songs will be stored:
 - The **notes** list stores the notes of the song, in order (from 1 to 15).
 - The **times** list is used to store the times that each note is played.

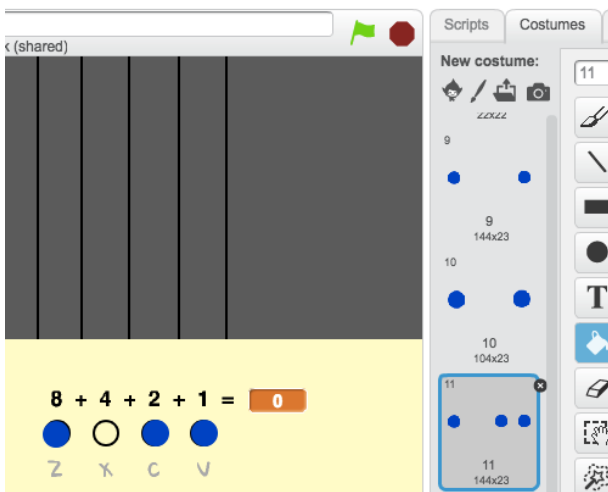


So for the data above:

- Note 1 (middle C) should be played at 5 seconds
- Note 1 should be played again at 5.5 seconds
- Note 3 should be played at 6 seconds
- etc...
- Right-click on the 'note' sprite and click **show**.



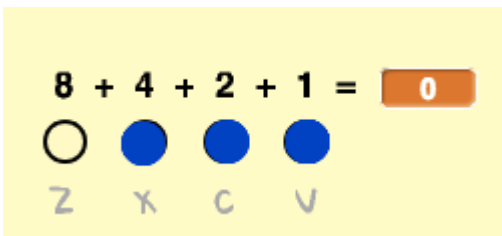
- If you click **Costumes**, you should see that the sprite has 15 different costume, one for each note.



- Add code to create a clone of the 'note' sprite for every note to be played. Each clone should be created two seconds before the time the note should be played, and should then move down the stage.

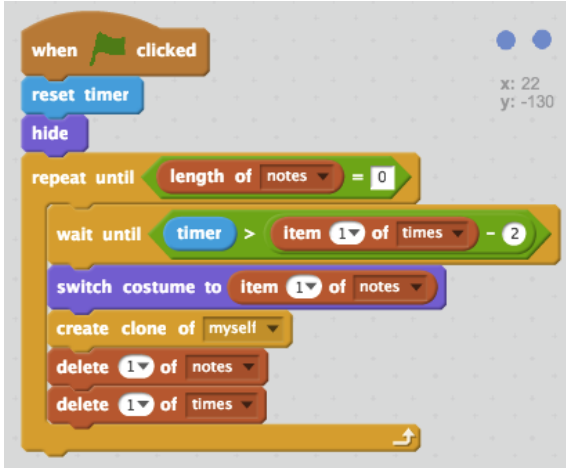
This will give the clone two seconds to move down the screen. You'll create the code to move your clones in a little bit!

Nothing will seem to happen when you test your code, because the 'note' sprite is hidden. If you show (or don't hide) the sprite, then you should see clones being created on top of each other.



? I need a hint

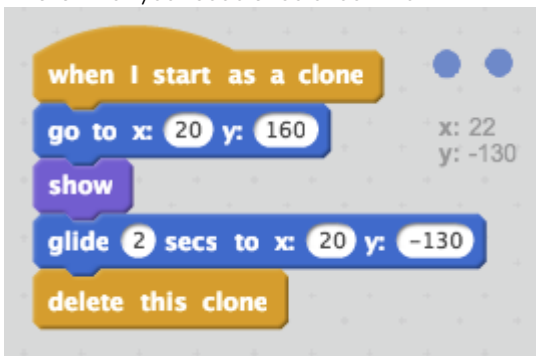
This is what your code should look like:



- Now add code to make each note clone glide from the top to the bottom of the screen before being deleted.

? I need a hint

This is what your code should look like:



Storing songs

You've made it so that notes are removed from the lists once they've been played, so you'll be left with empty lists:



You're now going to add code to store songs in your project, so that you don't have to add to your lists each time.

- Make a block called **load 'happy birthday'** that clears both the **notes** and **times** lists, and then adds the numbers back into both lists.

Test your new block by running it at the start of your project.

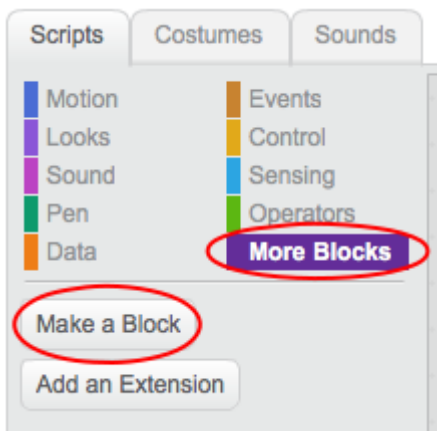


Each of your lists should now contain five numbers.



i Making a block

- Click the **Scripts** tab, then on **More Blocks**, and then click **Make a Block**.



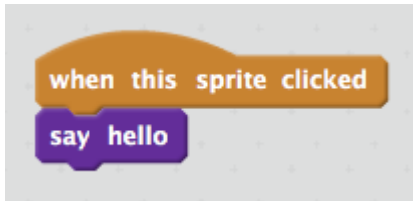
- Give your new block a name and then click **OK**.



- You will see a new **define** block. Attach code to this block.



- You can then use your new block just like any normal block.

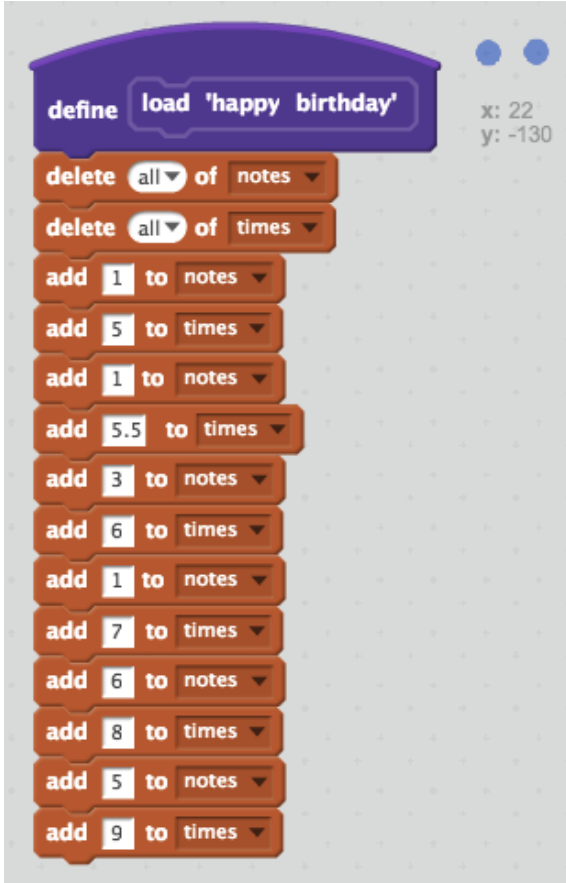


- The code attached to your new **define** block is run whenever the block is used.

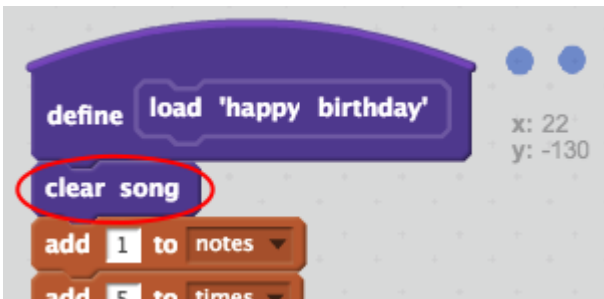


? I need a hint

This is what your code should look like:



- The code above is difficult to read. Make another block called **clear song**, which deletes all items from both lists. Use this block before adding to the lists.



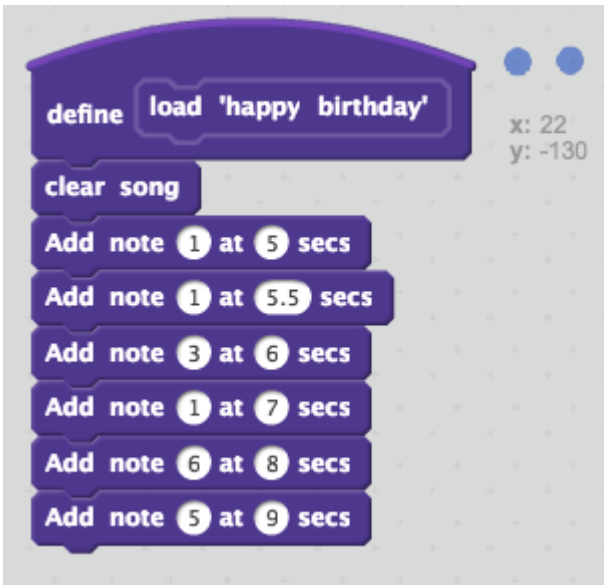
When you test your code, it should work just as it did before.

? I need a hint

This is what your code should look like:



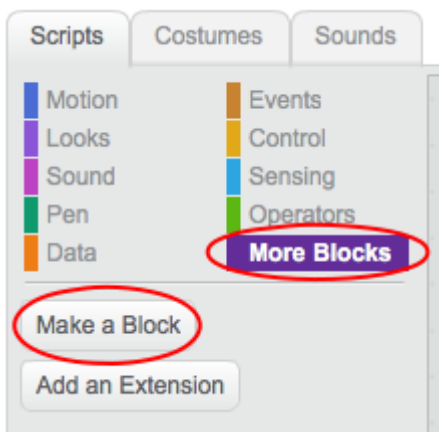
- You could make your code even easier to read by making another block which allows you to specify a note to be played along with a time.



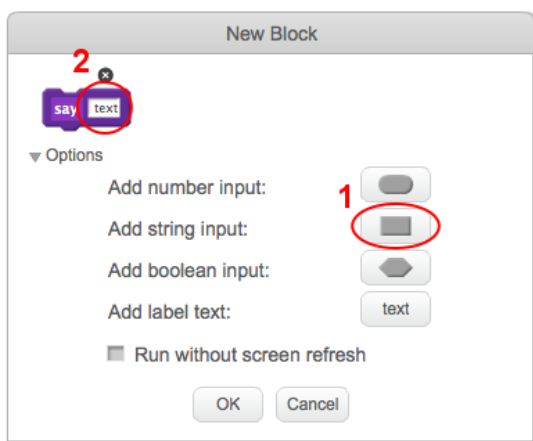
When you test your code, it should work just as it did before.

Making a block with parameters

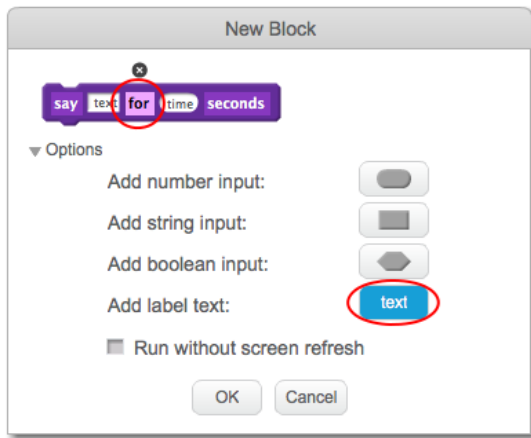
- Click on **More Blocks** in the Scripts tab, then click on **Make a Block**.



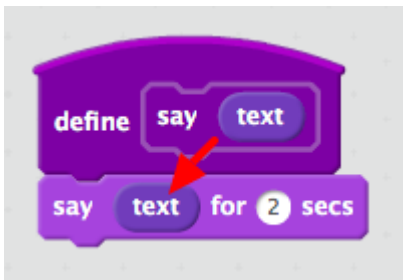
- You can create blocks that have 'gaps' to add data. These 'gaps' are called **parameters**. To add parameters, click **Options**, then click the type of data you want to add and then give your data a name.



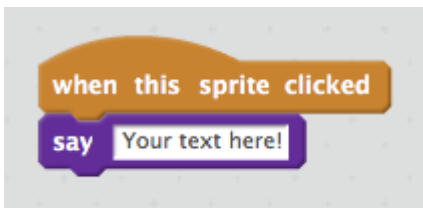
- If you want to add some text between parameters, you can add label text:



- You can then define your new block, and use the data by dragging the circular blocks to use them in your code.



- Now you add data as parameters into the gaps of your new block.

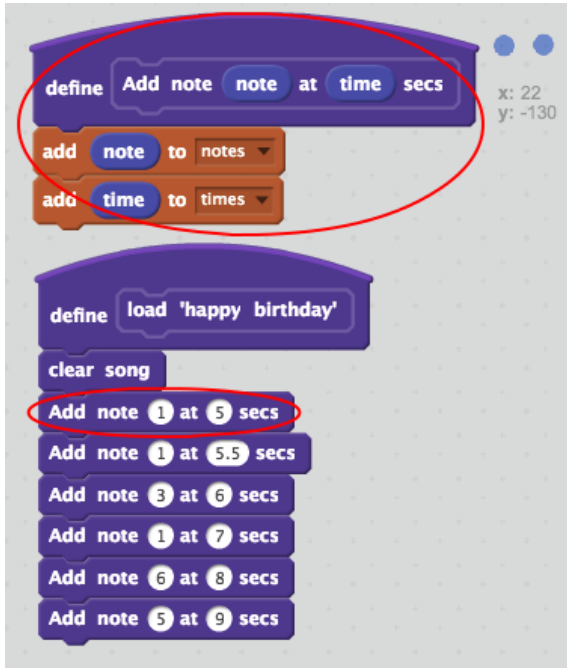


- Use the new **define** block with the gaps you have filled in by attaching code to it and adding it to your script.



? I need a hint

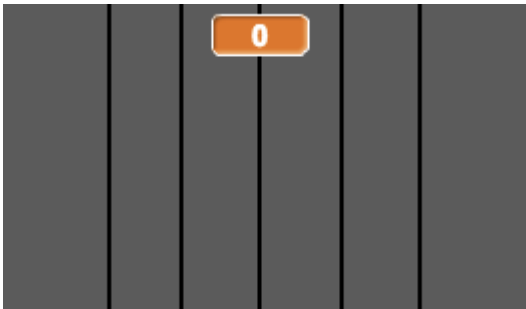
This is what your code should look like:



Keeping score

Improve your game by giving the player points each time the correct note is played.

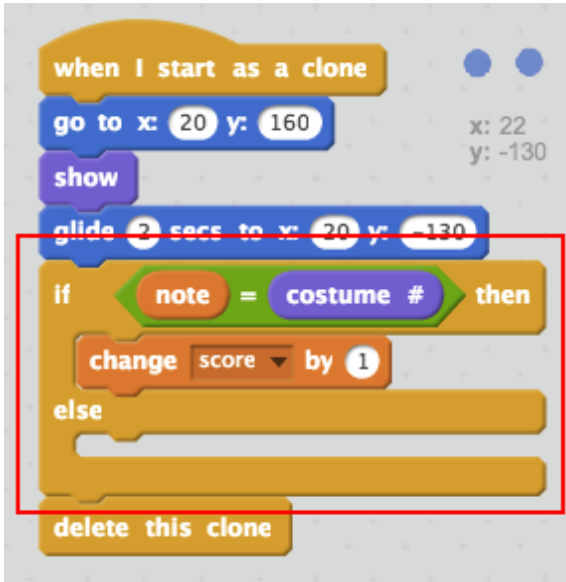
- Create a new variable called **score**, and place it at the top of your stage.



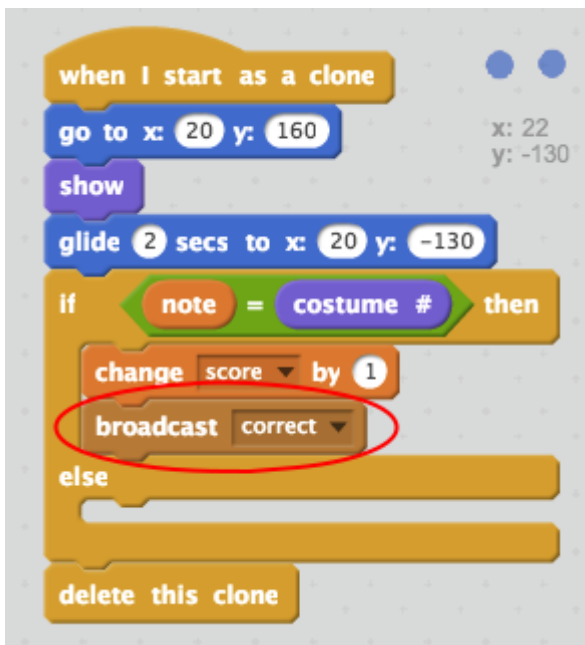
- Add to the player's score whenever they play the correct note at the correct time. Remember to set their score to 0 at the start of the game.

? I need a hint

This is what your code should look like:



- Broadcast a message called 'correct' when the correct note is played.

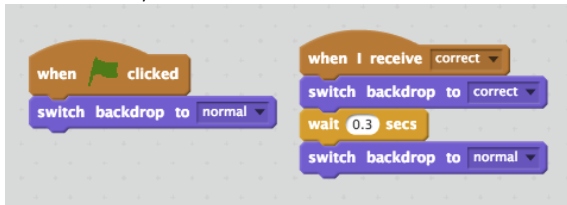


- Add code to your Stage to briefly change how it looks when the player plays the correct note. A costume has been provided for you.



? I need a hint

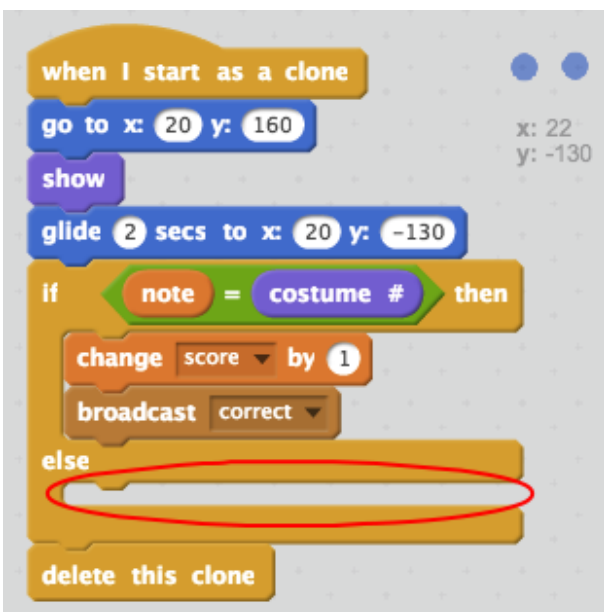
This is what your code should look like:



Challenge: incorrect notes

Your Binary Hero game is done now, but there are a few things you could do to make it even better!

For example, can you add code to change how the stage looks if the correct note isn't played?



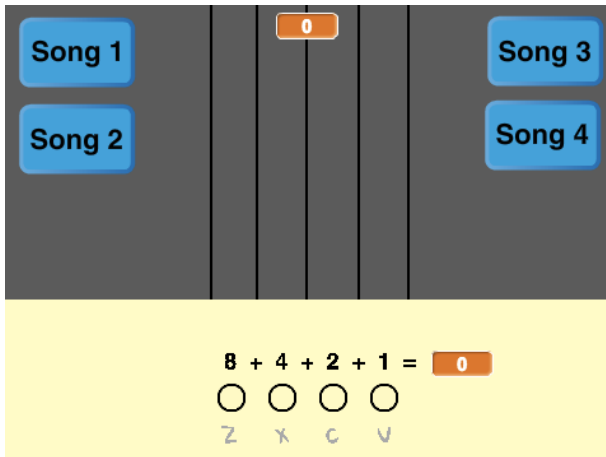
You'll need to add code very similar to the code for when a correct note is played, and a costume has been provided for you.

Challenge: create your own song

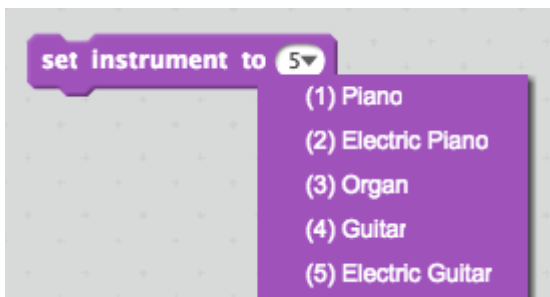
Can you add your own song to the game? Showing the timer will help you get an idea of when the notes of your song should be played.



You could also allow the player to choose a song at the start of the game.



You could even use different instruments for different songs!



Hour of Code

I've finished my Hour of Code! (<https://code.org/api/hour/finish>)

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