Objects in Motion

Using Computers To Tell Objects How To Move

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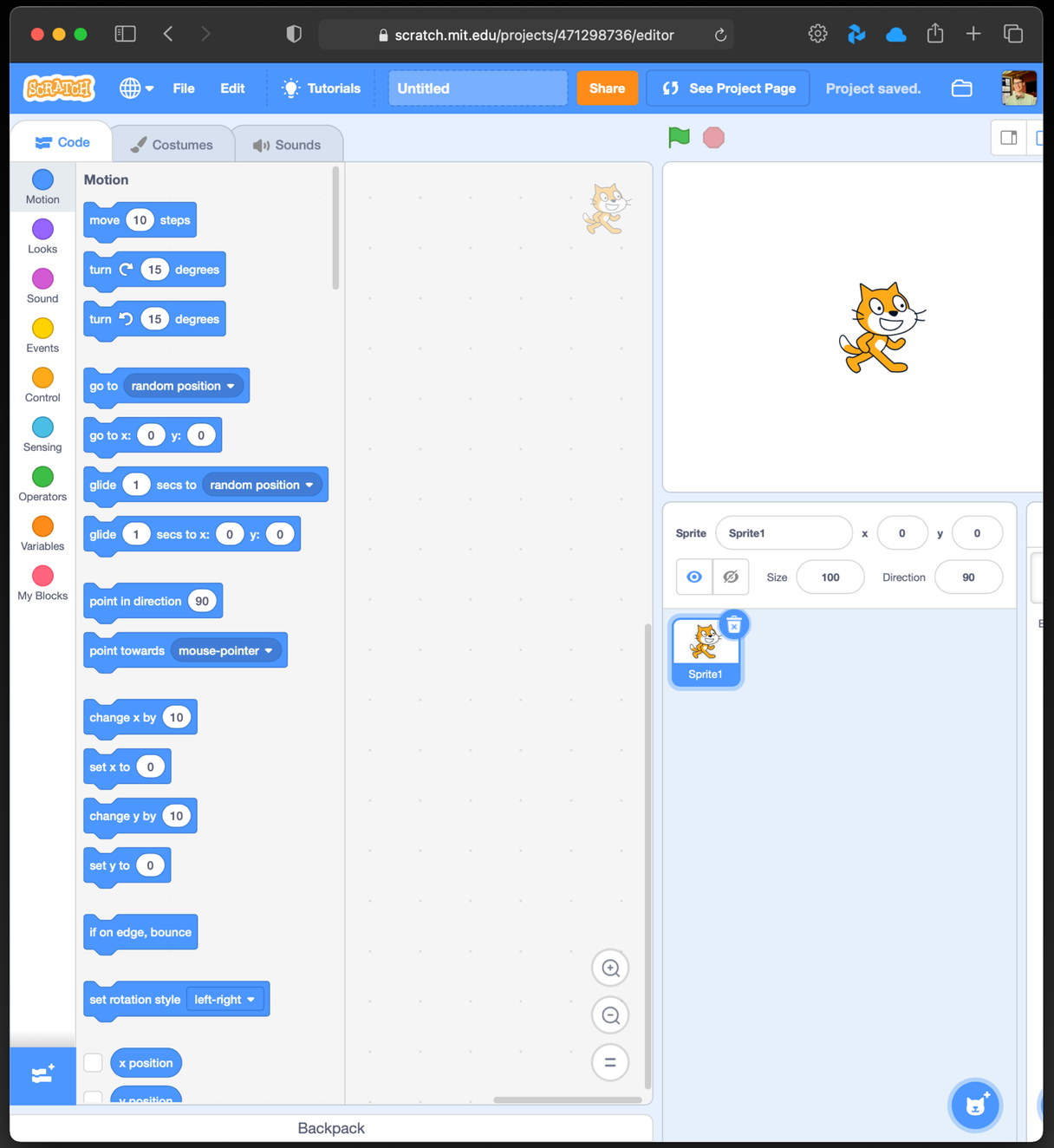
Motion

Making Objects Move

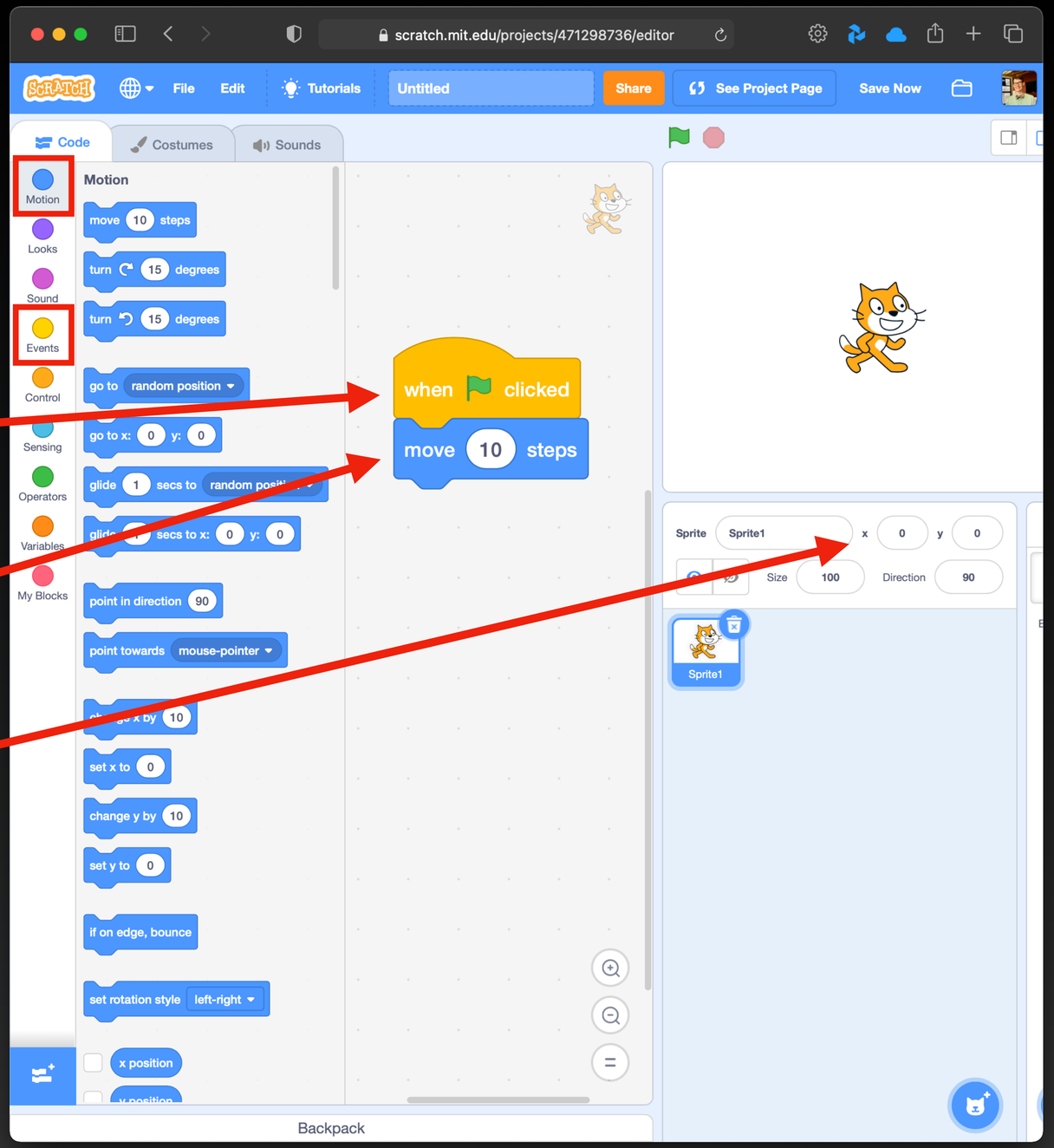
- We can write code to tell objects how to move.
- Let’s try it!
- https://scratch.mit.edu/projects/editor
- Scratch is a program that can help us visualize the code more easily.



Motion

Making Objects Move

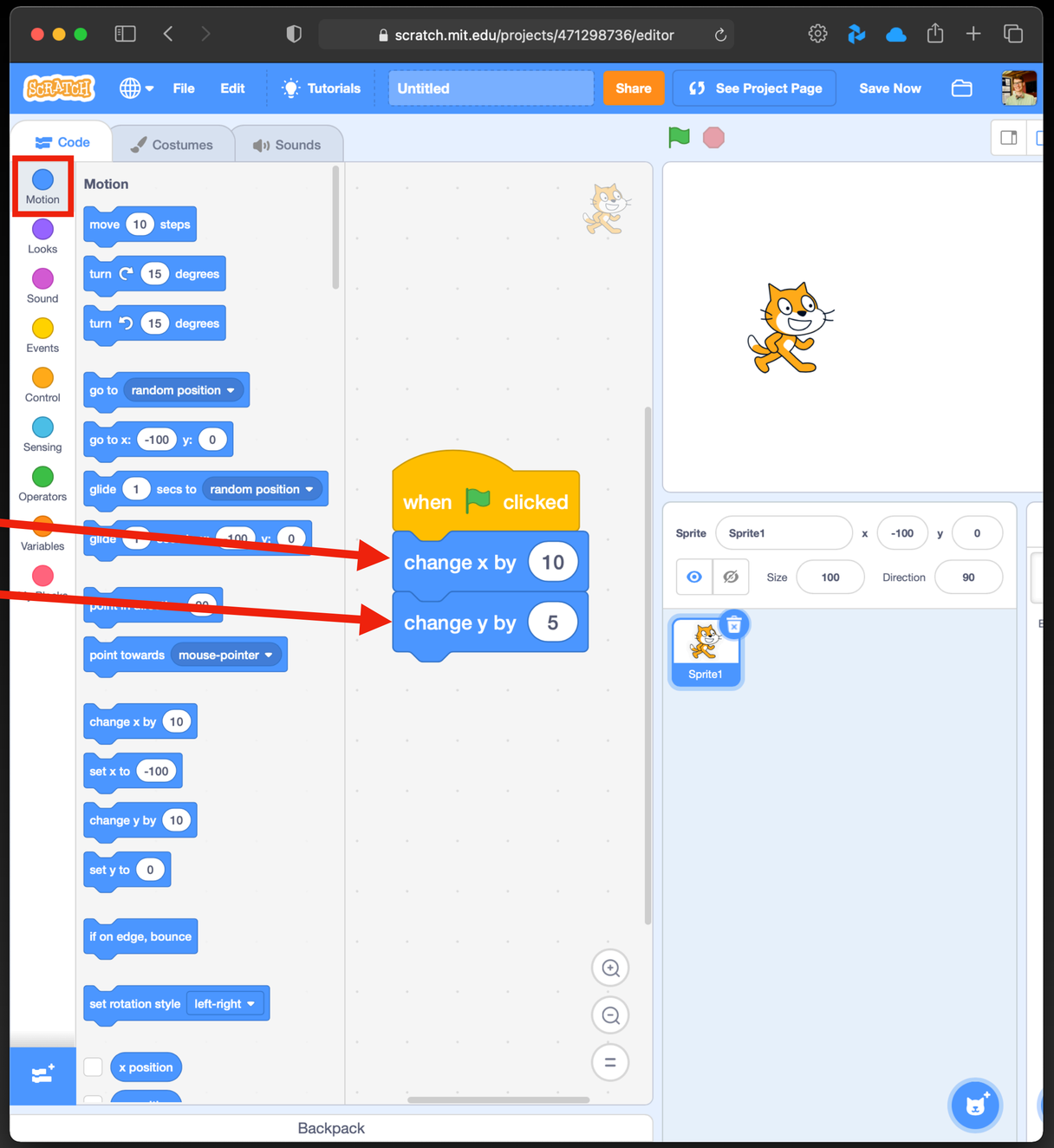
- Use “When 🚩 Clicked” to start the movement (from Events).
- Get the cat to move every time you click the green flag.
- Notice how the value for “x” changes as the cat moves.



Motion

Making Objects Move

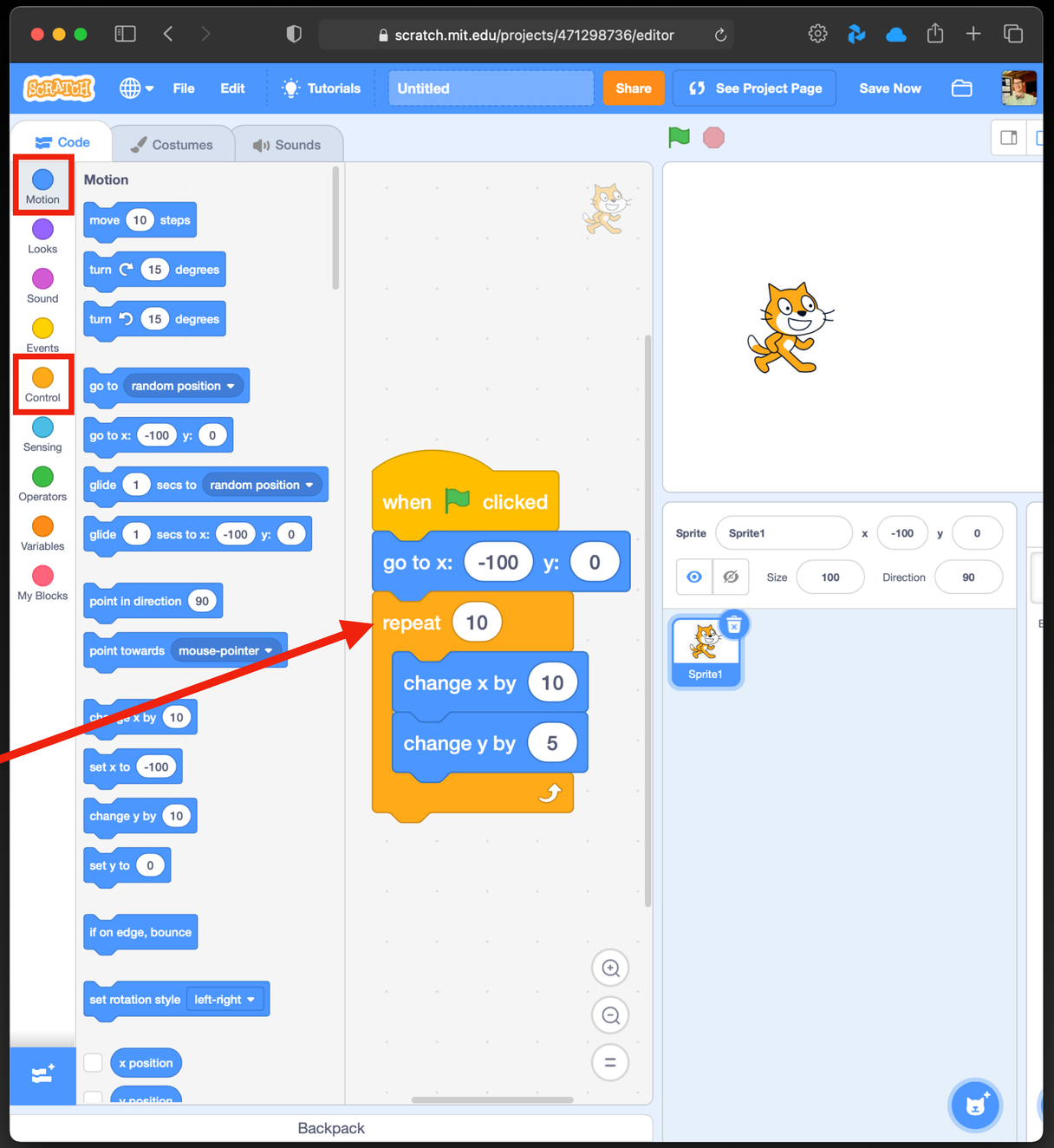
- Let's tell the cat to move
  10 steps to the right
  and 5 steps up
  every time we click the flag. 🚩
- You might need to click and drag the cat back to a good starting point first in order to have more space to move.



Motion

Making Objects Move

- Now, instead of dragging the cat back to the start and making the cat move by clicking over and over again, let's get the computer to do the work for us.
- For this we're going to use a "loop".
- In computer programming, a "loop" is a way for us to tell the computer to repeat a task over and over again.

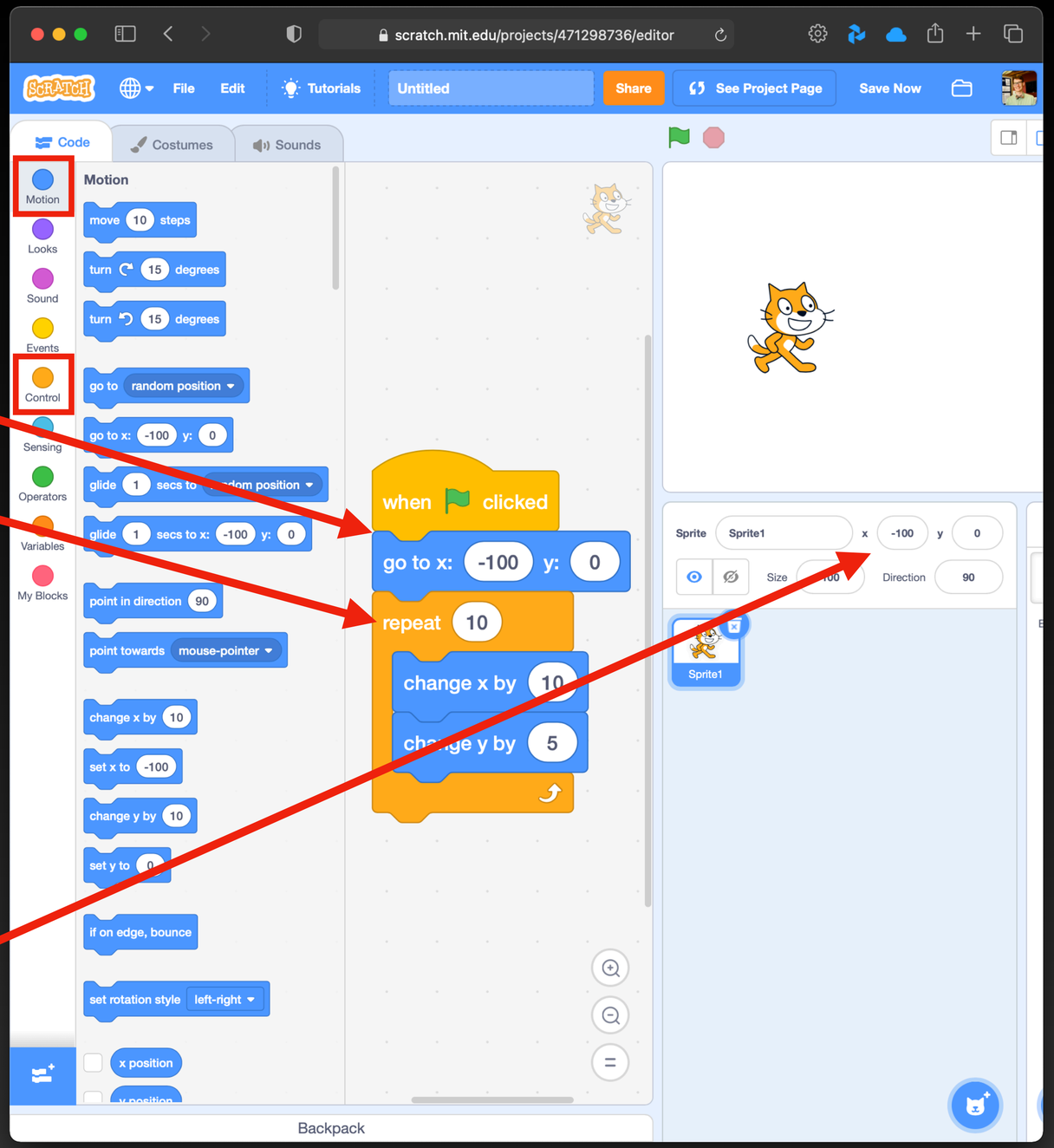


Motion

Making Objects Move

- Tell the computer where to start the cat.
- Then use a repeat loop to move the cat.

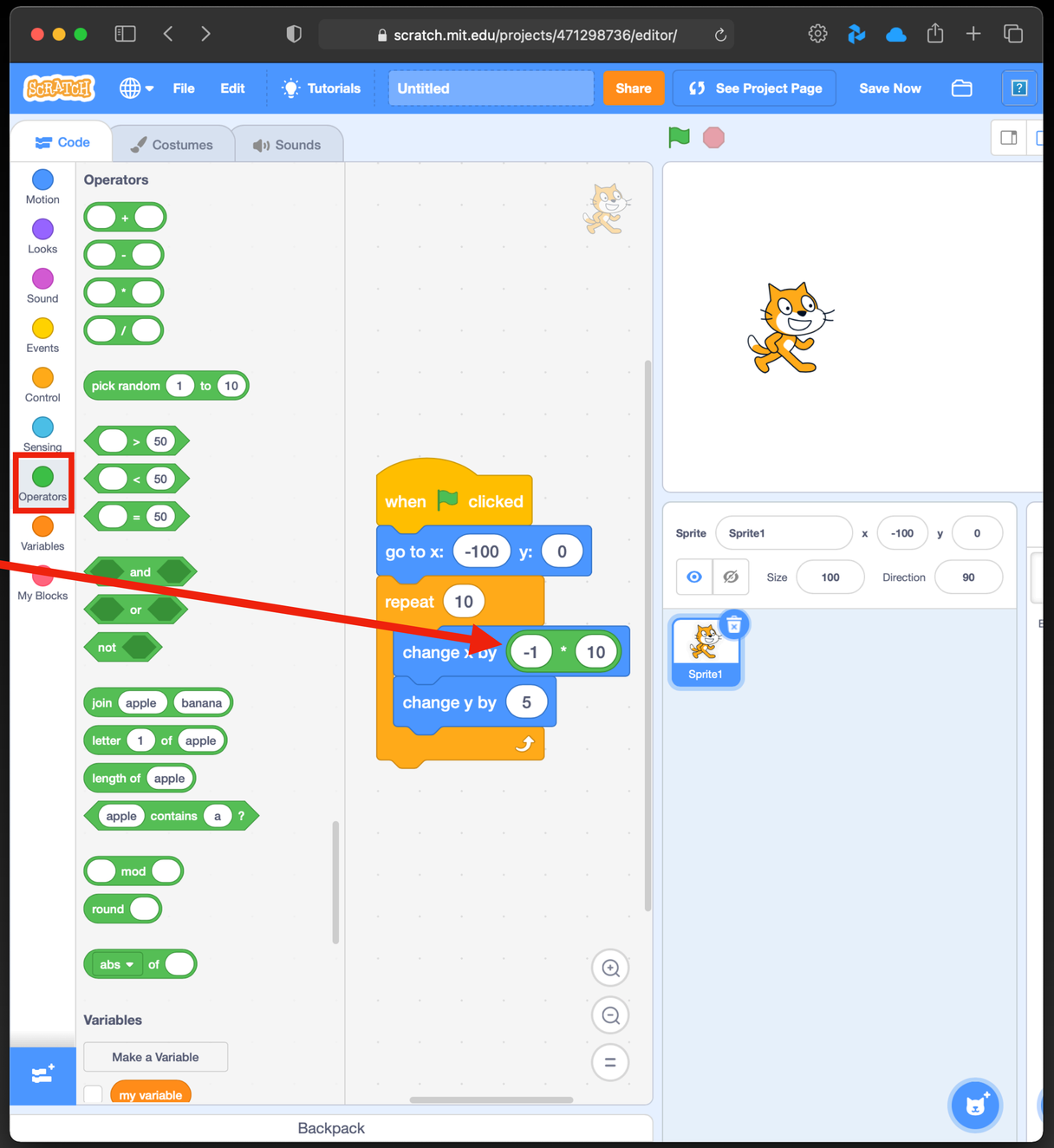
- If you repeat the movement for too long the cat will leave the screen. You can bring the cat back by typing in the starting point again here.



Motion

Making Objects Move

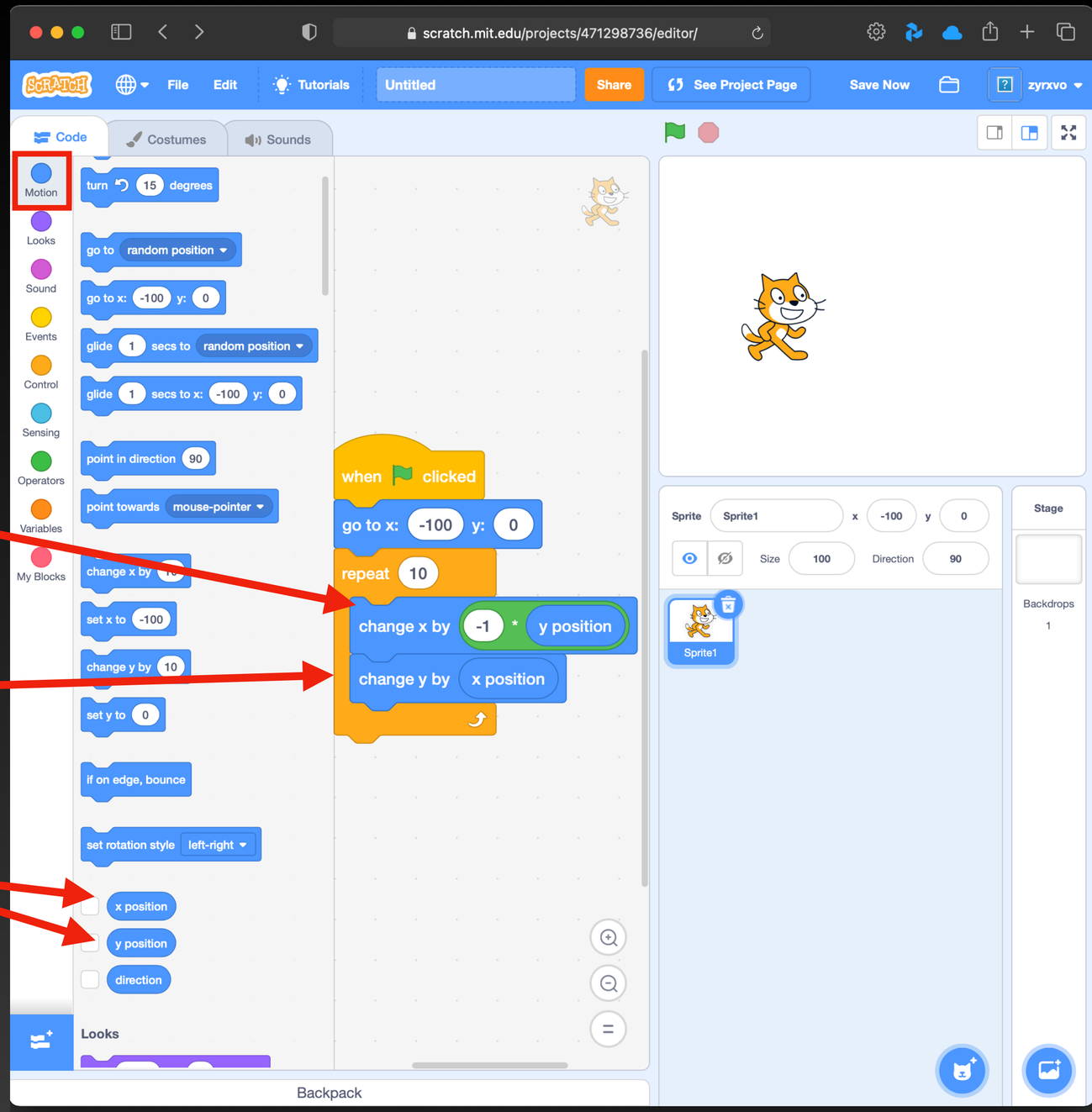
- Now let's add in some math to tell the cat to move backwards instead of forwards.
- We could type in –10 instead of +10, but by using math we can let the computer do more work for us later.



Motion

Making Objects Move

- Modify how the cat moves by changing “x” by the value of –1 times the cat’s “y position”.
- And modify the “change y by” the cat’s “x position”.
- You can get the “x position” and “y position” from bottom of the “Motion” tab.
- What kind of motion do you see?

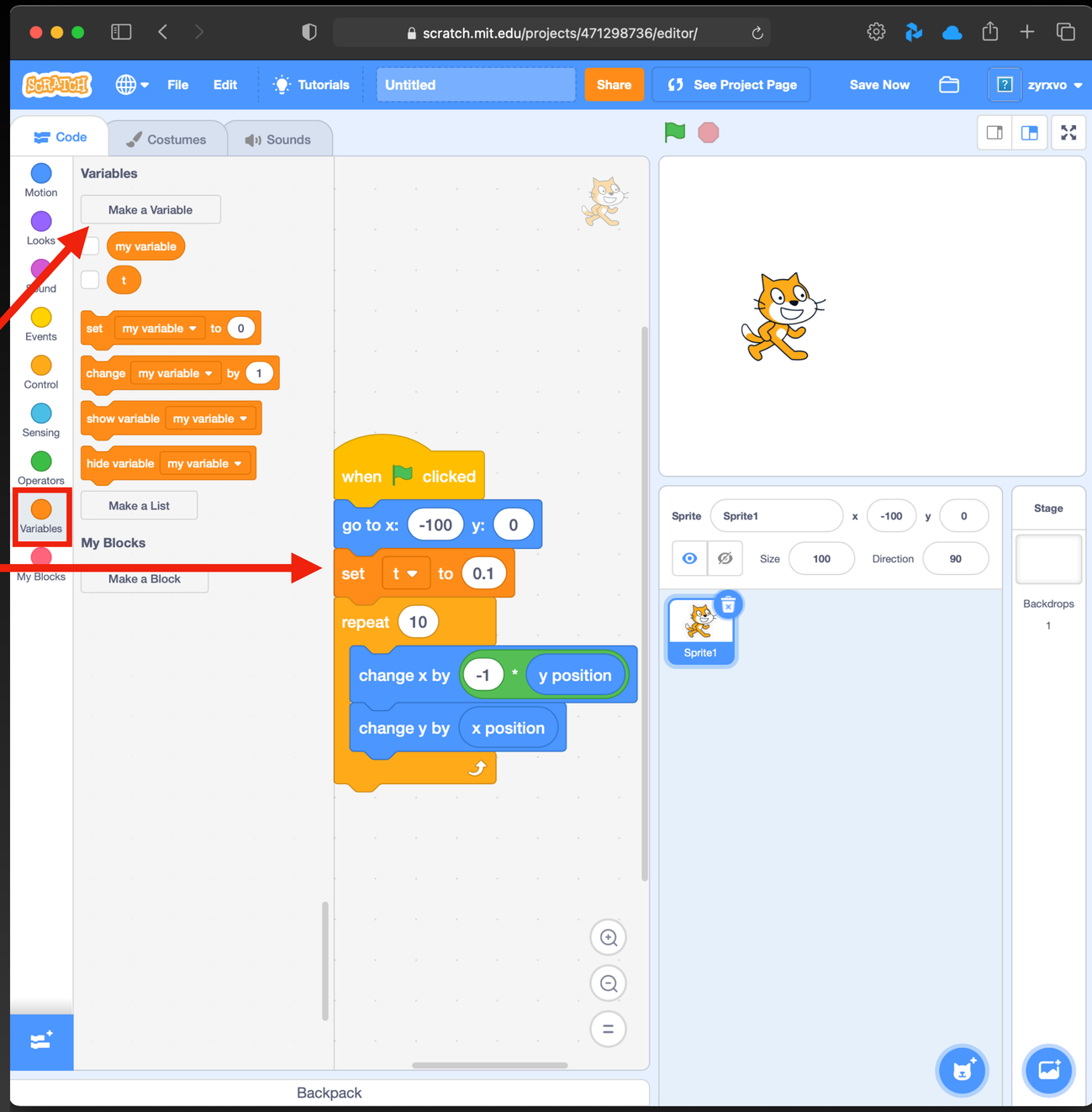


Motion

Making Objects Move

- To make the motion smoother, let's create a new variable called "t".
- Then set the variable t to 0.1

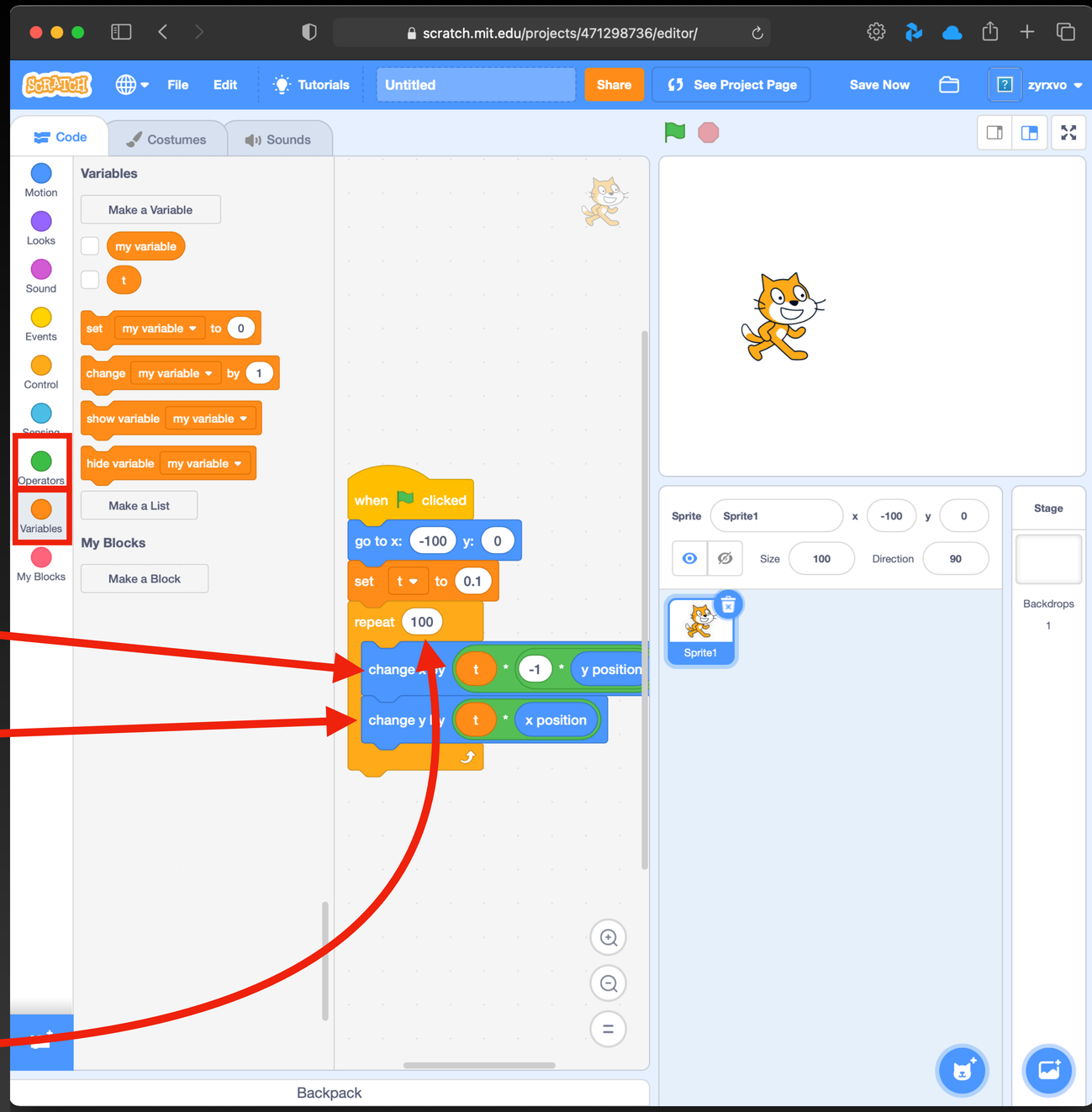
- We can use variables when coding to save information to use later in the program.
- We always need to set a variable before we can use it.



Motion

Making Objects Move

- Use the variable “t” with multiplication.
- Change x by “t” times –1 times y position
- Change y by “t” times x position.
- You may also need to increase the number of times we repeat the movement in order to watch it for longer.

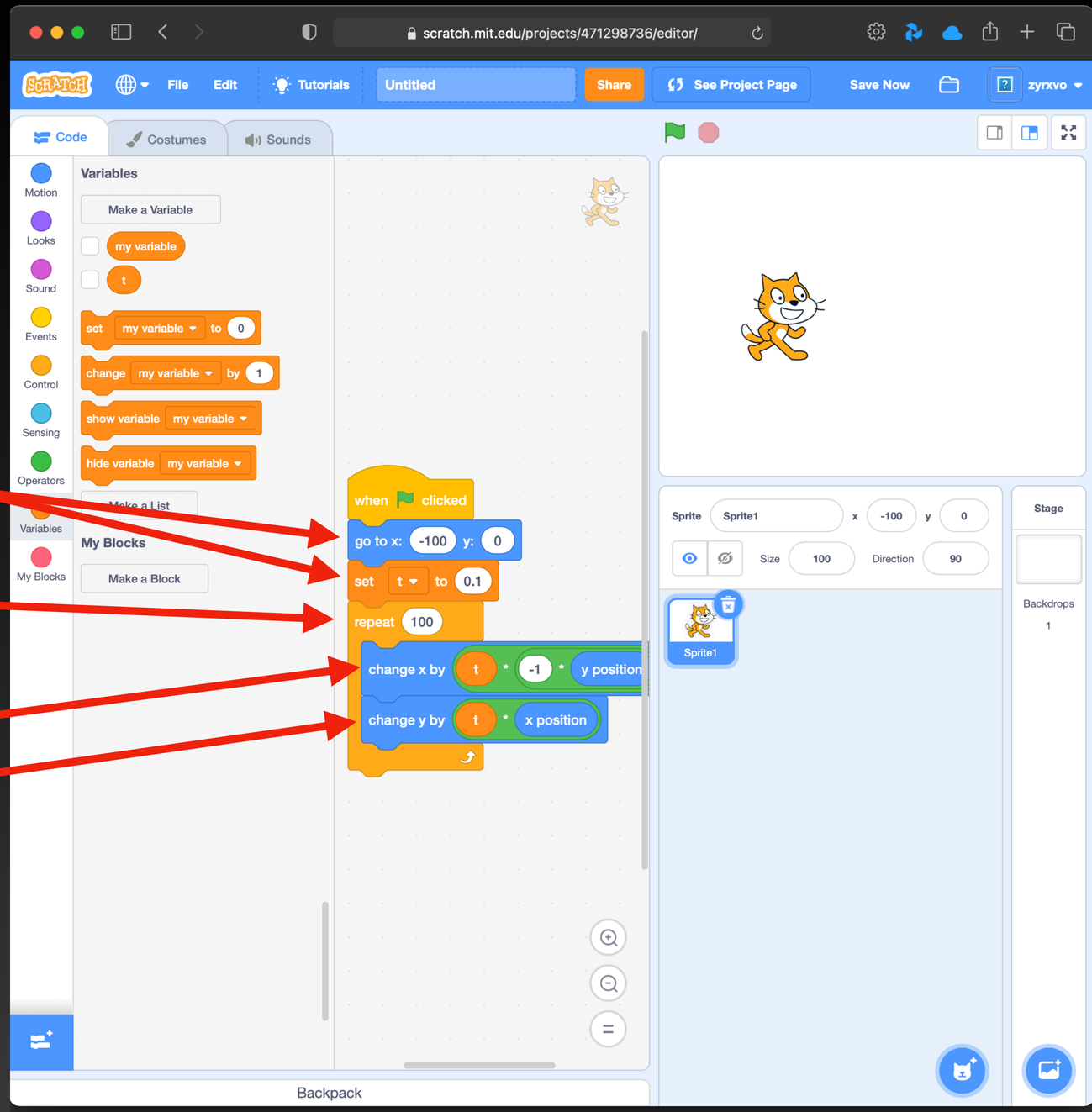


Motion

Making Objects Move

- Let’s review our code:
  - We first set our variables x, y, and t,
  - Then we set up a loop,
  - Inside the loop we
    changed x by t * (–1) * y
    changed y by t * x

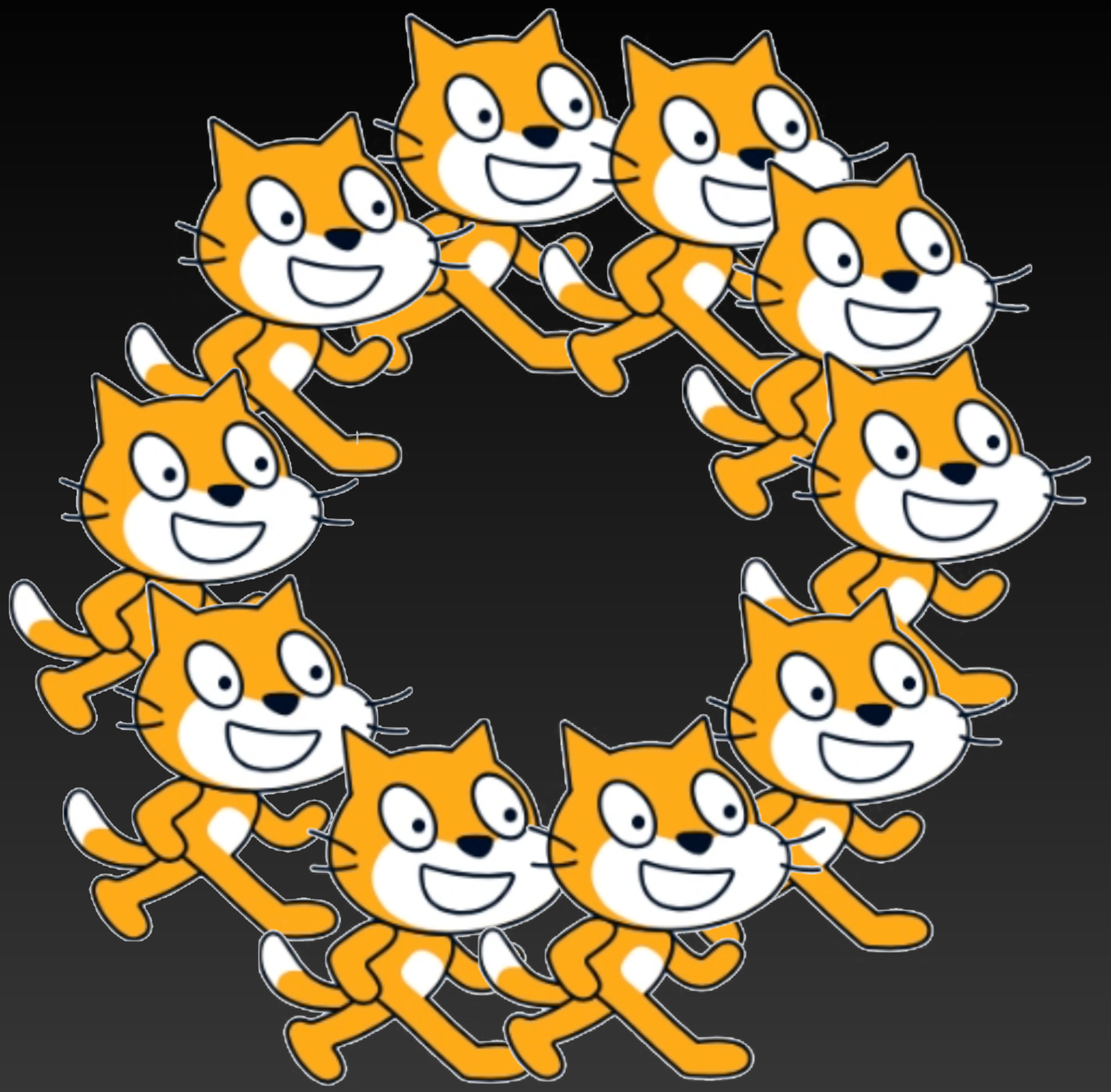
- This is called an algorithm.



Motion

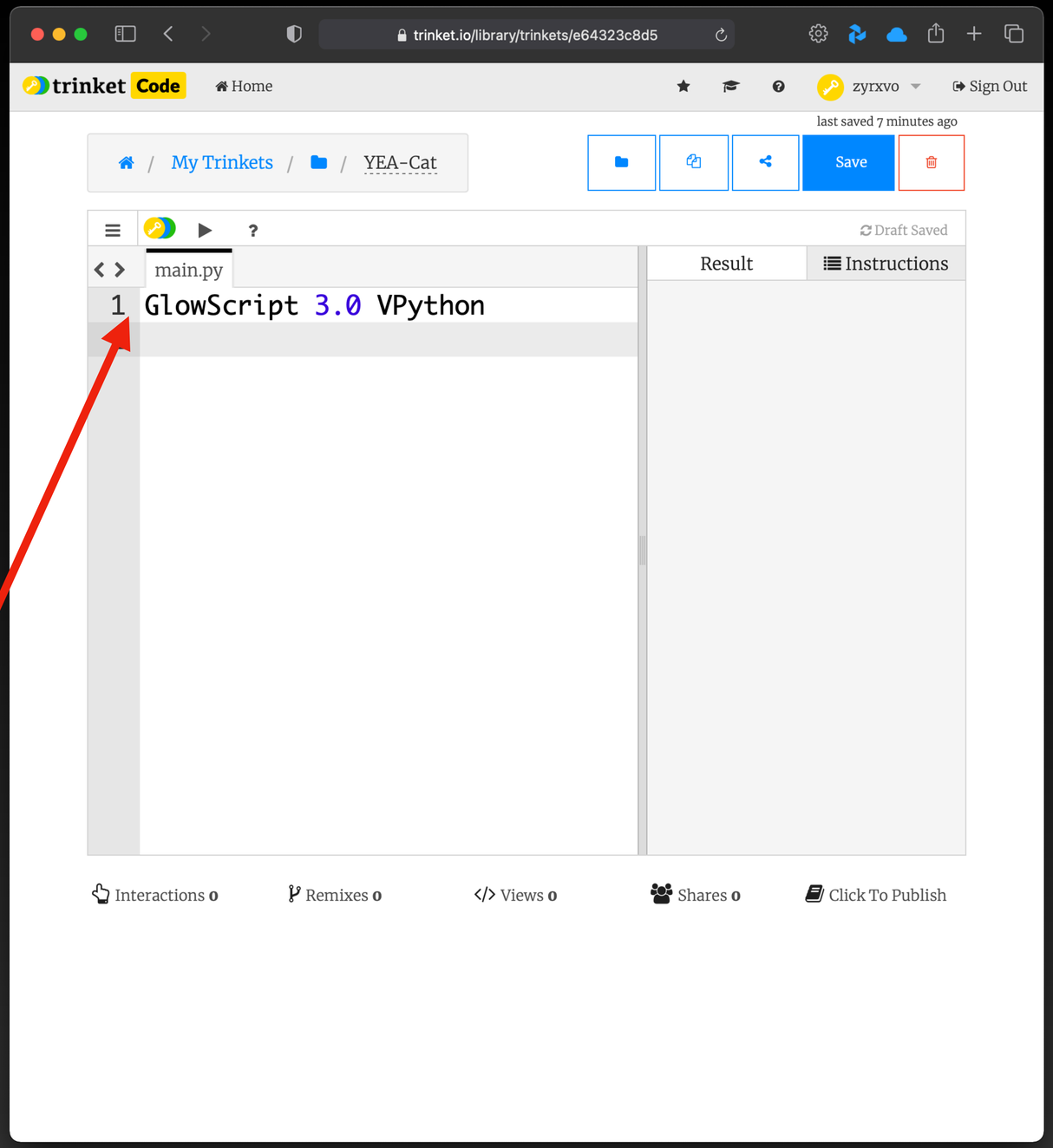
Making Objects Move

- This algorithm describes the motion of an object as it moves in a circle.
- Now let’s move this algorithm to the programming language Python.
- Let’s try it!
- https://trinket.io/library/trinkets/e64323c8d5
- Trinket lets us run Python code from anywhere.



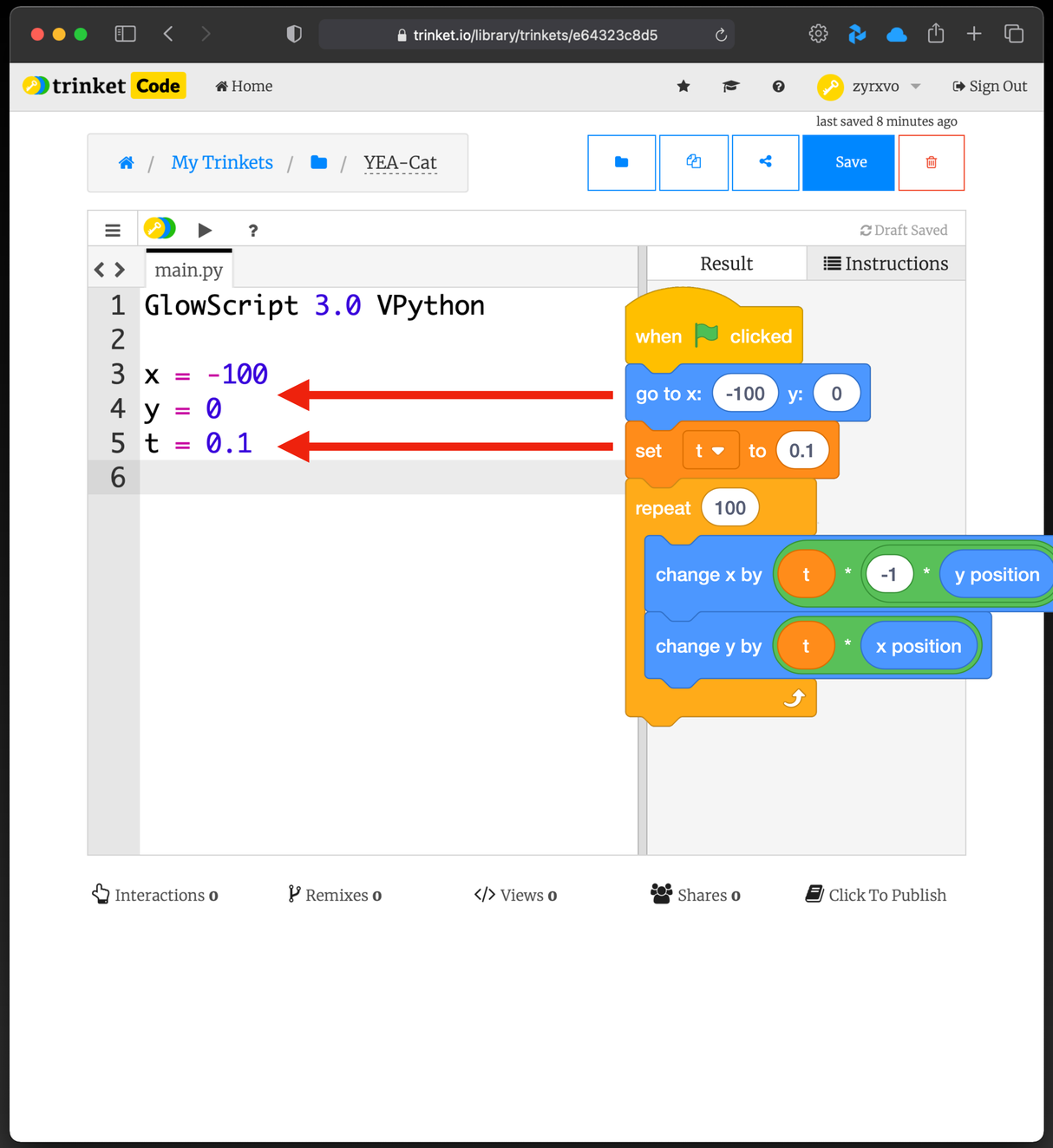
Motion
with Python

- This is what the Trinket Python editor looks like.
- In order to write Python code, we will need to type out the variable names and commands ourselves.
- Ignore the first line for now, but don’t delete it!
- Let’s do this step by step.



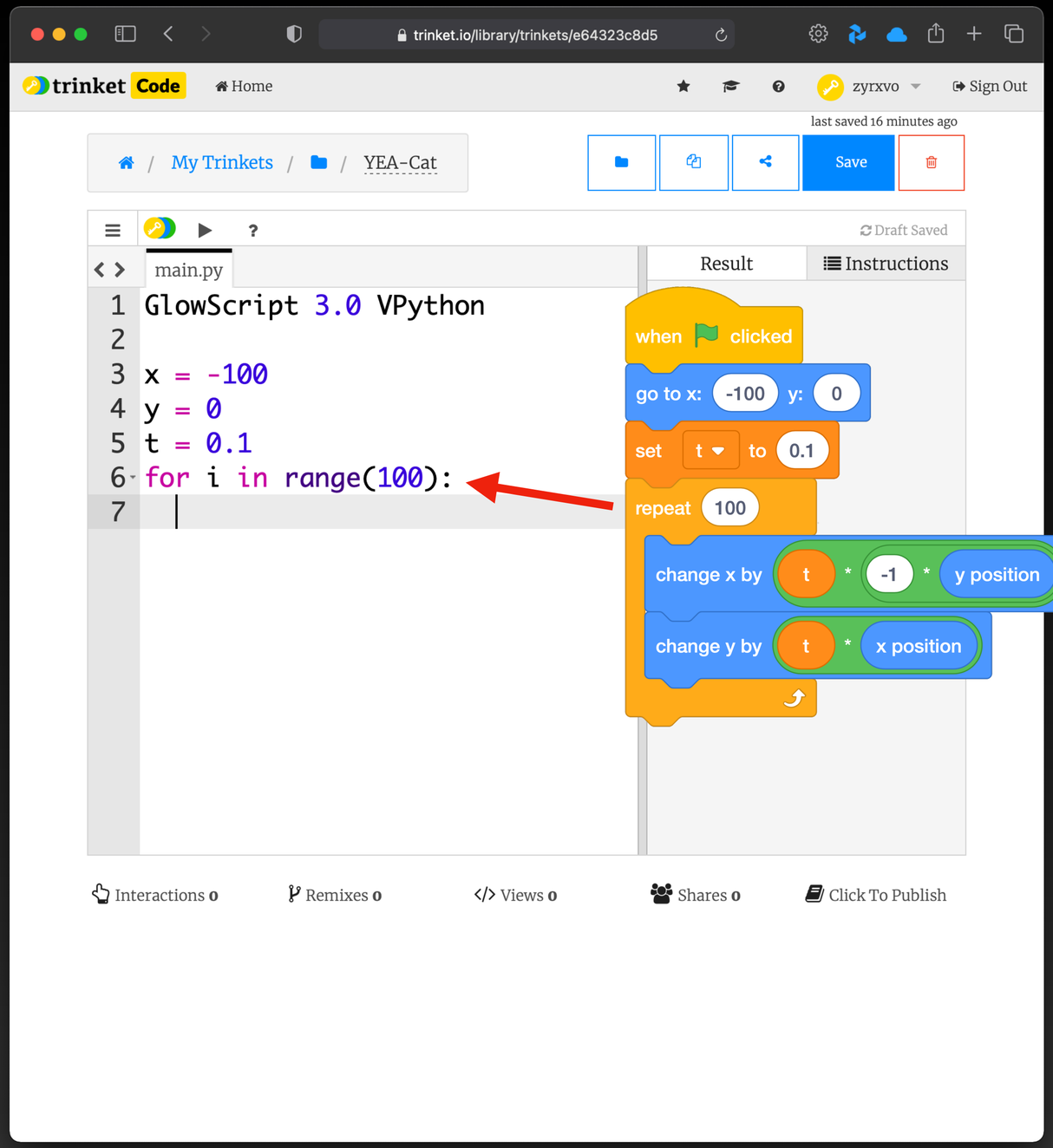
Motion
with Python

- We can create our variables x, y, and t by simple typing their names.
- In order to set the variable to a specific value we use the “=“.
- In Python, this is called “assigning”.
  Meaning we assign y to be equal to 0.



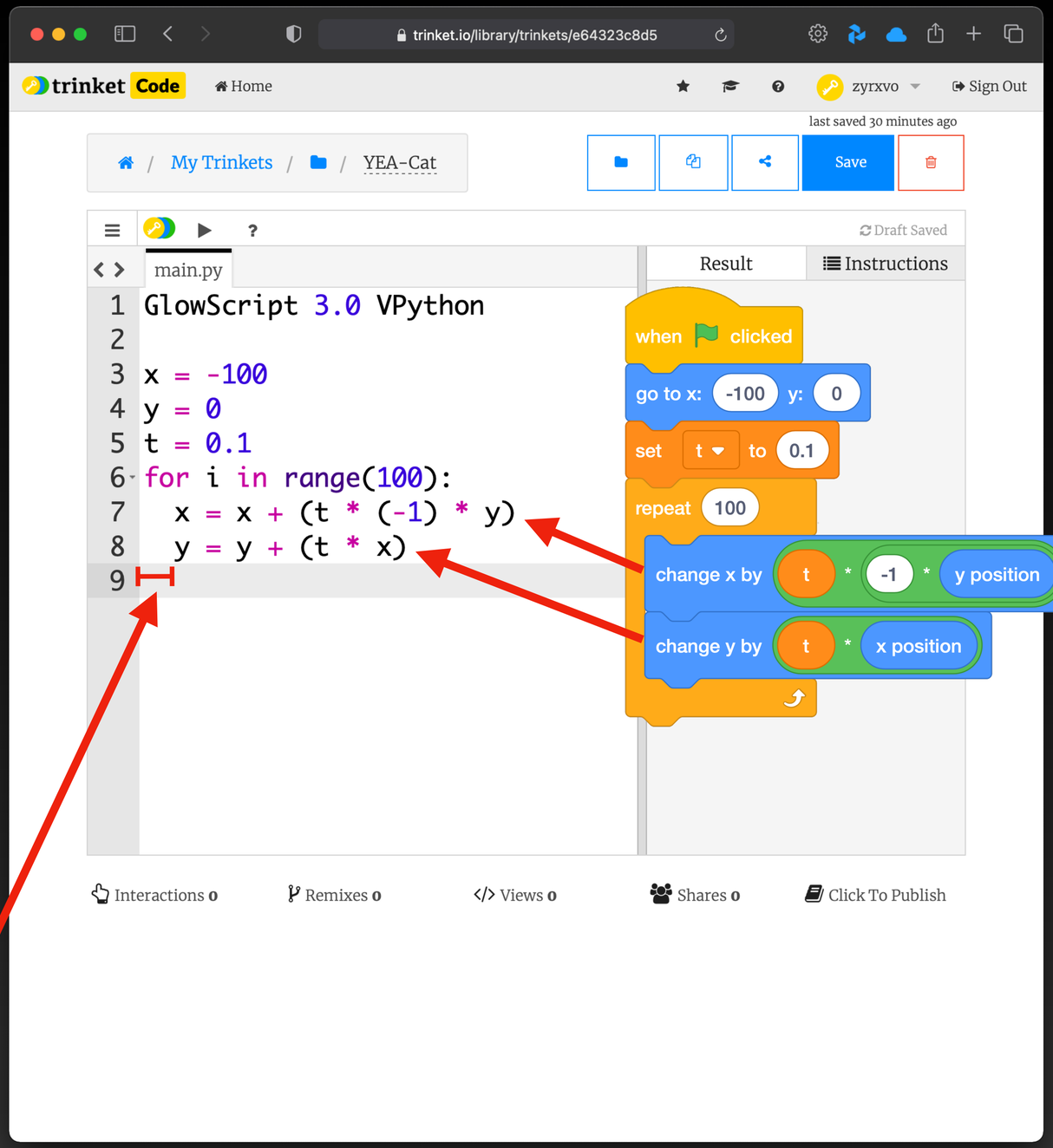
Motion
with Python

- In Python, if we want to repeat something a certain number of times, the easiest way to do it is by using a “FOR” loop.
- In English, line 6 says, “Create a list of 100 numbers and for each repetition of the loop assign i to the next number.”
- Because the range of numbers is 100, the loop will repeat 100 times.



Motion
with Python

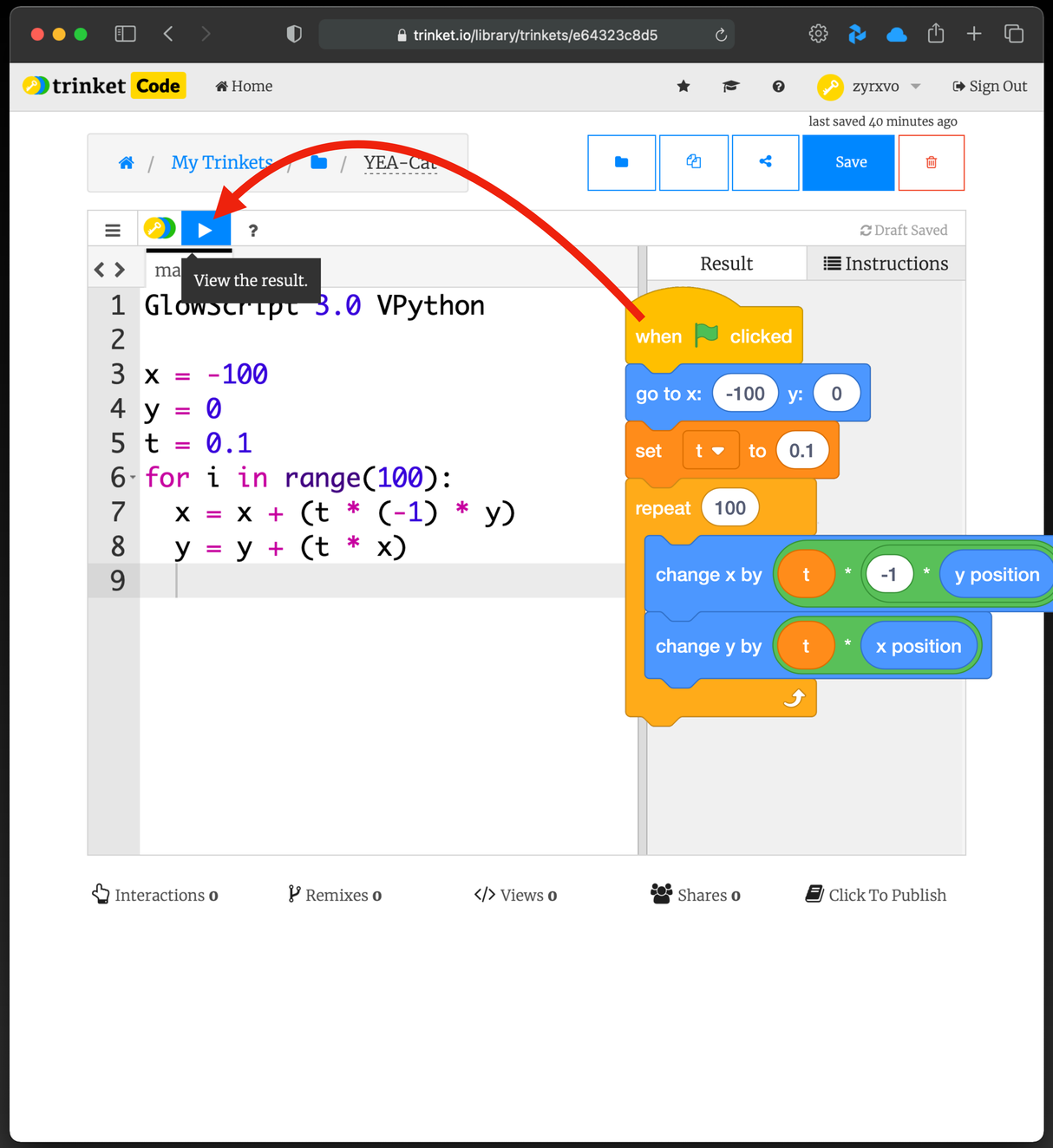
- In order to change x and y over and over again, we need to add a value to them and then assign that result to the variable again.
- So if $y = 0$, and $t \cdot x = -10$, then $y + (t \cdot x) = -10$.
- But if we don't assign the result –10 to y, then y will never change.
- Also notice the indented space inside the loop, this is necessary for Python.



Motion
with Python

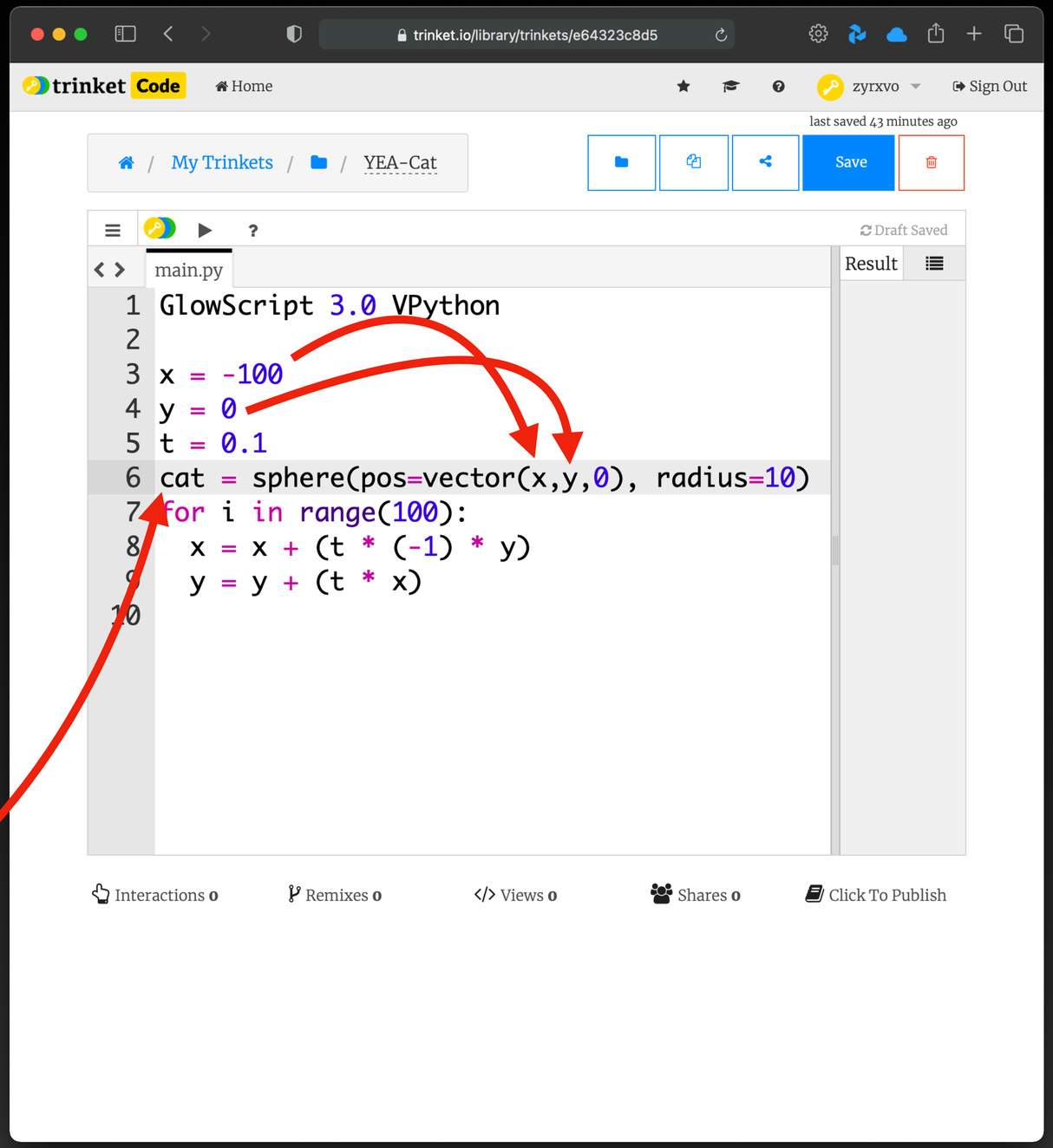
- With our algorithm now written in Python we can run our code by using the ▶ button at the top.

- What do you see?



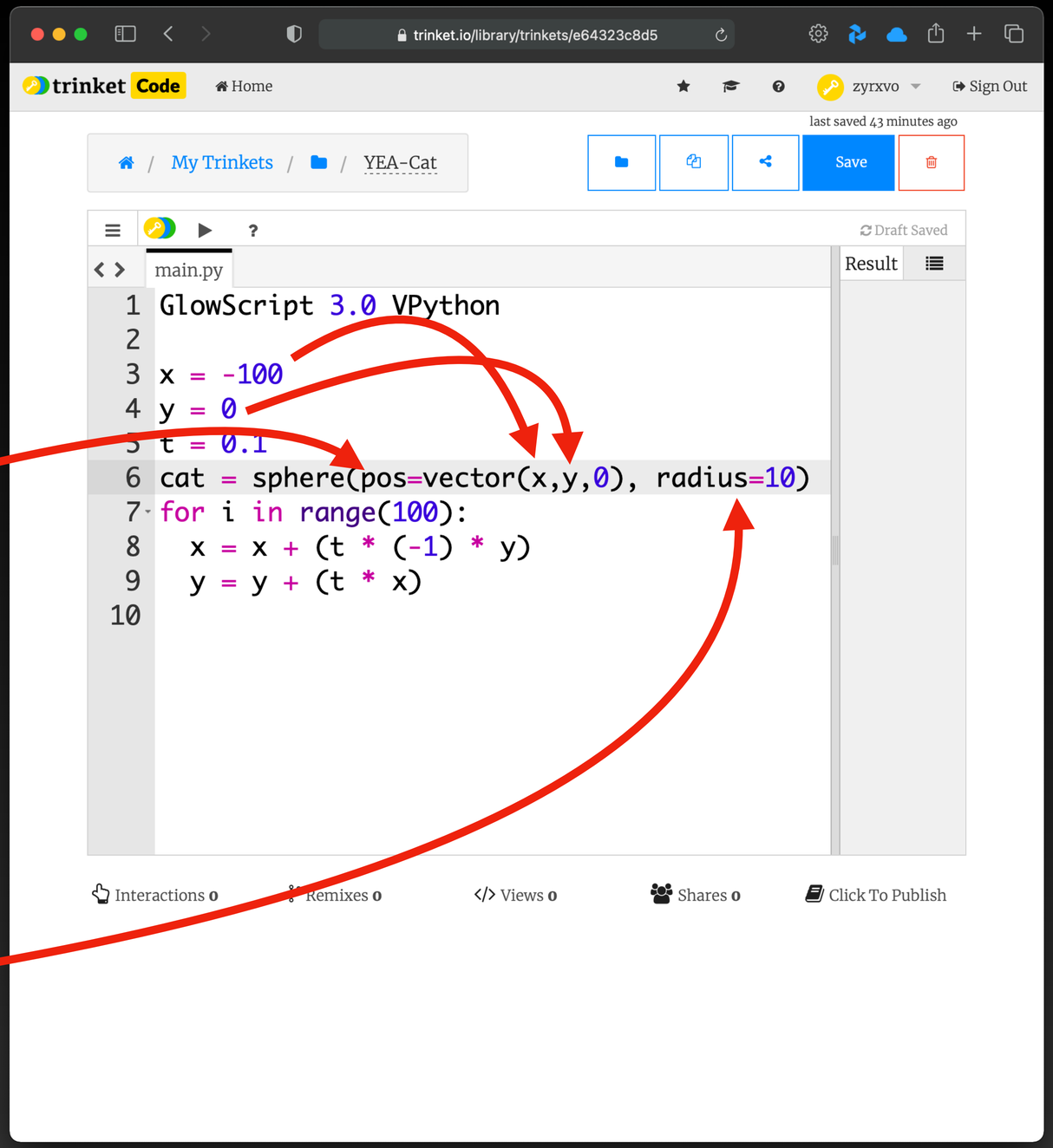
Motion
with Python

- We don’t see anything because we haven’t told Python what to draw.
- Scratch draws and moves the Cat for us, so now we need to tell the computer how to do it.
- Start by creating a new variable called “cat” and assigning a “sphere” object to it.



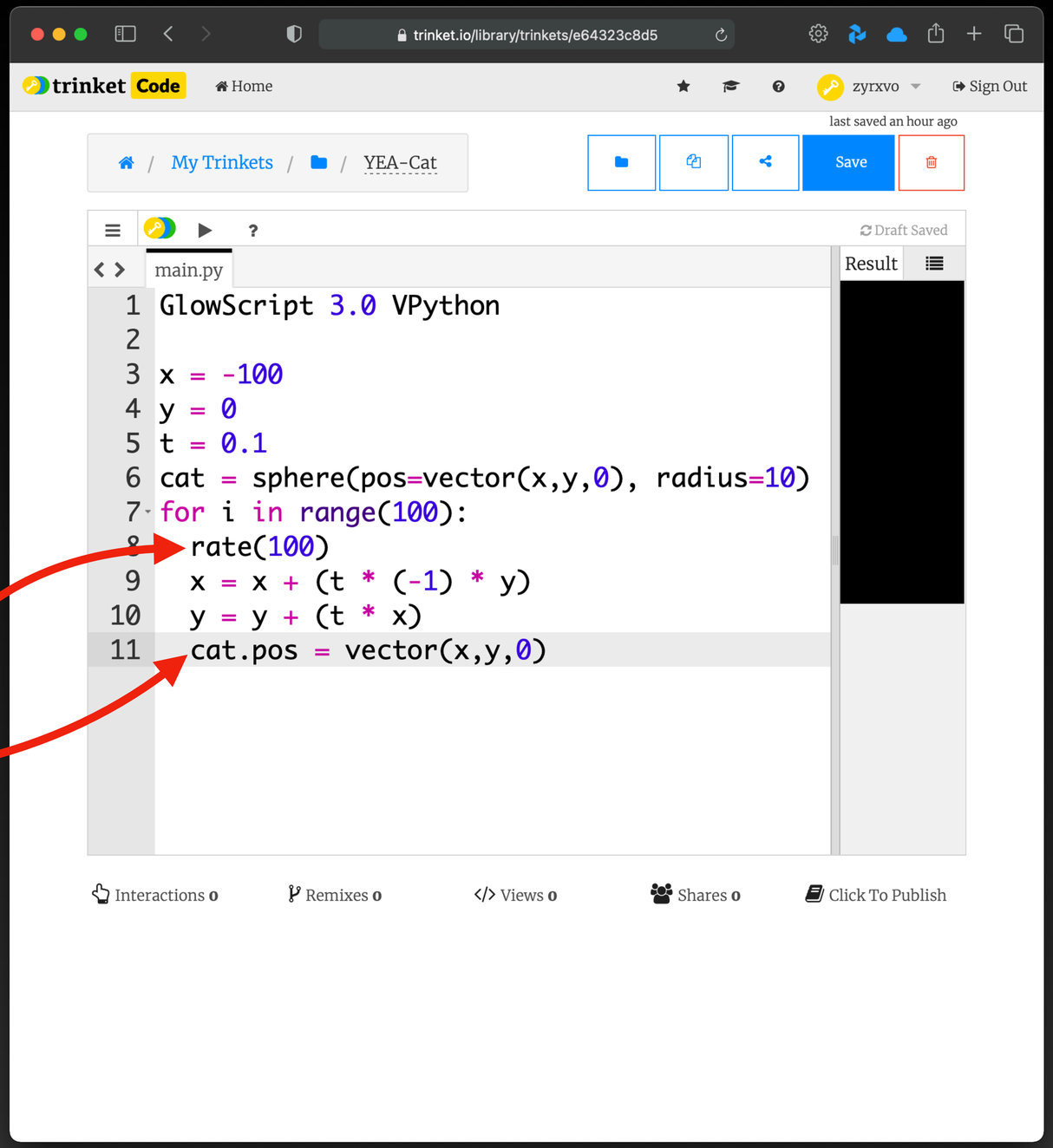
Motion
with Python

- We need set the initial position “pos” of the cat. To do that we write “pos = vector(x,y,0)”.
- This tells the computer to place our “cat” at our starting point defined by x and y.
- We can also set the initial size of the cat with “radius=10”.



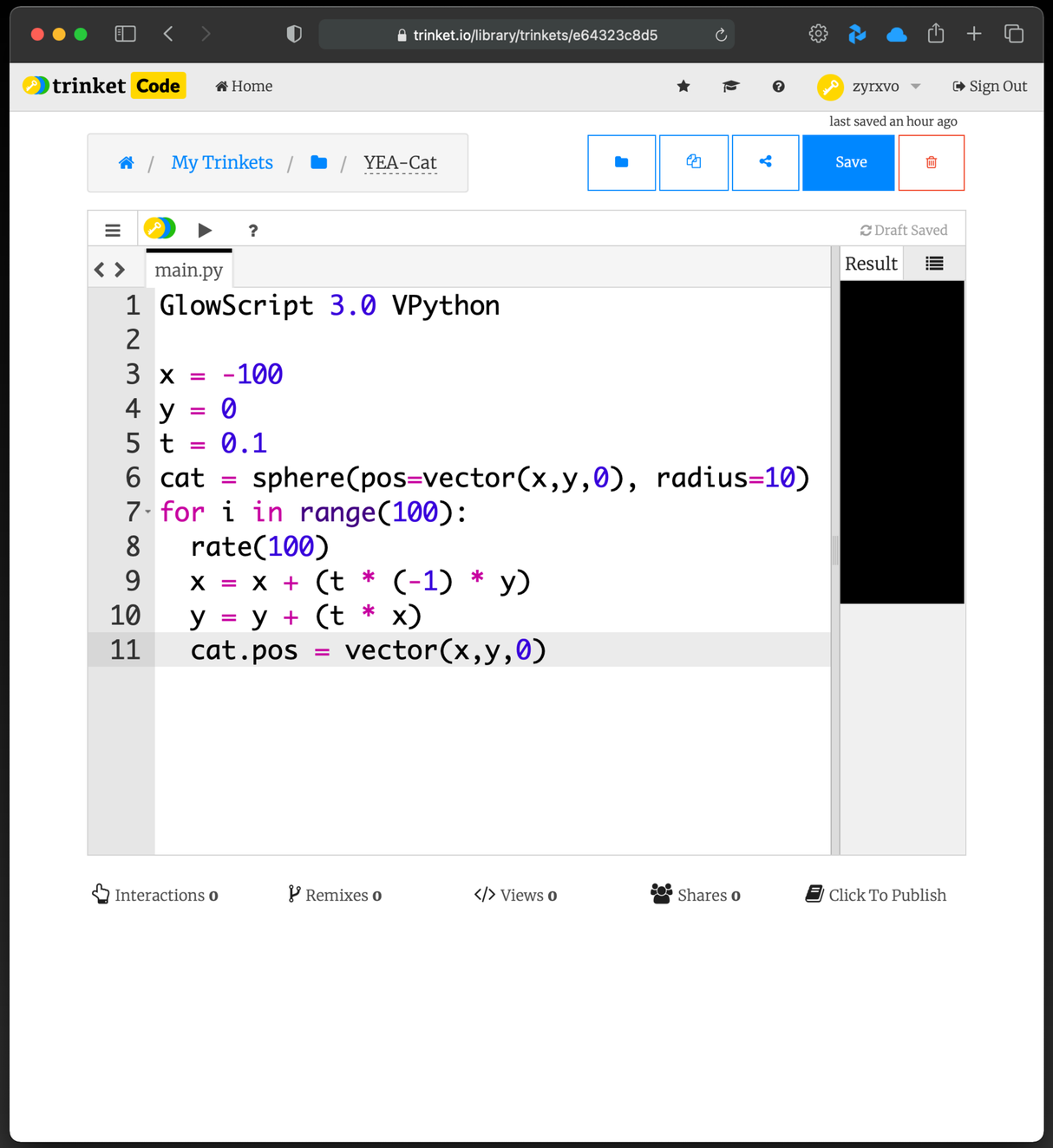
Motion
with Python

- Finally, we can update the x and y position of the “cat” every time we repeat the loop.
- We do this by writing “cat.pos = vector(x,y,0)”.
- Last of all, we need to add in a line that says “rate(100)” to tell the computer to run the code slow enough for us to watch.



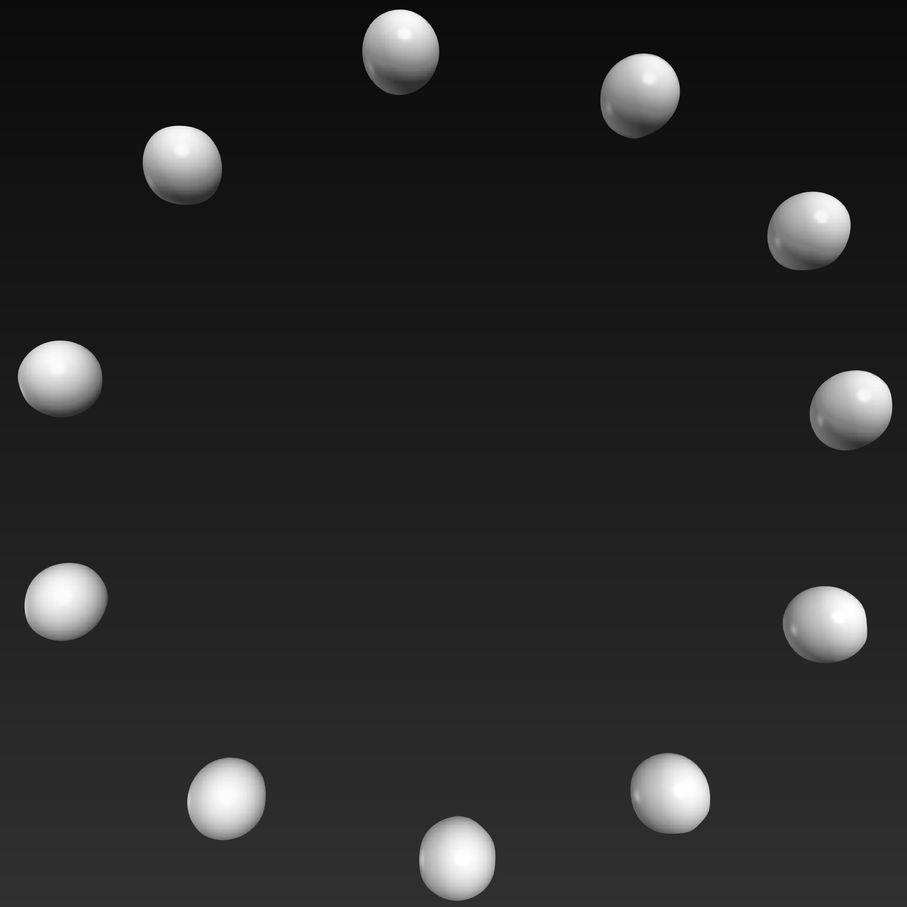
Motion
with Python

- The final code should look something like this
- Be careful of any spelling mistakes.
- If your code is not working, you can go to the solution here: https://trinket.io/library/trinkets/a2e31a1688



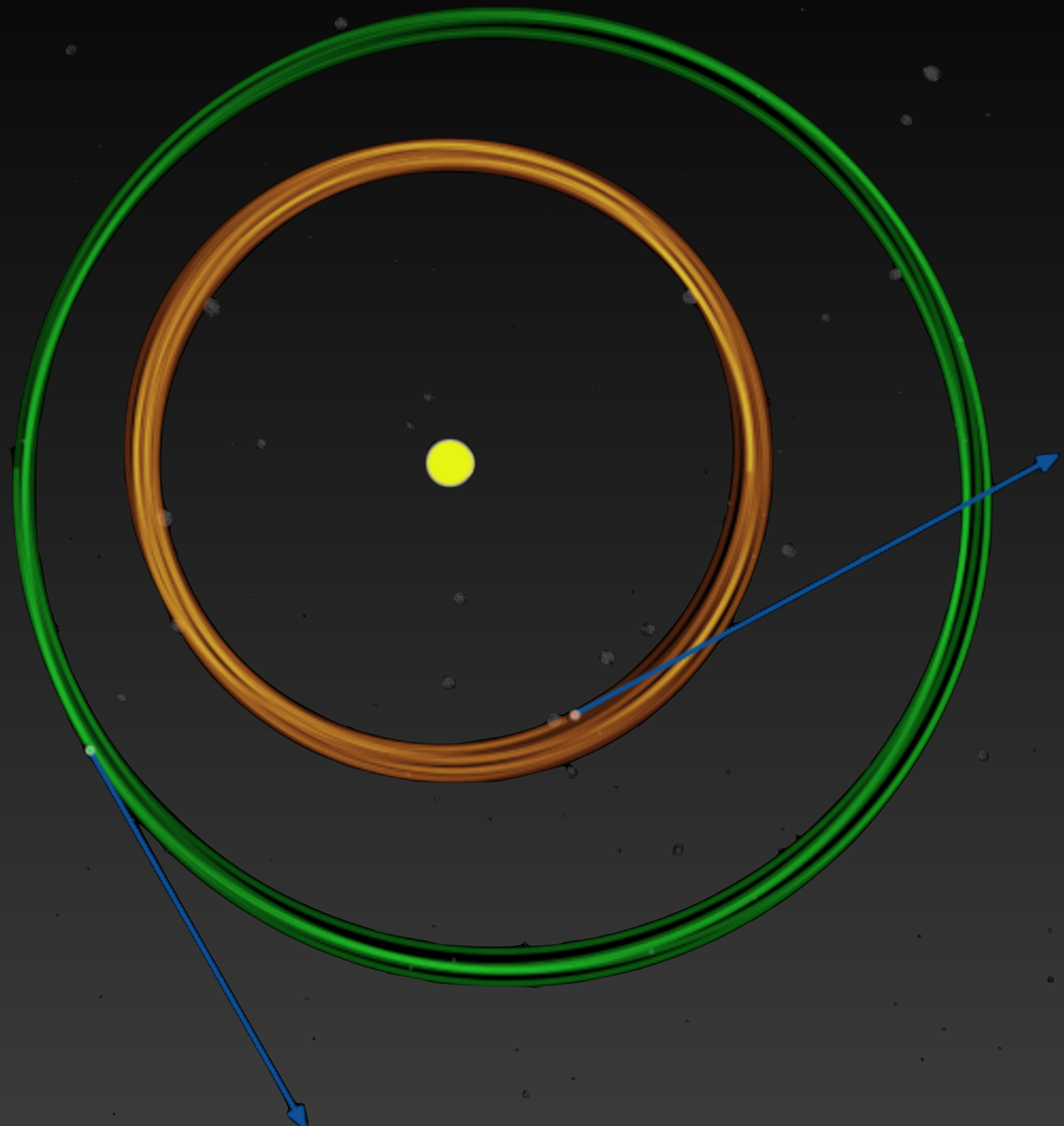
Motion
with Python

- You did it!
- It doesn’t look like a cat, but you wrote your own code that described the motion of an object as it moved in a circle!
- Play around with your code by changing some things.



Motion
Planets

- Computer code can be used to describe the motion of many different things.
- Let’s play around with code that other people have written and explore how planets and stars move because of gravity.
- http://labs.minutelabs.io/Chaotic-Planets/



Thank you
for joining me today!