An introduction to programming concepts with Scratch

(in 5 hours + homework)

itec | Information Technology Empowerment Center

Who computes?

- Scientists
- Engineers
- Businessmen
- Social scientists
- Artists
- FBI agents
- Brain surgeons
- Gamers
- Grandparents

Everyone uses information in some way. Computers do information processing.

What can we do with Scratch?

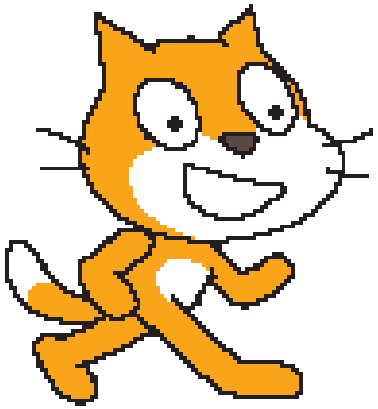
- Learn some computing concepts.
- Learn some practical algorithms.
- Use Scratch as computing tool.
- Have fun with Scratch creating stories, games, art.

Part I: Looks and Motion

- Goals:
  - Learn Scratch programming environment
  - Learn the looks and motion menus
  - Write a sequence of instructions

Start scratch and let's go!

- Click on the cat icon
- Scratch programming environment comes up
- We will first do simple things



Our Scratch environment

- ***Stage*** is at upper right (where actors act and information is displayed)
- ***Sprite*** is another name for actor.
- Instruction menus/panel at left (instructions for the actors)
- A ***script*** is another name for program or method; a script tells the actor what to do.
- Programming area in center; here is where we construct scripts for the sprites

We start with the cat sprite

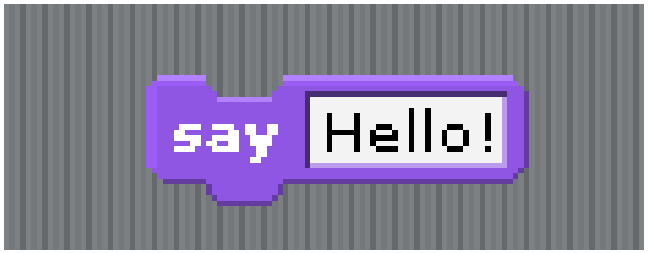
We will learn to use many other sprites later. For now we use the cat as our only actor. We script the BEHAVIOR of our cat.

The LOOKS menu

Has instructions for setting the color, size, and visibility of a sprite. Costumes will be used later.

The “hello” script (program)

- Choose the Looks menu
- Click on the “say hello” lego block
- Check your sprite behavior at the right
- Then click “say hello for 2 secs”



Your very first Scratch program!

Try some other looks operations (click on menu items)

- Change color effect by 25
- Change color effect by 25 again
- Hide
- Show
- Change size by 10
- Change size by 10 again
- Set size to 100%

Let's write a script to

- Say "hello" for 2 seconds
- Then change color by 25
- Then think "Hmm.." for 4 seconds
- Then change color by 75
- Then change size by 200

Drag each instruction from the menu to the center script area. Connect them into a single block. Edit the parameters to get the numbers we want.

Our script (program)

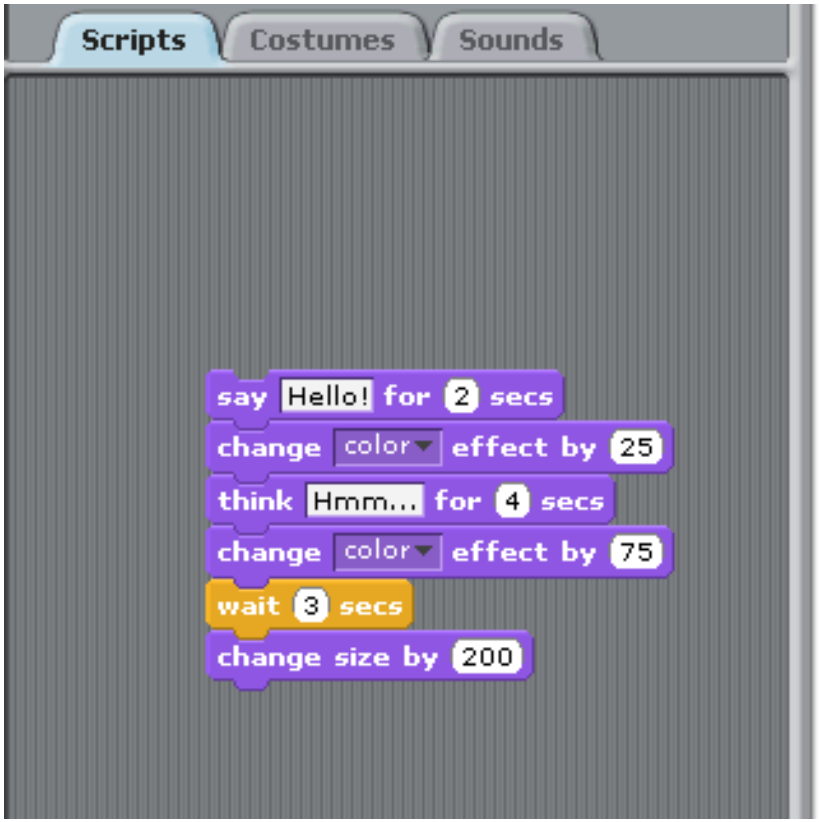
A sequence or block is a simple script or program

- The first instruction is done first
- The second instruction is done second
- The last instruction is done last.
- (if any one instruction is done, then every on of them is done)

The WAIT instruction

- WAIT is needed to slow down the acting so we can see or hear it properly (computers are too fast sometimes)
- Get the wait instruction from the CONTROL menu. Ignore the other menu options for now.
- Insert a wait in our looks script

3 second pause between changing color and size



Student exercise: write a script to do the following

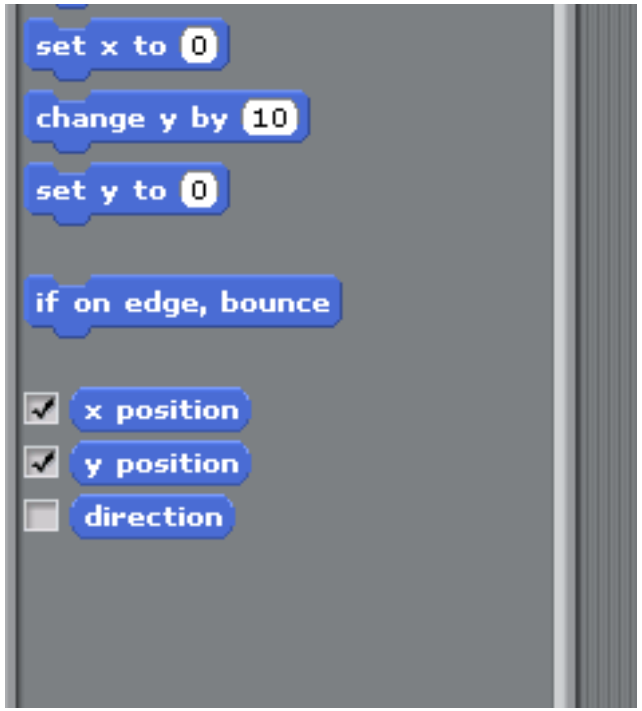
- Double the size of the sprite
- Wait 2 seconds
- Change the color of the sprite to green
- Wait 4 seconds
- Change the whirl effect to 100
- Say “That’s all folks!”

The MOTION menu

How to locate and orient a sprite;
moving a sprite.

Position on the stage

- Using the **Looks menu**, shrink our cat to 25%.
- Click on the **Motion menu**.
- Click to check the box for x-position and y-position
- Drag your cat around and note its x-y position.



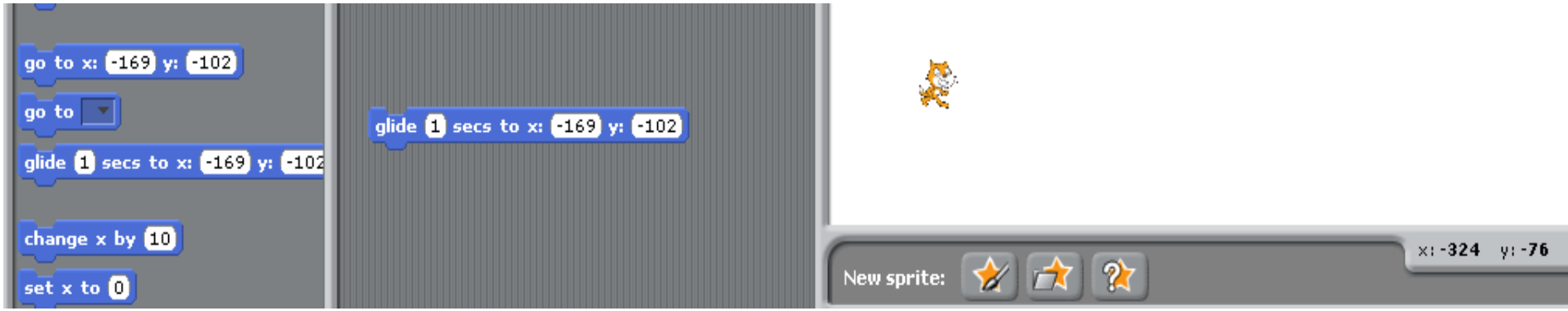
Exercises: goto instruction

- In the Motion menu, drag the “goto xy” instruction to the script panel.
- Edit the ***coordinates*** and click to see the sprite’s position
- A) goto x=200, y=0
- B) goto x=-200, y=0
- C) goto x=200, y=-100

Where does the cat go?

The “glide-to” instruction

- Drag the “glide-to” instruction into your script panel.
- Edit the coordinate values and click to see where your sprites goes.



Exercise

- Create a script to glide the sprite along the sides of a triangle. The first vertex of the triangle is (-100, -100). The second vertex is (200, -100). The third vertex is (50, 100). Make sure you complete the triangle.
- Change the speed of gliding and run again.

Angles and directions

Making your sprite go
this way and that way

Exercise Script

- Start at (-100, 100)
- Move 200 steps
- Turn right 90 degrees
- Move 200 steps
- Turn right 90 degrees
- Move 200 steps
- Turn right 90 degrees
- Move 200 steps

Use waits if needed to make the motion look smooth

Exercise/Homework Script

- Sprite starts at home base at x=-100; y=-50
- Sprite says “I hit the ball” for 2 seconds
- Sprite runs (east) 200 steps to 1st base
- Sprite changes color
- Sprite runs 200 steps to 2nd base (north: left turn from 1st base)
- Sprite doubles size
- Sprite says “I hit a double” for 5 seconds

End of Part I: Outcomes

Student should be able to control the looks of a sprite and its location on the stage. Students should be able to construct sequences of instructions controlling looks and location on the stage.

Part 2: Repetition and Variation

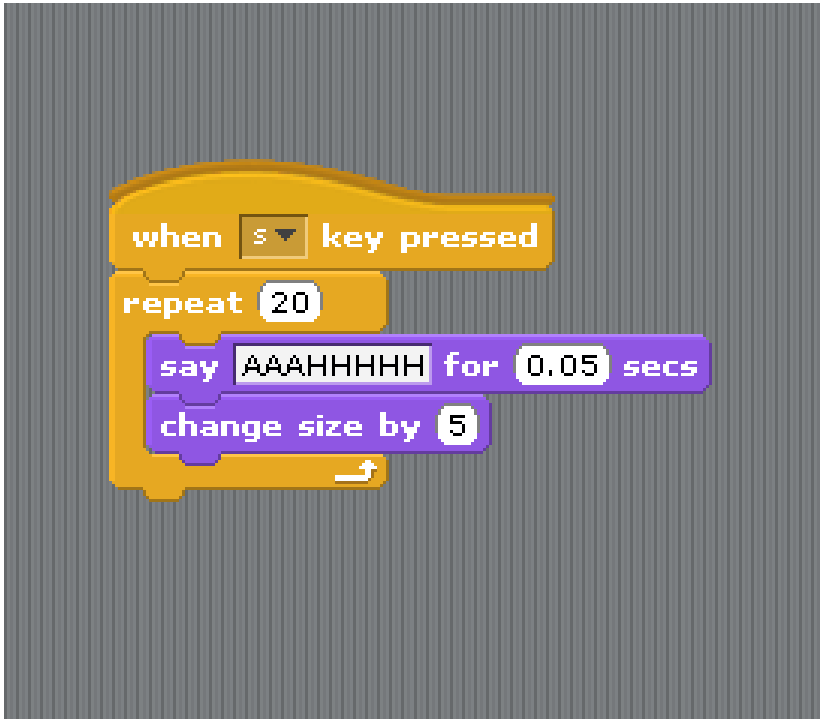
- Goals:
  - Learn how to program with ***repetition***
  - Learn how to change ***costumes***
  - Learn to controll execution (behavior) using special keys

The sneezing cat script

- We repeat 20 times

Say “AAAHHHH”
for a short time

Then grow the
cat 5 bigger



Exercise: bring the cat size down to normal

Repeat 20 times

Briefly say

"CCHHEEEW"

Then shrink the

cat's size by 5

Repeat N times and repeat ***forever*** are in the **Control menu**

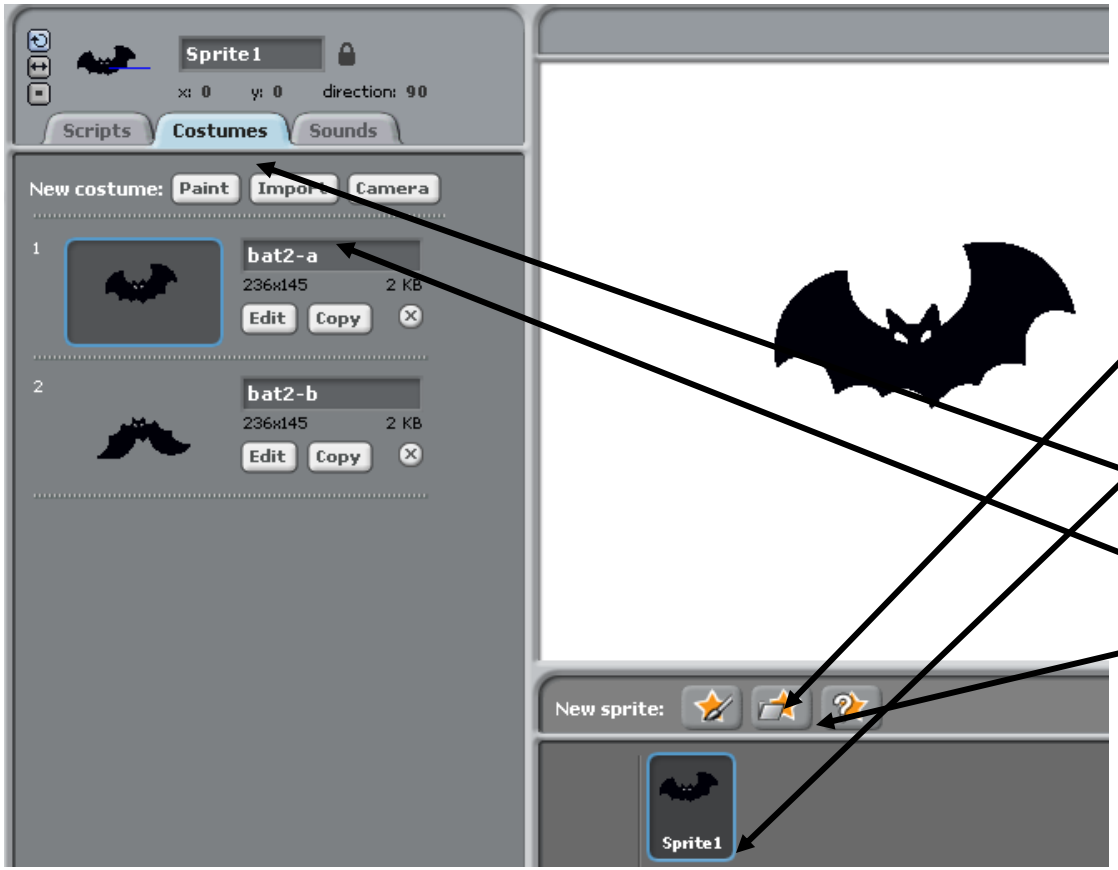
Exercise: Have the cat do a flip by rotating 20 degrees 18 times.

- Repeat from the Control menu: set the number of repetitions to 18
- Rotate from the Motion menu: set the size of each small rotation to 20 degrees

Changing costumes

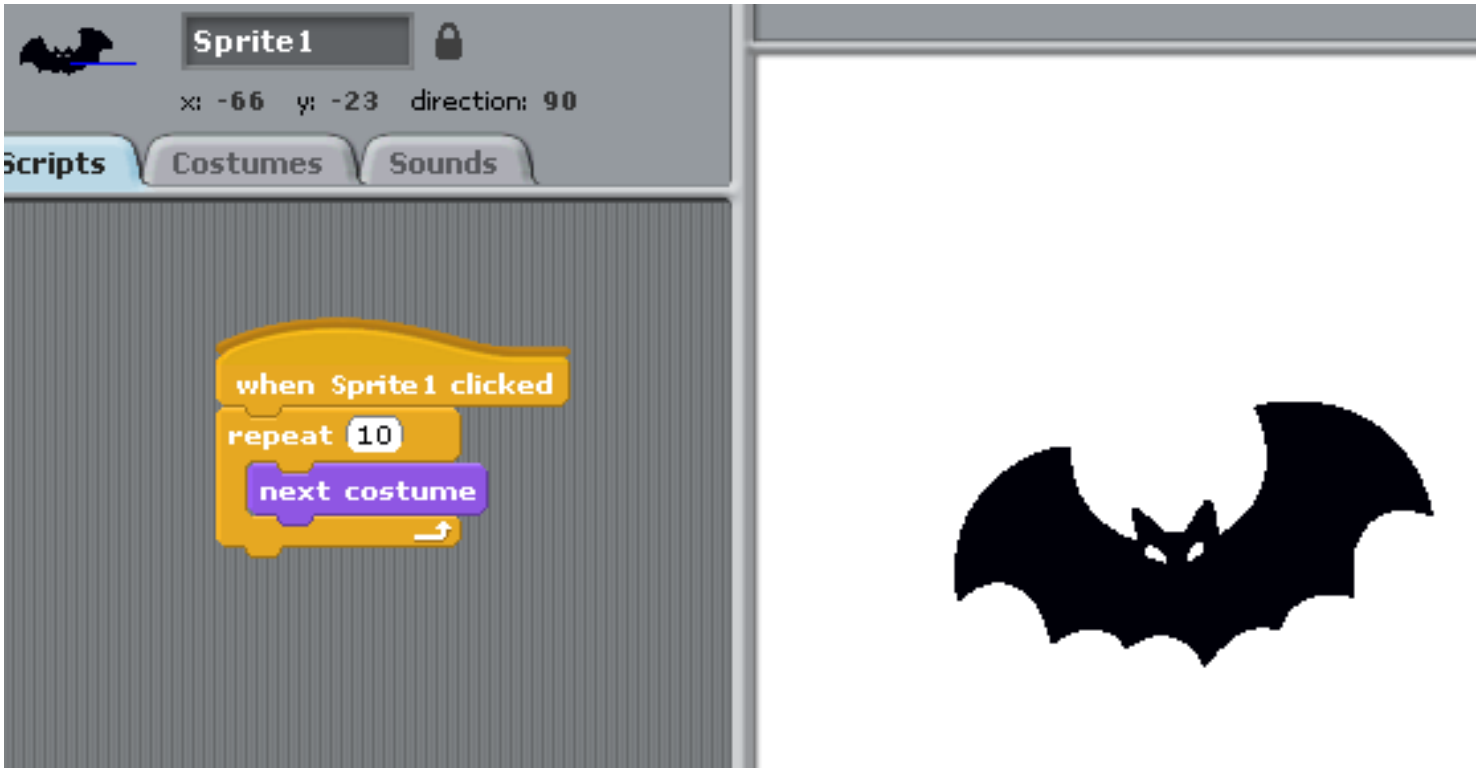
Another way to change the appea*rance* of a sprite.

Making a new costume to animate the bat



1) Get bat2-a sprite from the "sprite box".
2) Click on sprite
3) Click on "Costumes"
4) Click on "Import"
5) Now get bat-2b sprite from the sprite box

Use a loop to make the bat fly!

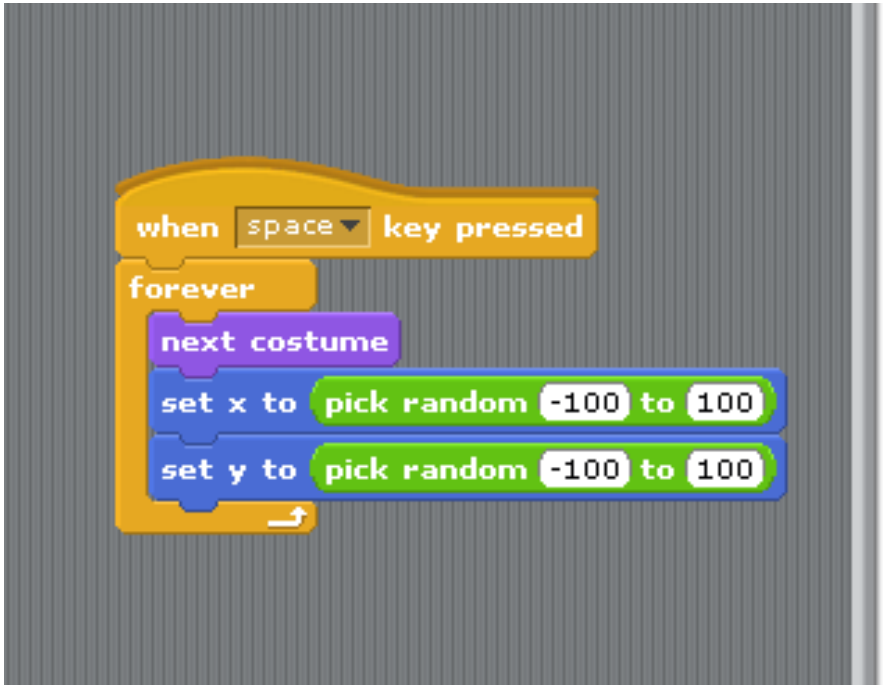


1) ***When*** and ***repeat*** from Control menu and 2) next costume from Looks menu.

Changing coordinates

- We can ***randomly*** set the location of the bat so it will “flutter”.
- Set X to a random number
- Set Y to a random number
- Move the bat to location (X,Y)
- Of course, the bat should remain on stage!

Using ***pick random***



Click the stop sign at the stage upper right to stop the forever loop.

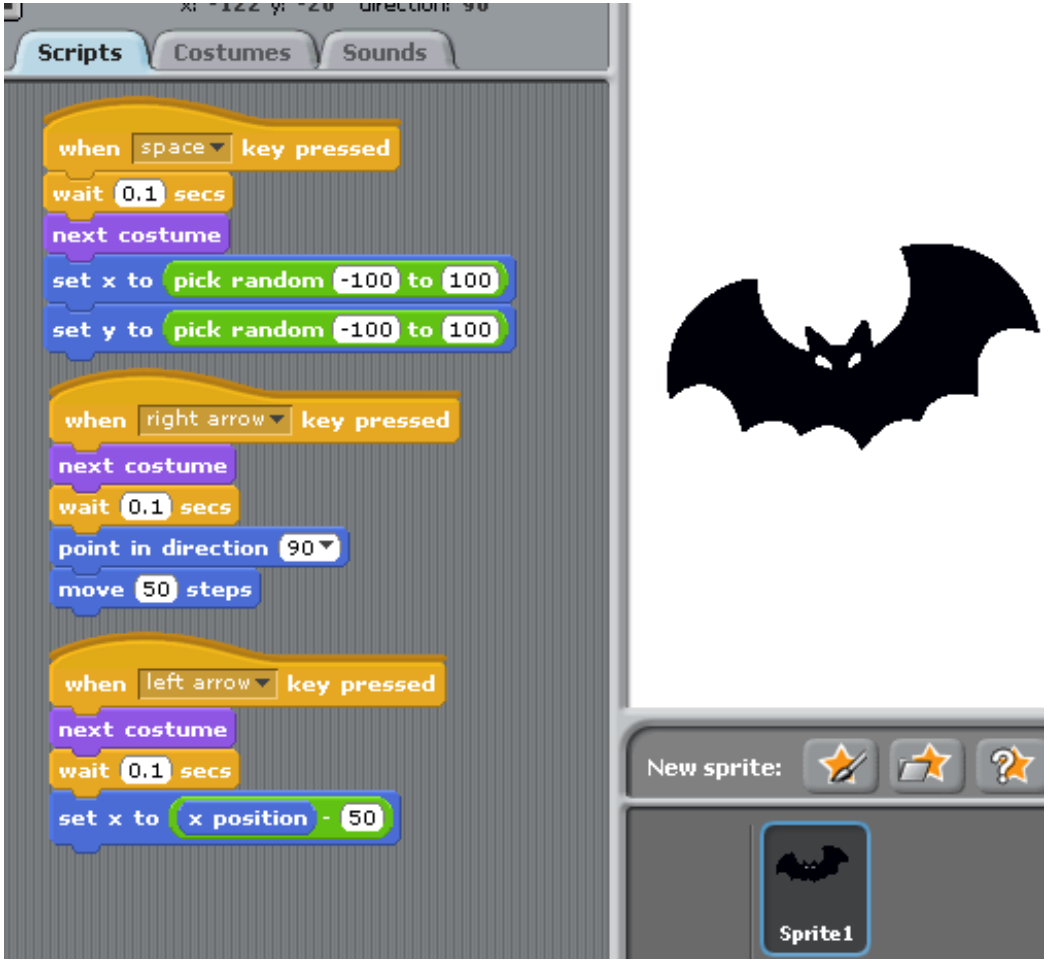
Do we need a wait in the loop? Try it to see the change in flying.

Controlling the bat's direction

- Let's create **multiple scripts**.
- Click space bar for random moves
- Click right arrow to move right
- Click left arrow to move left
- The bat will behave differently depending upon which key is typed!
- (So, could a gamer catch the bat?)

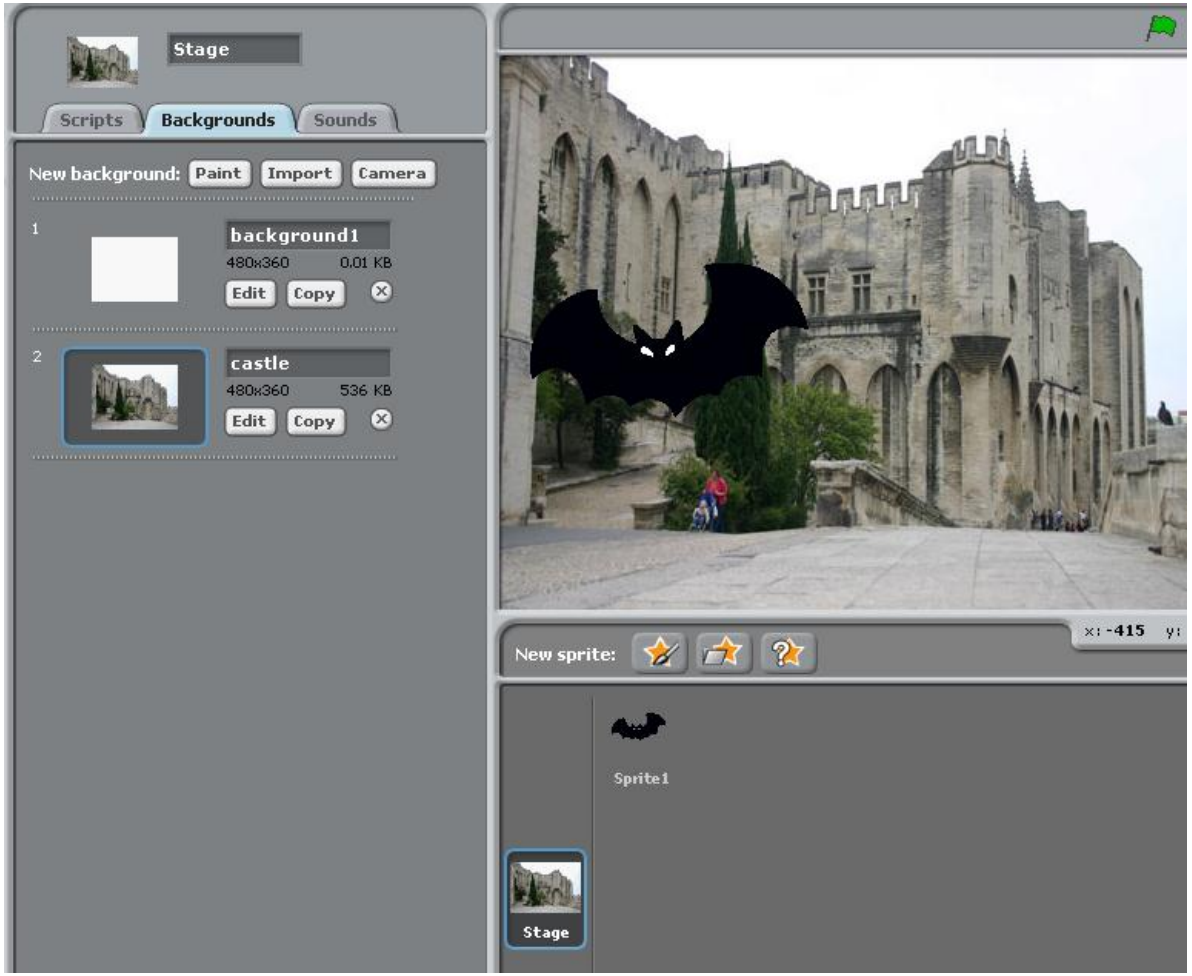
Multiple interactive bat flight

3 different behaviors for the bat



Adding a ***background***

- Click on the ***Stage*** icon at lower right
- Click on ***Backgrounds***
- Click on bat icon (Sprite1)
- Click on ***Scripts***
- FLY AGAIN!



Homework/Exercise:

- Add a behavior (script) to move the bat up with the up arrow.
- Add a behavior to move the bat down with the down arrow.

End of Part 2: outcomes

Student should be able to write a program controlled by a loop, and execute a script by clicking special keys. The student should also know how to use “costumes” to change the appearance of a sprite.

Part 3: Input/Output, Variables, Simple computing

- Goals:
  - Learn how the user and the program can communicate
  - Learn how to compute with formulas
  - Computing an average, perimeter of a geometric figure, etc

The SENSING menu

Getting information from the user
or some other machine

Asking the age of the user

- Program wants age of user (maybe to set a level of difficulty in a game)
- Program asks user for age
- User types in age
- Program stores the answer in a ***variable*** named “answer”

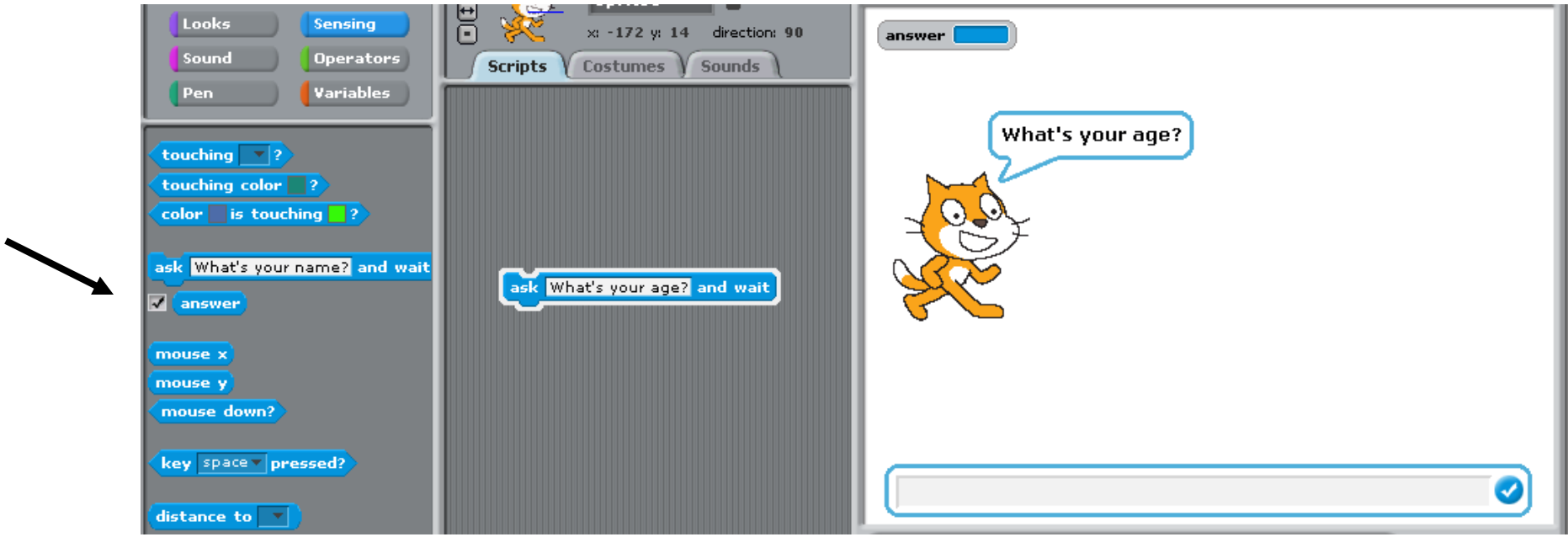
What is your age?

- Depends on who you are
- For one person it’s 12
- For another person it’s 27
- For yet another, it’s 19
- IT’S VARIABLE!

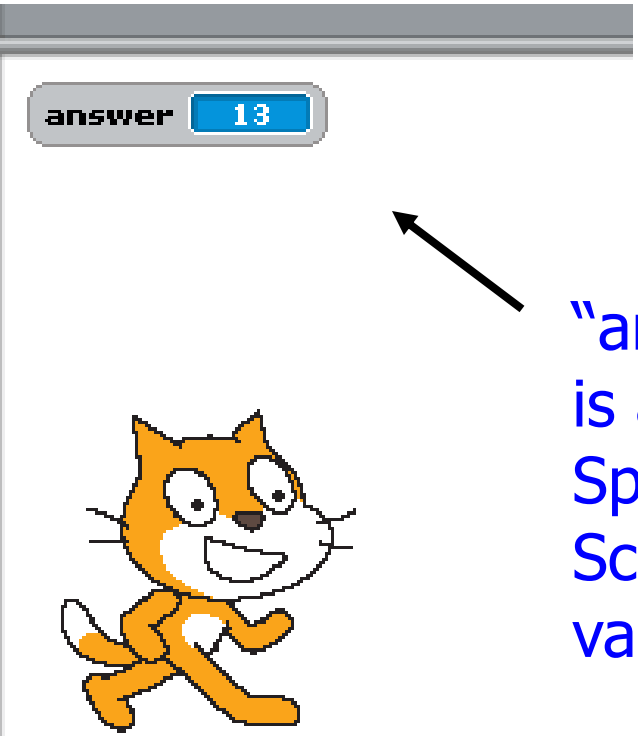
Use the SENSING menu

1) Ask the user for age; 2) user types in age;

3) result stored in "answer"

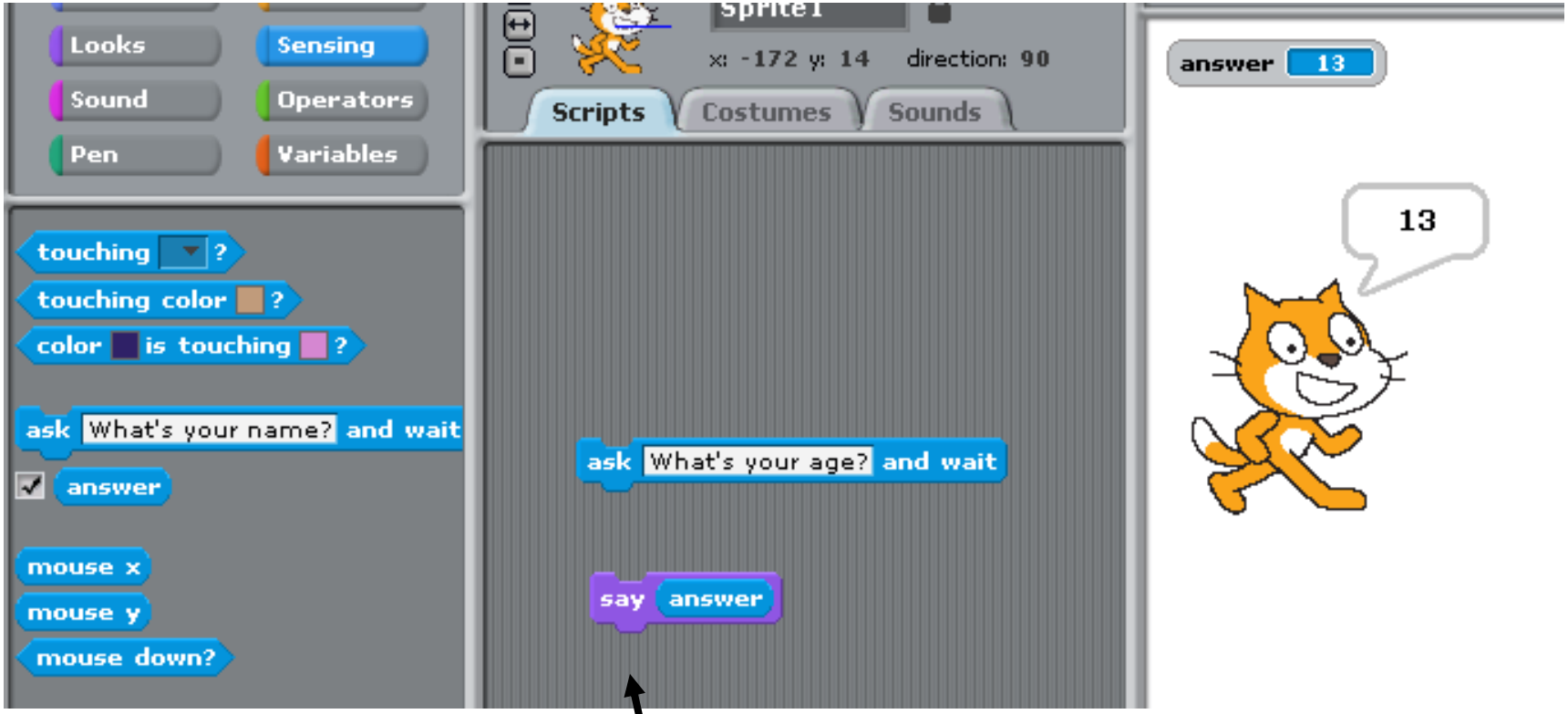


User types “13” and the script stores the answer



“answer” is a Special Scratch variable

OUTPUT: Giving the user information with say answer



Say is in Looks menu; drag "answer" from Sensing menu; click

Using the Variables menu

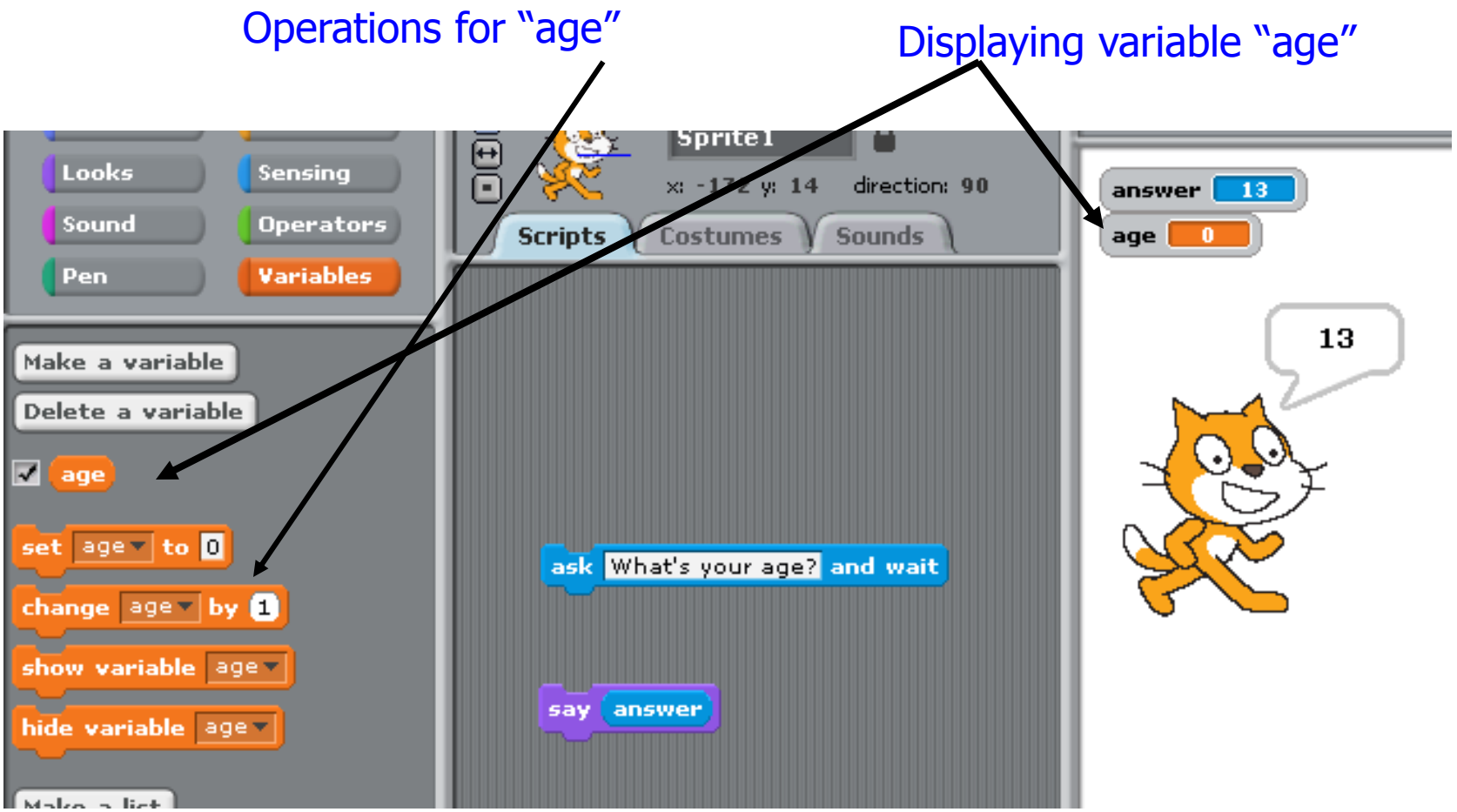
We can save an answer in our own named ***variable***;

Then we can program with many data items using many variables

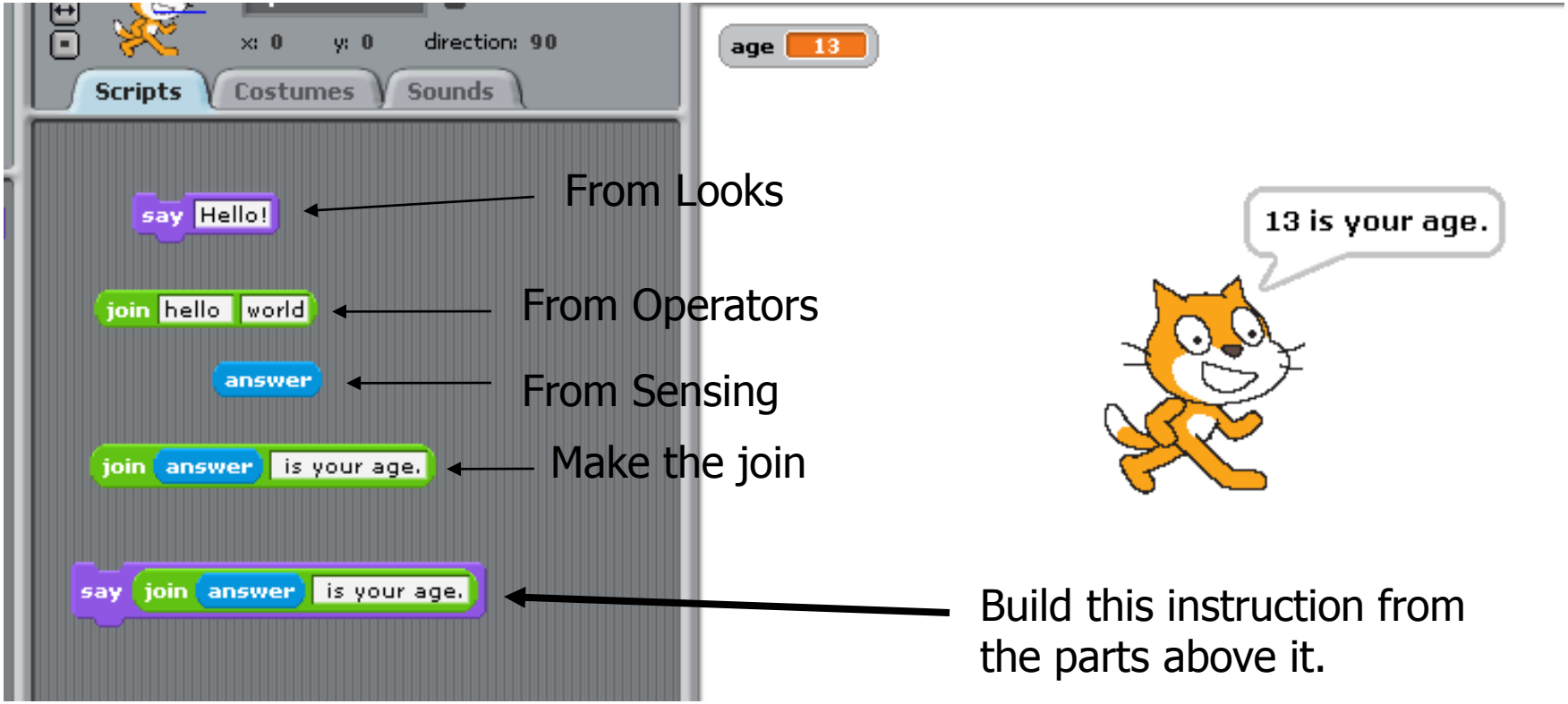
Making an “age variable”

1) Click Variables menu; 2) click “Make a variable”
2) Type in “age” and click OK

We have an “age variable”

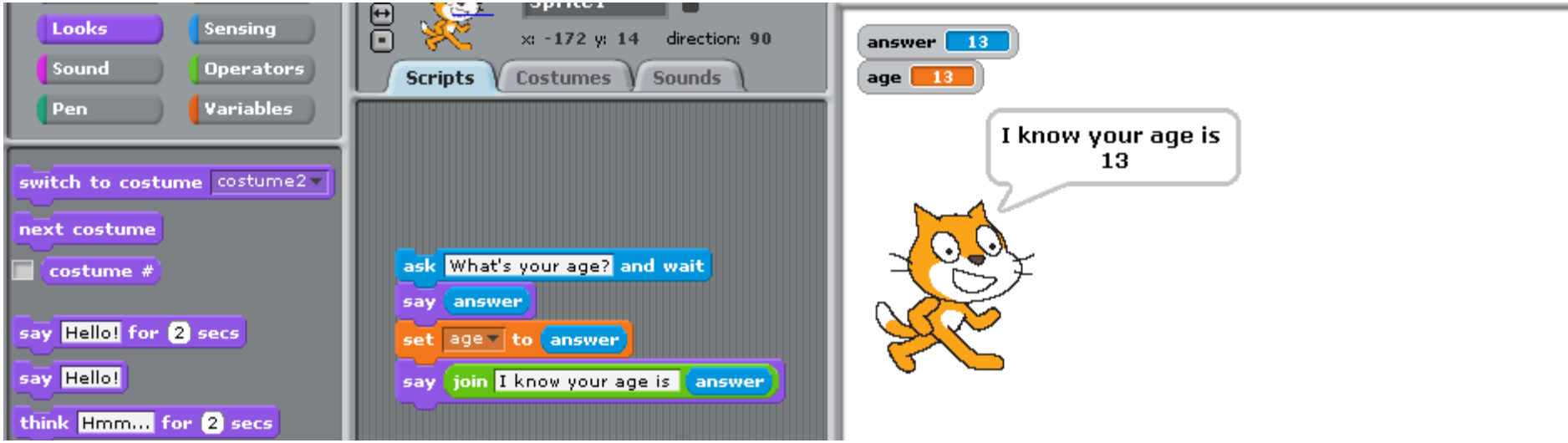


We can ***join*** text and a number to say things



Storing a value in a variable; then saying it to the user

1) **Set** from Variables menu; 2) **Say** from Looks menu; 3) **Join** from the Operators menu joins your text with the "answer"



Using ***variables*** in programs

- A script might have to remember information
- How far is the cat from the dog?
- How fast is the rocket moving?
- Where did the user click on the stage?
- What is my score in the game?
- What is the user's skill level?

Computing C = A + B (1 of 3)

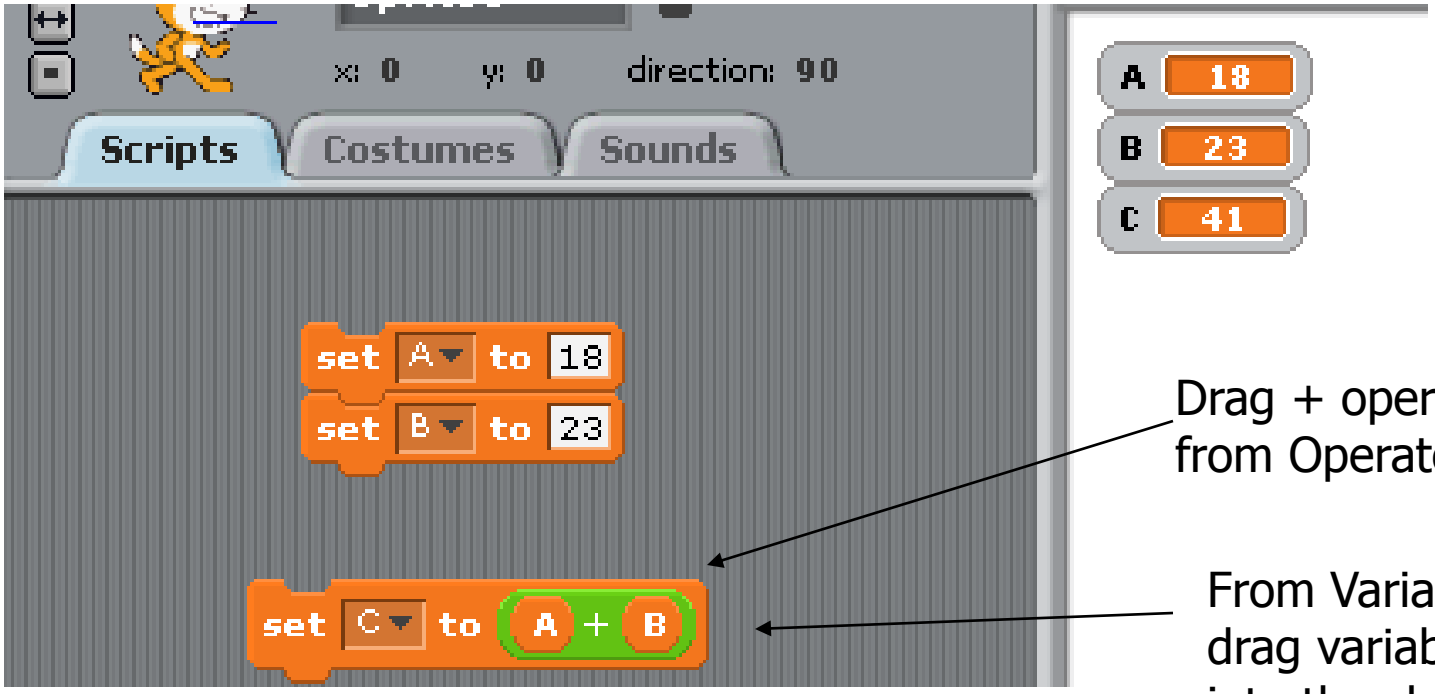
- Make 3 variables, A, B, and C
- Type in the values of A and B
- Set the value of C to the sum of A and B

Computing C = A + B (2 of 3)

- Make 3 variables, A, B, and C
- Type in the values of A and B
- Set the value of C to the sum of A and B

Computing C = A + B (3 of 3)

- Make 3 variables, A, B, and C
- Type in the values of A and B
- Set the value of C to the sum of A and B



Algorithm for computing the average of two numbers

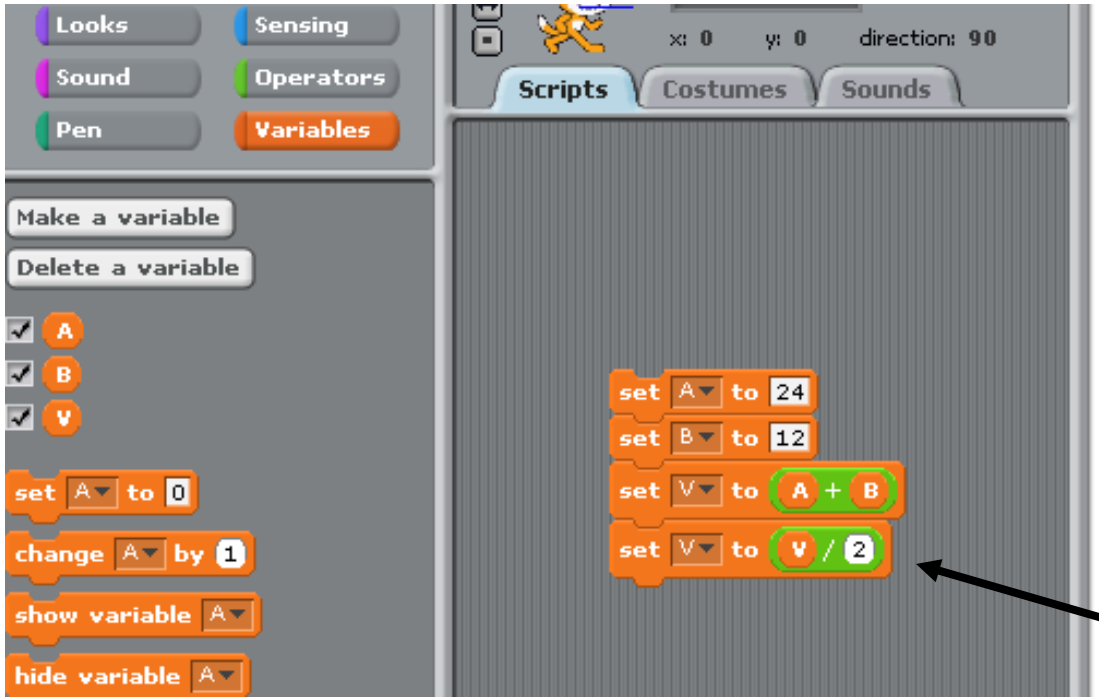
- Let the first number be A; say A=12
- And the second number be B; say B=15
- To compute the average _____
- So the average of 12 and 15 = _____

Programming the average

- A is the first “variable”: A = _____
- B is the second “variable”: B = _____
- V is the third variable: V = _____
- Take the value of A, add the value of B, divide this sum by 2, then set the value of V to this answer.
- V = (A+B)/2 (how to do it in Scratch?)

Script from Variables and Operators menus

Drag the variable names into the slots of the operators

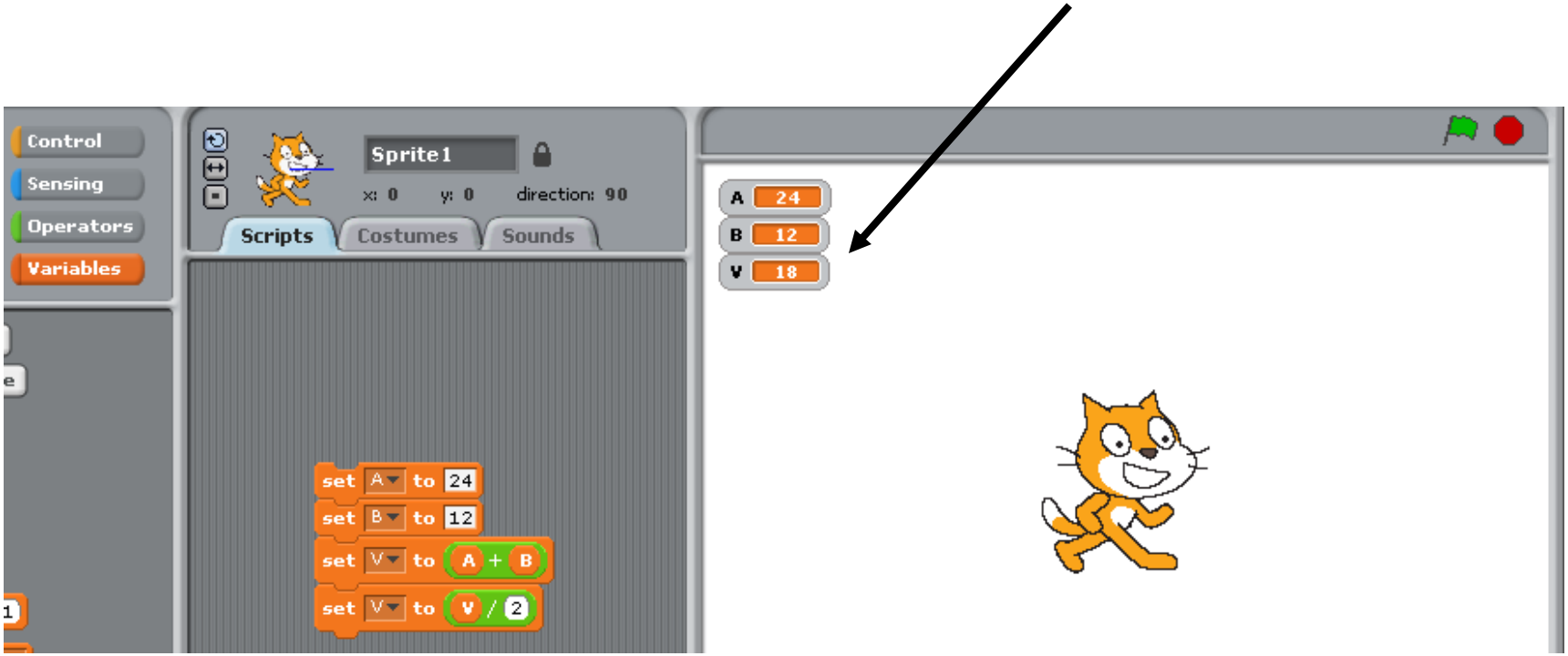


Script not yet executed

A formula from the Operators menu

After clicking to execute script

The variable V now stores the computed average of A and B



Exercise

- Put a Wait 5 secs in the script between the two set operations for variable V
- Execute the script and observe the changes in the value of V

Exercise

Change the values of A and B by editing the script (keep the Wait);

Input the age of grandchild and age of grandparent;

Click on your script to compute the average of the new A and B

Homework/Exercise: average program

- Modify the average program
- Ask the user for a value of A
- Ask the user for a value of B
- Compute V as the average
- Report the average to the user
- Run the program for different As and Bs

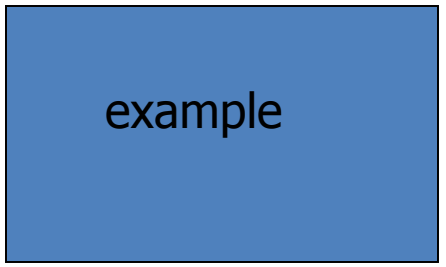
HW Exercises

- Average 3 numbers; say 12, 33, and 21

Computing perimeter of a rectangle: algorithm

- Ask the user for length L
- Ask the user for width W
- Compute P = (L+W)*2
- Report P to the user

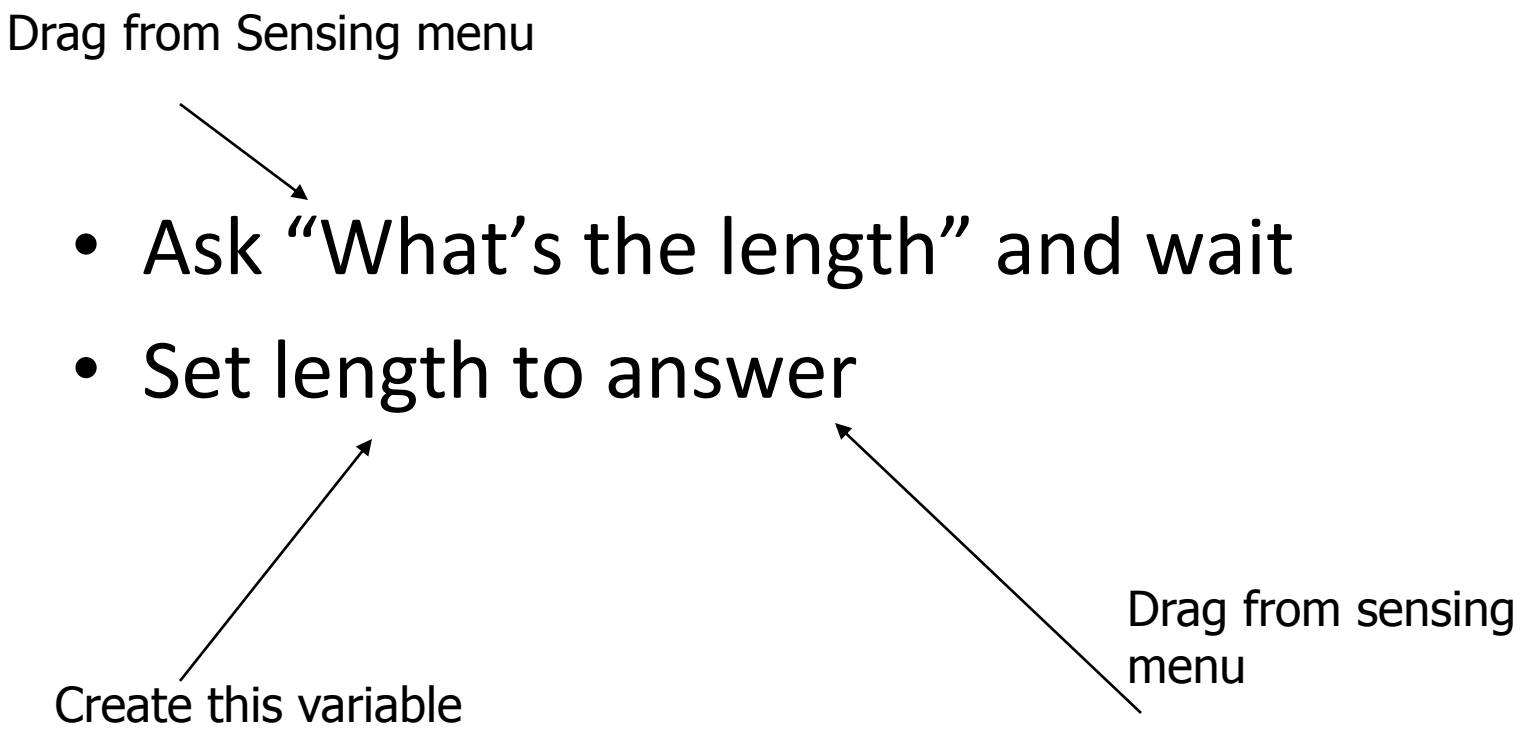
W = 10



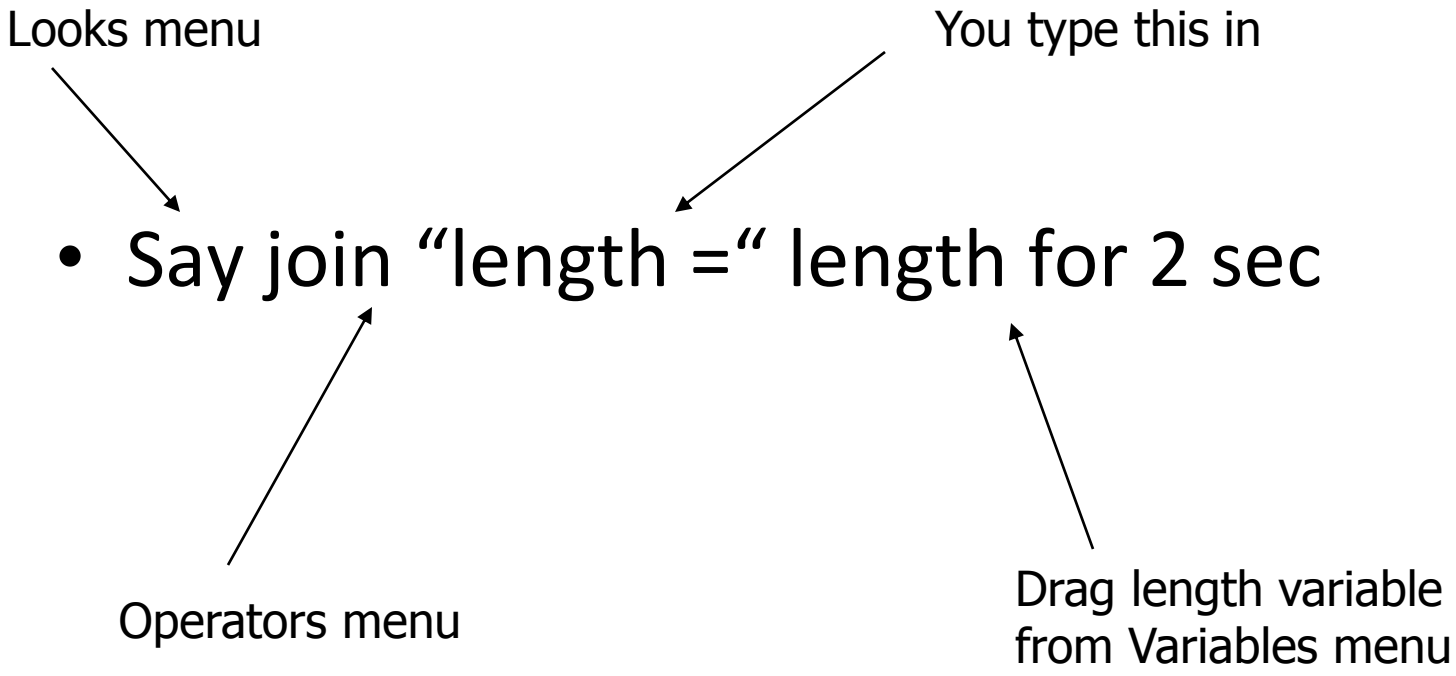
L=15

P = (15+10)*2 = 50

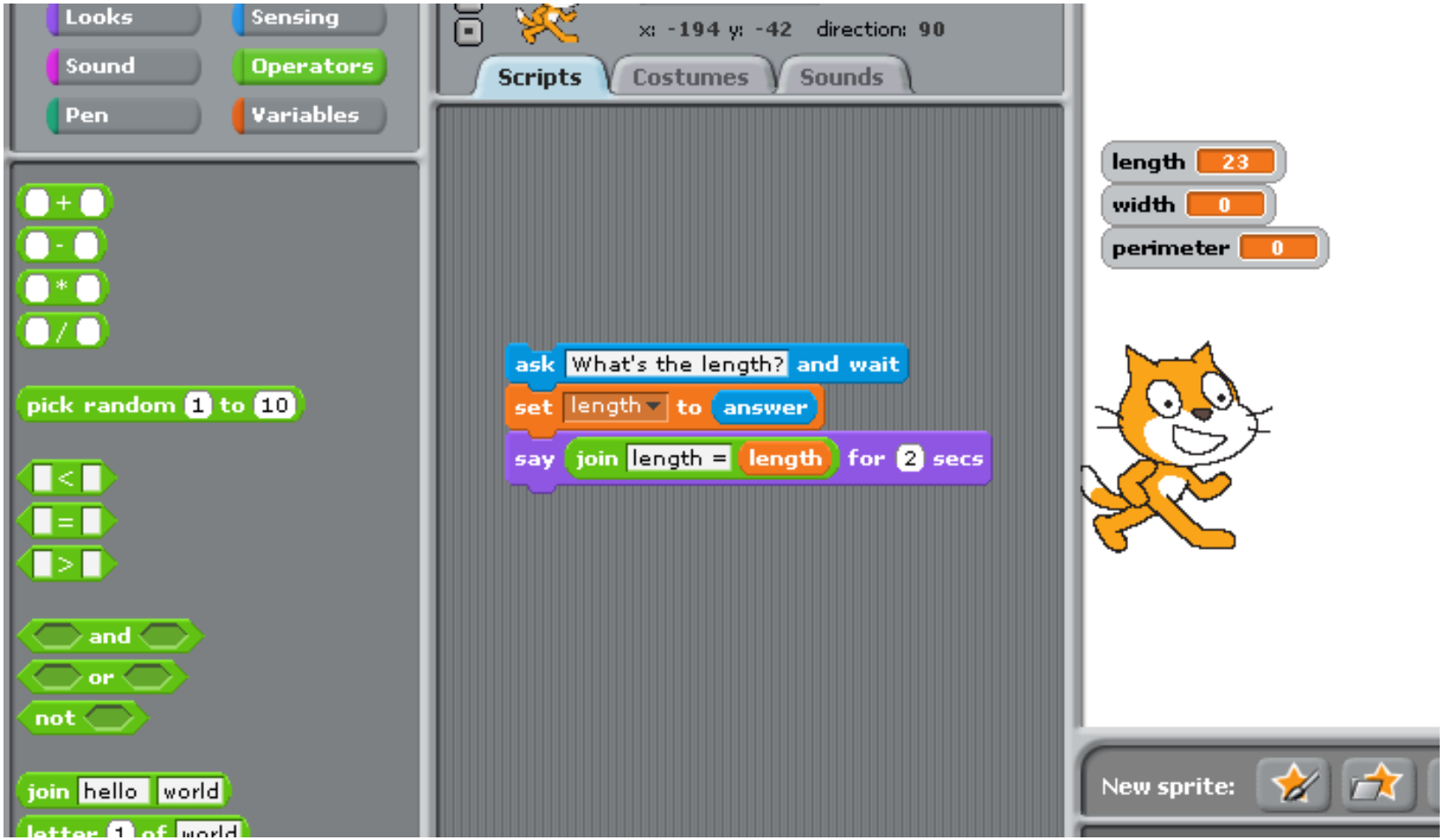
Review:
Getting length from user



Review: Reporting the value of a variable to the user



Review: Program with user input and output



HW Exercise: create the Scratch program we designed

- Ask the user for length L
- Ask the user for width W
- Compute P = (L+W)*2
- Report P to the user

Show your program to your Grandparent.

End of Part 3: outcomes

Student should be able to write a program to ask the user for data, compute using the data, and report the answer to the user. Students should be able to compute using common formulas.

Part 4: working with sounds and sprite communication

Part 4 goals

Learn how sprites can communicate by sending messages

Learn how to play sounds and to input your own voice

Communicating sprites: taking turns by message passing

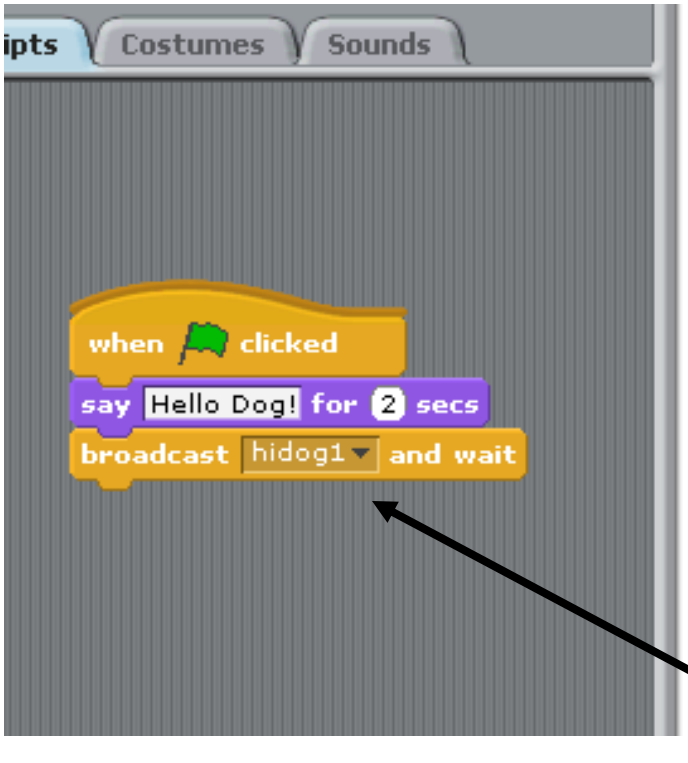
Get cat and dog sprites

Suppose cat speaks first

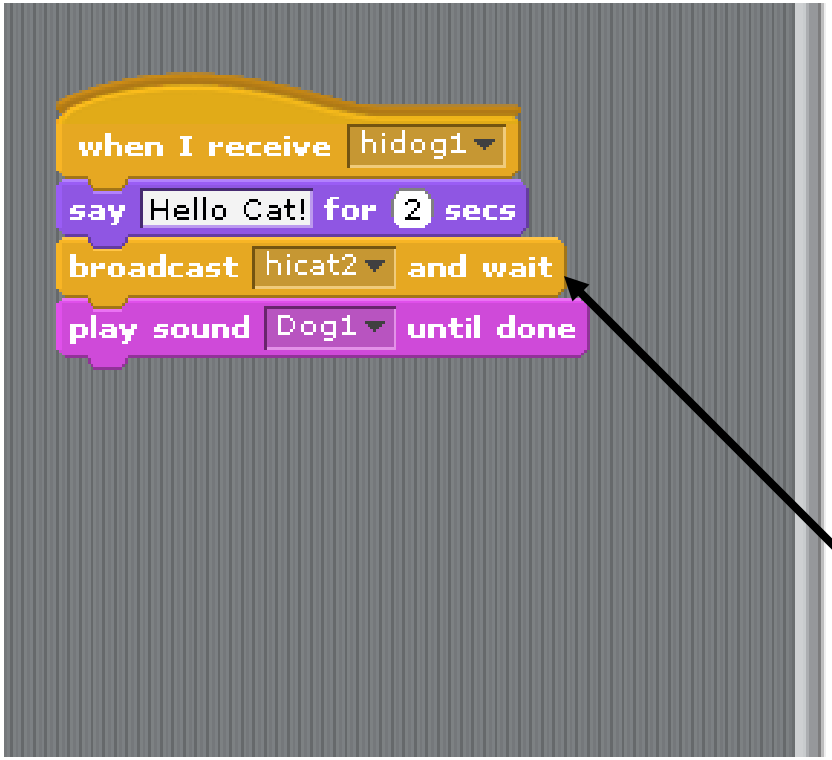
When finished, the cat can send a message to the dog to speak

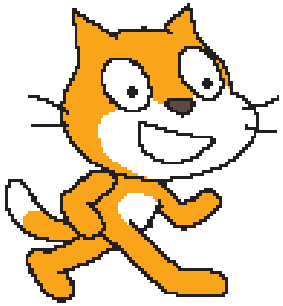
When the dog is finished, the dog can send a message to the cat to speak

First behavior for the cat

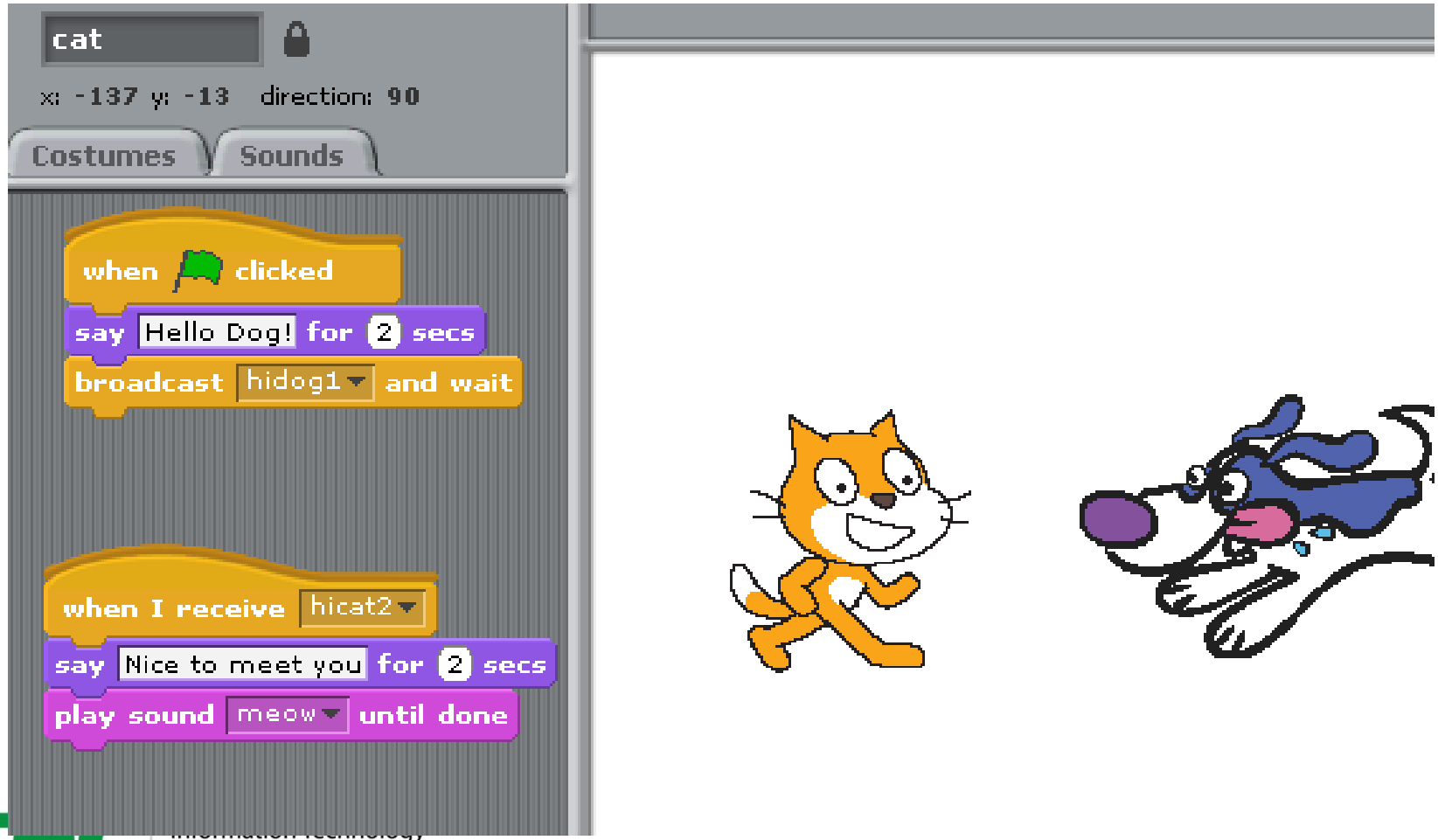


Dog is activated by hidog1 message

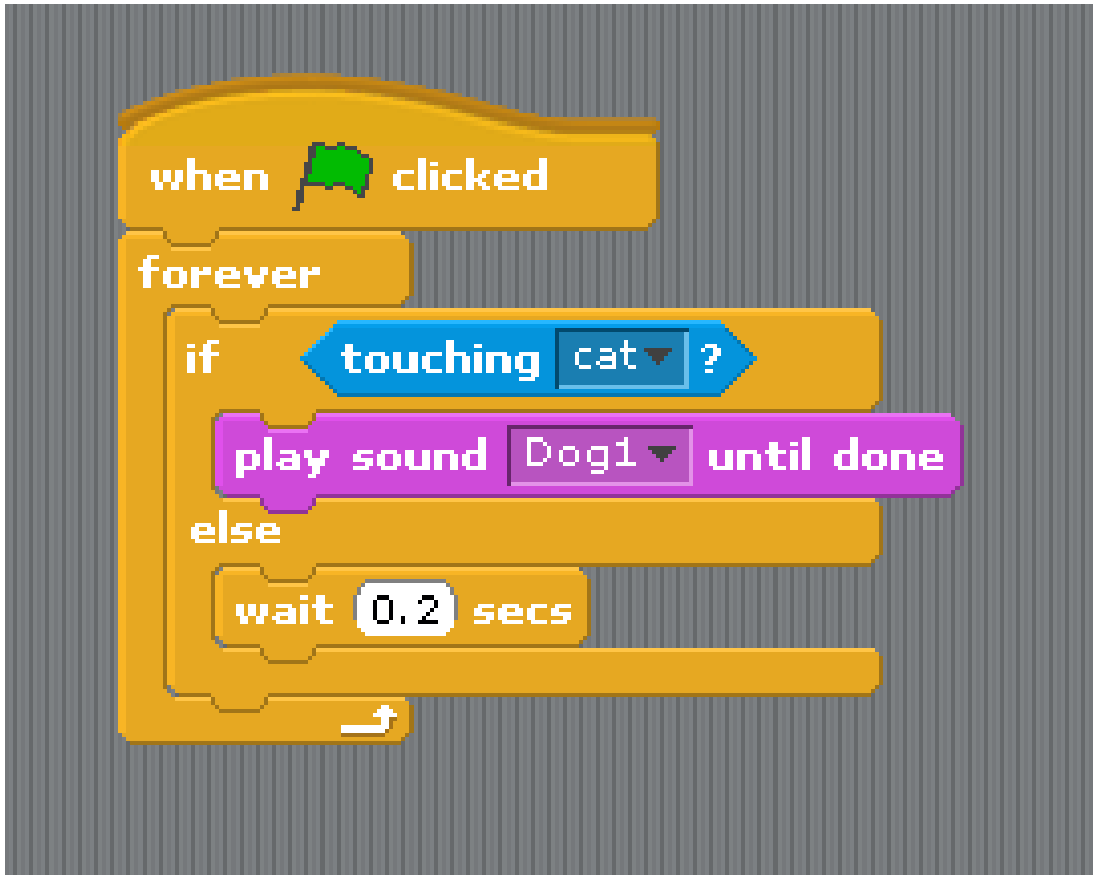




Cat's turn again after hicat2 message from the dog



Dog can have 2nd touching behavior



Sprites can have many behaviors

Activated by clicking green flag

Activated by clicking the sprite

Activated by a key being pressed

Activated by a message from another sprite

Activated by touching another sprite

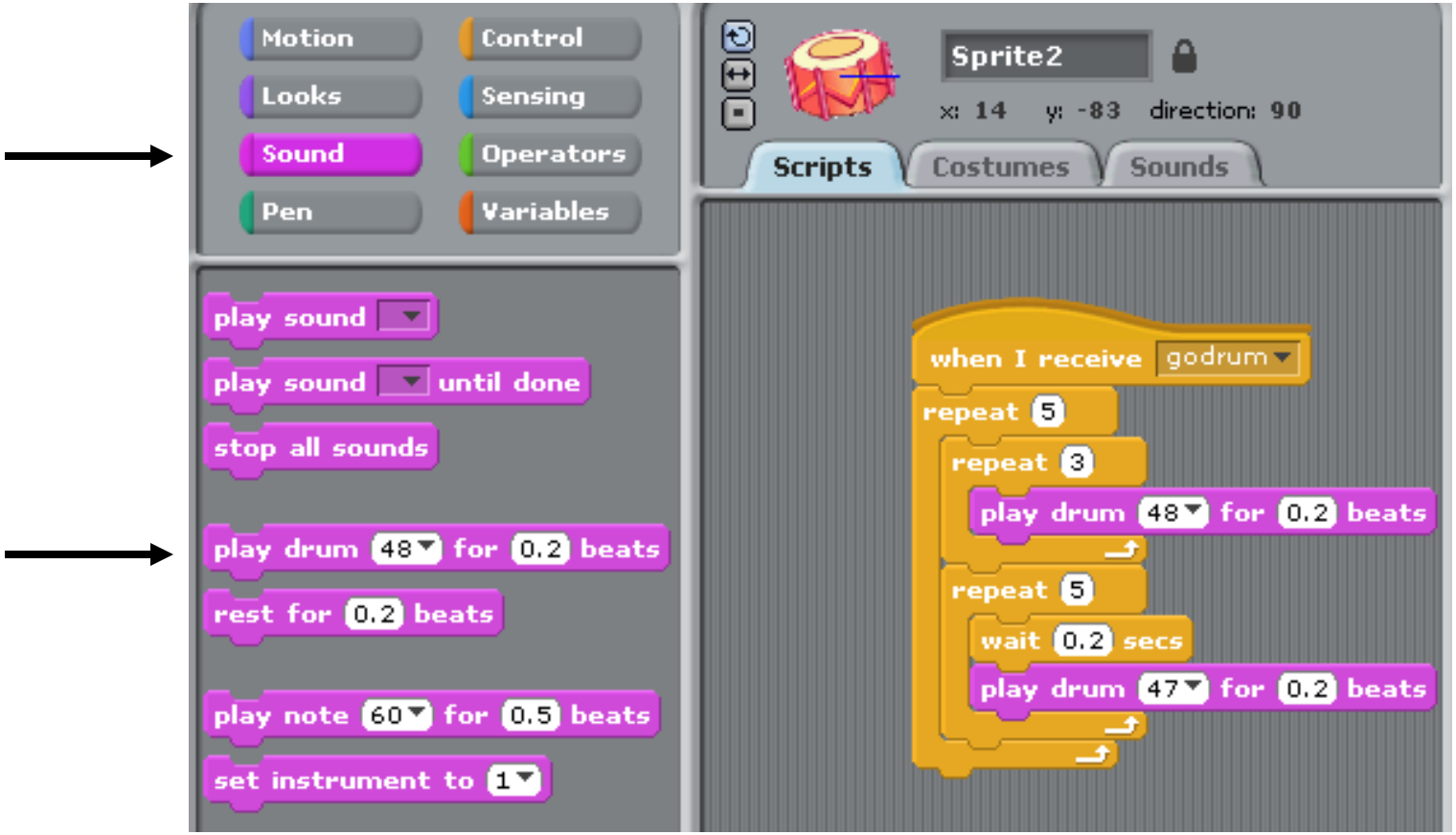
Using sounds

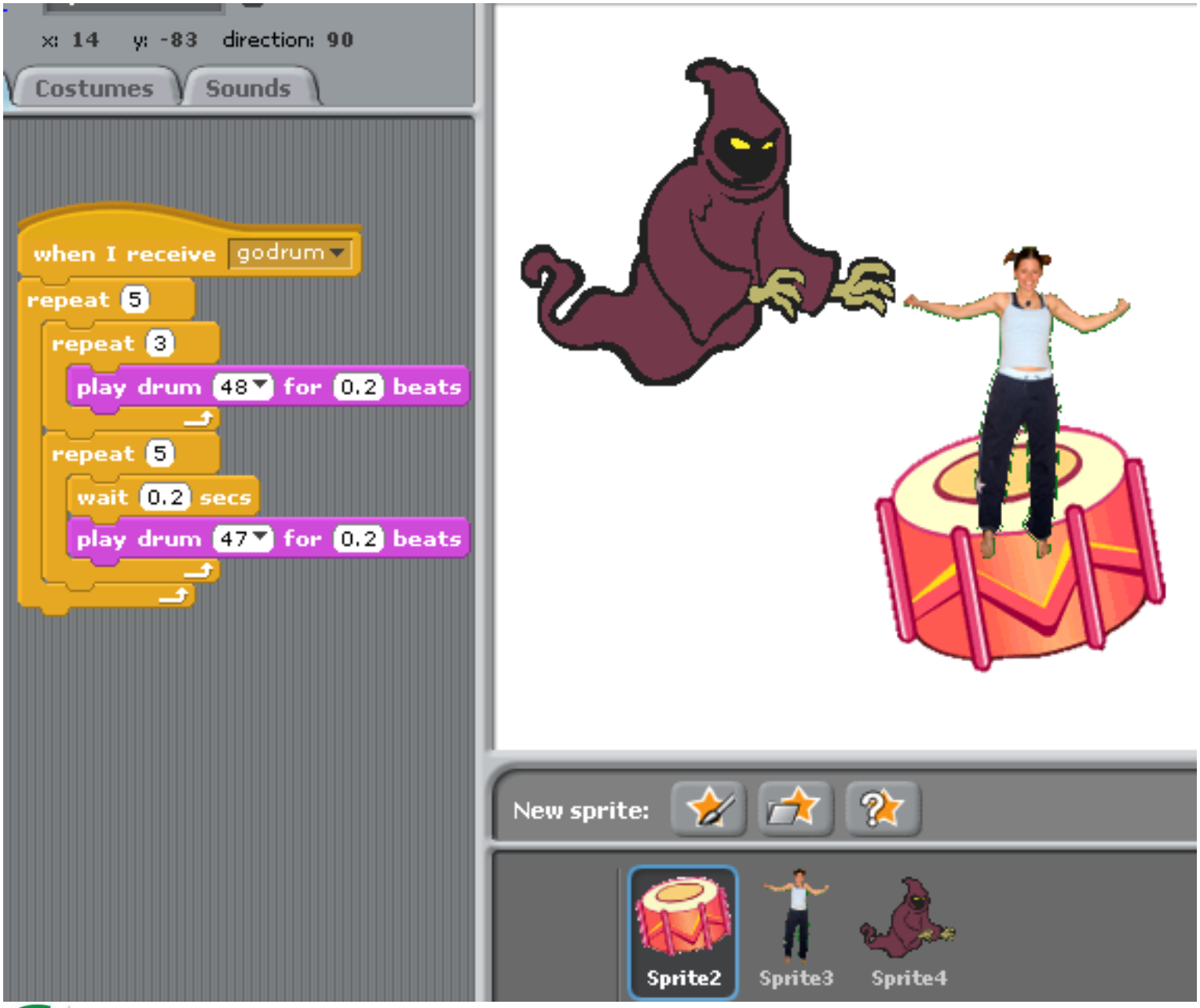
Sound library;

Speaking in the mike;

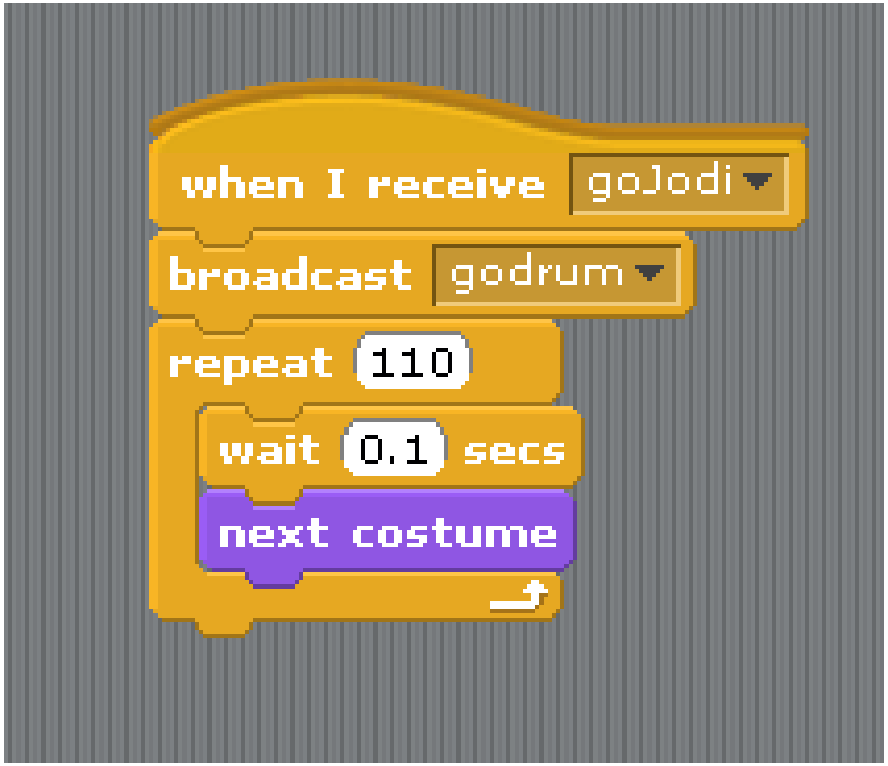
Importing music

Composing with drum beats



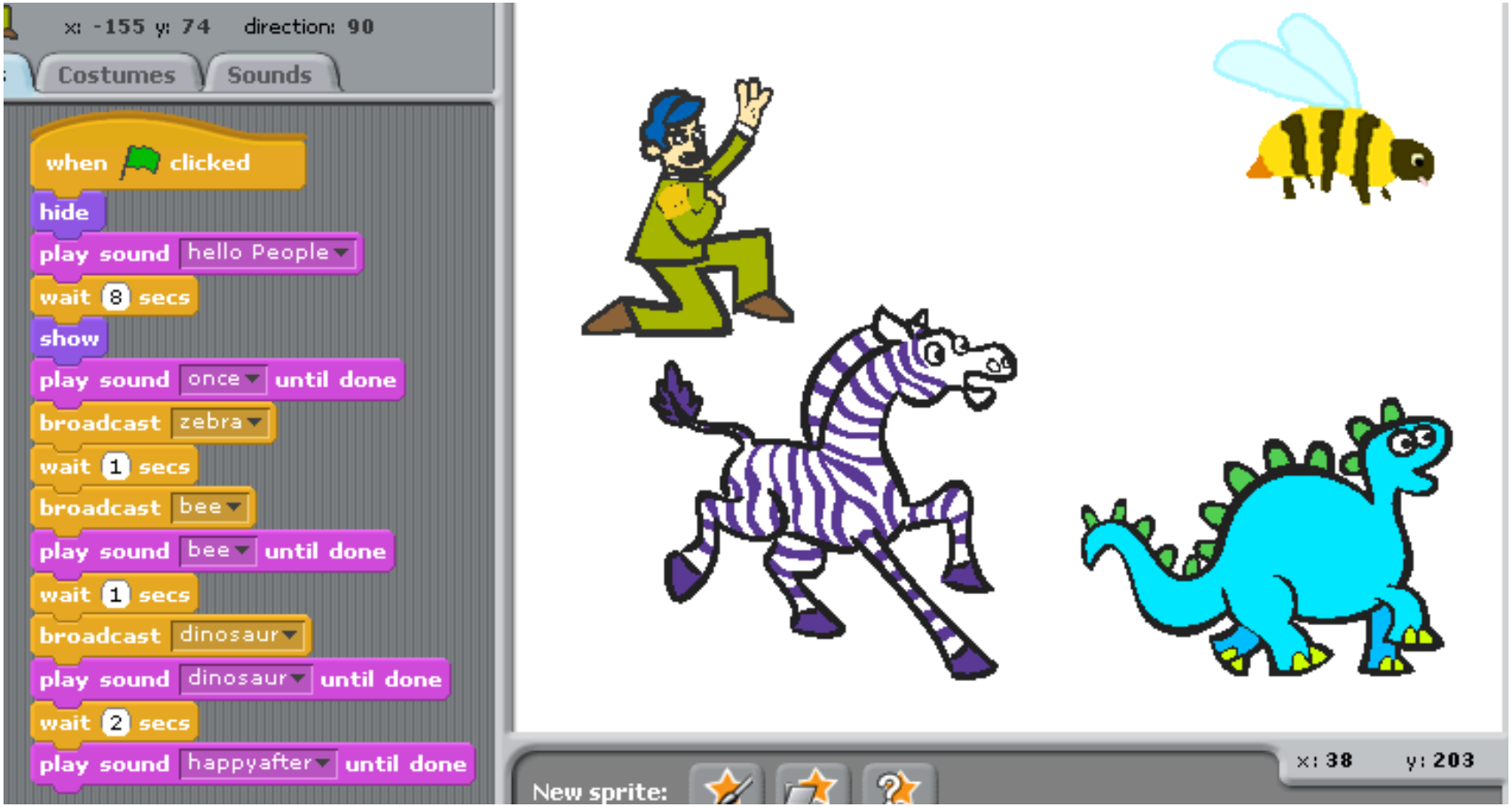

x: 14 y: -83 direction: 90
Costumes
Sounds
when I receive godrum
repeat 5
repeat 3
play drum 48 for 0.2 beats
repeat 5
wait 0.2 secs
play drum 47 for 0.2 beats
New sprite:
Sprite2
Sprite3
Sprite4

Jodi jumps on the drum



Recording from a mike (or an iPod or other music player)

The Friends Story (play it)



Variations in stories

Have several scenes

Scenes change with messages or variables

Make characters move

Make characters hide or show

Behavior can change with variables, touching, mousing.

Background music for each scene

Learning from examples

1. Click on the FILE tab
2. Click on the OPEN tab
3. Click on the Examples tab
4. Choose an example: for example, try STORIES and MAD LIB

End of Part 4: outcomes

Students should be able to program by passing messages. Students should be able to program their sprites to make sounds.