Availability of Slides

Go to

nbcs.rutgers.edu/~jt

to see the powerpoint slides and/or podcasts for this lecture

Scratch Programming

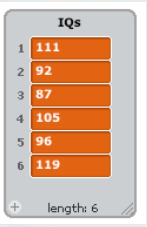
Lesson 7 : Lists

Multiple Values

- It is possible to create as variable that holds multiple items
- This is called a "list"

Multiple Values

- It is possible to create as variable that holds multiple items
- This is called a "list"
- The values in the list can be numbers ….



Multiple Values

- It is possible to create as variable that holds multiple items
- This is called a "list"
- The values in the list can be numbers ….
- Or text

Filling Lists

- Lists start out empty

Filling Lists

- Lists start out empty
- You can add to lists in various ways:

Filling Lists

- Lists start out empty
- You can add to lists in various ways:
  1. Click + when visible on stage

Filling Lists

- Lists start out empty
- You can add to lists in various ways:
  1. Click + when visible on stage
  2. Use the Add block to place new value at end of the list

Filling Lists

- Lists start out empty
- You can add to lists in various ways:
  1. Click + when visible on stage
  2. Use the Add block to place new value at end of the list

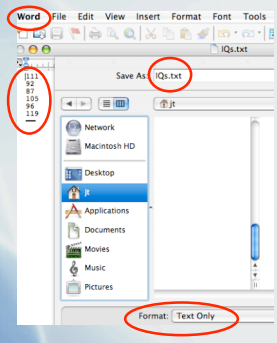
Filling Lists

- Lists start out empty
- You can add to lists in various ways:
  1. Click + when visible on stage
  2. Use the Add block to place new value at end of the list

Filling Lists

- Lists start out empty
- You can add to lists in various ways:
  1. Click + when visible on stage
  2. Use the Add block to place new value at end of the list
  3. Import from a file by right-clicking on list while on stage

Create file as Text-Only



Filling Lists

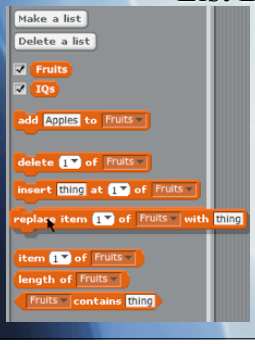
- Lists start out empty
- You can add to lists in various ways:
  1. Click + when visible on stage
  2. Use the Add block to place new value at end of the list
  3. Import from a file by right-clicking on list while on stage

Filling Lists

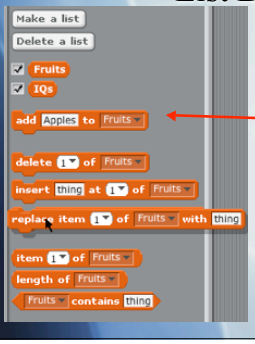
- Lists start out empty
- You can add to lists in various ways:
  1. Click + when visible on stage
  2. Use the Add block to place new value at end of the list
  3. Import from a file by right-clicking on list while on stage

Demo: Create and Fill Lists

List Blocks

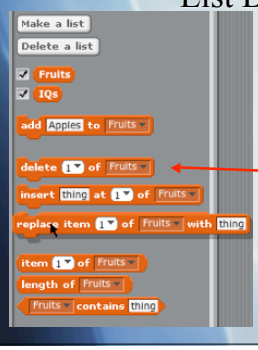


List Blocks



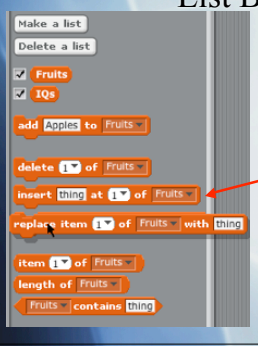
Add item to end of list - length of list grows

List Blocks



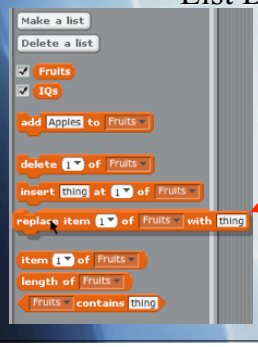
Remove particular item from some spot in list - length of list gets smaller

List Blocks



Place a new item at a particular spot in the list, moving others down - length of list grows

List Blocks



Overwrite the value at a particular spot in the list with a new value - lists stays same length

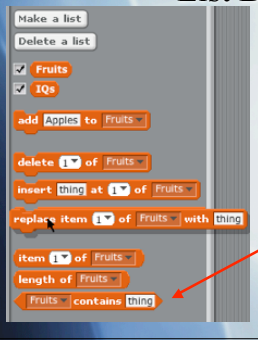
List Blocks

What value is currently at a particular spot in the List? - used as a value in many other blocks such as Say or a + operator

List Blocks

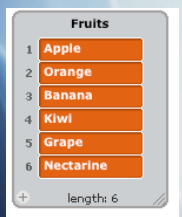
How many items are currently in the list? - used as a value for other blocks such as Repeat

List Blocks

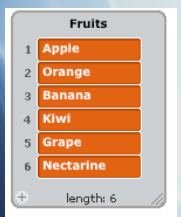


Is a particular item currently in a specified list? True or False? -
- used as a condition,
- for example in an IF

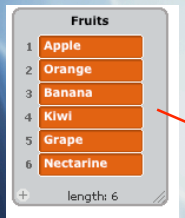
Examples

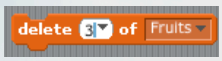


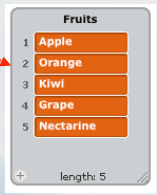
Examples



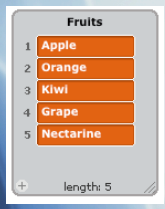
Examples



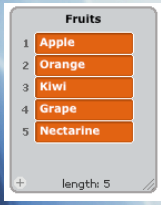




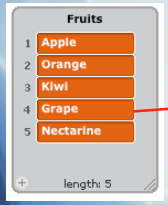
Examples

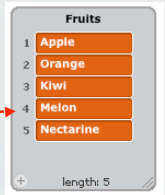


Examples

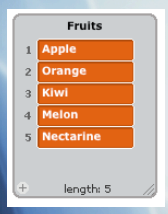


Examples

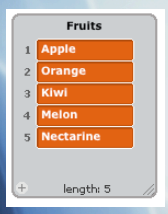




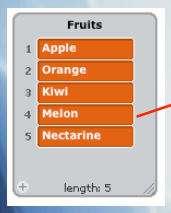
Examples



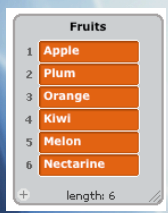
Examples



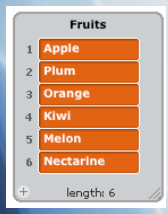
Examples

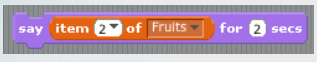


Examples

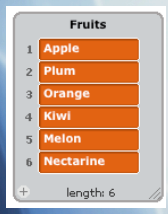


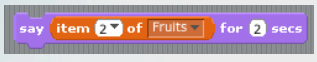
Examples

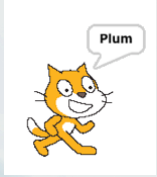




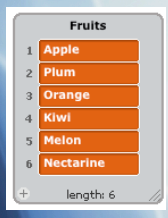
Examples



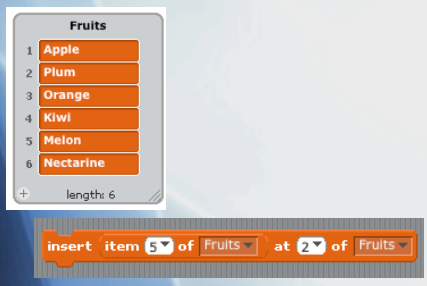




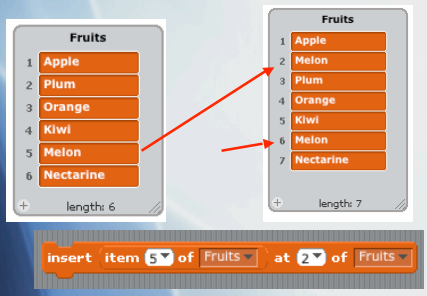
Examples



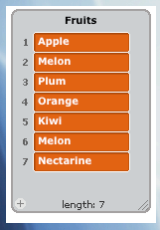
Examples



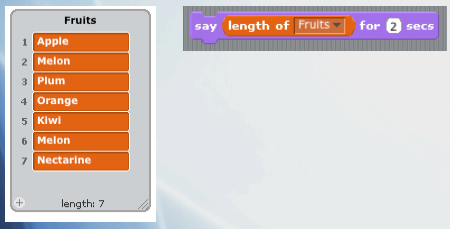
Examples



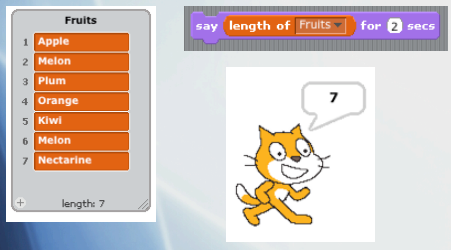
Examples



Examples



Examples

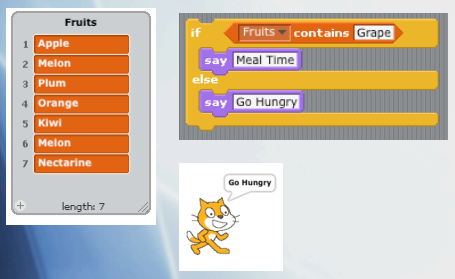


Examples

Examples

Examples

Examples



Problem

- Get the population of some states and display the average population of those states

Problem

- Get the population of some states and display the average population of those states
- Approach
  - Get the various populations
  - Figure out Average
  - Say it

Get Populations

- Let's place the populations in a list called Population

Get Populations

- Let's place the populations in a list called Population
- Let's get it in millions (for example "12.3")

Get Populations

- Let's place the populations in a list called Population
- Let's get it in millions (for example "12.3")
- We are not told how many states, so let's keep getting them until a special value is entered that is not a state - let's say "-100"

Get Populations

- Let's place the populations in a list called Population
- Let's get it in millions (for example "12.3")
- We are not told how many states, so let's keep getting them until a special value is entered that is not a state - let's say "-100"

This is called a "sentinel" or "flag"

Get Populations

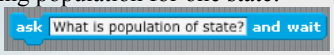
- Let's place the populations in a list called Population
- Let's get it in millions (for example "12.3")
- We are not told how many states, so let's keep getting them until a special value is entered that is not a state - let's say "-100"
- Let's cause this script to happen when the character a (for "ask") is typed

Get Populations

- Work on getting population for one state:

Get Populations

- Work on getting population for one state:
  1. Ask



Get Populations

- Work on getting population for one state:
  1. Ask
  2. Add to list

Get Populations

- Work on getting population for one state:
  1. Ask
  2. Add to list

Wait - there is a problem

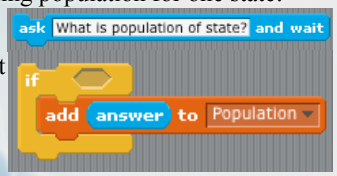
Get Populations

- Work on getting population for one state:
  1. Ask
  2. Add to list

Wait - there is a problem - what if they enter the sentinel -100? That isn't a real population and doesn't belong in our list.

Get Populations

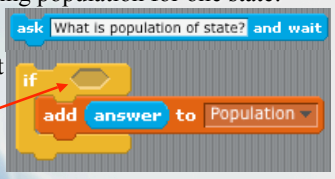
- Work on getting population for one state:
  1. Ask
  2. Add to list



Use IF

Get Populations

- Work on getting population for one state:
  1. Ask
  2. Add to list

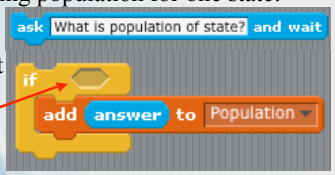


What condition?

Use IF

Get Populations

- Work on getting population for one state:
  1. Ask
  2. Add to list

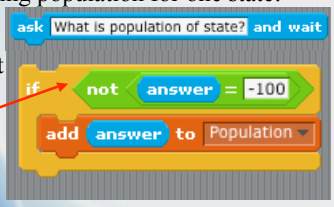


What condition?
Hint: it uses a boolean

Use IF

Get Populations

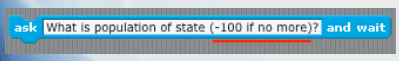
- Work on getting population for one state:
  1. Ask
  2. Add to list



What condition?
Hint: it uses a boolean

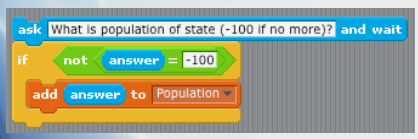
A more helpful Say

- Let's remind them of the sentinel in the say.



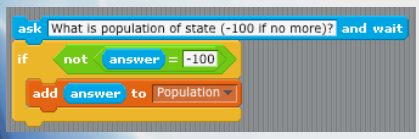
Get Populations

- Work on getting population for one state:



Get Populations

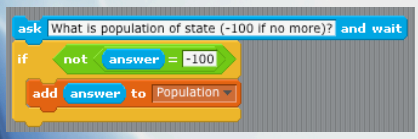
- Work on getting population for one state:



- What can we use to do many states?

Get Populations

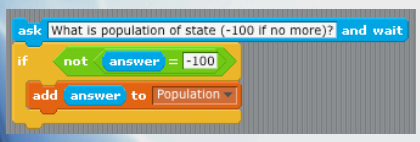
- Work on getting population for one state:



- What can we use to do many states? Loop

Get Populations

- Work on getting population for one state:



- What can we use to do many states? Loop
  How about a Repeat Until

Get Populations

- What can we use to do many states? Loop
  How about a Repeat Until

Get Populations

- What can we use to do many states? Loop
  How about a Repeat Until

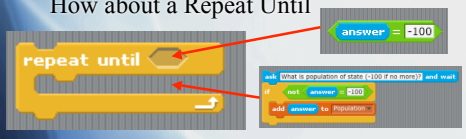
Get Populations

- What can we use to do many states? Loop
  How about a Repeat Until

What condition needs to be
True for us to stop getting populations?

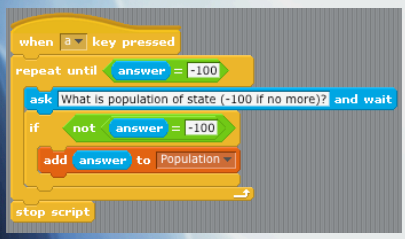
Get Populations

- What can we use to do many states? Loop
  How about a Repeat Until

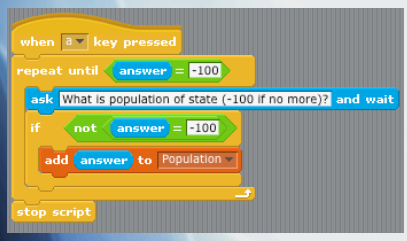


What condition needs to be
True for us to stop getting populations?

Get Populations: Complete Script



Get Populations: Complete Script



Demo: Populations 1

Populations: The Rest

- Get the population of some states and display the average population of those states
- Approach
  - Get the various populations
  - Figure out Average
  - Say it

Populations: The Rest

- Get the population of some states and display the average population of those states
- Approach
  - Get the various populations
  - Figure out Average
  - Say it

Populations: The Rest : Average

- To get the average, we have to add up all the populations and divide by the number of states

Populations: The Rest : Average

- To get the average, we have to add up all the populations and divide by the number of states
- How can we know how many states there are?

Populations: The Rest : Average

- To get the average, we have to add up all the populations and divide by the number of states
- How can we know how many states there are? Hint: what aspect of the Population lists tells us how many states?

Populations: The Rest : Average

- To get the average, we have to add up all the populations and divide by the number of states
- How can we know how many states there are? Hint: what aspect of the Population lists tells us how many states? It was one of the list blocks we learned before.

Populations: The Rest : Average

- To get the average, we have to add up all the populations and divide by the number of states
- How can we know how many states there are? Hint: what aspect of the Population lists tells us how many states? It was one of the list blocks we learned before.

Populations: The Rest : Average

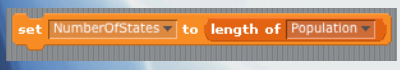
- To get the average, we have to add up all the populations and divide by the number of states
- How can we know how many states there are? Let's place this in a variable called: NumberOfStates

Populations: The Rest : Average

- To get the average, we have to add up all the populations and divide by the number of states
- How can we know how many states there are? Let's place this in a variable called: NumberOfStates

Populations: The Rest : Average

- To get the average, we have to add up all the populations and divide by the number of states
- NumberOfStates is length of Population list



Populations: The Rest : Average

- To get the average, we have to add up all the populations and divide by the number of states
- NumberOfStates is length of Population list
- Let's call the sum of all the populations - TotalPopulation

Populations: The Rest : Average

- To get the average, we have to add up all the populations and divide by the number of states
- NumberOfStates is length of Population list
- Let's call the sum of all the populations - TotalPopulation (we will come back to this)

Populations: The Rest : Average

- To get the average, we have to add up all the populations and divide by the number of states
- NumberOfStates is length of Population list
- Let's call the sum of all the populations - TotalPopulation

Populations: The Rest : Average

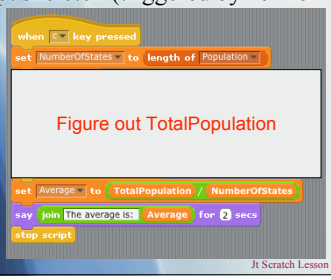
- To get the Average, we have to add up all the populations and divide by the number of states ← So, what is the equation for this?
- NumberOfStates is length of Population list
- Let's call the sum of all the populations - TotalPopulation

Populations: The Rest : Average

- To get the Average, we have to add up all the populations and divide by the number of states
- NumberOfStates is length of Population list
- Let's call the sum of all the populations - TotalPopulation

Populations: The Rest : Average

Script skeleton (triggered by "c" for Calculate)



Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

Populations: TotalPopulation

- Approach:
  - Start at zero

  - Go thru all the states
  - Add state's population on to total

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

What type of script block is needed?

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

What type of script block is needed?
How about a loop?

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

What type of script block is needed?
How about a loop? Do we know how many times?

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

What type of script block is needed?
How about a loop? Do we know how many times? Yes - how many?

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

What type of script block is needed?
How about a loop? Do we know how many times? Yes - how many? NumberOfStates

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

What type of script block is needed?
How about a loop? Do we know how many times? Yes - how many? NumberOfStates

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

What is given State's Population?

- Given the various populations are in the Population list, what list block do we use to see a particular one?

What is given State's Population?

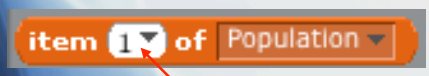
- Given the various populations are in the Population list, what list block do we use to see a particular one?

What is given State's Population?

- Given the various populations are in the Population list, what list block do we use to see a particular one?

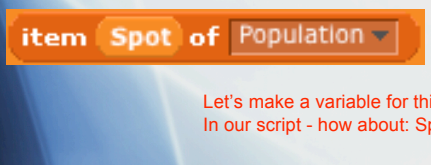
What is given State's Population?

- Given the various populations are in the Population list, what list block do we use to see a particular one?



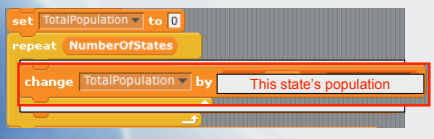
What is given State's Population?

- Given the various populations are in the Population list, what list block do we use to see a particular one?



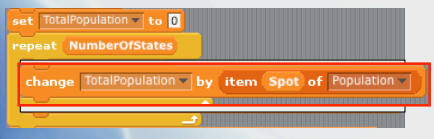
Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total



Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total



Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

One little issue, Spot has no value yet

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

So we need to make sure we start it at zero, and then increment it right before each time we want to handle a new state

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

… increment it right before each time we want to handle a new state

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

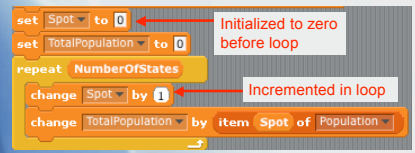
… increment it right before each time we want to handle a new state … that, is each time around the loop (in the loop)

Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

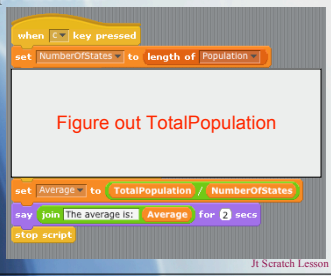
Populations: TotalPopulation

- Approach:
  - Start at zero
  - Go thru all the states
  - Add state's population on to total

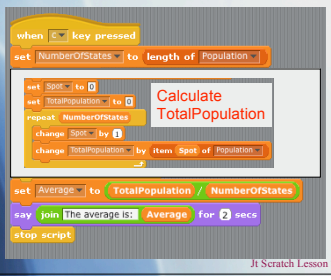


Populations: The Rest : Average

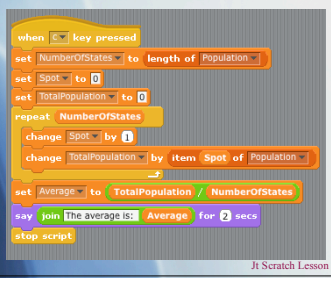
Script skeleton



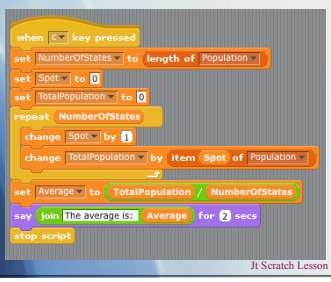
Populations: The Rest : Average



Populations: The Rest : Average



Populations: The Rest : Average



Demo: Populations 2

Enhancement

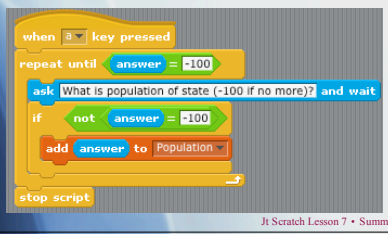
- Let's add a script, triggered by l (for list) to say all the names of the states which have a population over a certain threshold and to tell us how many states were in that category

Enhancement

- Since we never asked for state names, we should modify the add script:

Enhancement

- Since we never asked for state names, we should modify the add script:



Enhancement

- Since we never asked for state names, we should modify the add script
- We need a place to store the state names

Enhancement

- Since we never asked for state names, we should modify the add script
- We need a place to store the state names
- Let's use a new list for this called StateNames

Enhancement

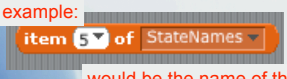
- Since we never asked for state names, we should modify the add script
- We need a place to store the state names
- Let's use a new list for this called StateNames

For example:

Enhancement

- Since we never asked for state names, we should modify the add script
- We need a place to store the state names
- Let's use a new list for this called StateNames

For example:



would be the name of the 5th state

Parallel Lists

- Here Population and StateNames are two separate lists that work together

Parallel Lists

- Here Population and StateNames are two separate lists that work together
- For example, the third value in the StateNames list is the name of that state, while the third value in ther Population lists is that state's population

Parallel Lists

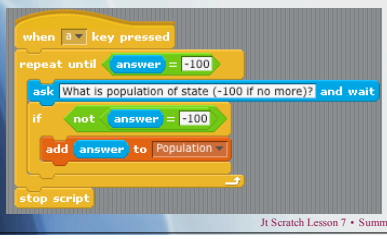
- Here Population and StateNames are two separate lists that work together
- For example, the third value in the StateNames list is the name of that state, while the third value in ther Population lists is that state's population
- Works like fields in a record in a database

Parallel Lists

- Here Population and StateNames are two separate lists that work together
- For example, the third value in the StateNames list is the name of that state, while the third value in ther Population lists is that state's population
- Works like fields in a record in a database
- In programming, this is called "parallel lists"

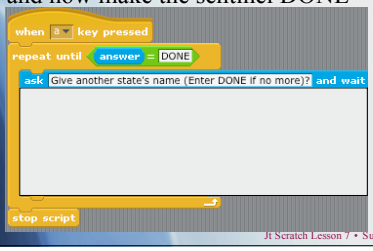
Enhancement

- The old version of the script:



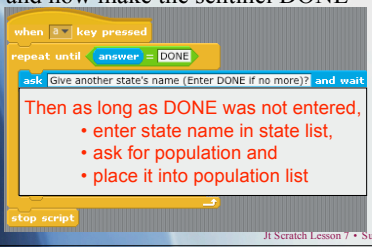
Enhancement

- Each time, let us now ask for state name first and now make the sentinel DONE



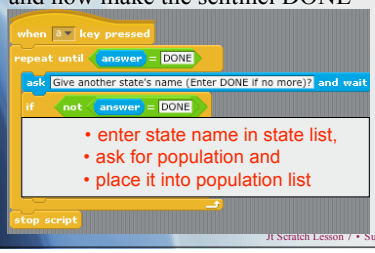
Enhancement

- Each time, let us now ask for state name first and now make the sentinel DONE



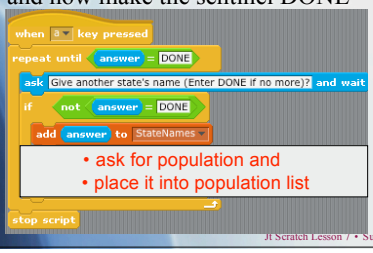
Enhancement

- Each time, let us now ask for state name first and now make the sentinel DONE



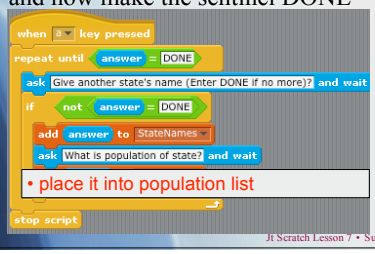
Enhancement

- Each time, let us now ask for state name first and now make the sentinel DONE



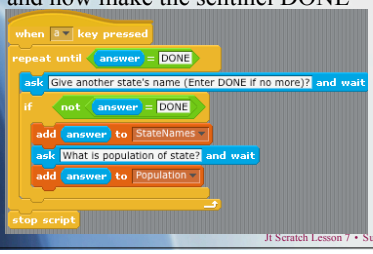
Enhancement

- Each time, let us now ask for state name first and now make the sentinel DONE



Enhancement

- Each time, let us now ask for state name first and now make the sentinel DONE



List Over Threshold Script

- Let's add a script, triggered by l (for list) to say all the names of the states who have a population over a certain threshold and to tell us how many states were in that category

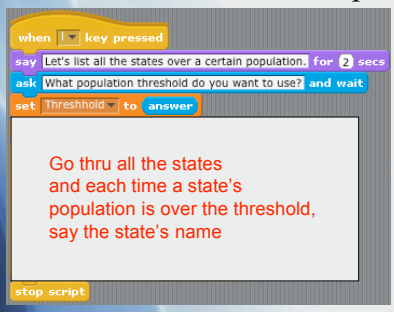
List Over Threshold Script

- Let's add a script, triggered by l (for list) to say all the names of the states who have a population over a certain threshold …

List Over Threshold Script

Announce what is going on & ask for threshold

List Over Threshold Script

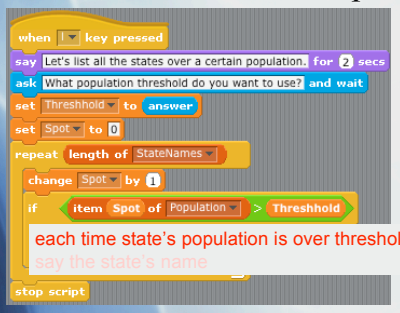


Go thru all the states
and each time a state's
population is over the threshold,
say the state's name

List Over Threshold Script

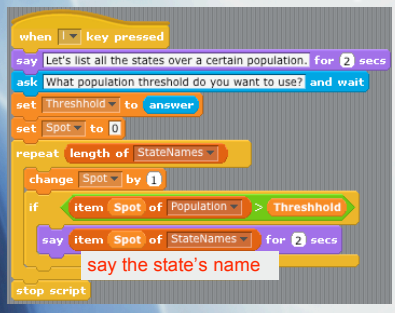
Go thru all the states
and each time a state's
population is over the threshold,
say the state's name

List Over Threshold Script



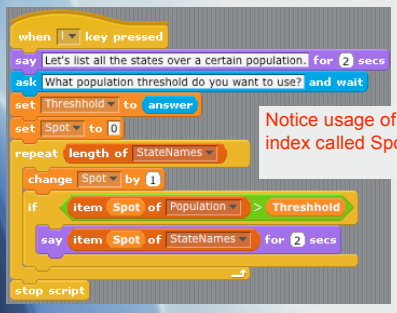
each time state's population is over threshold,
say the state's name

List Over Threshold Script



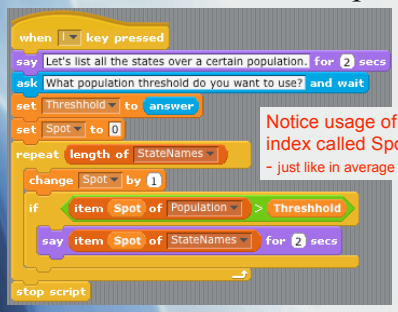
say the state's name

List Over Threshold Script



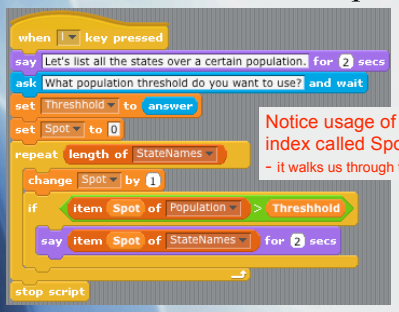
Notice usage of the index called Spot

List Over Threshold Script



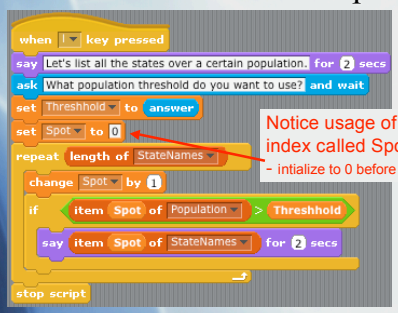
Notice usage of the index called Spot
- just like in average script -

List Over Threshold Script



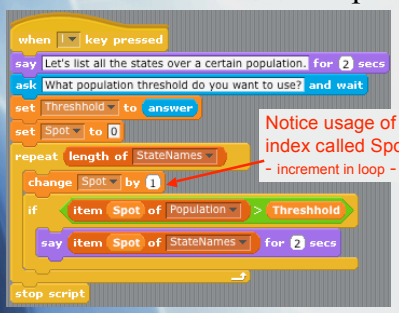
Notice usage of the index called Spot
- it walks us through the list -

List Over Threshold Script



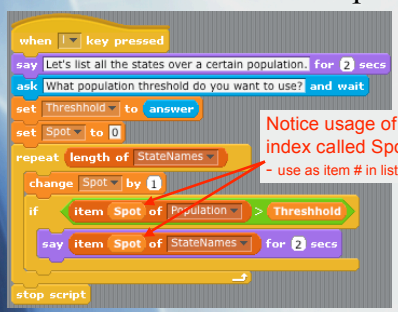
Notice usage of the index called Spot
- intialize to 0 before loop -

List Over Threshold Script



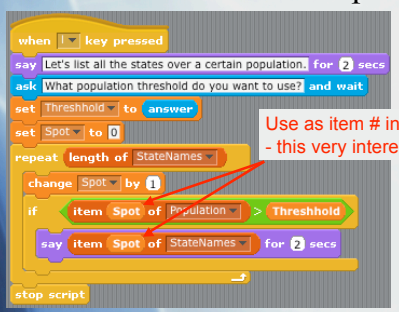
Notice usage of the index called Spot
- increment in loop -

List Over Threshold Script



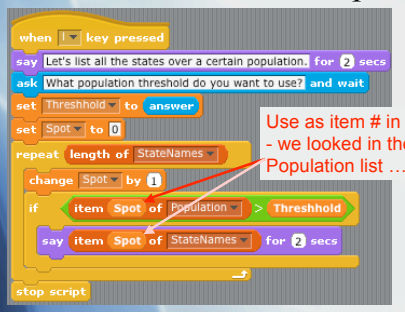
Notice usage of the index called Spot
- use as item # in lists -

List Over Threshold Script



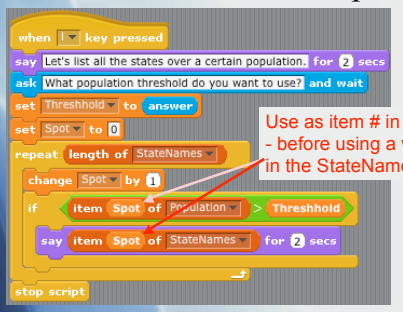
Use as item # in lists
- this very interesting

List Over Threshold Script



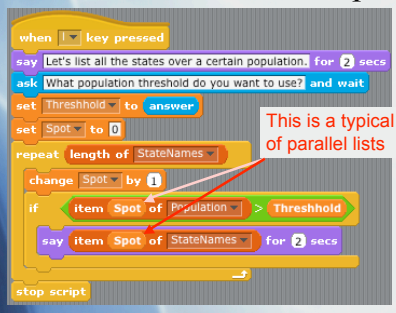
Use as item # in lists - we looked in the Population list ….

List Over Threshold Script



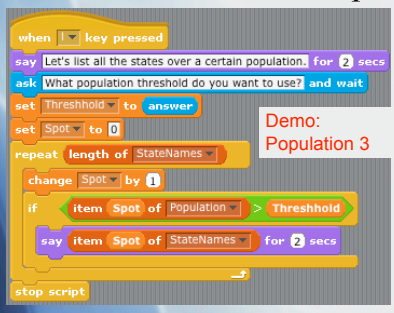
Use as item # in lists - before using a value in the StateNames list

List Over Threshold Script



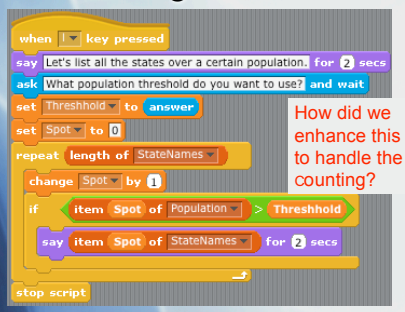
This is a typical use of parallel lists

List Over Threshold Script



Demo: Population 3

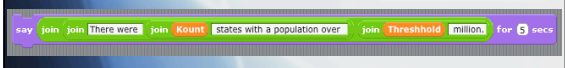
Handling the Count



How did we enhance this script to handle the counting?

Handling the Count

How did we enhance this script to handle the counting?

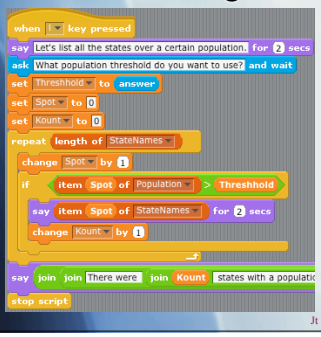


Handling the Count

New variable

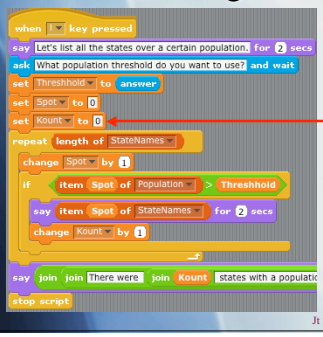
How did we enhance this script to handle the counting?

Handling the Count



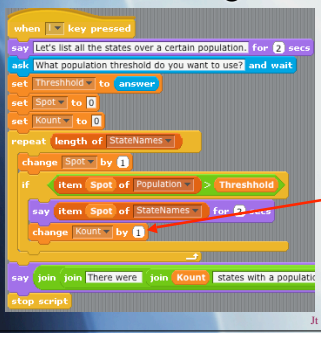
How did we enhance this script to handle the counting?

Handling the Count



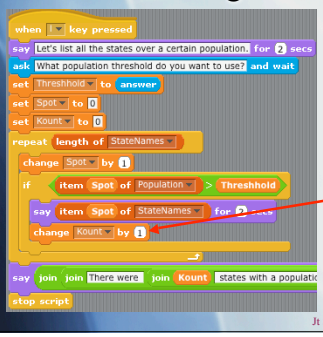
1. Kount is initialized to zero one time before the loop

Handling the Count



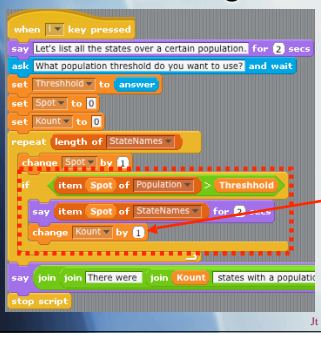
2. Kount incremented possibly over and over

Handling the Count



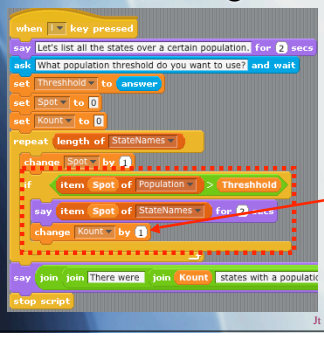
2. Kount incremented possibly over and over - therefore in the loop

Handling the Count



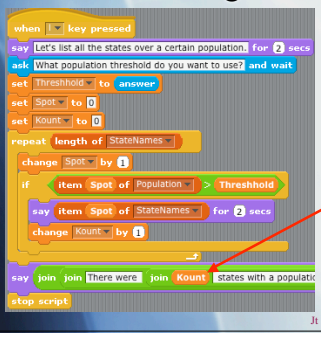
2. Kount incremented - but guarded by the IF, so only happens sometimes - when population was large enough

Handling the Count



2. Kount incremented - but guarded by the IF, so maybe never happens and stays at zero, or maybe gets bigger

Handling the Count



3. Kount is displayed on screen AFTER loop is over

Final Enhancement

- Add a script triggered when the sprite itself is clicked that asks for the name of a state, and then replies with the population of that state

Final Enhancement

- Add a script triggered when the sprite itself is clicked that asks for the name of a state, and then replies with the population of that state
- Approach:
  - Get name of state you are interested in

Final Enhancement

- Add a script triggered when the sprite itself is clicked that asks for the name of a state, and then replies with the population of that state
- Approach:
  - Get name of state you are interested in
  - Go through all the states in list of StateNames

Final Enhancement

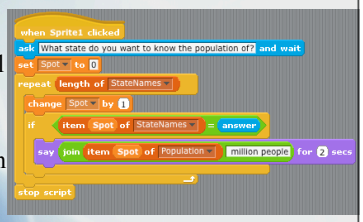
- Add a script triggered when the sprite itself is clicked that asks for the name of a state, and then replies with the population of that state
- Approach:
  - Get name of state you are interested in
  - Go through all the states in list of StateNames
  - When current state is the one being looked for, say the population using the parallel list Population

Final Enhancement

- Add a script triggered when the sprite itself is clicked that asks for the name of a state, and then replies with the population of that state
- Approach:
  - Get name of state you are interested in
  - Go through all the states in list of StateNames
  - When current state is the one being looked for, say the population using the parallel list Population
  - Use an index in standard way to walk thru list

Final Enhancement

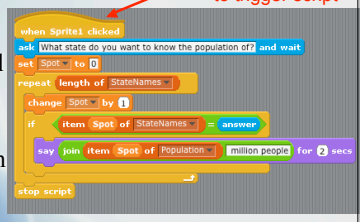
1. Get name of state
2. Go through all StateNames
3. When found say Population
4. Use an index



Final Enhancement

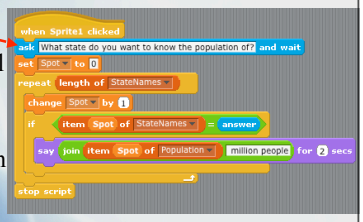
1. Get name of state
2. Go through all StateNames
3. When found say Population
4. Use an index

New way to trigger script



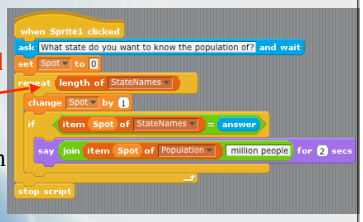
Final Enhancement

1. Get name of state
2. Go through all StateNames
3. When found say Population
4. Use an index



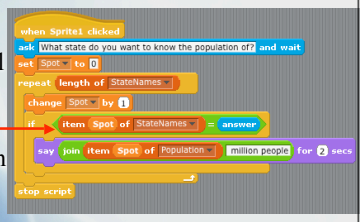
Final Enhancement

1. Get name of state
2. Go through all StateNames
3. When found say Population
4. Use an index



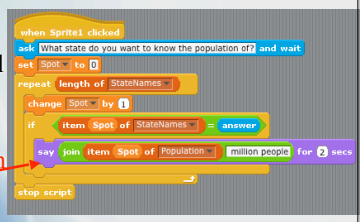
Final Enhancement

1. Get name of state
2. Go through all StateNames
3. When found say Population
4. Use an index



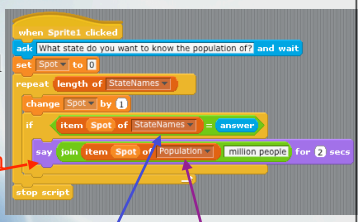
Final Enhancement

1. Get name of state
2. Go through all StateNames
3. When found say Population
4. Use an index



Final Enhancement

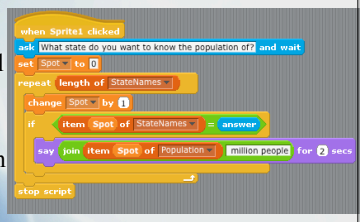
1. Get name of state
2. Go through all StateNames
3. When found say Population
4. Use an index



Taking advantage of parallel lists again, looking in StateNames before saying item in same place of Population list

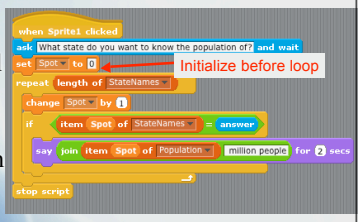
Final Enhancement

1. Get name of state
2. Go through all StateNames
3. When found say Population
4. Use an index



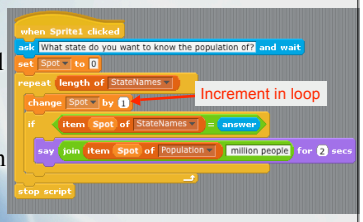
Final Enhancement

1. Get name of state
2. Go through all StateNames
3. When found say Population
4. Use an index



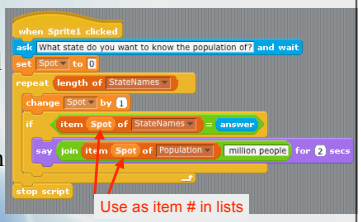
Final Enhancement

1. Get name of state
2. Go through all StateNames
3. When found say Population
4. Use an index



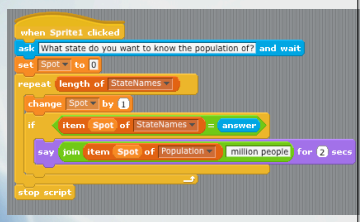
Final Enhancement

1. Get name of state
2. Go through all StateNames
3. When found say Population
4. Use an index



Final Enhancement

Demo:
Populations 4

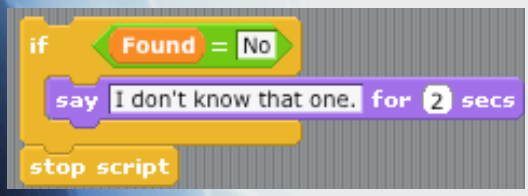


Last Look

- How did it say "I don't know that one."

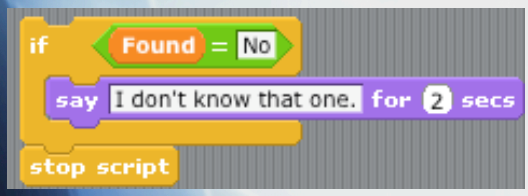
Last Look

- How did it say "I don't know that one."



Last Look

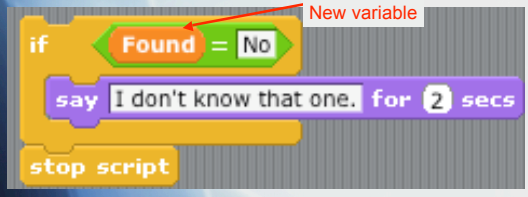
- How did it say "I don't know that one."



This final decision is made after searching through the whole list - so AFTER the loop

Last Look

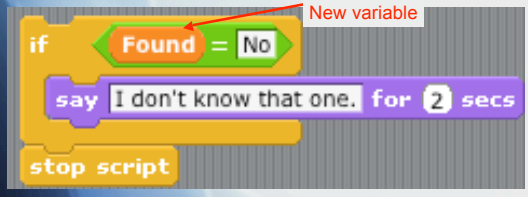
- How did it say "I don't know that one."



This final decision is made after searching through the whole list - so AFTER the loop

Last Look

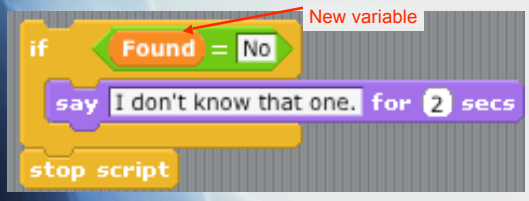
- How did it say "I don't know that one."



Need to initialize found to No before the search through the list

Last Look

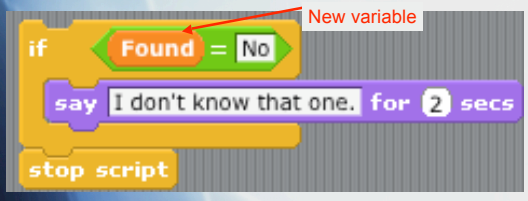
- How did it say "I don't know that one."



Need to initialize found to No before the search through the list - if state never found, Found will remain = to No

Last Look

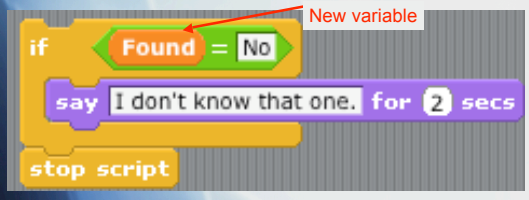
- How did it say "I don't know that one."



Need to initialize found to No before the search through the list - if state never found, Found will remain = to No and thus at the end this will be said

Last Look

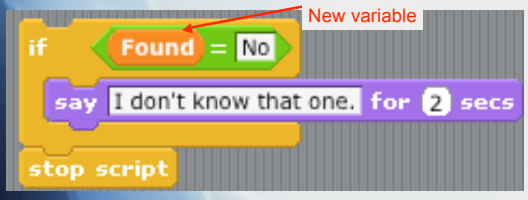
- How did it say "I don't know that one."



Need to initialize found to No before the search through the list - however if state is found, need to change Found to Yes

Last Look

- How did it say "I don't know that one."

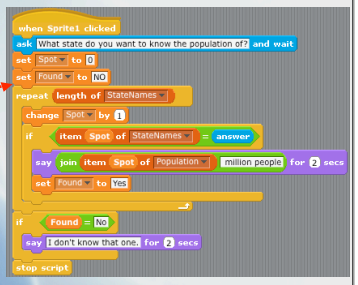


Need to initialize found to No before the search through the list - however if state is found, need to change Found to Yes - in loop, in other IF

Last Look

Need to initialize found to No before the search through the list

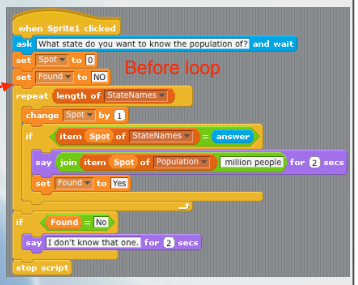
However, if state is found, need to change Found to Yes - in loop, in other IF



Last Look

Need to initialize found to No before the search through the list

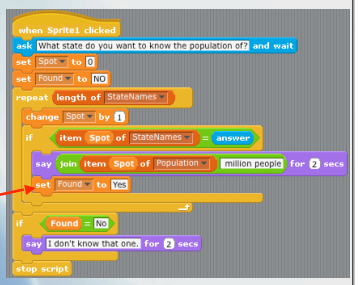
However, if state is found, need to change Found to Yes - in loop, in other IF



Last Look

Need to initialize found to No before the search through the list

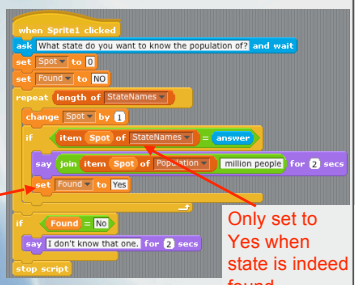
However, if state is found, need to change Found to Yes - in loop, in other IF



Last Look

Need to initialize found to No before the search through the list

However, if state is found, need to change Found to Yes - in loop, in other IF



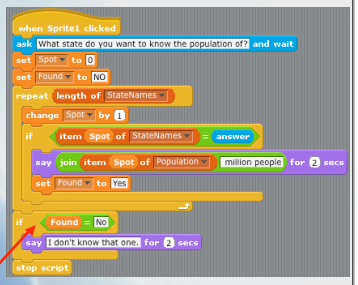
Only set to Yes when state is indeed found

Last Look

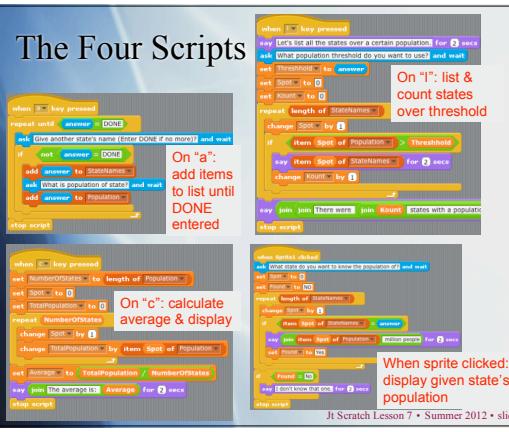
Need to initialize found to No before the search through the list

However, if state is found, need to change Found to Yes - in loop, in other IF

After search loop is finished, so Don't Know said only when not found



The Four Scripts



On "a": add items to list until DONE entered

On "l": list & count states over threshold

On "c": calculate average & display

When sprite clicked: display given state's population

Availability of Slides

Go to

nbcs.rutgers.edu/~jt

to see the powerpoint slides and/or podcasts for this lecture