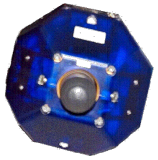
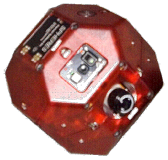
ZERO ROBOTICS





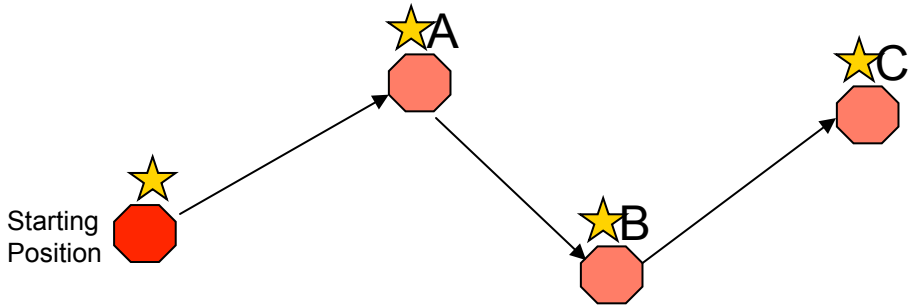
ISS PROGRAMING CHALLENGE

The Conditionals:
The Basics of “If-Then”

Goals

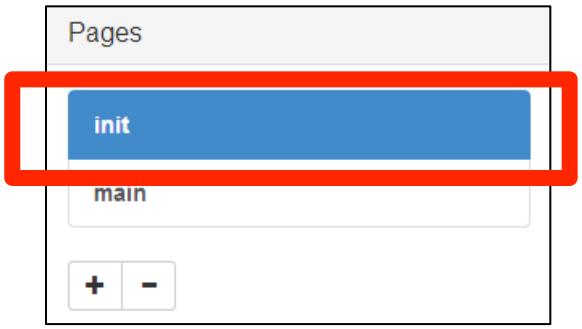
- In this tutorial you will:
  - Learn to use "if-then" statements in programming
  - Use the logic operator: ">"
  - Learn about counters
  - Learn about flow charts

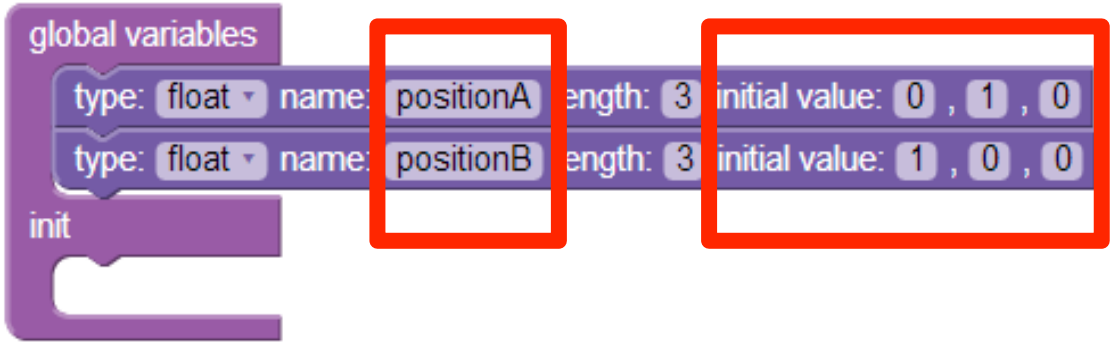
  - Program a SPHERES satellite to follow a path to multiple locations!



Create A New Project and Declare Variables

- Open the ZR IDE
- Select “New Project”
  - Project name: **Project 4**
  - Graphical Editor
  - Game: FreeMode
- Go to **Init** Page/Variables accordion
- Create an array called “positionA”
  - type: float
  - name: **positionA**
  - length:3
  - Set Initial value to: **0,1,0**
- Create a second array called “positionB”
  - type: float
  - name: **positionB**
  - length: 3
  - Set Initial value to: **1,0,0**

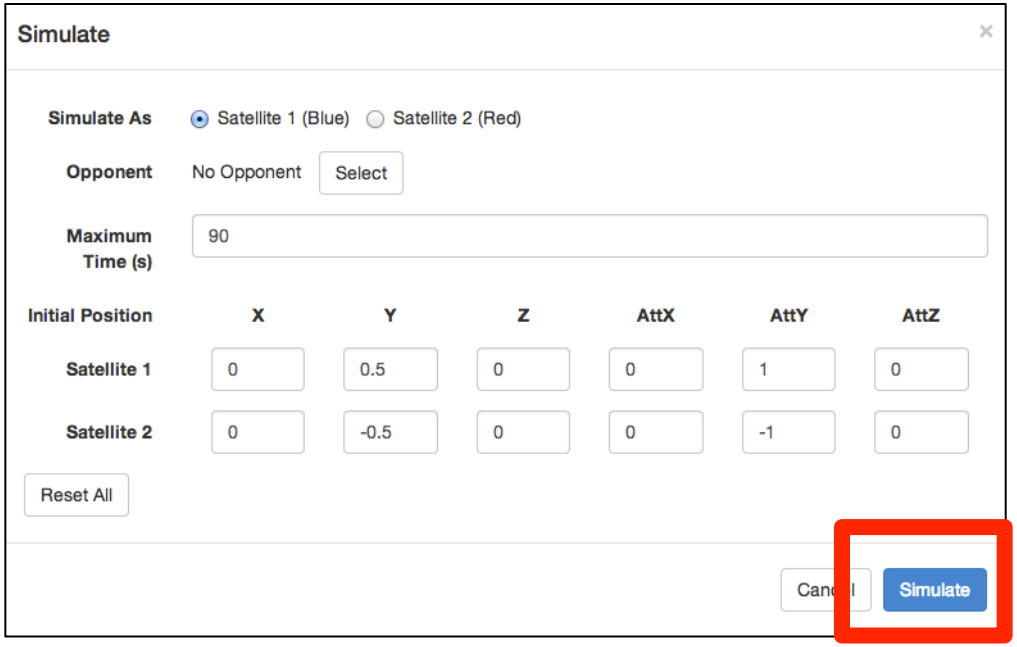




ZERO ROBOTICS
ISS PROGRAMING CHALLENGE

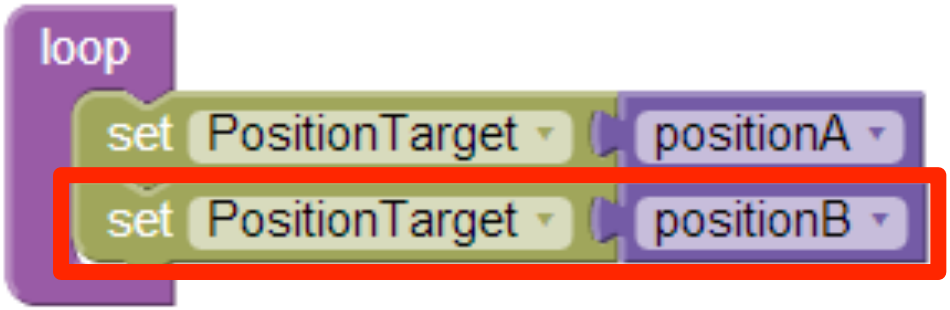
Introduce a SPHERES Control Function

- Return to “main” page
- Create a statement to set the position of the SPHERES satellite
  - Click on the “SPHERES Controls” accordion
  - Select the“setPositionTarget” block and **drag and drop** the block inside the “**loop**”
  - Toggle “—Select—” to “**positionA**”
- Compile, Simulate
  - In the Simulation Settings pop-up box, set Maximum Time to 90 seconds
- Click the “Simulate” button and View Results
- The satellite will move to PositionA
- Click “Back to Project”



Test a 2nd SPHERES Control Function

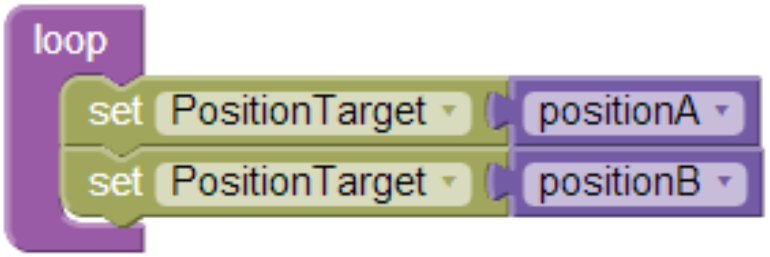
- Test what happens:
  - Drag and Drop another "setPositionTarget" block in the loop below the first block (Remember to make sure the blocks snap together)
  - Select Position B
- Compile, Simulate
- Click the "Simulate" button and View Results
- Question: Did the satellite move first to position A and then to position B?



Test a 2nd SPHERES Control Function, cont.

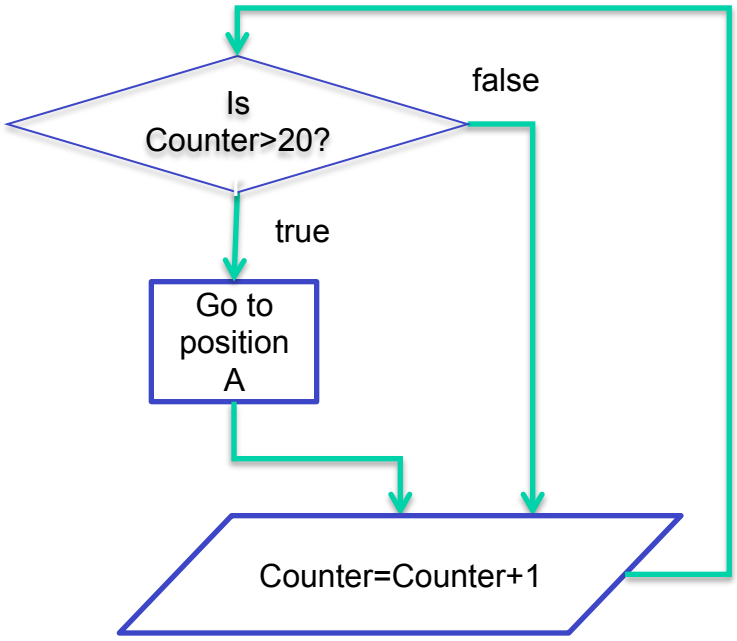
- No, It only moved to Position B.
- Why?
  - The SPHERES controller runs **all** the instructions in the loop once per second
  - When it receives two similar instructions, like "setPositionTarget," it will always follow the last instruction,

    ….unless there are **conditionals** written into the program!



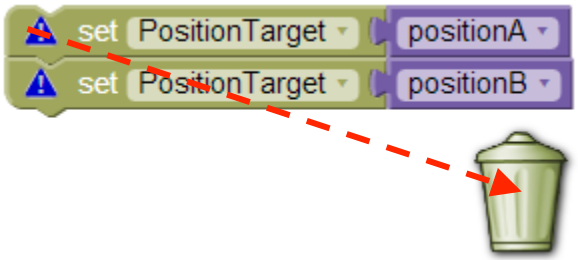
What are conditionals?

- Conditionals give instructions about *when* to do something
- An "if-then" statement is an example of a conditional.
  - **If** something is true **then**…..
- For example: Suppose we want the satellite to wait 20 seconds before it moves to position A?
  - This example is described in the flow diagram to the right
  - counter is a variable that starts at 0
  - Add 1 to the counter each second (each time the loop runs) to keep track of the time
  - If counter is greater than 20, then go to position A; otherwise, do nothing and just keep counting

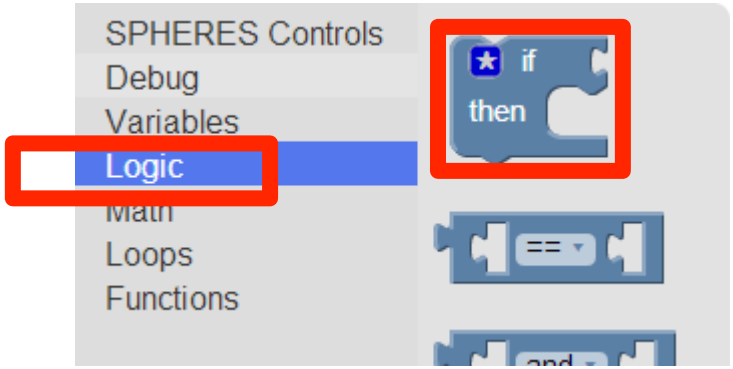


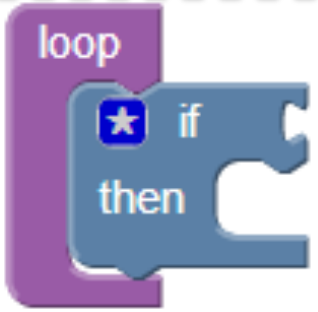
Programming with conditionals

- Before getting started:
  - Delete the SPHERES Control functions you recently added by clicking on the top block and dragging them to trash



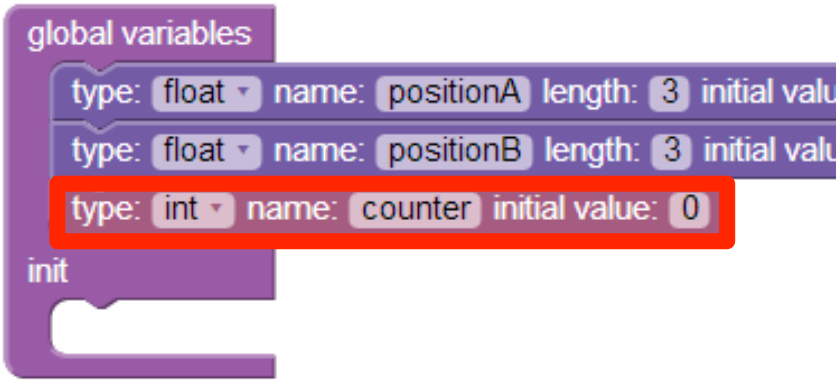
- We want to create the following conditional statement:
  - **If** "counter">20, **Then** go to "positionA"
- Click on the Logic accordion and select "**if - then**"
- Drag and drop the "If - Then" block into the loop
  - **Note**: Try not to click on the  . If you click on the star a popup window will open . You can close the popup window by clicking on the star again. (You will use this feature later.)





Programming with conditionals, cont

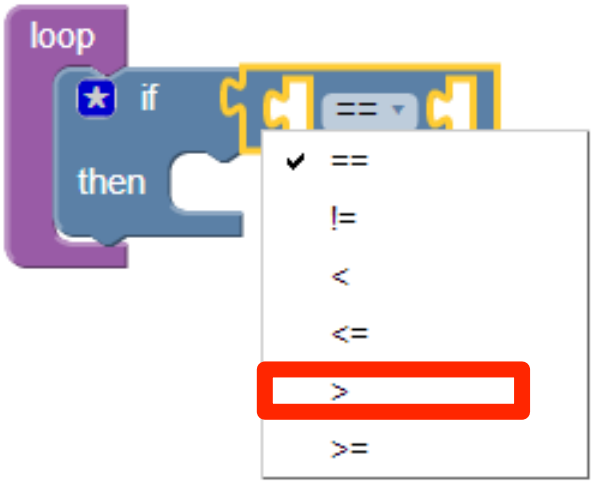
- Next go to the **Init** page to create a new variable
- Select a pink variable block to create a new variable called "counter" as follows :
- Select
  - type: int (*since we will count in whole numbers*)
  - name: counter
  - initial value: 0
- Return to the **main** page



Programming with conditionals, cont

- Remember, we want to create the following conditional statement:
  - **If "counter">20,** Then go to positionA

- Go to the logic accordion and drag the "__==__" block from the logic accordion onto the "if" statement as shown.



- Change the "==" to ">" using the dropdown menu

Programming with conditionals, cont

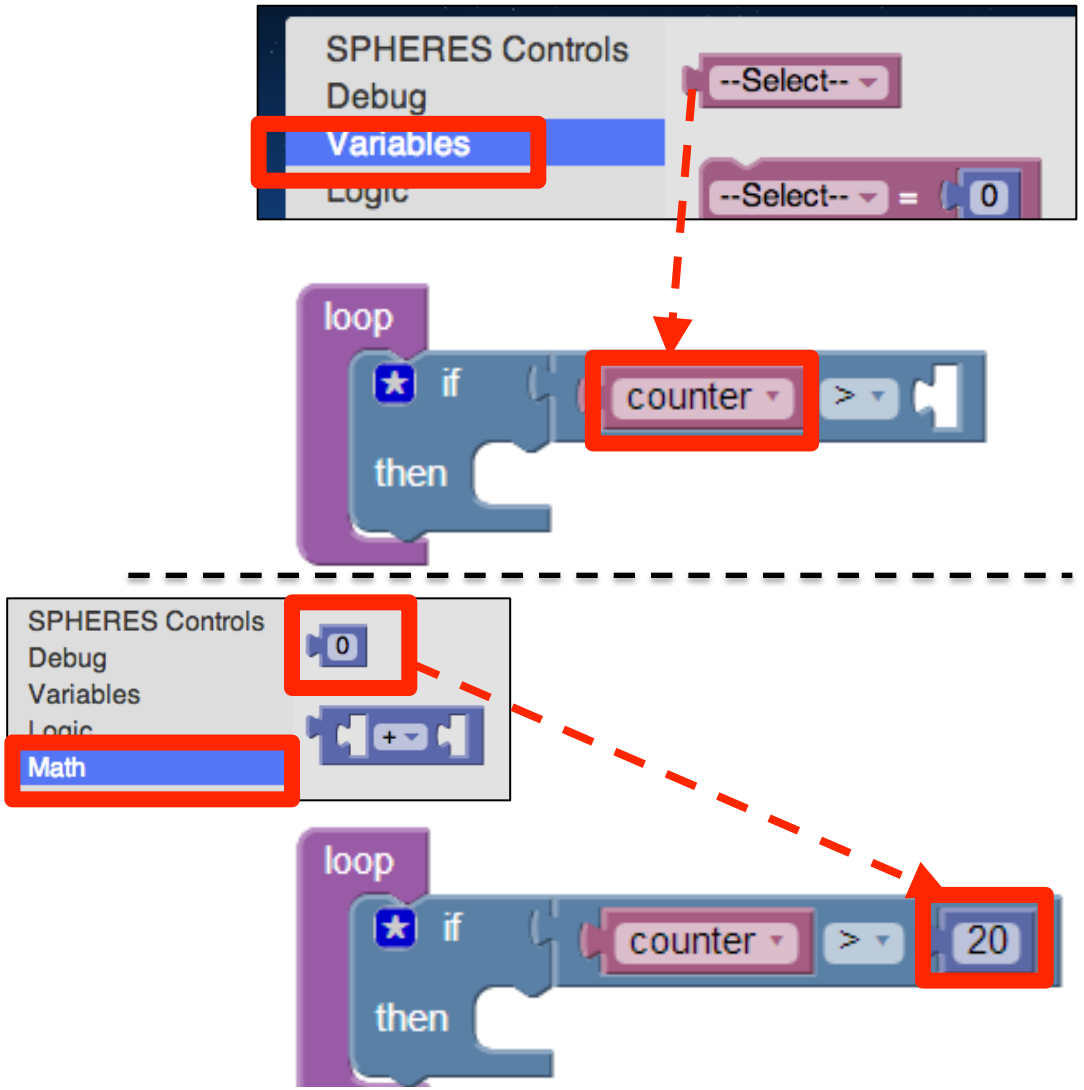
Next change the statement:

if "__" > "__".. into …

if "counter>20"…

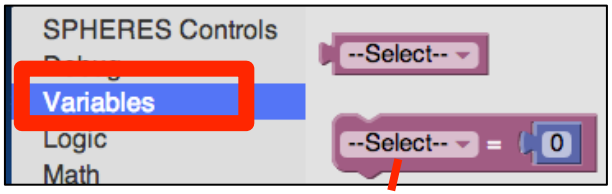
as follows:

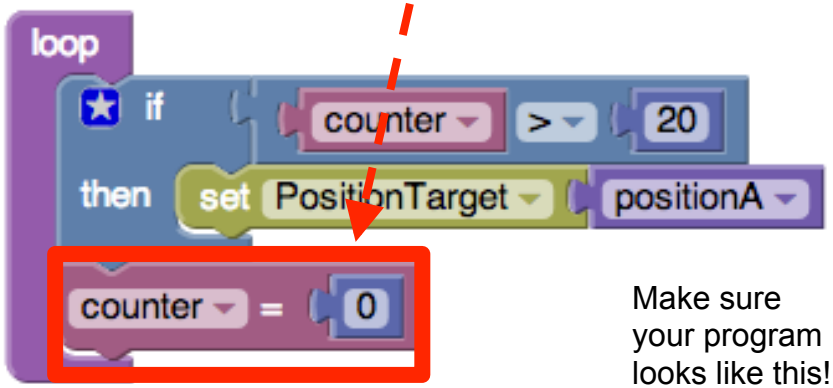
- Go to the "**Variable**s" accordion
  - Find the pink "**--Select--**" block
  - Drag and drop the block into the first empty space and toggle to "counter"
- Go to the "**Math**" accordion
  - Find the blue "0" block (number block)
  - Drag and drop the "0" block into the second empty space
  - Change the "0" to "20" by typing in the number 20



Programming with conditionals, cont

- We are almost there!
- Remember we want to create the following conditional statement:
  - **If** counter > 20, **then** go to positionA
- Click on the "SPHERES Controls" accordion
  - Drag and drop "setPositionTarget" into the if-then statement
  - Select "positionA" from the drop down menu
- The last step is to increment the counter (set: counter = counter+1)
  - Go to the "Variables" accordion
  - Find the "**--Select---=0**" block
  - Drag and drop the block into the loop **after** the "if-then" block
  - Toggle to "**counter**"

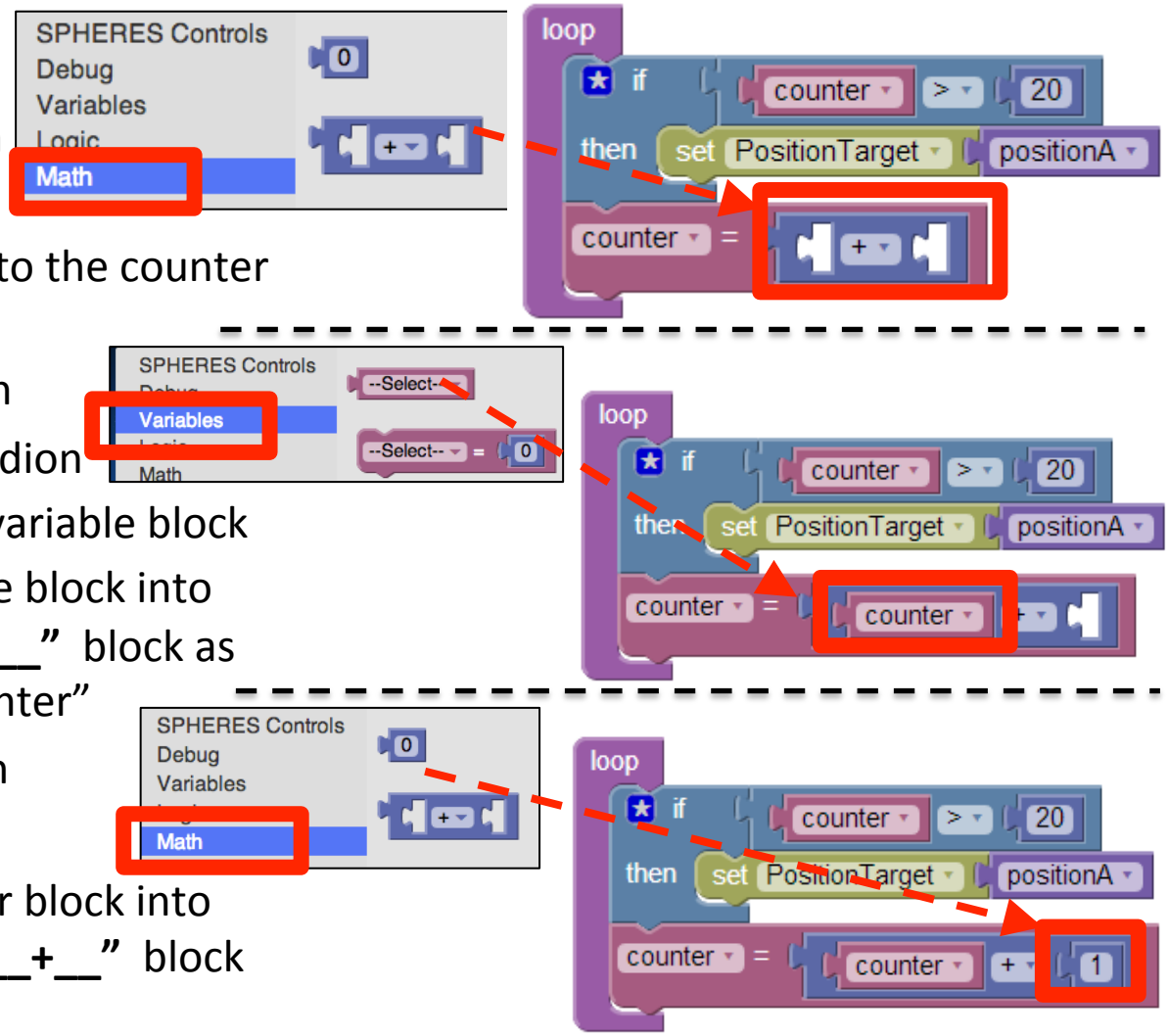




Make sure your program looks like this!

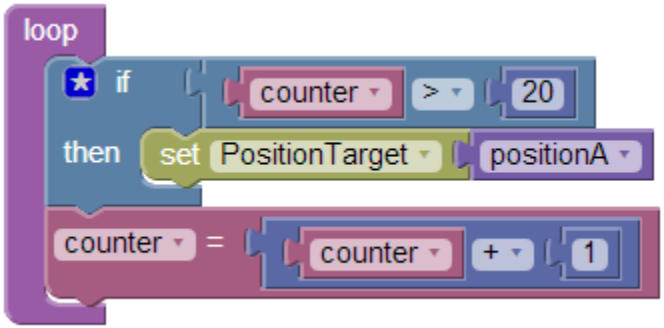
Programming with conditionals, cont

- Change **counter= "0"** into
  counter=counter +1
- First go to the Math accordion
  - Find the "__+__" block
  - Drag the "__+__" block into the counter block as shown
  - Drag the "0" block to trash
- Next go to the Variables accordion
  - Find the pink "--Select--" variable block
  - Drag and drop the variable block into the first space in the "__+__" block as shown and toggle to "counter"
- Now go to the Math accordion
  - Find a blue number block
  - Drag and drop the number block into the second space in the "__+__" block
  - Set the number block to 1

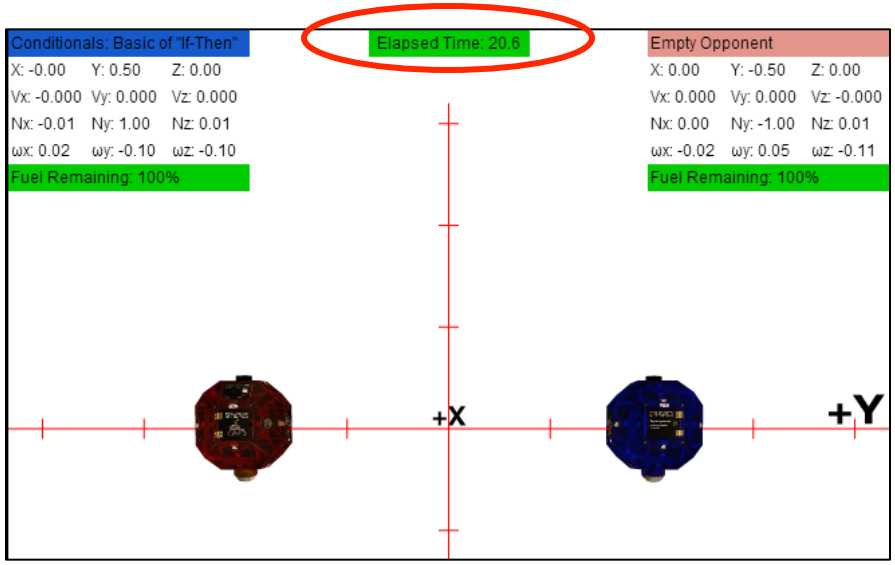


Programming with conditionals, cont

- Your new program will tell the SPHERES satellite to wait until the count of 20 and then move to positionA.



- Compile, Simulate
  - Maximum Time: 90 seconds



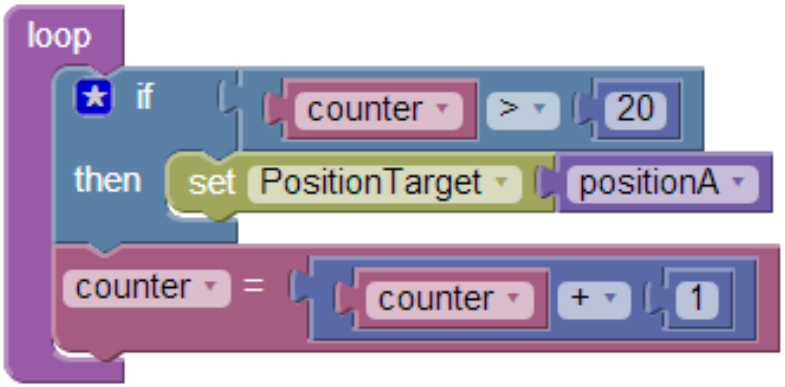
- Simulate and View Results!
- The Blue SPHERE should start to move after: Elapsed Time is > 20

  (Because the counter increases by one every second)

Text Version of Code

- Click “Back to Project”
- Compare:

Your program - versus - C Code

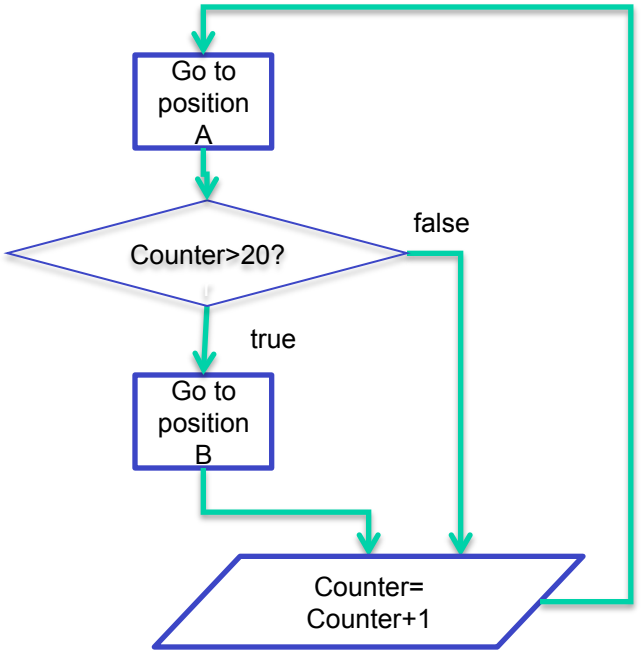



```
1 void loop() {
2   if (counter > 20) {
3     api.setPositionTarget(positionA);
4   }
5   counter = counter + 1;
6 }
```

Move to multiple locations using conditionals

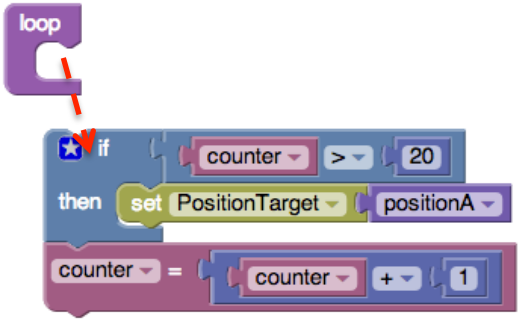
- Next let's make a program that first sends the SPHERES satellite to positionA, and if the counter > 20 then sends the satellite to positionB

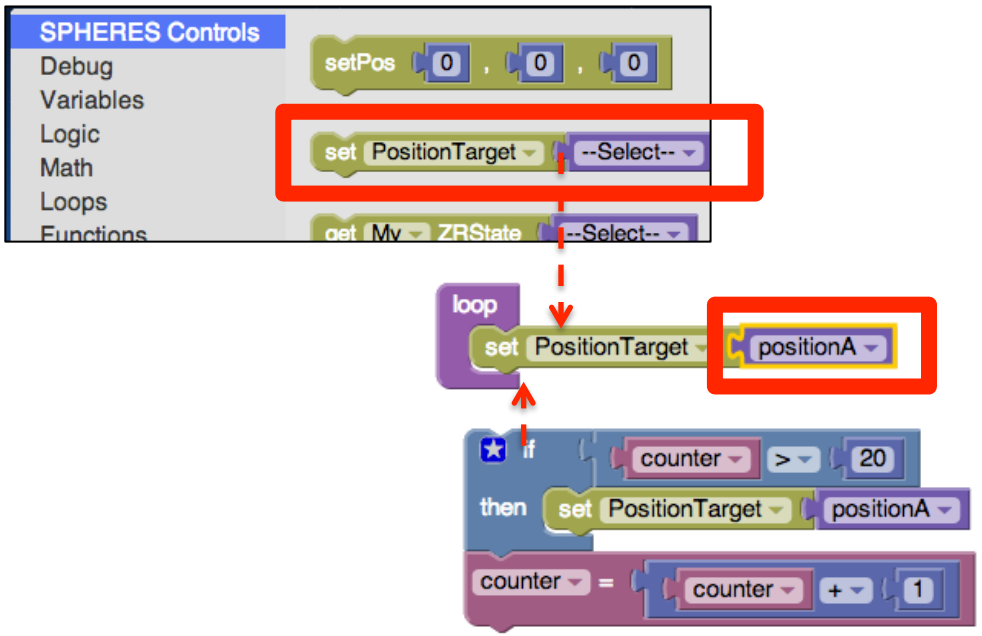
- See the flow diagram to the right for this program



Moving to multiple locations, cont.

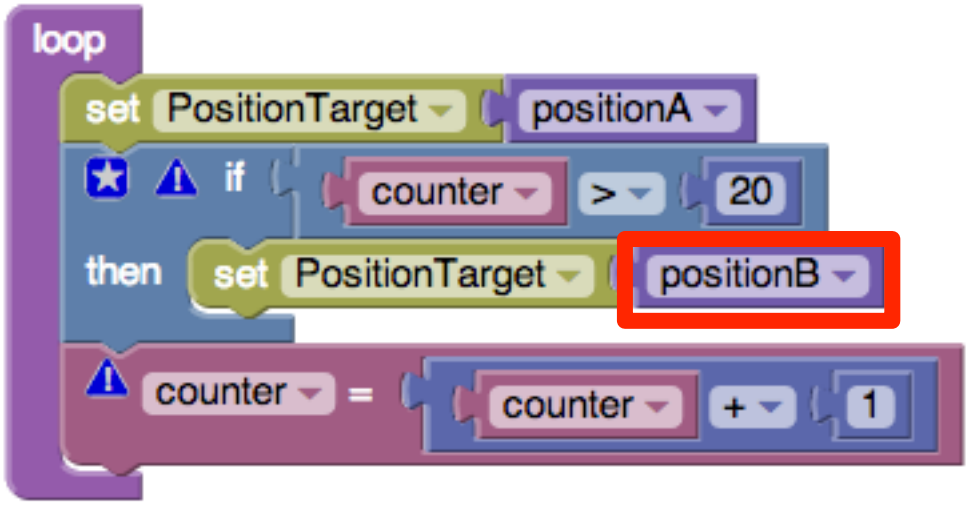
- First click on the top block in the loop and drag everything out of the loop but DO NOT DELETE
- On the SPHERES Control accordion
  - Select “setPositionTarget”
  - Drag and drop a new “setPositionTarget”block into the loop
  - Toggle to “position A”
- Click on the top block of the program that you removed from the loop and drag it back into the loop





Moving to multiple locations, cont.

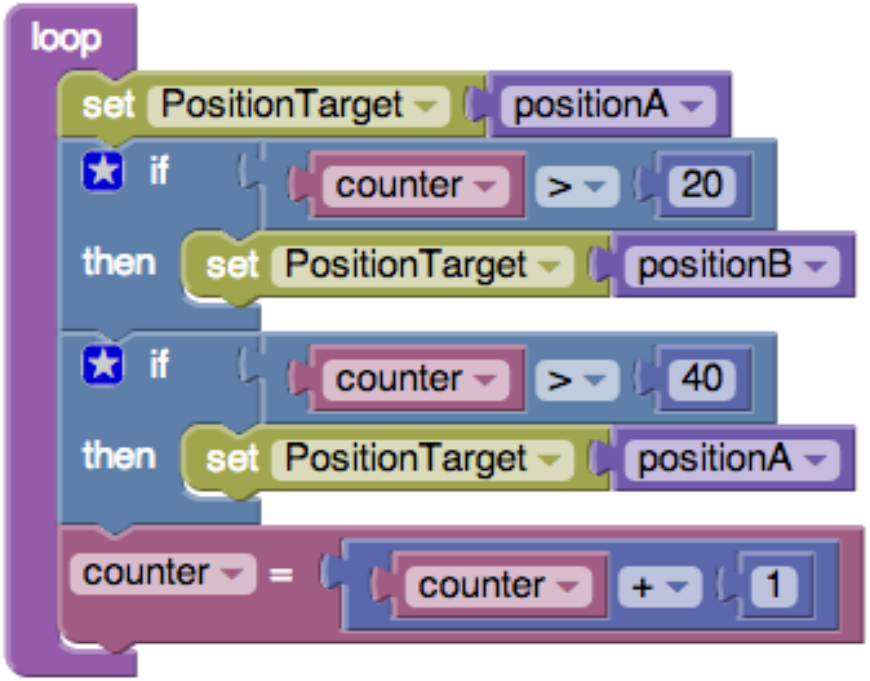
- Change the target position inside the “if-then” block to “position B”
- Simulate and View Results!
  - The satellite should travel first to position A and then to position B!



Moving to multiple locations, cont.

- Try creating the program shown on the right using two "if-then" statements.

- This program will:
  - –First send the SPHERES satellite to positionA
  - – If the counter > 20, send the satellite to positionB
  - –If the counter > 40, send the satellite back to positionA



Review

- Congratulations!
- You have learned to use if-then statements to autonomously move a SPHERES satellite to multiple locations!