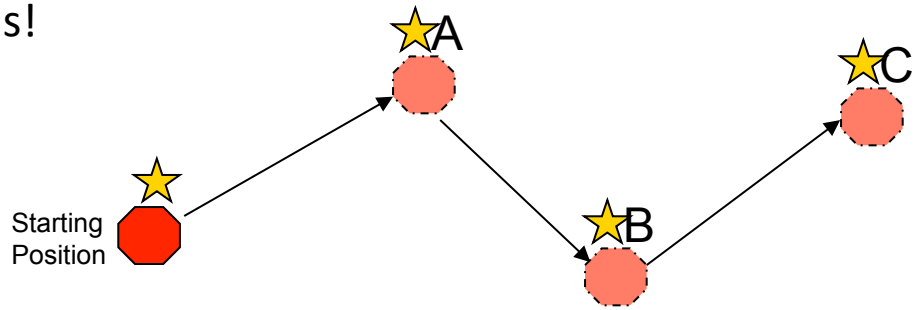
ZERO ROBOTICS

ISS PROGRAMING CHALLENGE

Conditionals:
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
  - Use flow charts to diagram program logic
  - 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**
  - Game: FreeMode
  - Text Editor

- Create an array called “positionA”
  - Above void init() { type in **float positionA[3];**
  - To set the initial values to {0,1,0}, type the following in void init():

    positionA[0] = 0;
    positionA[1] = 1;
    positionA[2] = 0;

```
//Declare any variables shared between functions here
float positionA[3];

void init(){
  //This function is called once when your code is first loaded.

  //IMPORTANT: make sure to set any variables that need an initial value.
  //Do not assume variables will be set to 0 automatically!
  positionA[0] = 0;
  positionA[1] = 1;
  positionA[2] = 0;
}

void loop(){
  //This function is called once per second.  Use it to control the satellite.
}
```

Create A New Project and Declare Variables (cont.)

- Create an array called **positionB**
  - Above void init() type in
    float positionB[3];
  - To set the initial values to {1,0,0}, type the following under void init():
    positionB[0] = 1;
    positionB[1] = 0;
    positionB[2] = 0;

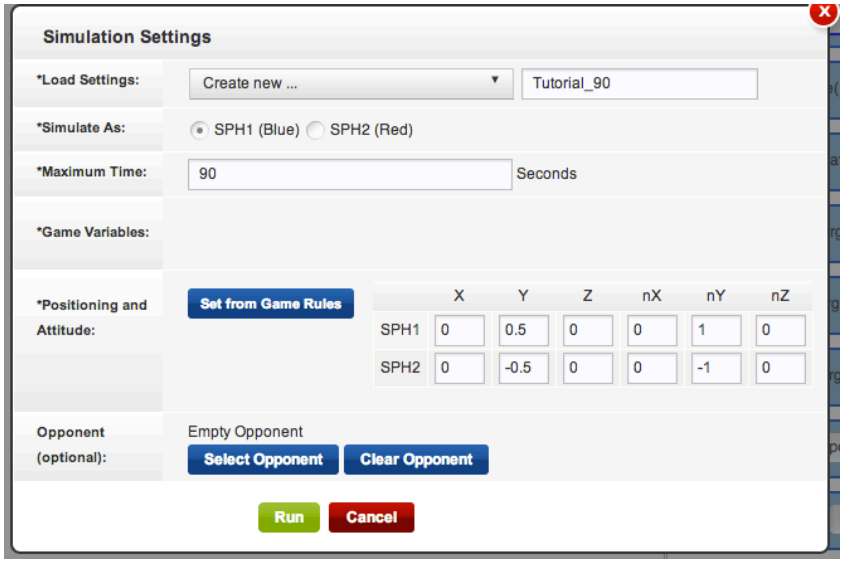
```
1  //Declare any variables shared between functions here
2  float positionA[3];
3  float positionB[3];
4
5  void init(){
6    //This function is called once when your code is first loaded.
7
8    //IMPORTANT: make sure to set any variables that need an initial value.
9    //Do not assume variables will be set to 0 automatically!
10   positionA[0] = 0;
11   positionA[1] = 1;
12   positionA[2] = 0;
13   positionB[0] = 1;
14   positionB[1] = 0;
15   positionB[2] = 0;
16 }
17
18 void loop(){
19   //This function is called once per second.  Use it to control the satellite.
20 }
21
```

Introduce a SPHERES Control Function

- Create a statement to set the position of the SPHERES satellite
  - In void loop () type in **api.setPositionTarget(positionA);**

```
18 void loop(){
19   //This function is called once per second.  Use it to control the satellite.
20   api.setPositionTarget(positionA);
21 }
```

- Compile, Simulate
  - In the Simulation Settings pop-up box:
    - *Load Settings:
      - Select "**Create new…**",
      - Type a settings name: "**Tutorials_90**"
    - * "Maximum Time":
      - **Verify this is set to 90 seconds**
- Click on green "Run" button to view simulation
- The satellite will move to positionA



Test with a 2nd SPHERES Control Function

- Add another position target (positionB.)
  - Below api.setPositionTarget(positionA);
    type in **api.setPositionTarget(positionB);**

```
18 void loop(){
19   //This function is called once per second.  Use it to control the satellite.
20   api.setPositionTarget(positionA);
21   api.setPositionTarget(positionB);
22 }
```

- Test what happens:
  - Compile, Simulate
  - Click on green “Run” button to view simulation
  - Did the satellite move first to position A and then to position B?

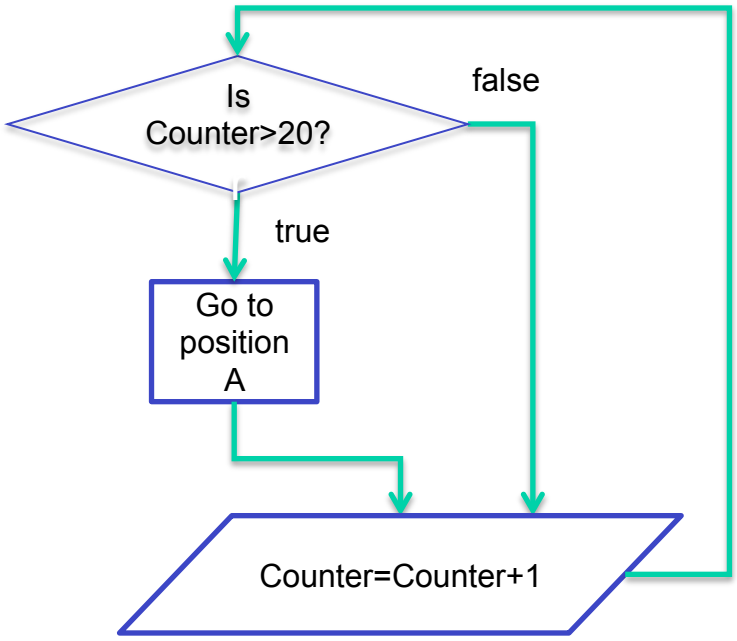
Test a 2nd SPHERES Control Function, cont.

- Answer: 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 in the program!

```
18 void loop(){
19   //This function is called once per second.  Use it to control the satellite.
20   api.setPositionTarget(positionA);
21   api.setPositionTarget(positionB);
22 }
```

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

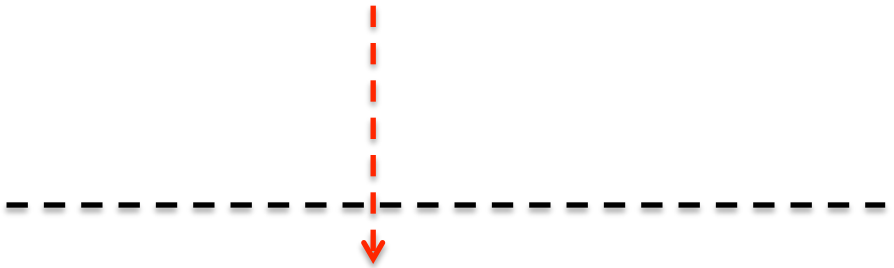


Programming with conditionals

- Before getting started:
  - Delete the setPositionTarget text we just wrote under void loop()

```
18 void loop(){
19   //This function is called once per second.  Use it to control the satellite.
20 }
```

- We want to create a conditional "If" statement.
  - Under void loop(), type in **if () {**, skip a few lines to leave yourself room for coding, and type in **}** to close of your if statement.



```
18 void loop(){
19   if(){
20
21   }
22 }
```

Programming with conditionals, cont

Next, create a new variable that holds only one number, call it "counter".

- Under the two position arrays, type **int counter;**
- To set the variable to zero, type **counter = 0;** under the other initial values.

```
1  //Declare any variables shared between functions here
2  float positionA[3];
3  float positionB[3];
4  int counter;
5
6  void init(){
7    //This function is called once when your code is first loaded.
8
9    //IMPORTANT: make sure to set any variables that need an initial value.
10   //Do not assume variables will be set to 0 automatically!
11   positionA[0] = 0;
12   positionA[1] = 1;
13   positionA[2] = 0;
14   positionB[0] = 1;
15   positionB[1] = 0;
16   positionB[2] = 0;
17   counter = 0;
18 }
```

Programming with conditionals, cont

- Remember, we want to create the following conditional statement:
  - **If** counter > 20, **then** go to positionA
  - Type **counter > 20** after **if** and between the parentheses.
    - The code in the curly brackets {} is executed only if the condition in the parentheses () is true.
  - To go to positionA, type **api.setPositionTarget(positionA);** under **if(counter>20) {**
  - Finally, increment **counter** (increase its value by 1.) Type **counter++;** outside the if statement.
    - **counter = counter + 1;**

      would do the same thing

```
20 void loop(){
21   if(counter>20){
22
23   }
24 }
```

```
20 void loop(){
21   if(counter>20){
22     api.setPositionTarget(positionA);
23   }
24 }
```

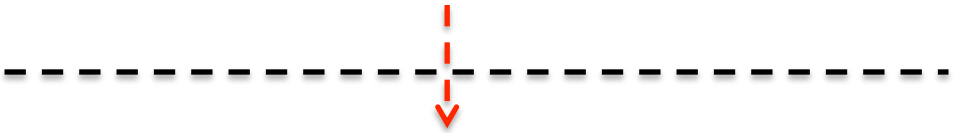
```
void loop(){
  if(counter>20) {
    api.setPositionTarget(positionA);
  }
  counter++;
}
```

Programming with conditionals, cont

- Your new program will tell the SPHERES to wait 20 seconds and then move to positionA.

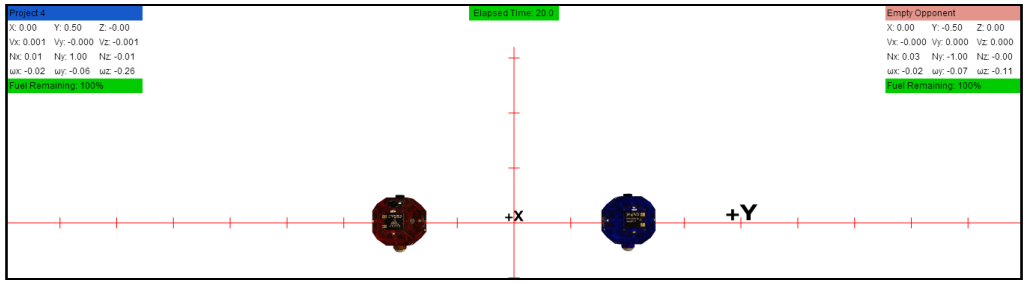
```
void loop(){
  if(counter>20) {
    api.setPositionTarget(positionA);
  }
  counter++;
}
```

- Compile, Simulate
  - Load settings: Tutorial _90



- Run!

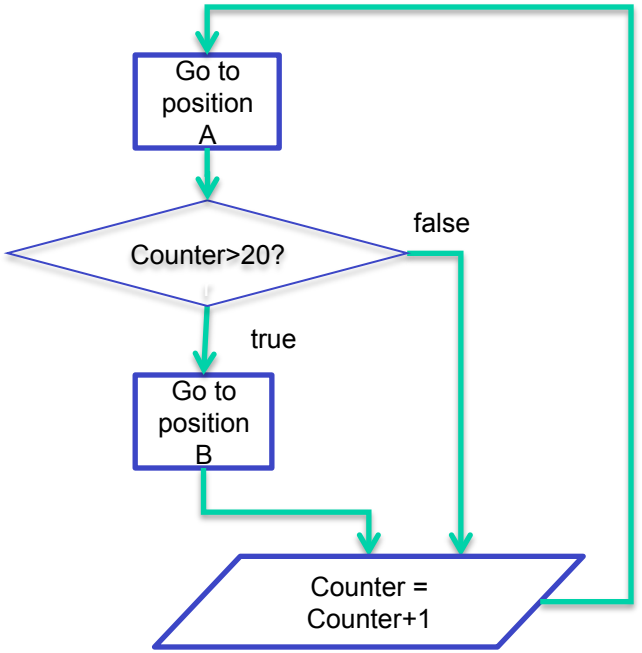
- The blue SPHERES should start to move after the Elapsed Time counter at the top is > 20
  - counter increases by 1 every second



Move to multiple locations using conditionals

- Let's make a program that first sends the SPHERES satellite to positionA, then to positionB after 20 seconds

- The flow chart shows the logic for this program



Moving to multiple locations, cont.

- In **void loop()** above the "if" statement we wrote earlier, type **setPositionTarget(positionA);**
- Change the target position inside the "if" statement from **positionA** to **positionB**
- Simulate and Run!
  - The satellite should travel first to position A and then to position B!

```
void loop(){
   api.setPositionTarget(positionA);
   if(counter>20) {
      api.setPositionTarget(positionB);
   }
   counter++;
}
```

Moving to multiple locations, cont.

- Try creating the program shown on the right using two “if” statements.

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

```
void loop(){
  api.setPositionTarget(positionA);
  if(counter>20) {
    api.setPositionTarget(positionB);
  }
  if(counter>40) {
    api.setPositionTarget(positionA);
  }
  counter++;
}
```

Bracket Syntax

- A note on bracket syntax: for conditionals, if the "then" code is **only one line**, you don't need curly brackets.
- It is still a good idea to add brackets for readability, but they have no effect.
- The two conditionals below are identical.

```
14    if (counter>20)
15      api.setPositionTarget(positionA);
```

```
14    if (counter>20){
15      api.setPositionTarget(positionA);
16    }
```

Review

- Congratulations!
- You used “if-then” statements to move a SPHERES satellite to multiple locations!