ZERO ROBOTICS

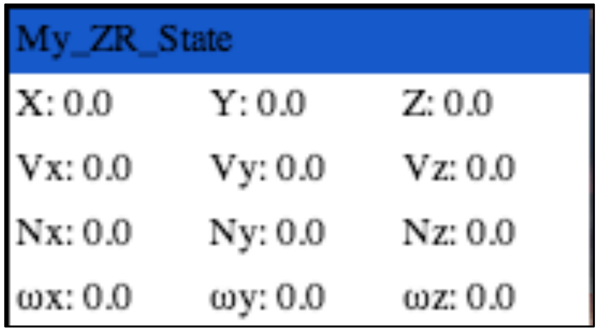
ISS PROGRAMING CHALLENGE

Applied Conditionals

Goals

In this tutorial you will:

Learn how to use getMyZRState
in conditional statements



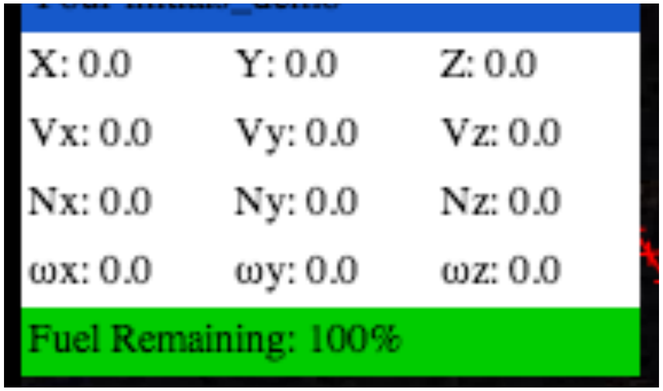
My_ZR_State

Position	X: 0.0	Y: 0.0	Z: 0.0
Velocity	Vx: 0.0	Vy: 0.0	Vz: 0.0
Pointing vector	Nx: 0.0	Ny: 0.0	Nz: 0.0
Rotation rates	ωx: 0.0	ωy: 0.0	ωz: 0.0

getMyZRState Review

- `getMyZRState` retrieves the following information about the Blue satellite

Position	(x,y,z)
Velocity	(vx,vy,vz)
Pointing vector	(nx,ny,nz)
Rotation rates	(ωx, ωy, ωz)



X: 0.0 Y: 0.0 Z: 0.0
Vx: 0.0 Vy: 0.0 Vz: 0.0
Nx: 0.0 Ny: 0.0 Nz: 0.0
ωx: 0.0 ωy: 0.0 ωz: 0.0
Fuel Remaining: 100%

- These same values are displayed in upper right corner of the simulation window
- The ZRState information is provided in an array of size 12:

[0] [1] [2]
[3] [4] [5]
[6] [7] [8]
[9] [10] [11]

(remember the counting starts from 0, you see only 0-11 and not 1-12)

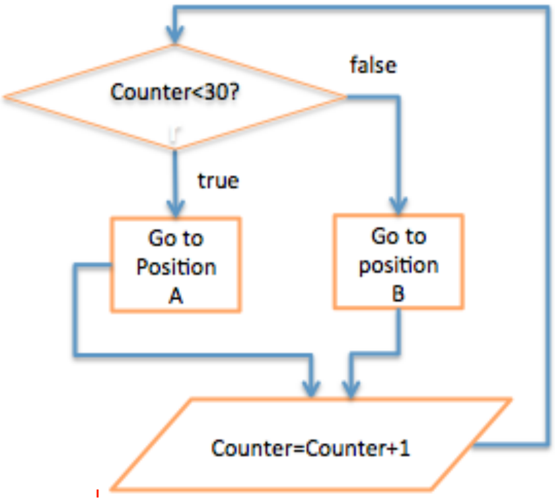
- `getMyZRState` [0], [1], [2] represent the *x*, *y*, and *z* coordinates of the SPHERES

Use of getMyZRState

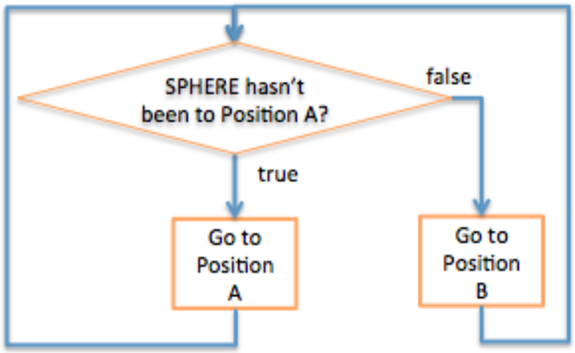
- You can use `getMyZRState` to figure out where your SPHERES satellite is relative to a specific location in the game arena
- This means you can use ZR State information ***instead* of a counter** to decide when things happen—this is very useful in the game!
- In this tutorial you will use *getMyZRState* information to program the following:

  If the satellite has not reached positionA, **then** continue to positionA

  else go to positionB



Counter ----versus--- No counter

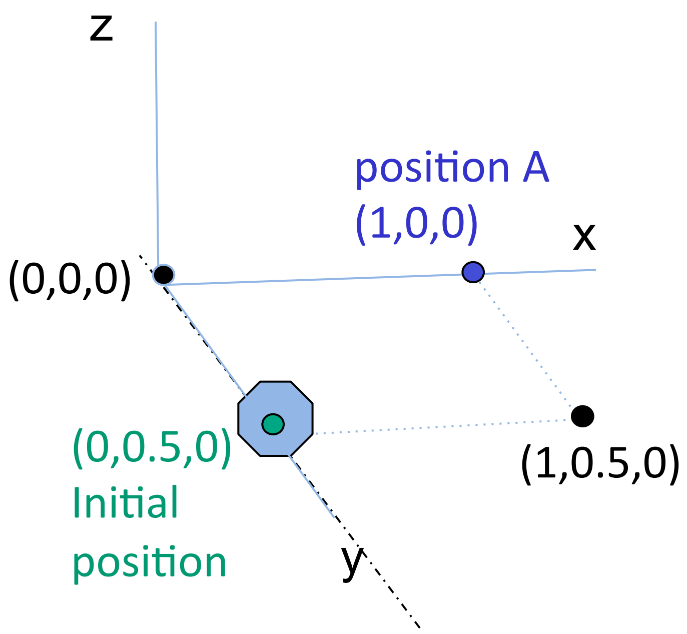


Use of getMyZRState (cont.)

- First some things to consider in the example to the right:
  - Q: How does the *x* coordinate of the satellite change as it moves from initial position (0,0.5,0) to position A (1,0,0) in the picture?
  - A: The satellite starts with *x* coordinate=0 and moves towards *x* coordinate=1
- For this example, we will use the SPHERES *x*-coordinate information to decide if the satellite has reached positionA.
- Since: (Initial position x-coordinate) < (Position A x-coordinate) we can compare the moving SPHERES x-coordinate with positionA's x-coordinate as follows:

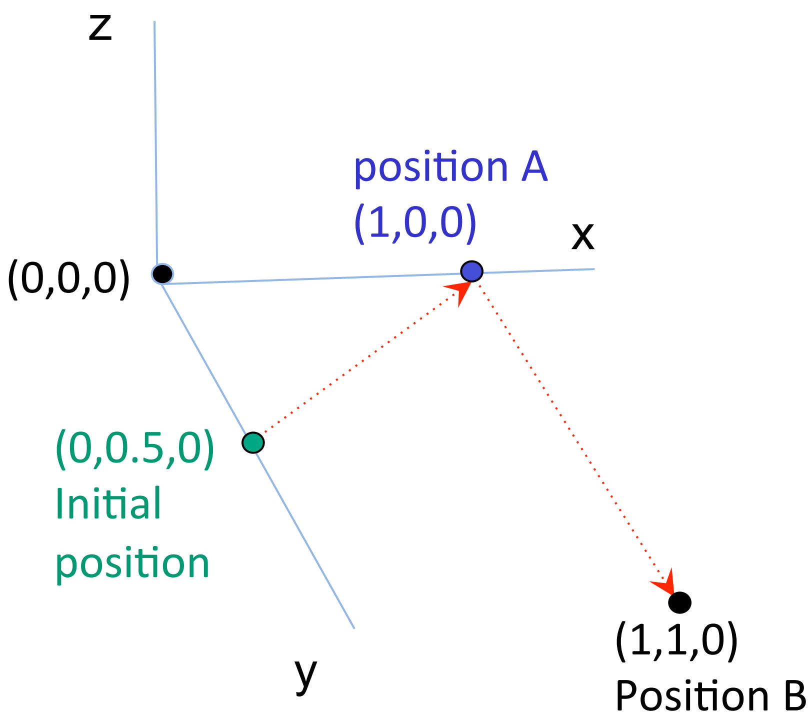
  If myZRState[0] < positionA [0],

  then keep moving toward positionA



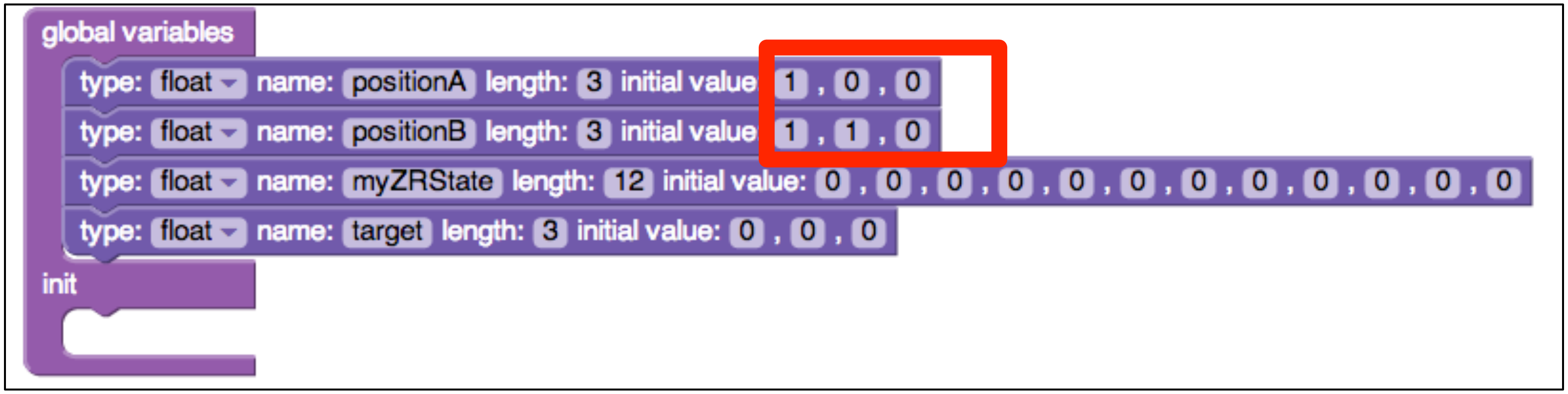
Use of getMyZRState (cont.)

- Because the SPHERES controller is not perfectly accurate, it is best to pick a target x coordinate that comes *just before* the point the satellite is moving toward (just before position A)
  - Example: x=0.97 is close to x=1.0
  - Pick target x= 0.97
  - This gives you some margin for error (.03 meters (3cm))
- Program outline:
  - If myZRState[0] < 0.97
  - Then go to position A (x = 1.0)
  - Else go to position B



Create a New Project/Declare variables and arrays

- Let’s get started: Create a new project
- Name it **“Project9”** and choose “FreeMode” and “Graphical Editor”
- Create the following variables and arrays:
  - `float positionA[3]`
    - Set initial value to **1,0,0**
  - `float positionB[3]`
    - Set initial value to **1,1,0**
  - `float myZRstate[12]`
    - Leave initial value blank
  - `float target[3]`
    - Leave initial value blank



global variables

type: float name: positionA length: 3 initial value 1 , 0 , 0

type: float name: positionB length: 3 initial value 1 , 1 , 0

type: float name: myZRState length: 12 initial value: 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0 , 0

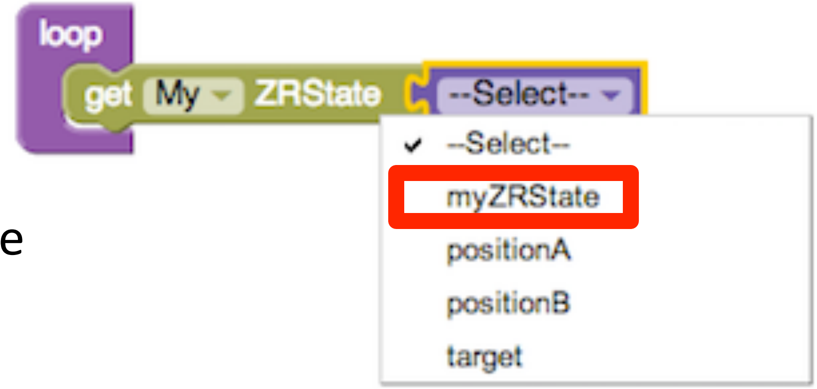
type: float name: target length: 3 initial value: 0 , 0 , 0

init

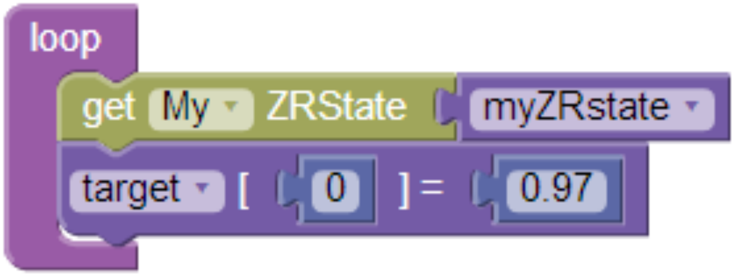
Assign values to “myZRstate” and “target”

- On the main page: Drag and drop `getMyZRState` into the loop.
  - Select `myZRstate` from the drop down menu to assign `myZRstate` equal to the satellite’s state

  The **myZRState** information will change as the satellite moves. This information will be updated each time the loop is called.



- Assign a value to `target[0]`
  - Find the **“Select [0]= 0”** array block in Variables accordion and drag and drop it into the loop.
  - Select `target` from the dropdown menu
  - Set `target[0]=0.97`

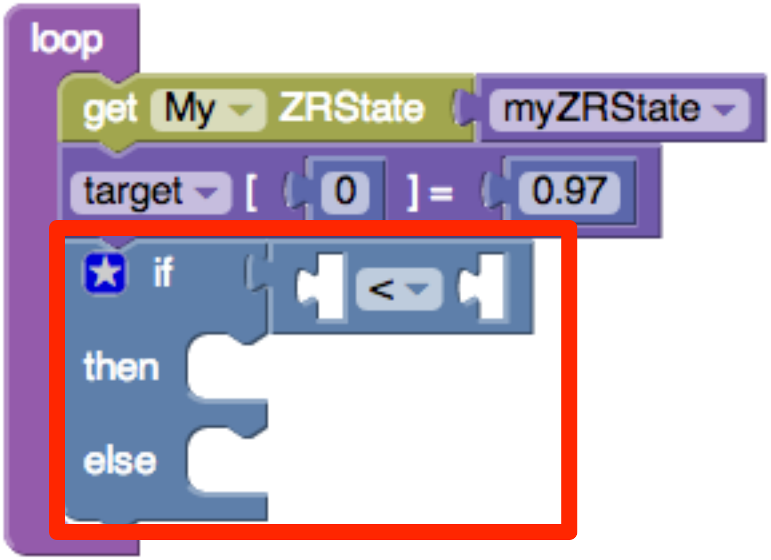


If-Then-Else using myZRState

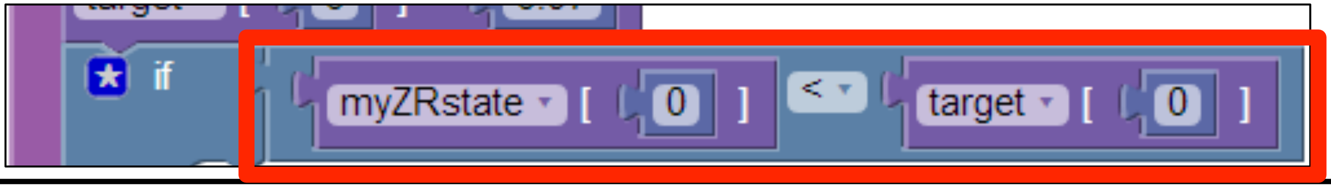
- Drag an "If-Then" block into the loop and add an "else" statement
- Drag the "<" block from the Logic accordion into condition space
- In the first empty space of the "<" block
  - Drag the "`Select [0]`" array block from the Variables accordion and toggle to `myZRstate[0]`
- In the second empty space
  - Drag "`Select [0]`" array block from the Variables accordion and toggle to "`target [0]`"
- You will get the following statement:

If `myZRstate[0] < target[0]`

then…



```
loop
  get My ZRState myZRState
  target [ 0 ] = 0.97
  if [ ] < [ ]
  then
  else
```



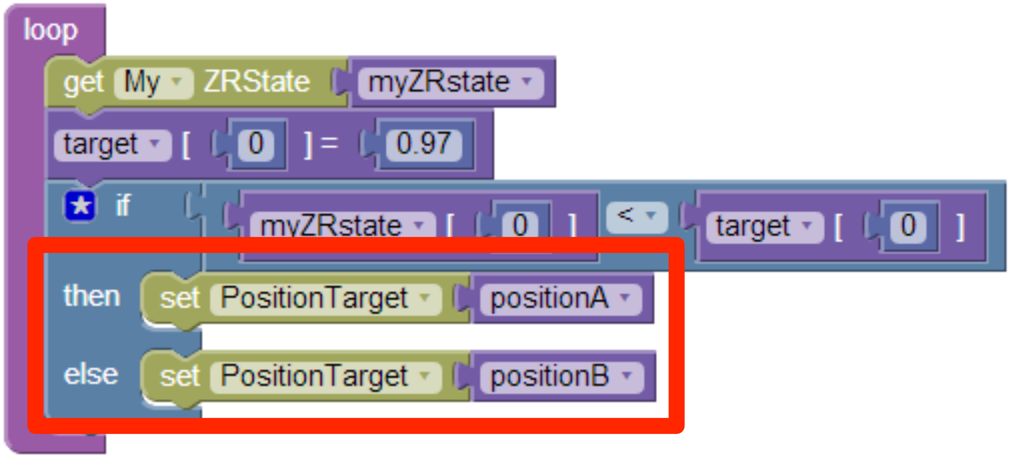
```
if  myZRstate [ 0 ] < target [ 0 ]
```

If-Then-Else using myZRState (cont.)

- Complete the conditional statement shown below by dragging two “setPositionTarget” blocks from the SPHERES Controls accordion into the “If-Then-Else” block as shown to the right.

  If myZRstate [0] < target [0] **then**
  setPositionTarget to positionA
  else setPositionTarget to positionB

Your program



```
loop
  get My ZRState myZRstate
  target [ 0 ] = 0.97
  if myZRstate [ 0 ] < target [ 0 ]
  then set PositionTarget positionA
  else set PositionTarget positionB
```

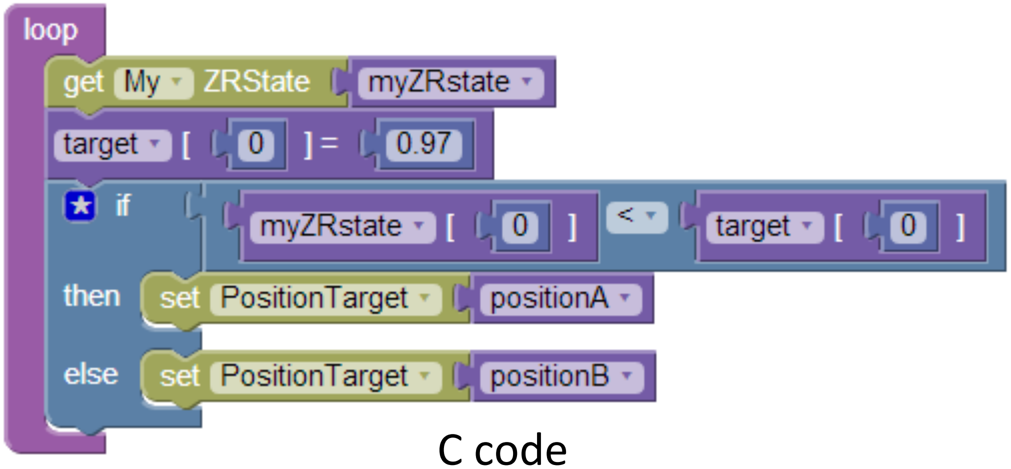
- Compile and simulate
  - Maximum Time: 90 seconds
  - View simulation
  - Click “Back to Project”

Blue satellite should move from:
initial position➔ positionA ➔ positionB
without pausing

If-Then-Else using myZRState (cont.)

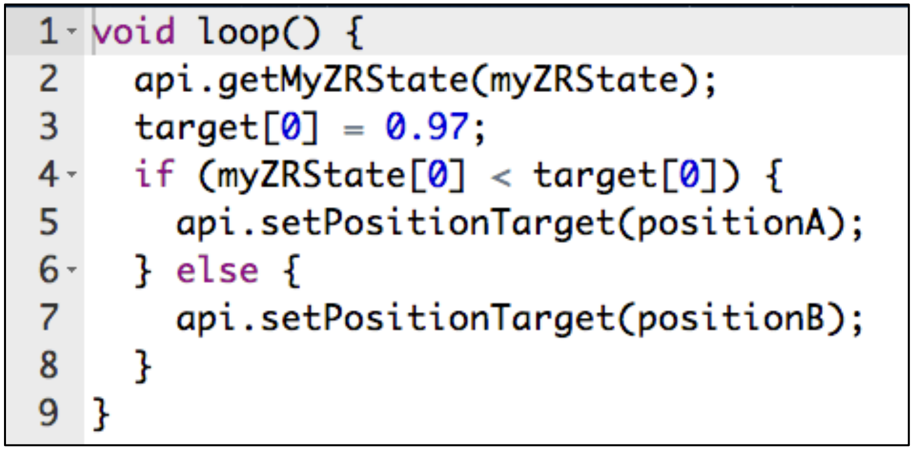
- If your SPHERE did not behave as expected:
  - Troubleshooting
    - Carefully check that your program matches the one shown to the right
    - Check that you have correctly initialized your variables
  - Make any corrections and simulate again
- Otherwise compare your program to the C code

Your program



```
loop
  get My ZRState myZRstate
  target [ 0 ] = 0.97
  if myZRstate [ 0 ] < target [ 0 ]
  then set PositionTarget positionA
  else set PositionTarget positionB
```

C code



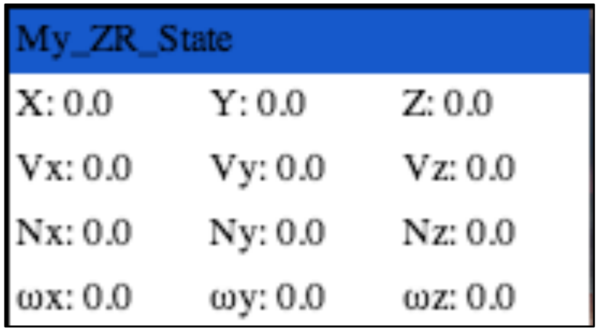
```
void loop() {
  api.getMyZRState(myZRState);
  target[0] = 0.97;
  if (myZRState[0] < target[0]) {
    api.setPositionTarget(positionA);
  } else {
    api.setPositionTarget(positionB);
  }
}
```

Review

Congratulations!

You have learned how to:

Learn how to use getMyZRState in conditional statements in your programs!



	My_ZR_State		
Position	X: 0.0	Y: 0.0	Z: 0.0
Velocity	Vx: 0.0	Vy: 0.0	Vz: 0.0
Pointing vector	Nx: 0.0	Ny: 0.0	Nz: 0.0
Rotation rates	ωx: 0.0	ωy: 0.0	ωz: 0.0