The Conditionals:
The Basics of “If-Then”
(Project 4)
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
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
- Close simulation window
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 \textit{when} to do something.
- An “if-then” statement is an example of a conditional.
  - \textbf{If} something is true \textbf{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 star. 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.)
• 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
• 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
Next change the statement:

if “__” > “__”.. into ...

if “counter>20”...

as follows:

• Go to the “Variables” 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”
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
Your new program will tell the SPHERES satellite to wait until the count of 20 and then move to position A.

- 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)
• Close simulation window
• Compare:

Your program - versus - C Code

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

loop
if counter > 20
then set PositionTarget = positionA

counter = counter + 1
Next let’s make a program that first sends the SPHERES satellite to position A, and if the counter > 20 then sends the satellite to position B.

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