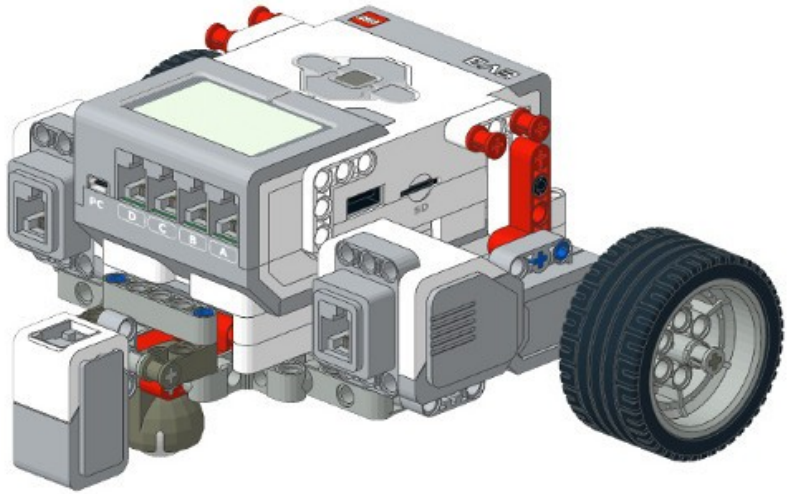
LEGO mindstorms EV3

Dealing with Spike Gyro



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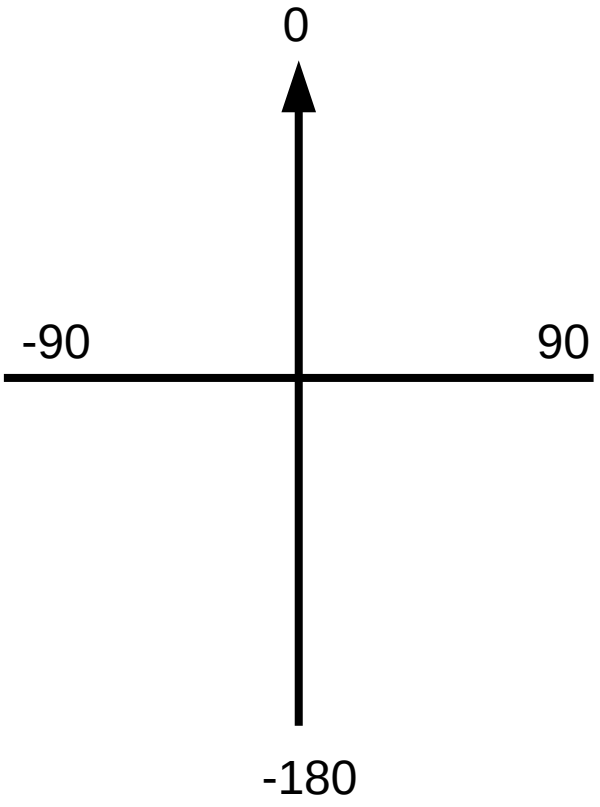
EV3 vs Spike Gyro

- EV3 gyro
  - Always increase when turning clockwise and decrease when turning counter-clockwise
  - No upper or lower limit (ie. can be greater than 360 and less than -360)
  - Example: 178, 179, 180, 181…, 359, 360, 361...

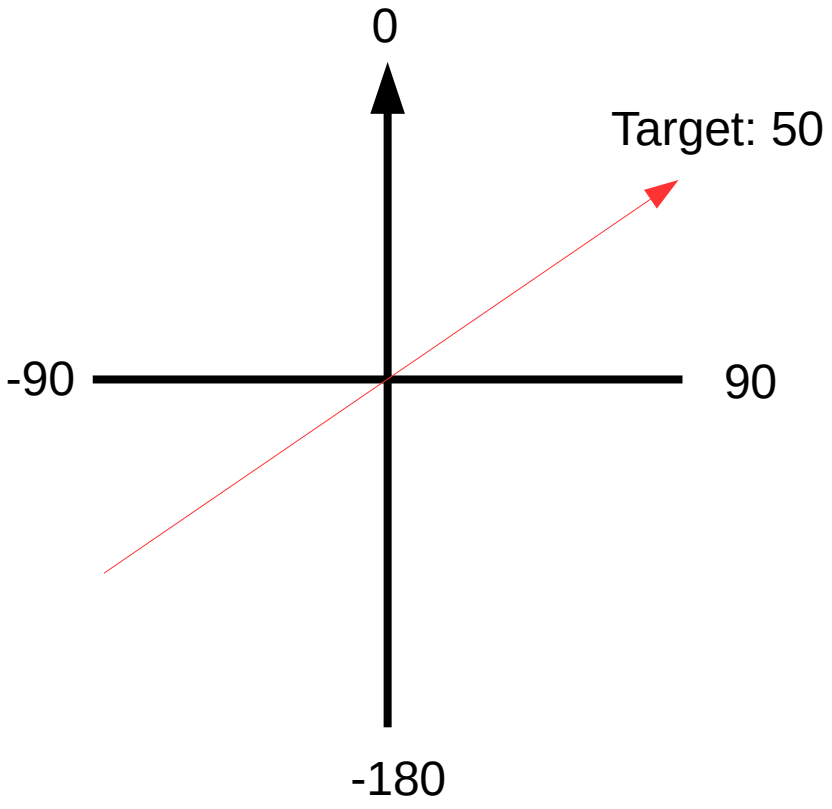
EV3 vs Spike Gyro

- Spike gyro
  - Usually increase when turning clockwise and decrease when turning counter-clockwise
  - Rolls over at 180/-180 degrees
  - Max of 179 and min of -180
  - Example: 178, 179, -180, -179, -178



Problem

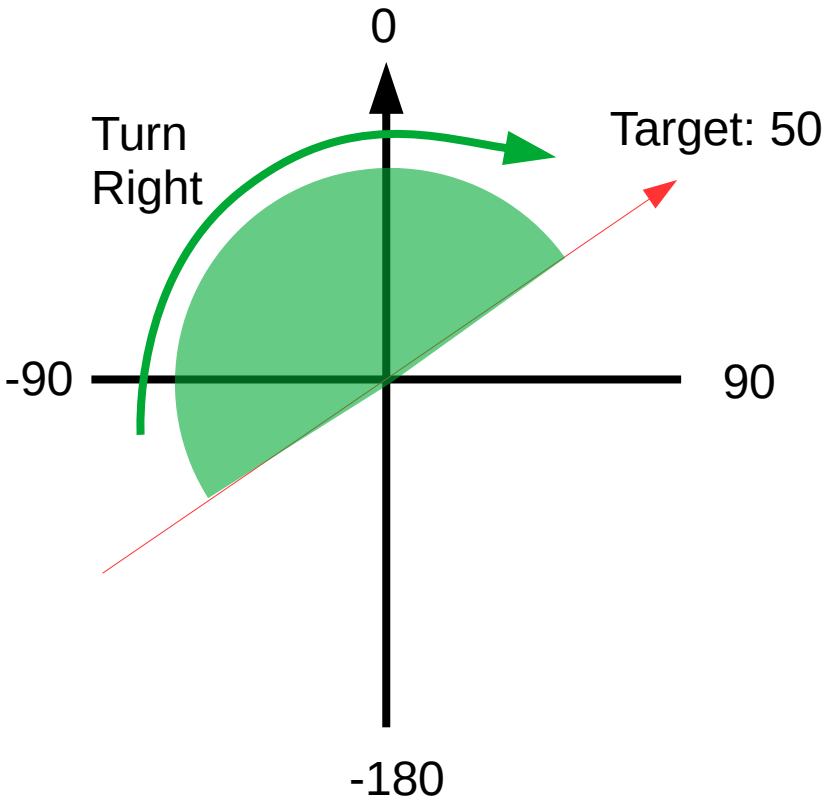
- Consider…
  - You want to turn towards 50 degrees...



Problem

- Consider…
  - All angles within the green area are <u>less</u> than 50…
  - ...and we need to turn <u>right</u>

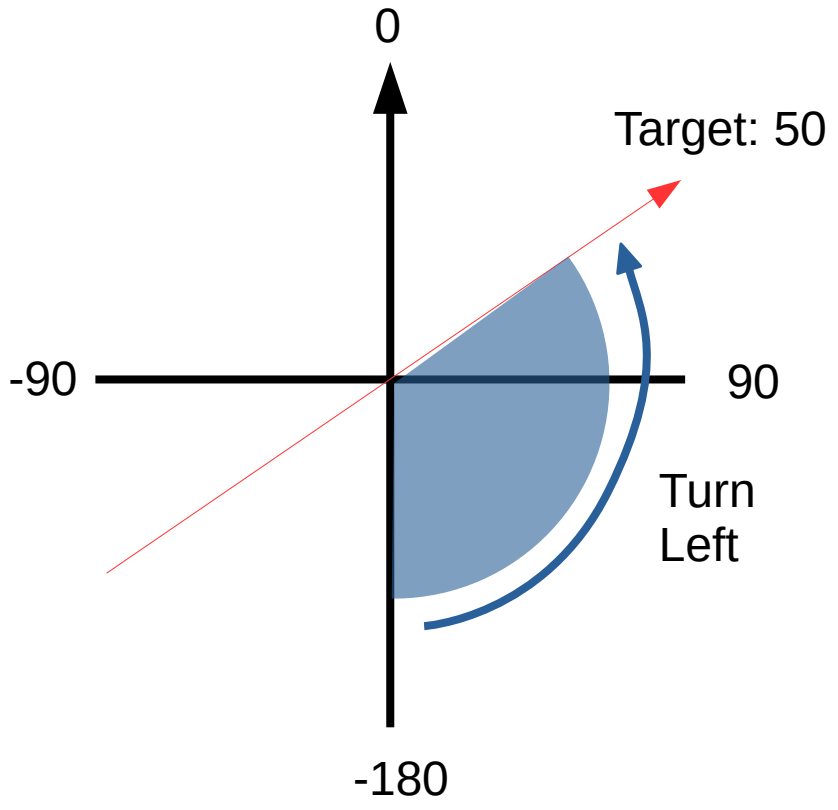
```
if gyro_angle < target:
  turn_right()
```



Problem

- Consider…
  - All angles within the blue area are more than 50…
  - ...and we need to turn left

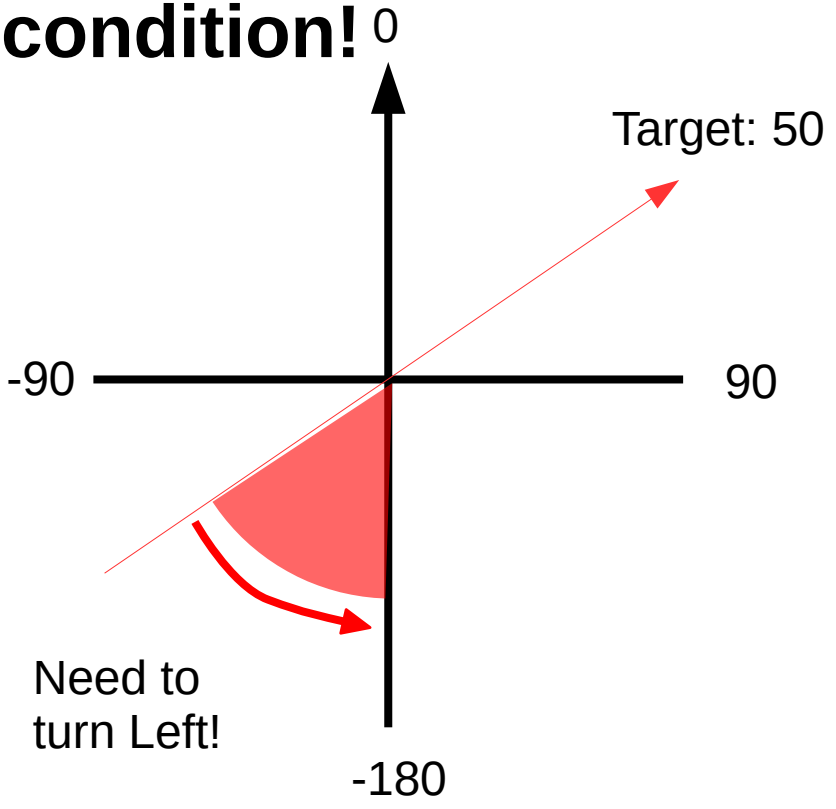
```
if gyro_angle < target:
  turn_right()
elif gyro_angle > target:
  turn_left()
```



Problem

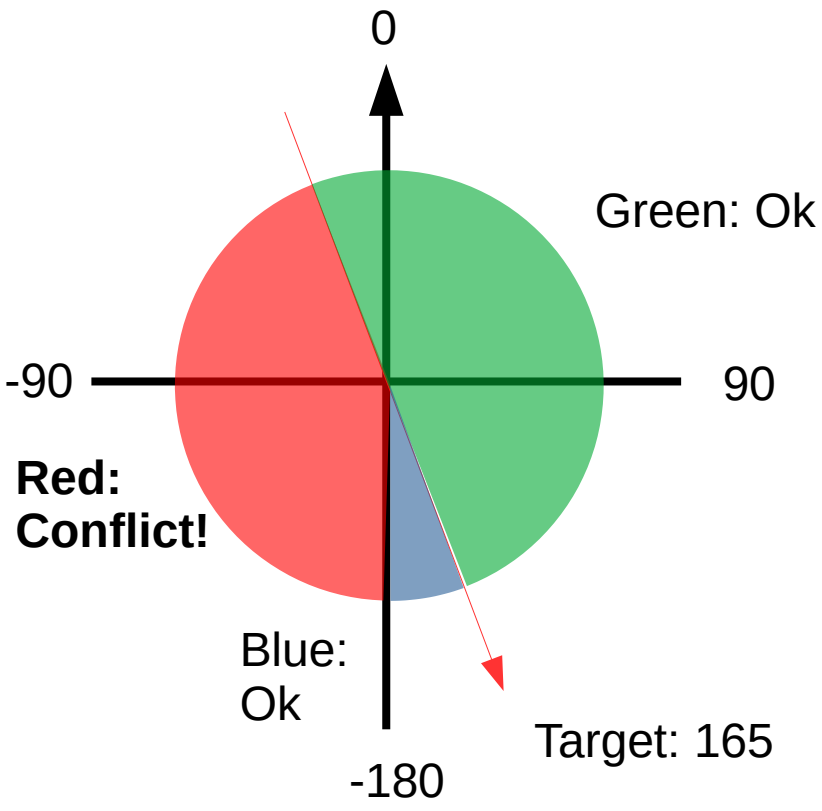
- Consider…
  - Angles within the red area are less than 50…
  - ...but we need to turn left!
  - **Conflicts with the first condition!**

```
if gyro_angle < target:
  turn_right()
elif gyro_angle > target:
  turn_left()
```



Problem

- This gets worse as the angle approaches 180 degrees
  - Red area gets bigger
  - Blue area gets smaller



Solution 1

- Reset the gyro
  - Resetting the gyro sets the current direction to 0
  - Do this before a gyro turn…
    - Works as long as turn is less than 180 degrees
  - Do this before a gyro move…
  - Simple solution, but will have some drawbacks...

Solution 1

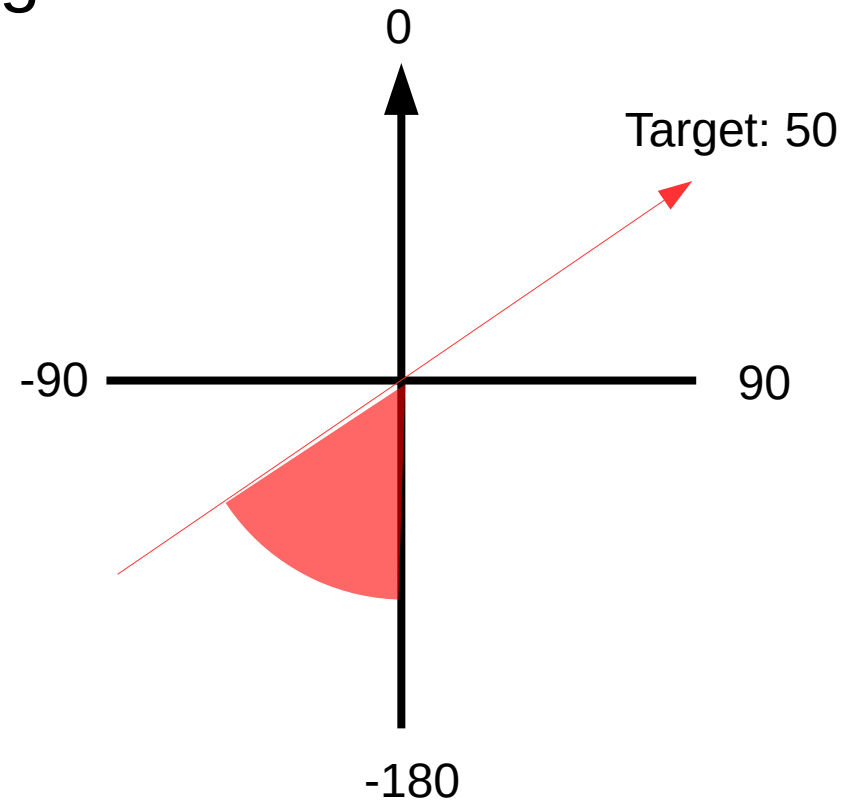
- Drawbacks
  - Every reset will introduce some errors
  - Consider:
    - Perform a gyro turn to 90, but the robot overshoots and turns to 91 instead
    - When gyro is reset, 91 will now be treated as 0 and there will be a permanent 1 degree error
  - The above error can be corrected with code, but...
  - ...overshoot may be less than 1 degree (eg. 0.4 deg) and may not be detectable, and hence uncorrectable in code

Solution 2

- Modify the angles in the red region so that…
  - Angles to the left of the target is always less
  - Angles to the right of the target is always more
- Angles can be modified by adding / subtracting 360 degrees
- More complicated, but avoids accumulating errors through resets

Solution 2

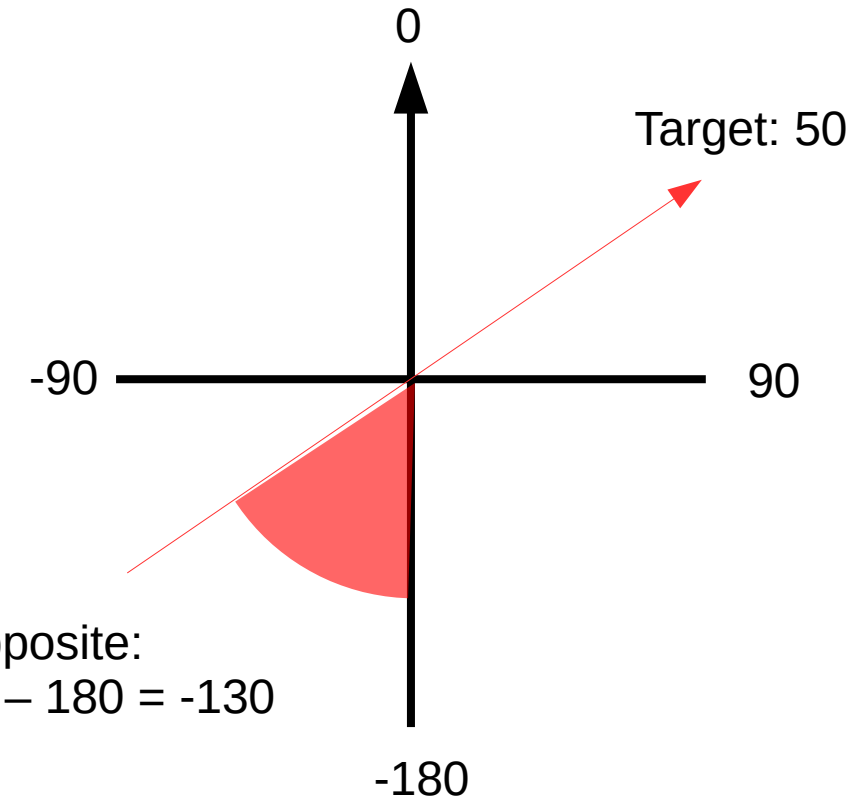
- How to modify the angles in the red region?
  1) Identify angles in red region
  2) Modify angles by adding / subtracting 360
- Two cases…
  - Target > 0
  - Target < 0



Solution 2

1) Identify angle in red region (target angle > 0)
   a) Find opposite angle (target - 180)
   b) Angles less than opposite are in red region
2) Add 360 degrees

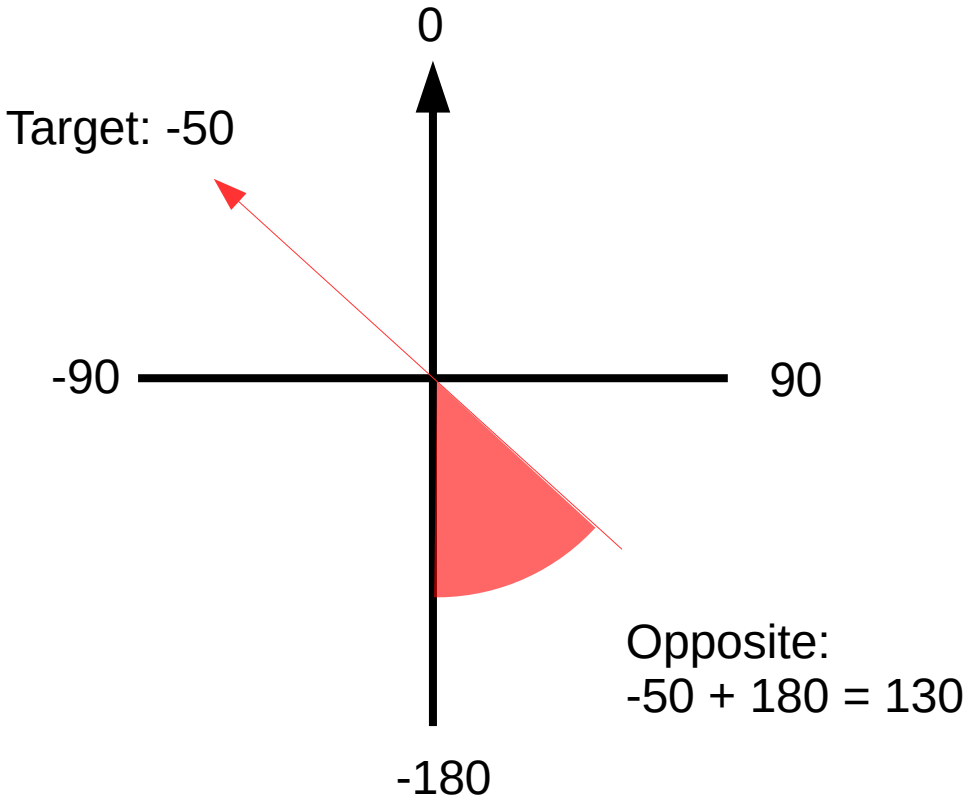
```
if target > 0:
  opposite = target - 180
  if gyro_angle < opposite:
    gyro_angle += 360
```



Solution 2

1) Identify angle in red region (target angle < 0)
   a) Find opposite angle (target + 180)
   b) Angles more than opposite are in red region
2) Subtract 360 degrees

```
if target > 0:
  opposite = target - 180
  if gyro_angle < opposite:
    gyro_angle += 360
else:
  opposite = target + 180
  if gyro_angle > opposite:
    gyro_angle -= 360
```



Best Practice

- In Python:
  - Make a function that returns the modified angle
- In Blocks:
  - My Blocks can’t return a value
  - Make a My Block that saves the modified angle in a variable
  - Runs the My Block, then read the modified gyro angle from the variable

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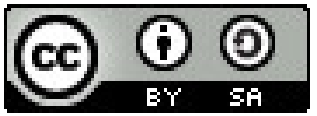

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