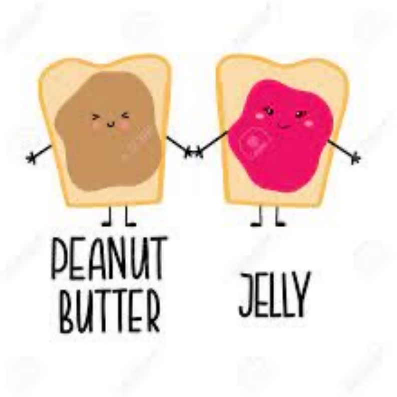
Lego Robotics Camp

Day 2: Conditionals and Loops

Review

- Yesterday we:
  - Engaged with the four pillars of computational thinking
  - Designed algorithms for simple tasks (PB&J, robot dancing)
  - Got acquainted with our robots and programming environment
  - Learned about variables (names for specific objects in our programs)



Today's Plan

- Today we will:
  - Learn about **conditionals** and **loops**
  - Design simple algorithms for parking our robots

~~Simon~~ Jeannie Says…

Conditional Statements

- **If** (you were born in the winter) then (touch your head)

  Else (clap your hands)

- **If** (you play the trumpet) then (jump up and down 3 times)

  Else (spin in a circle)

- **If** (your favorite ice cream flavor is chocolate) then (clap your hands)

  Else if (your favorite ice cream flavor is vanilla) then (touch your toes)

  Else (sit on the floor)

- **If** (some condition is true) then (do some action)

  Else if (some other condition is true) then (do some other action)

  Else (do some other different action)

Conditional Statements

- True and false are called **boolean** values
- If-else (or **conditional**) statements require checking if a **boolean condition** is true or false and responding appropriately
- In Python:

Else if

```
if condition1 is true:
     do action 1
elif condition2 is true:
     do action 2
else:
     do action 3
```

Python example

```
if condition1 is true:
     do action 1
elif condition2 is true:
     do action 2
else:
     do action 3
```

```
a = 200
b = 33
if b > a:
  print("b is greater than a")
elif a > b:
  print("a is greater than b")
else:
  print("a is equal to b")
```

Python example

```
if condition1 is true:
     do action 1
elif condition2 is true:
     do action 2
else:
     do action 3
```

```
a = 200
b = 33
if b > a:
  print("b is greater than a")
elif a > b:
  print("a is greater than b")
else:
  print("a is equal to b")
```

condition1: is b > a?

Python example

```
if condition1 is true:
      do action 1
elif condition2 is true:
      do action 2
else:
      do action 3
```

```
a = 200
b = 33
if b > a:
  print("b is greater than a")
elif a > b:
  print("a is greater than b")
else:
  print("a is equal to b")
```

condition1: is b > a? False.

Python example

```
if condition1 is true:
      do action 1
elif condition2 is true:
      do action 2
else:
      do action 3
```

```
a = 200
b = 33
if b > a:
  print("b is
elif a > b:
  print("a is greater than b")
else:
  print("a is equal to b")
```

condition2: is a > b?

Python example

```
if condition1 is true:
     do action 1
elif condition2 is true:
     do action 2
else:
     do action 3
```

```
a = 200
b = 33
if b > a:
  print("b is
elif a > b:
  print("a is greater than b")
else:
  print("a is equal to b")
```

condition2: is a > b? True. In this case, since it is true, we would print that a is greater than b.

Python example

```
a = 33
b = 33
if b > a:
  print("b is greater than a")
elif a > b:
  print("a is greater than b")
else:
  print("a is equal to b")
```

Suppose condition1 and condition2 are **both** false. Then we end up here.

```
if condition1 is true:
      do action 1
elif condition2 is true:
      do action 2
else:
      do action 3
```

Python example

```
if condition1 is true:
     do action 1
elif condition2 is true:
     do action 2
else:
     do action 3
```

```
a = 33
b = 33
if b > a:
 print("b is greater than a")
elif a > b:
 print("a is greater than b")
else:
 print("a is equal to b")
```

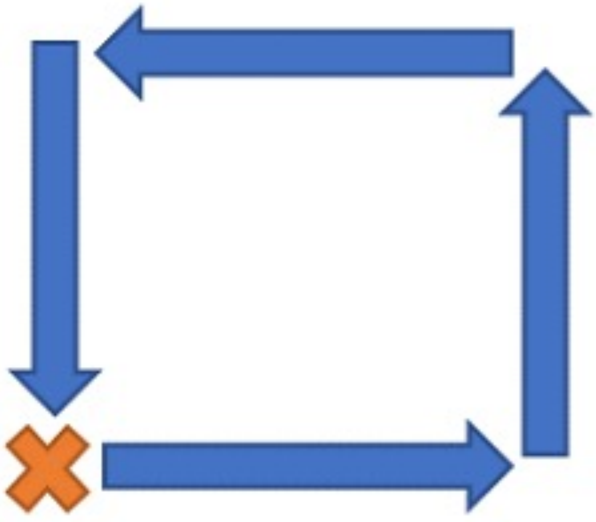
Note that punctuation and indentation matter A LOT!

Square Dancing

- Suppose we want to design a simple algorithm for walking in a perfect square around the room
  - Start and end at same spot
  - Remember pillars of computational thinking

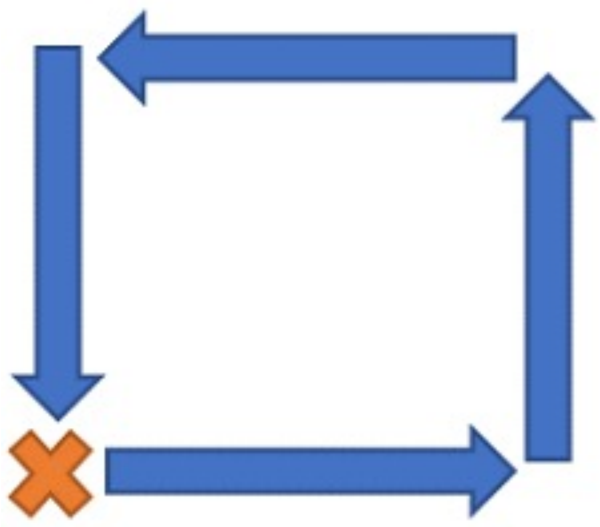
    (decomposition, pattern recognition,

    abstraction, algorithms)



Square Dancing

- Suppose we want to design a simple algorithm for walking in a perfect square around the room
  - Walk forward 10 steps
  - Turn left 90 degrees
  - Walk forward 10 steps
  - Turn left 90 degrees
  - Walk forward 10 steps
  - Turn left 90 degrees
  - Walk forward 10 steps
  - Turn left 90 degrees



Square Dancing

- Suppose we want to design a simple algorithm for walking in a perfect square around the room
  - Walk forward 10 steps
  - Turn left 90 degrees
  - Walk forward 10 steps
  - Turn left 90 degrees
  - Walk forward 10 steps
  - Turn left 90 degrees
  - Walk forward 10 steps
  - Turn left 90 degrees

How can this be simplified?

Square Dancing

- Suppose we want to design a simple algorithm for walking in a perfect square around the room
  - Walk forward 10 steps
  - Turn left 90 degrees
  - Walk forward 10 steps
  - Turn left 90 degrees
  - Walk forward 10 steps
  - Turn left 90 degrees
  - Walk forward 10 steps
  - Turn left 90 degrees

How can this be simplified?

Which lines are repeated?

Square Dancing

- Suppose we want to design a simple algorithm for walking in a perfect square around the room
  - Walk forward 10 steps
  - Turn left 90 degrees
  - Walk forward 10 steps
  - Turn left 90 degrees
  - Walk forward 10 steps
  - Turn left 90 degrees
  - Walk forward 10 steps
  - Turn left 90 degrees

How can this be simplified?

Which lines are repeated?

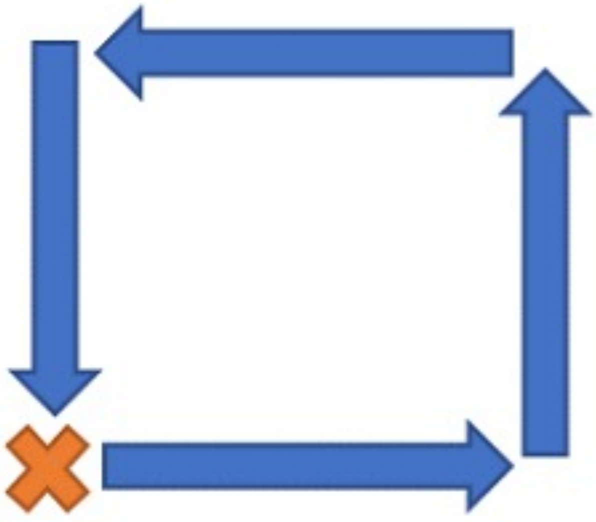
How many times are they repeated?

Square Dancing

- Suppose we want to design a simple algorithm for walking in a perfect square around the room

  - Repeat 4 times:
    - Walk forward 10 steps
    - Turn left 90 degrees

  - This is called a **loop**
  - Simplifies and shortens repeated code



Robot Example

```
robot.straight(500)
robot.turn(90)
robot.straight(500)
robot.turn(90)
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robot.turn(90)
robot.straight(500)
robot.turn(90)
```

Robot Example

~~`robot.straight(500)`~~
~~`robot.turn(90)`~~
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~~`robot.straight(500)`~~
~~`robot.turn(90)`~~

```
num_turns = 0;
while num_turns < 4:
    robot.straight(500)
    robot.turn(90)
    num_turns = num_turns+1
```

Loops

- While condition is true:
    - Do some action repeatedly
- If condition never becomes false, the loop will go on forever!
- This is called an **infinite loop**
- In Python, loops look like:

```
while condition1 is true:
     do action1
```

Will repeat until the condition becomes false!

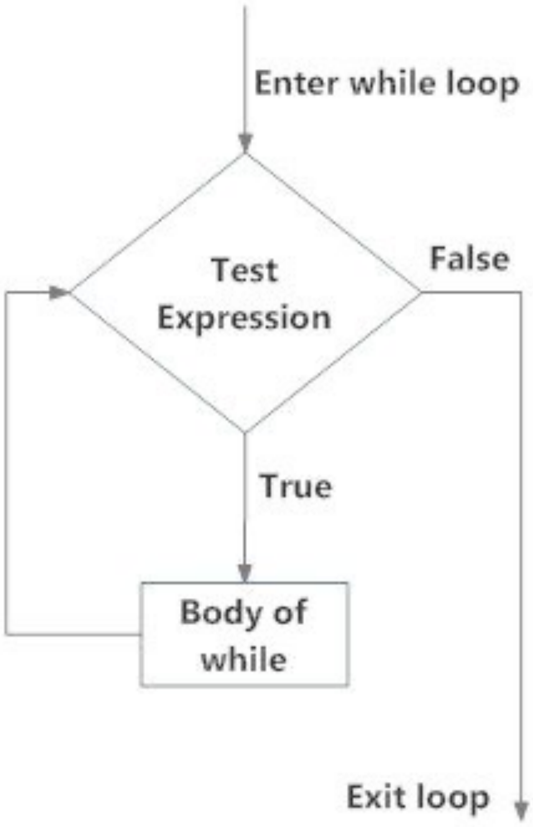


Fig: operation of while loop

Python example

```
while condition1 is true:
    do action1
```

```python
a = 1
while a < 6:
    print(a)
    a = a + 1
```

Print the value of a while a is less than 6. What will this print?

Python example

```
while condition1 is true:
      do action1
```

```
a = 1
while a < 6:
     print(a)
     a = a + 1
```

Print the value of a while a is less than 6. What will this print?

1
2
3
4
5

Python example

```
while condition1 is true:
     do action1
```

```
a = 1
while True:
     print(a)
     a = a + 1
```

What will this print?

Python example

```
while condition1 is true:
     do action1
```

```python
a = 1
while True:
     print(a)
     a = a + 1
```

What will this print?
1
2
3
4
5
6
… it will go on forever!

Python Quiz

```
a = 1
b = 5
while a < b:
    print(a)
    a = a + 1
```

What will this print?

Python Quiz

```python
a = 1
b = 5
while a < b:
    print(a)
    a = a + 1
```

What will this print?

1
2
3
4

Hard Python Quiz

```
a = 1
b = 5
c = 3
while a < b:
    print(a)
    if a == c:
        print(“we are here!”)
    a = a + 1
```

Is a equal to c?

What will this print?

Hard Python Quiz

```
a = 1
b = 5
c = 3
while a < b:
    print(a)
    if a == c:
        print(“we are here!”)
    a = a + 1
```

What will this print?

1

2

3

we are here

4

Summary

- Conditionals and loops allow us to solve much more interesting problems with our robots
- Tomorrow we’ll look at some examples

BREAK

Parking Algorithms

- Yesterday we made our robots move
- Today we'll examine algorithms for parking your robots
- We won't need conditionals or loops (yet)
- The goal of today's lab is to gain more experience with moving and turning our robots

- What are common parking scenarios?

Parking Algorithms

- Yesterday we made our robots move
- Today we’ll examine algorithms for parking your robots
- We won’t need conditionals or loops (yet)
- The goal of today’s lab is to gain more experience with moving and turning our robots

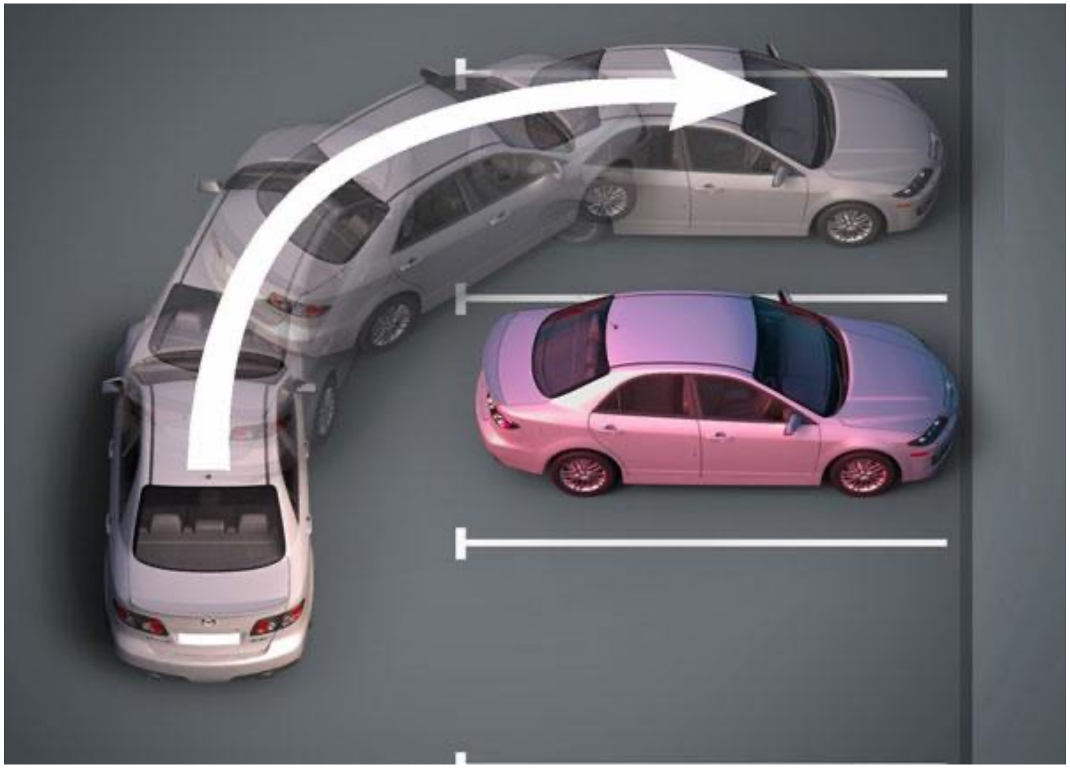
- What are common parking scenarios?
  - Perpendicular parking
  - Parallel parking

Perpendicular Parking

- Bad examples:

Perpendicular Parking

- Park in spaces that are perpendicular (90 degrees) away from your car's straight line motion



Think Pair Share

- Work with a partner to develop your own algorithm for perpendicular parking your robots!
- You aren’t writing actual code (yet!)
- You are thinking about the logical steps
- Example:
  - Move forward 500 cm
  - Turn 90 degrees clockwise
  - Move backward 500 cm
  - Turn 60 degrees counter-clockwise

Challenges

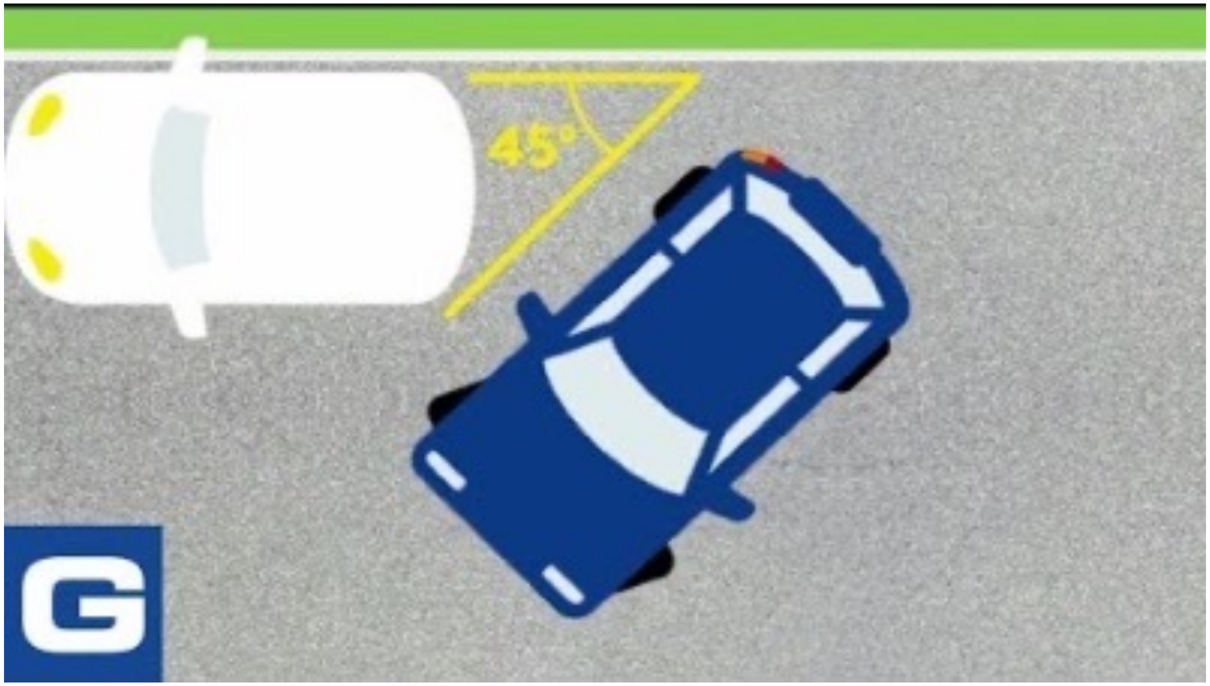
- Why was this hard?
- What information did you need to write this algorithm?
- Suppose we want to make our robots *autonomous* (self-driving). How would this work for your parking algorithm?

Parallel Parking

- First, let’s look at an example of a bad algorithm

Parallel Parking

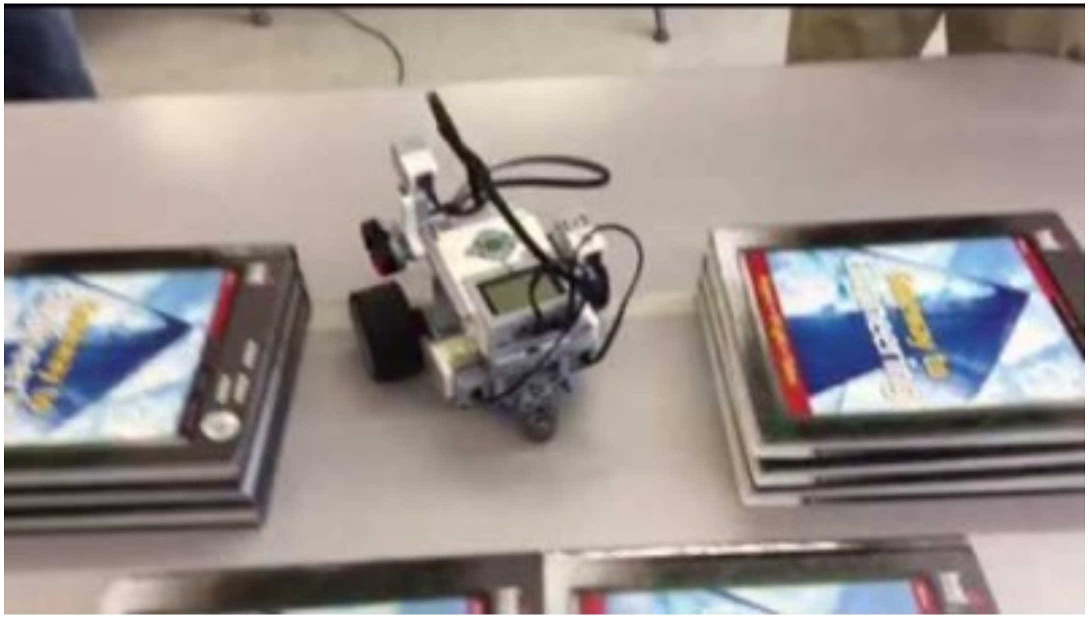
- Here's a good algorithm



Parallel Parking

Parallel Parking

- One more using EV3 robots



Think Pair Share

- Work with a partner to develop your own algorithm for parallel parking your robots
- You still aren’t writing actual code (yet!)
- You are thinking about the logical steps
- Example:
  - Move forward 500 cm
  - Turn 90 degrees clockwise
  - Move backward 500 cm
  - Turn 60 degrees counter-clockwise

Self-Driving Cars

- Let’s extend this idea a bit and think about self-driving cars
- What decisions do cars have to make when parking?
- What other decisions to cars make when driving?
- How do self-driving cars work?

Lab

- For lab today, you will write code for parking your robots
- Start with perpendicular, then try parallel
- You can create your own practice course
- But you have to pass my test to get your license!
- Think about what it would take to make your robot autonomous with respect to parking.

LUNCH BREAK