Oklahoma Drone workshop

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What Are We Doing Today?

- Programming drones!
  - The drones will be entirely autonomous. No RC!
- Learning python
  - Python is an extremely flexible language in use by a variety of industries

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Drones Can Be used to Save Lives

- http://www.flyzipline.com

https://hitconsultant.net/2016/11/11/zipline-medical-drone-delivery-funding/

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Today's Schedule

- Morning combined session
  - Drone safety
  - Drone catching
  - Connecting to the drones
  - Ensuring we can all fly

- Morning session novice
  - Variables and objects
  - Conditionals
  - Loop basics

- Morning session advanced
  - Variables and objects
  - User input
  - Conditionals
  - Looping
  - Sensors: Vision

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Afternoon challenges

Regular challenges

1. Deliver blood to a single hospital
2. Deliver blood to multiple hospitals
3. Flying Art: N-sided Horizontal Polygons
4. Traversing obstacles (flying through hoops)

Advanced challenges

1. Flying Art: N-sided Vertical Polygons
2. Vision Challenge: Looking for a marker
3. Vision Challenge: Using vision to navigate obstacles and land precisely

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KIPR and Drones

- KIPR will be holding a Fall 2019 K-12 drone contest in Oklahoma
- GCER has an aerial competition for all ages (K-12 and adults)
  - GCER is in Norman: July 7-11, 2019
  - You are welcome to participate 2019 using what you have learned here!
  - Our team is the Flying Twisters

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Safety First!

- Drones can cause injury!!
- Safety rules:
  1. No flying over/near anyone in the classroom
  2. Must fly in the flying zone
  3. Only trained adults may catch drones
  4. Anyone in the flying zone must be wearing safety glasses
  5. If you are not wearing glasses, do NOT put your eyes near the propellers

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Examining Your Drone

- Each group should have a drone and a laptop
  - Mambo FPV:
    - Camera/wifi router, four propeller guards, a small battery, and the drone
- Propeller guards will help save fingers and walls
  - Blades stop automatically when they touch something but they still HURT!
  - We have extra guards as needed

Parrot Mambo FPV

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Catcher Training

- We need volunteers!
- We will train adult catchers
  - Youth can watch & learn
- Mambos are quite easy to catch
- If you own a bebop and want to program it at home: Bebops are harder and more dangerous to catch

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Powering Your Drone Throughout The Day

- Mambo:
  - ~8 minutes of flight
  - We have many extra batteries and and a rapid charging station. We need all our batteries back at the end of the day (all are labeled OU and have green tape)!
    - Batteries do wear out. If you find a distended one, please give it to us for safe disposal
  - Notes:
    - Mambo will turn itself off after several minutes of no flight
    - Mambo's camera turns off after 1 minute of no flight but restarts if you fly
  - How do you know the battery is dead?
    - Red blinking eyes!

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First exercise: Deliver blood to the hospital

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Connecting To Your Drone: Part 1

- Turn the drone on
  - Mambo: Small power button on bottom
- Mambo:
  - Eyes will blink
  - Camera light will blink then turn solid green

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Connecting Your Laptop To Your Drone

- You must connect your laptop to your drone's wifi to control it!
- Remember, this will NOT give you an internet connection!
  - It may give you an error saying you have limited connectivity, no internet connection, etc.
  - Ignore that!
- You can NOT control your drone from OUWIFI. You MUST be connected to YOUR drone's wifi.
  - Do NOT connect to other team's drones. This is dangerous and **we will remove you from the workshop if you do this**.

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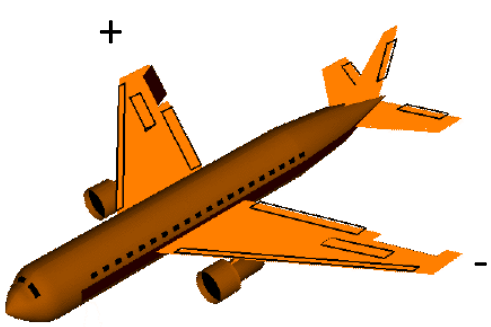
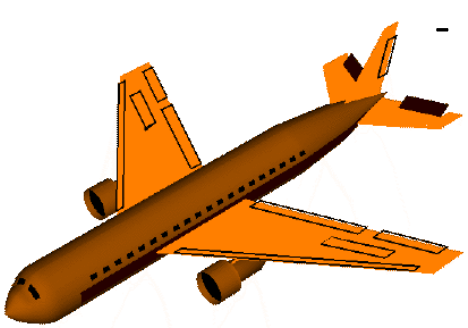
Simon says: Roll Pitch Yaw

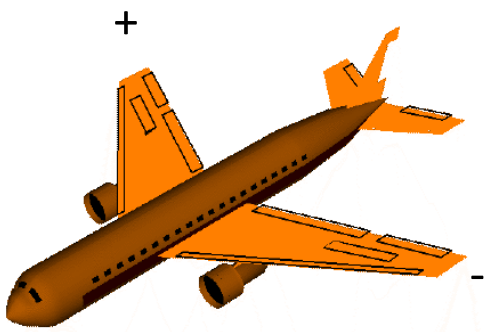


Roll

+



Pitch



Yaw

GIFS from https://commons.wikimedia.org/wiki/Category:Roll,_Pitch_and_Yaw

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Getting started: Programming

- Live demo of how to start Jupyter

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Python versus C

Python

- Case sensitive
- Tabs matter!
- No semicolons
- Variables don't need to be declared up front
  - i = 0
- Interpreted line by line

C

- Case sensitive
- Tabs don't matter
- All lines end with semicolons
- Variables must be declared with types
  - int i = 0;
- Compiles entire program

Getting started: Programming

- First line:

```
from pyparrot.Minidrone import Mambo
```

- What does this mean?
  - Python needs to know where the related packages are
  - From <the name of the package file> import <the things that you need out of the file>
  - pyparrot = the package
  - Mambo/Bebop are the parts of the pyparrot package we need
  - Mambo/Bebop are also the specific classes (data types) we need

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Drone Objects/Classes

- Next line of your code:

```
drone = Mambo(use_wifi=True)
```

- What does this do?
  - Variables/Objects

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Variables

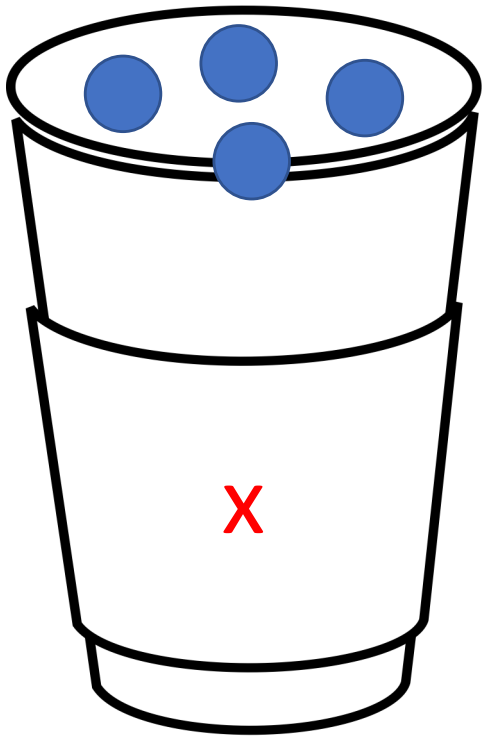
- Stores a value for later use

```
x = 3
```

- Can be changed throughout the program

```
x = x + 1
```

- Equals is assignment
  - NOT algebra



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Python Primitive Variable Types

- Like other programming languages, Python provides a standard set of primitive variable types: integer, float, boolean, string …
- One difference: the type of a variable is not explicitly declared, it is inferred by the context. For example:

```
foo = 5
```

Automatically creates a variable that contains an int and assigns the value *5*

Objects: Going beyond the primitives

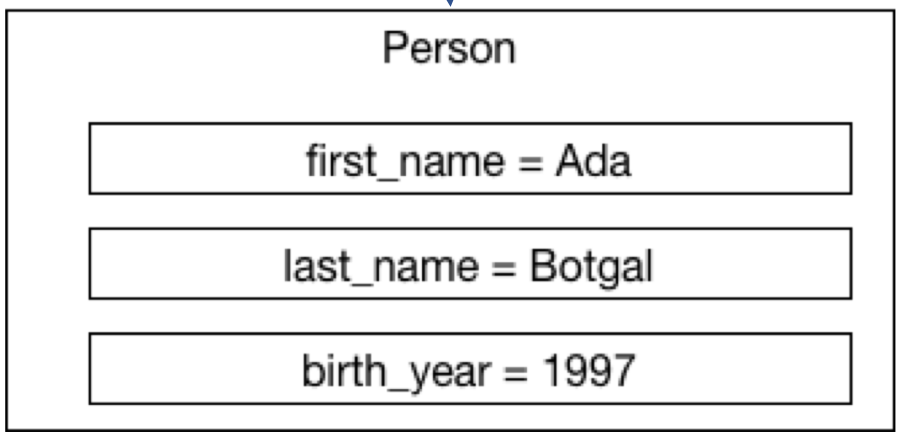
- We often want to represent higher-level concepts that cannot be captured with a primitive variable type
- For example: Person
  - Data:
    - First Name
    - Last Name
    - Birth Year
  - Method:
    - Compute age

Classes in Python

```
class Person:
    def __init__(self, firstName, lastName, birthYear):
        self.first_name = firstName
        self.last_name = lastName
        self.birth_year = birthYear

    def compute_age(self, year):
        return (year - self.birth_year)


botgal = Person("Ada", "Botgal", 1997)
age = botgal.compute_age(2018)
print("Age of %s is %d" % (botgal.first_name, age))
```



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Drone Objects/Classes

- What does this line of code do?

```
drone = Mambo(use_wifi=True)
```

- Create a variable named drone
- This variable is an instance of a Mambo object

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Mambo methods

- Documentation at https://pyparrot.readthedocs.io
- Common and useful commands for today:

```
connect(num_retries)
disconnect()
safe_takeoff(timeout)
safe_land(timeout)
set_max_tilt(degrees)
set_max_vertical_speed(speed)
flat_trim()
smart_sleep(seconds)
fly_direct(roll, pitch, yaw, vertical_movement, duration)
```

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Your first program

- TURN OFF YOUR DRONES
- We will fly them AFTER you get your code typed in and ONLY in the flying zone

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Your First Mambo program: A Short Flight

```
from pyparrot.Minidrone import Mambo

# create the drone object and connect
drone = Mambo(use_wifi=True)
drone.connect(num_retries=3)

# maximum speeds - DO NOT CHANGE
drone.set_max_tilt(10)
drone.set_max_vertical_speed(1)

drone.flat_trim()

# takeoff
drone.safe_takeoff(5)

# fly forward a small amount for one second
drone.fly_direct(roll=0, pitch=10, yaw=0, vertical_movement=0, duration=1)

# land and disconnect
drone.safe_land(5)
drone.disconnect()
```

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Errors

- Red underlines mean there is an error! What is the error here?

```
# fly forward a small amount for one second
drone.fly_direct(roll=0, pitch=10, yaw=0, vertical_movement=), duration=1)
```

- Yellow is a warning. What is the error here?

```
# maximum speeds - DO NOT CHANGE
drone.set_max_tilt2(10)
```

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Your turn!

Get those drones delivering blood to the hospital!

Figure out how to change your pitch parameters to get to the hospital

Pitch ranges from -100 to 100

Duration is in seconds

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Time to break into two groups

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