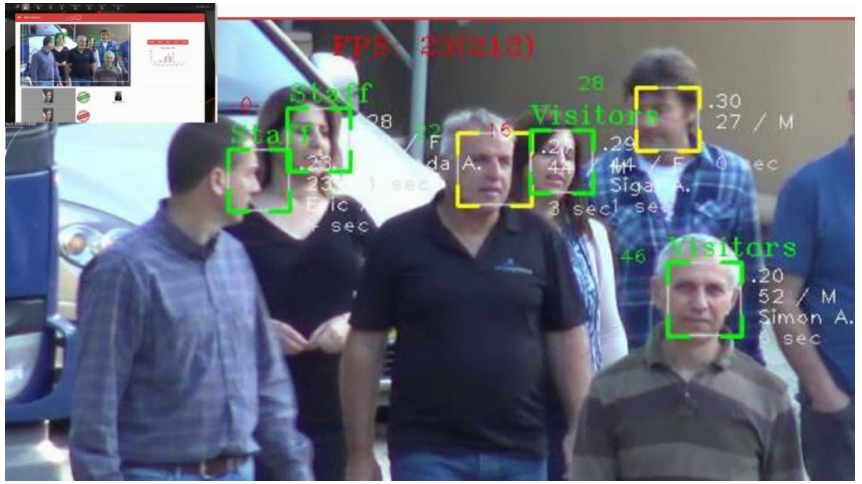
부산동고등학교 AI 메이커 동아리



AI 드론 제작

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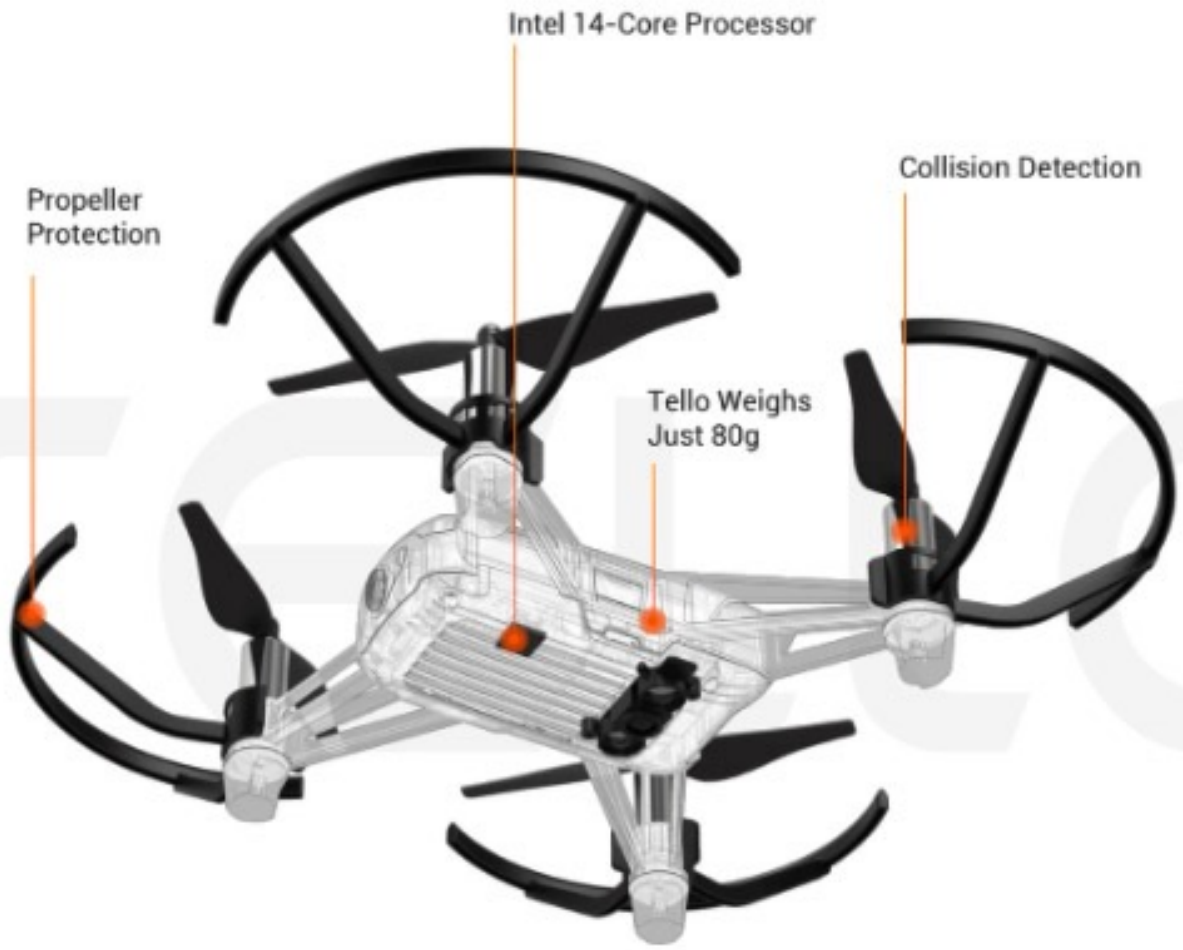
강의 내용

- DJI Tello 드론 기초
  - 드론의 종류, 비행원리, Tello 드론 구성요소(HW, SW) 등
  - 드론 앱을 사용한 드론 비행 기초 실습
  - 드론 비행시 주의 할 점
- Tello SDK를 이용한 파이썬 코딩(1)
  - 파이썬 프로그래밍 기초
  - DJITelloPy 모듈
  - 기본 동작 제어
    - takeoff, land, up/down, forward/backward, cw/ ccw 등
  - 키보드 제어
- Tello SDK를 이용한 파이썬 코딩(2)
  - OpenCV 기초
  - 드론 카메라 이미지 캡쳐 및 저장
  - 드론 동영상 전송 및 저장
- 파이썬 기반 AI 드론 코딩
  - Cascade Classifier를 이용한 안면 인식
  - 드론 제어(PID 제어)
  - following me 드론 제작
- 팀 프로젝트 : 창의적인 AI 드론 제작

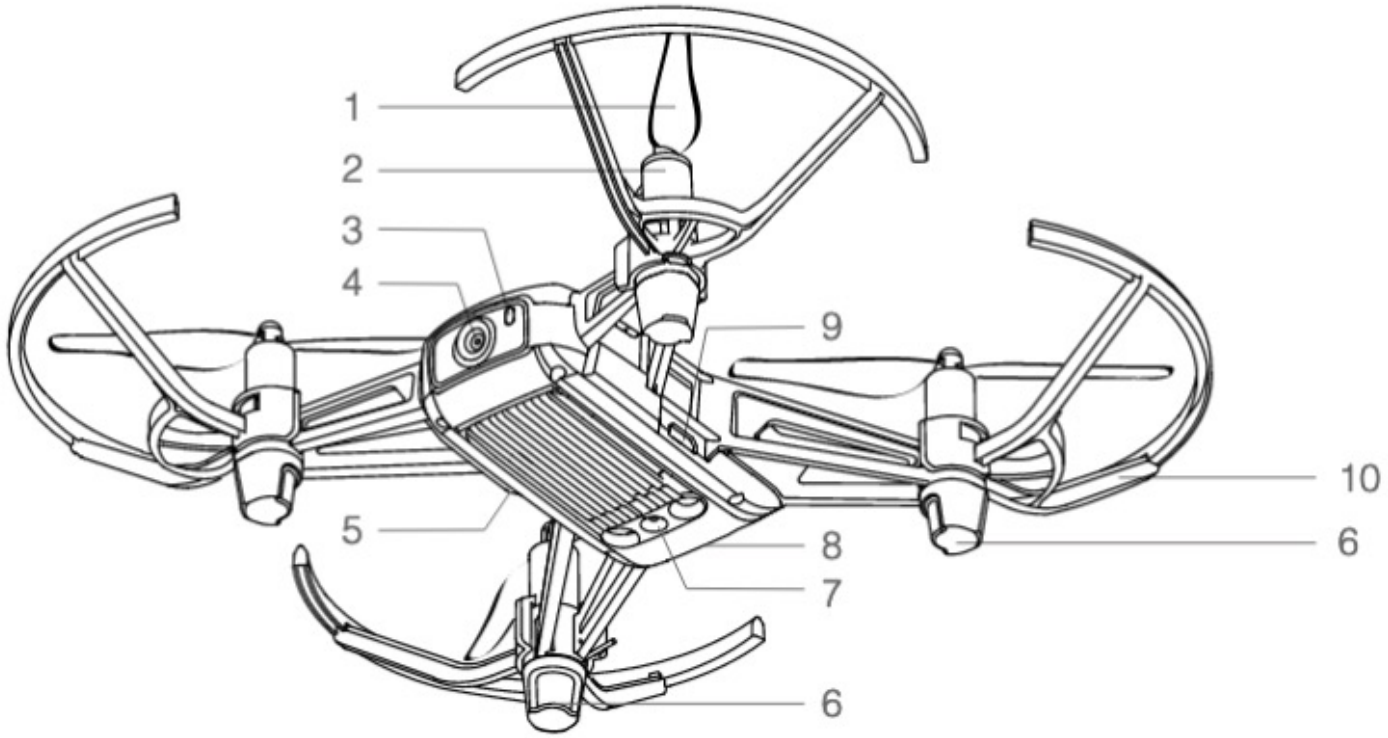
강의 자료, 소스 코드 다운로드

- https://github.com/BSDH-AI-Drone

Tello Drone 구성 요소



Tello Drone 구성 요소



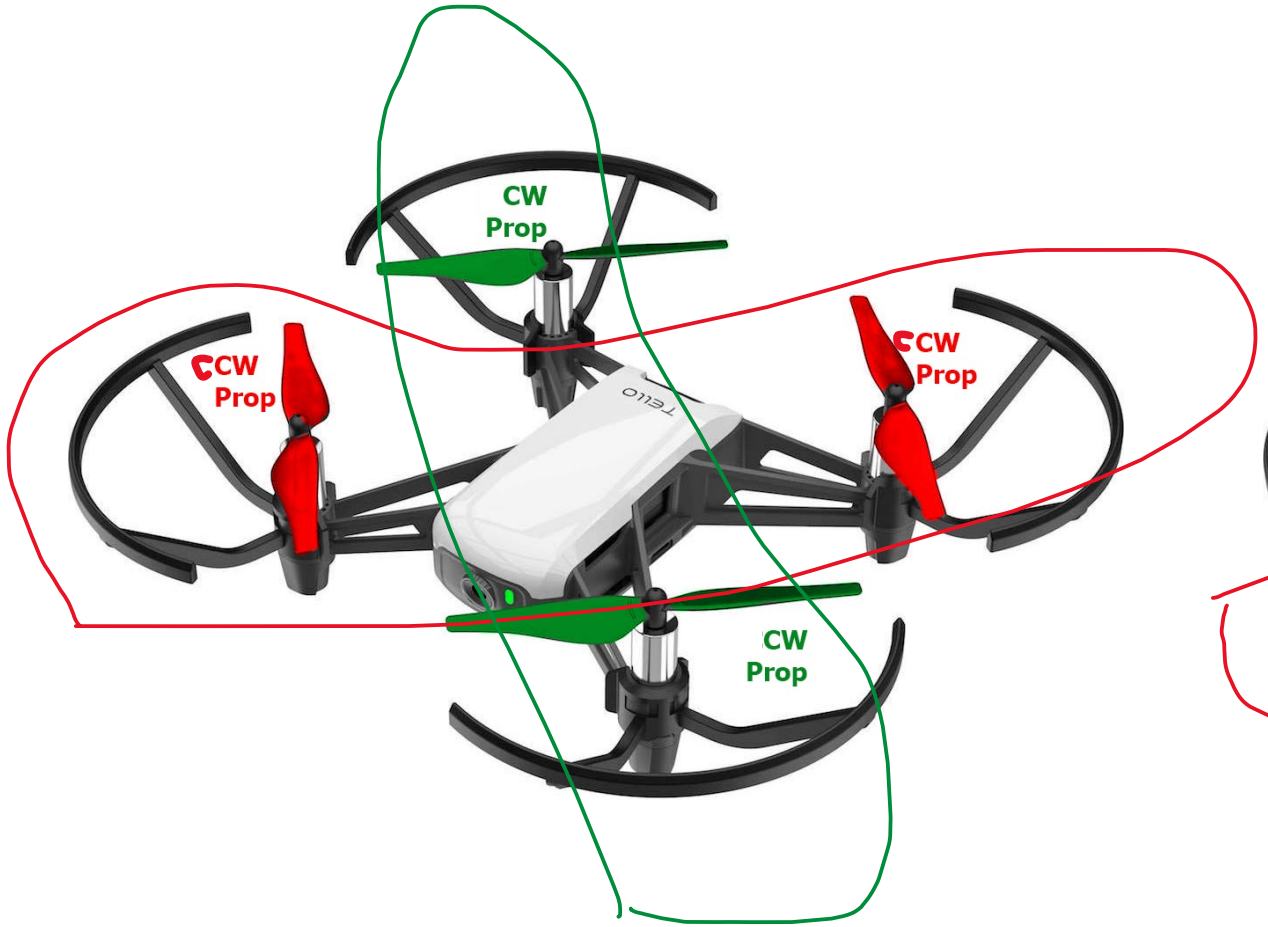
1. Propellers
2. Motors
3. Aircraft Status Indicator
4. Camera
5. Power Button
6. Antennas
7. Vision Positioning System
8. Flight Battery
9. Micro USB Port
10. Propeller Guards

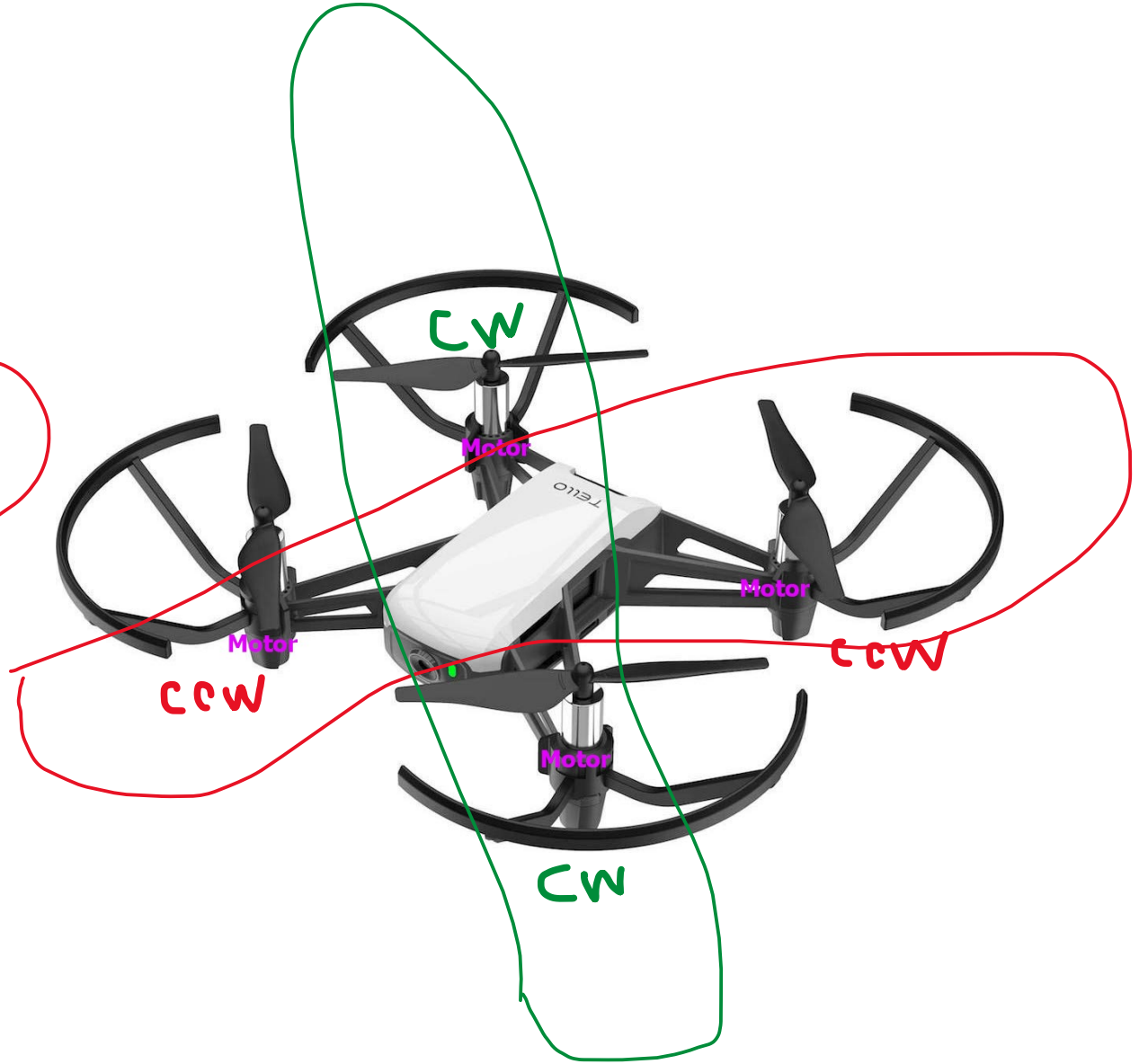
Tello 드론 사양

Weight	87 g
Dimensions	98×92.5×41 mm
Propeller	3 inches
Integrated Functions	Telemetric sensor
	Barometer
	LED
	Vision System
	Wi-Fi 2.4 GHz 802.11n
	Real-time streaming 720p
Port	USB battery charging port
Operating temperature range	from 0° to 40°
Operating frequency range	from 2.4 to 2.4835 GHz
Transmitter (EIRP)	20 dBm (FCC)
	19 dBm (CE)
	19 dBm (SRRC)

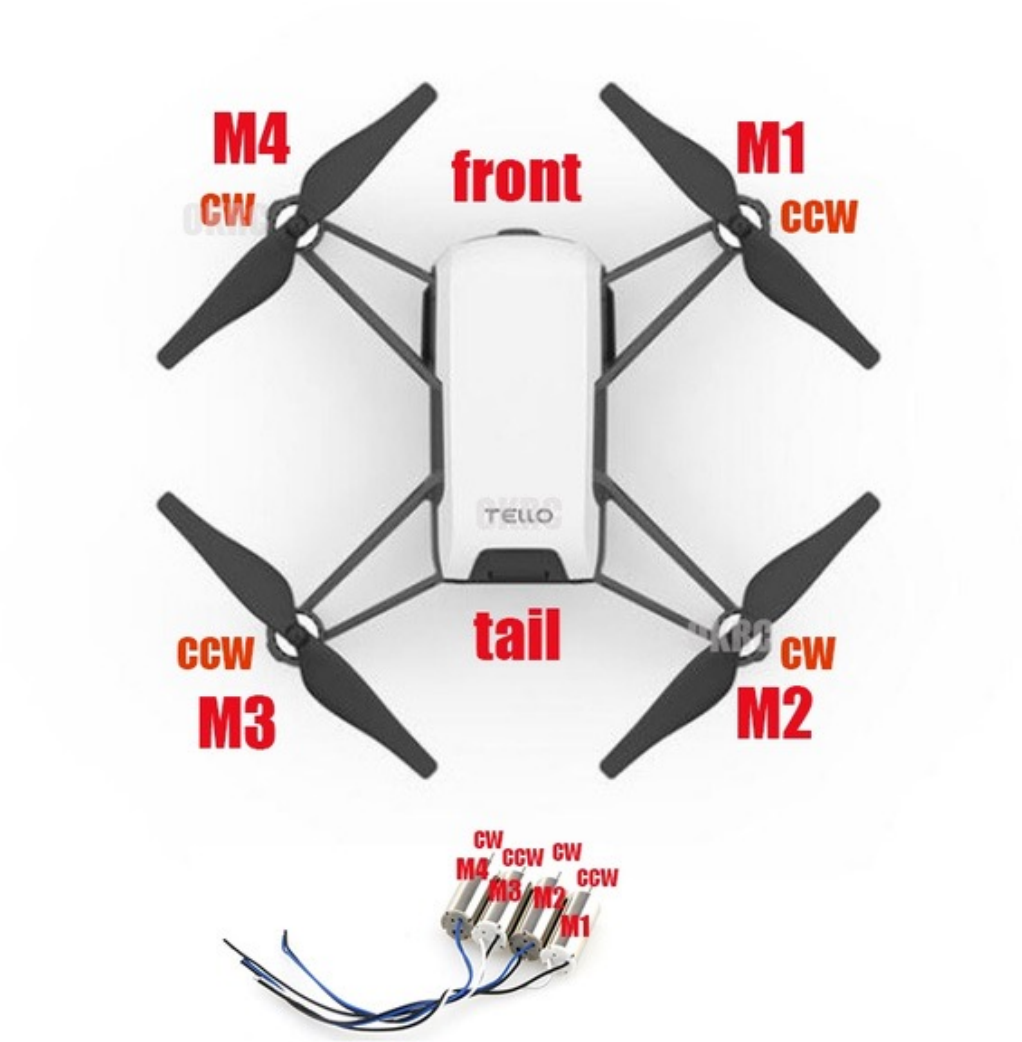
참고 : https://dl-cdn.ryzerobotics.com/downloads/Tello/Tello%20User%20Manual%20v1.4.pdf

프로펠러/ 모터

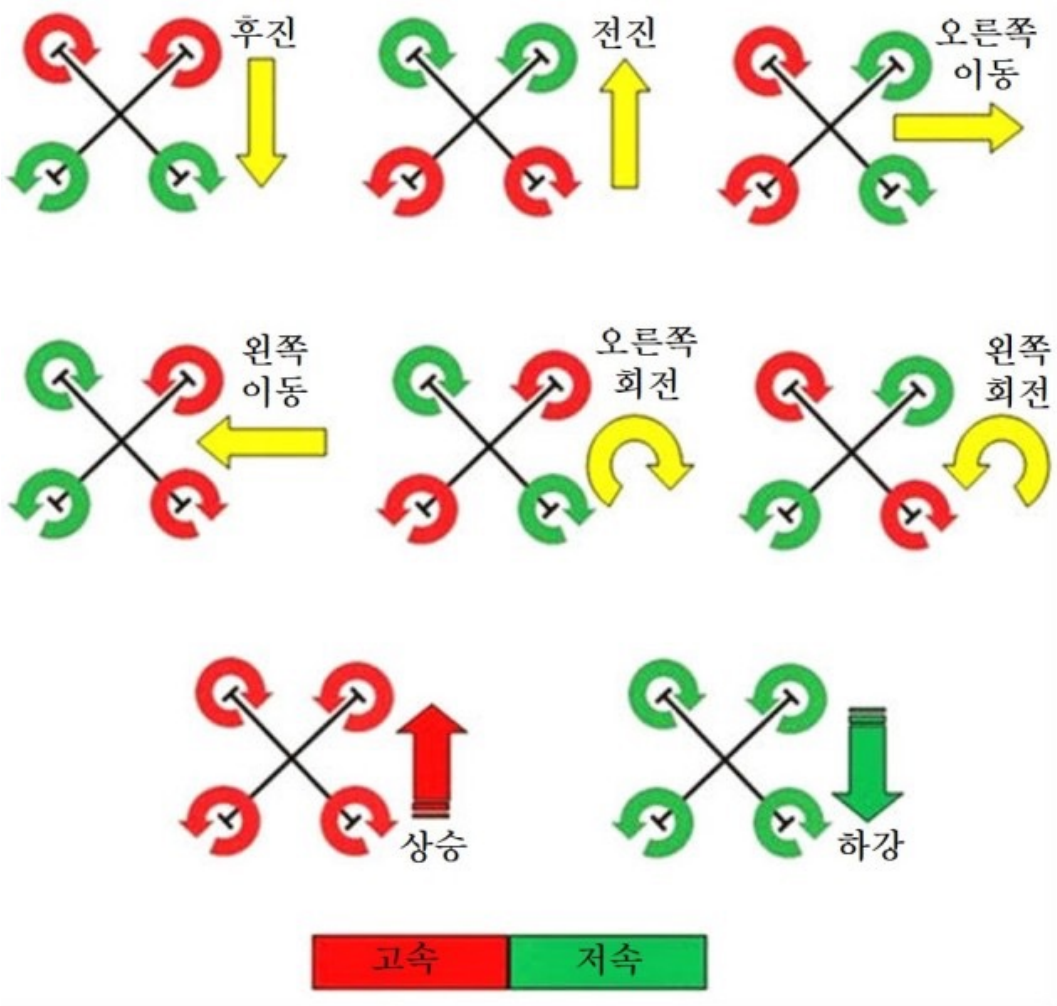

CW
Prop
CCW
Prop
CCW
Prop
CW
Prop


CW
Motor
Motor
CCW
Motor
CCW
Motor
CW

프로펠러/ 모터


M4
cw
front
M1
ccw
TELLO
ccw
M3
tail
cw
M2
cw
M4
ccw
M3
cw
M2
ccw
M1

드론의 비행 원리 : Quadcopter



Tello 드론 전용 앱

Tello App

Tello App can experience more flight modes of Tello, with real-time image-transmission interface and camera,video-recording functions, which can easily experience the fun of aerial-photography. Tello app can also set the parameters of the drone, upgrade the firmware and calibrate the drone. Therefore, the Tello app is an essential software for using the Tello.

Download on the App Store

Requires iOS 9.0 or later.

Download for Android

Android version 4.4.0 or later.

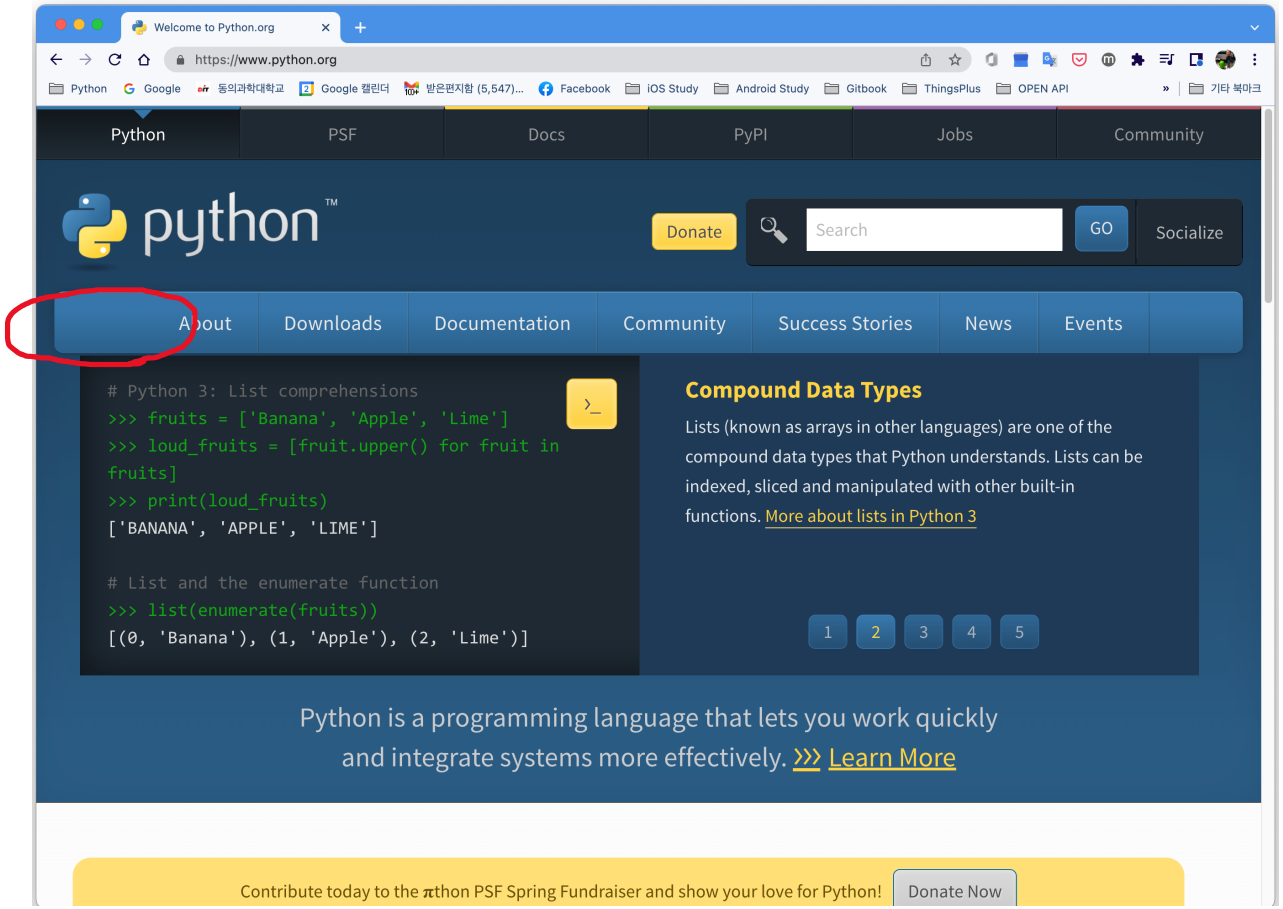
Tello 드론 전용 앱

- Tello 사용자 매뉴얼 : https://bit.ly/3ygby6T

Tello SDK를 이용한 파이썬 코딩(1)

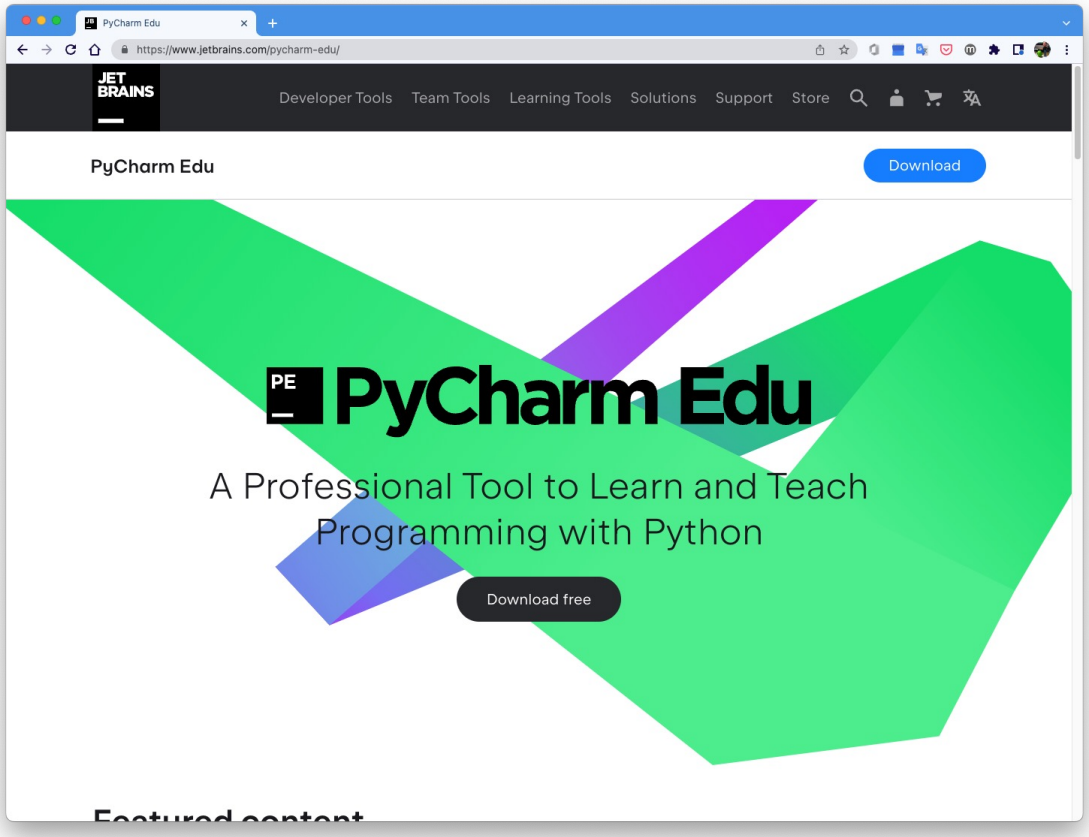
파이썬 설치

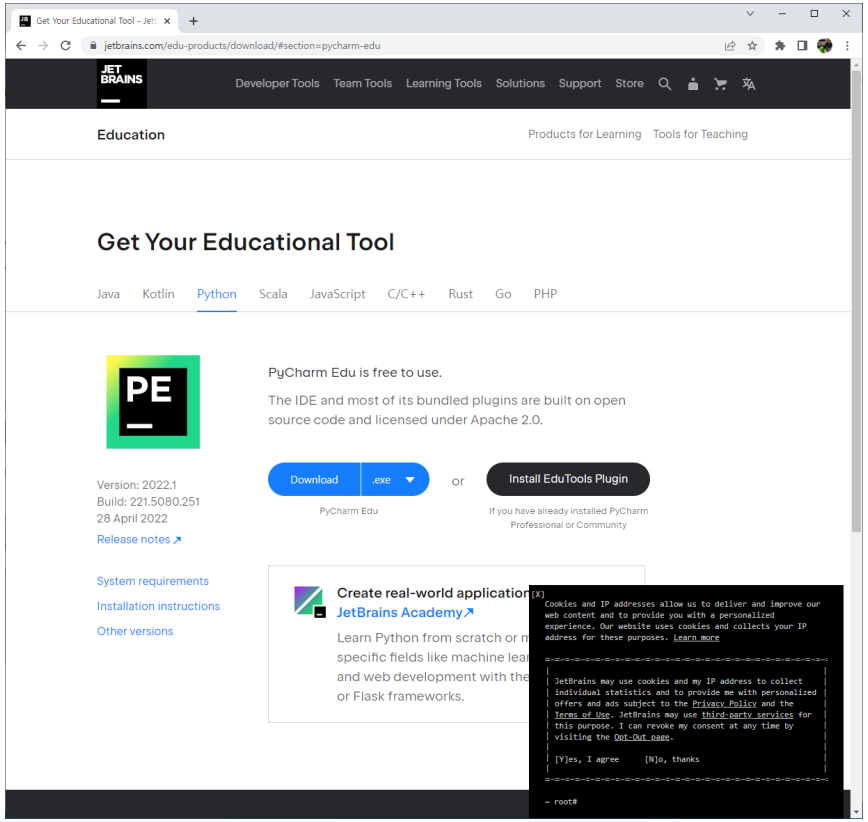
- 파이썬 공식 사이트 : https://www.python.org/
- 파이썬 3.7 ~ 3.8 다운로드



PyCharm(파이썬 통합개발도구) 설치

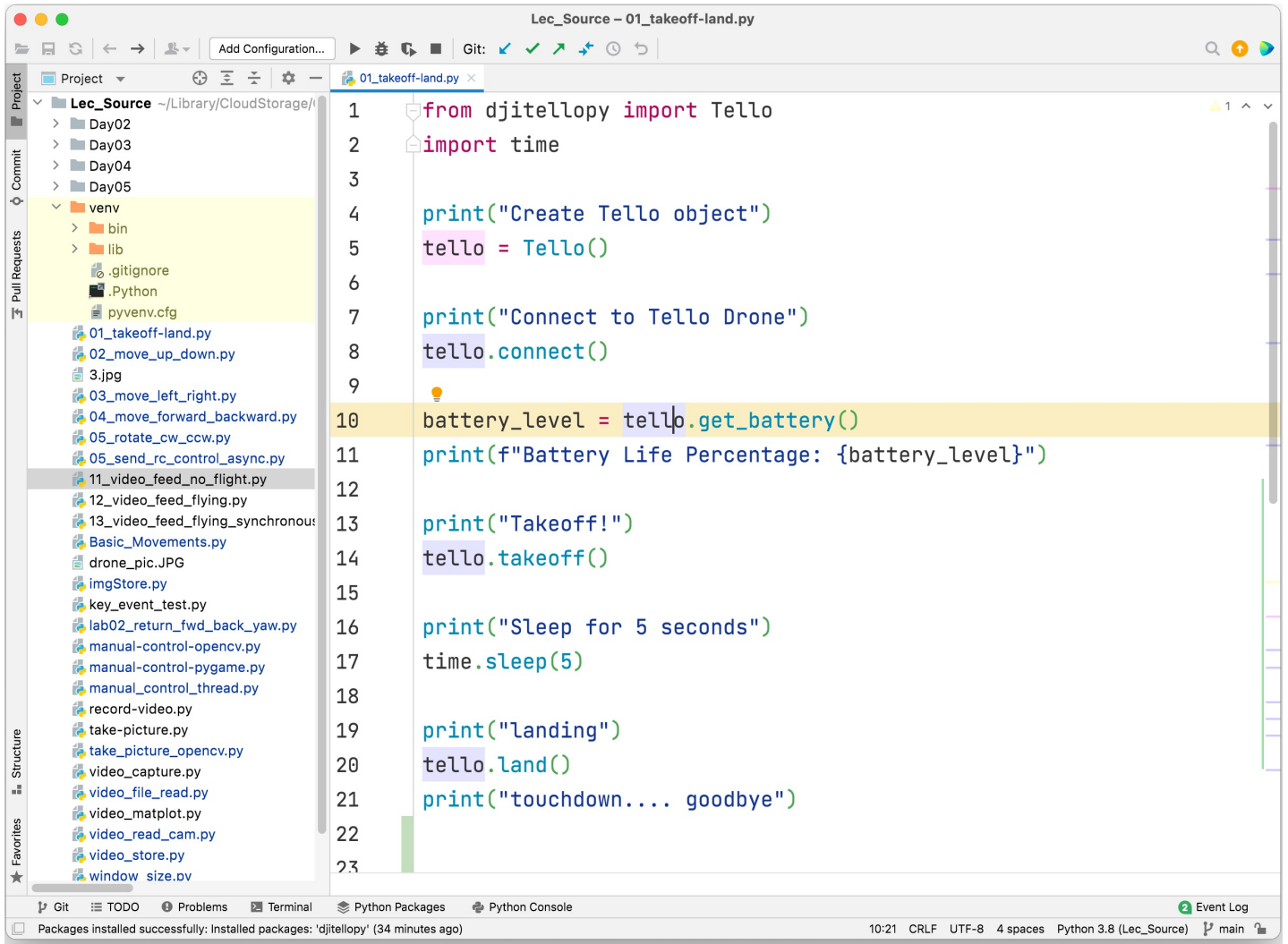
- Pycharm Edu 다운로드 및 설치
  - https://www.jetbrains.com/ko-kr/pycharm-edu/





PyCharm 사용하기

- https://blog.dalso.org/language/python/13534



파이썬 기초 프로그래밍

PYTHON BASICS

- Python Basics 다운로드
  - https://bit.ly/3yiBxxz

```
Code:
print('Hello World')
myData = 'Hello World'
print(len(myData))
print(type(myData))
Result:
Hello World
11
<class 'str'>
```

by Murtaza Hassan

DJITelloPy 모듈

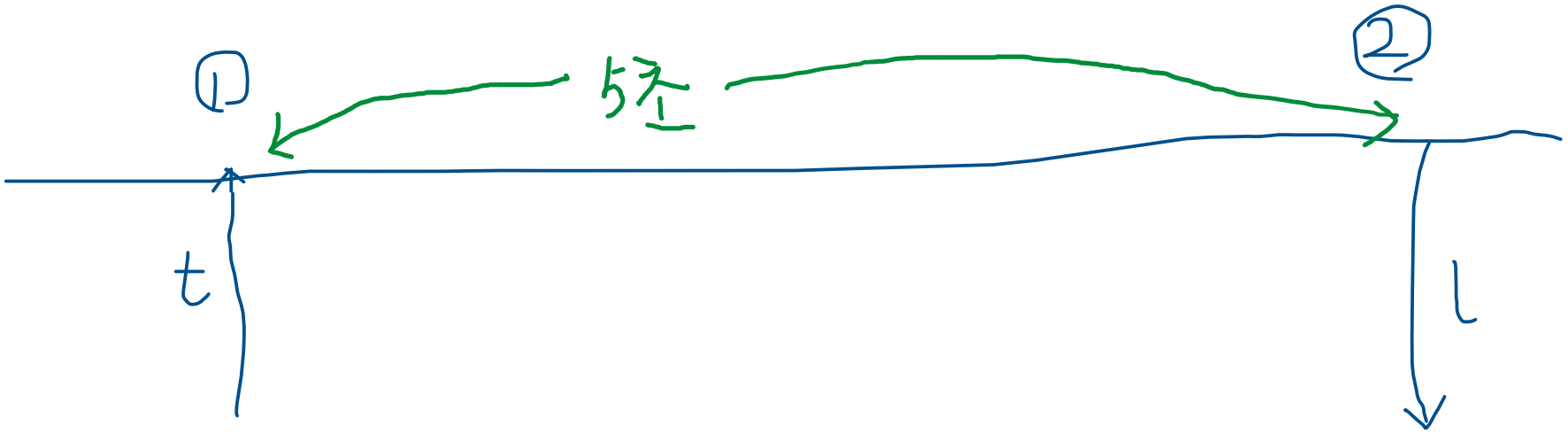
- API : https://djitellopy.readthedocs.io/en/latest/tello/
- DJITelloPy 모듈 설치
  - PyCharm
    - [setting]->[Project]->[Python Interpreter] -> + 'djitellopy'
  - Terminal
    - pip install djitellopy

기본 동작 제어

- takeoff/ land
  - `takeoff(), land()`
- move up/ down
  - `move_up(), move_down()`
- move left/ right
  - `move_left(), move_right()`
- move forward/ backward
  - `move_forward(), move_backward()`
- rotate_cw_ccw
  - `rotate_clockwise(), rotate_counter_clockwise()`
- send_rc_control_async
  - `send_rc_control(self, left_right_velocity, forward_backward_velocity, up_down_velocity, yaw_velocity)`
- Example Code : https://github.com/damiafuentes/DJITelloPy/tree/master/examples

실습 01

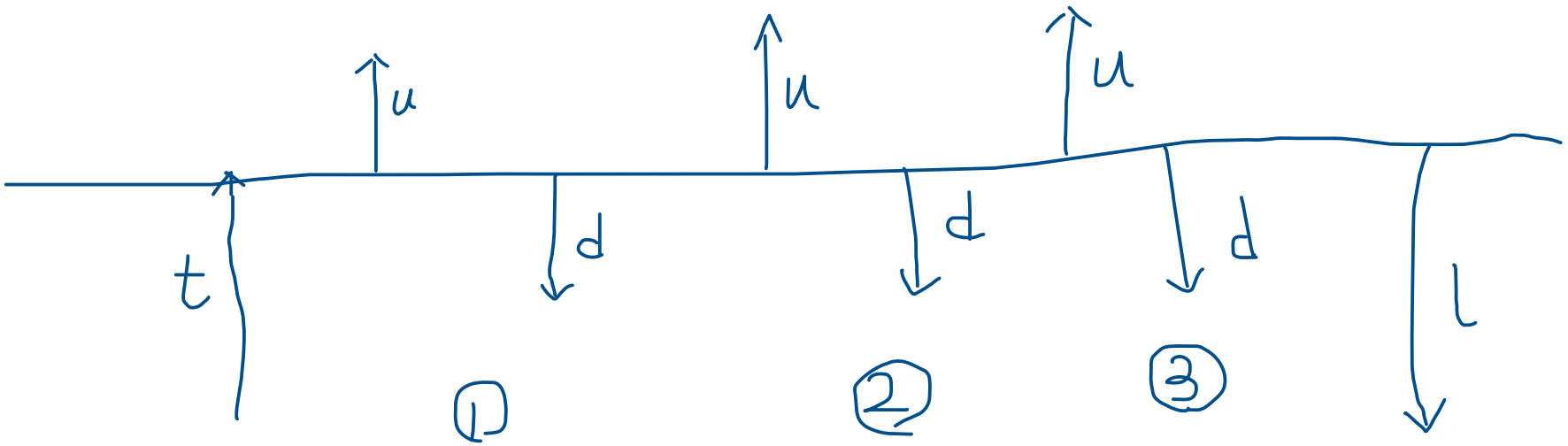
- takeoff -> landing



```
from djitellopy import Tello
import time

print("Create Tello object")
tello = Tello()

print("Connect to Tello Drone")
tello.connect()

battery_level = tello.get_battery()
print(f"Battery Life Percentage: {battery_level}")

print("Takeoff!")
tello.takeoff()

print("Sleep for 5 seconds")
time.sleep(5)

print("landing")
tello.land()
print("touchdown.... goodbye")
```

실습 02

- takeoff -> 3회 up(40) -> down(40) 반복 -> landing



- 참고

```
from djitellopy import Tello

tello = Tello()

tello.connect()
tello.takeoff()

tello.move_left(100)
tello.rotate_clockwise(90)
tello.move_forward(100)

tello.land()
```

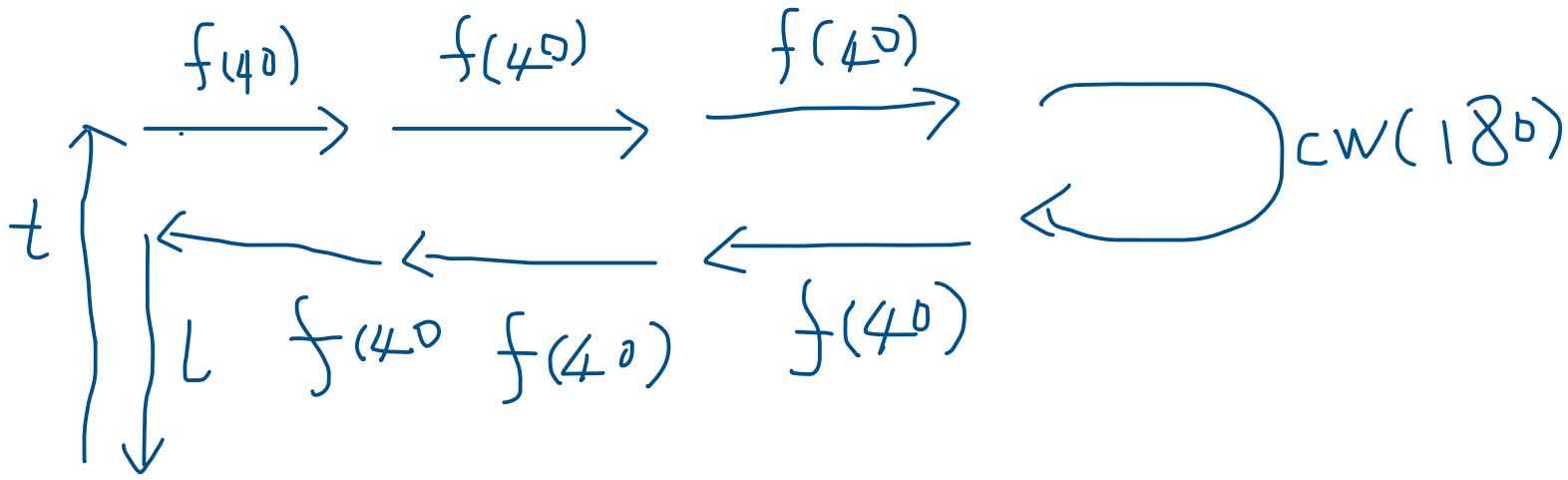
반복문 : for in range()

```
from djitellopy import Tello

myTello = Tello()
myTello.connect()
myTello.takeoff()

myTello.move_up(30)
myTello.move_down(30)

myTello.move_up(50)
myTello.move_down(50)

myTello.move_up(50)
myTello.move_down(50)

myTello.land()
```

```
from djitellopy import Tello

myTello = Tello()
myTello.connect()
myTello.takeoff()

for i in range (0,3) :
    myTello.move_up(30)
    myTello.rotate_counter_clockwise(90)
    myTello.move_down(30)

myTello.land()
```

실습 03

- takeoff -> fwd(40) -> fwd(40) -> fwd(40) -> cw(180) -> fwd(40) -> fwd(40) -> fwd(40) -> land
- fwd(40)을 반복문으로 구현해 보자



input() 함수를 사용한 드론 제어

```
from djitellopy import tello

myTello = tello.Tello()
myTello.connect()

while True:
    command = int(input("Enter Command!"))
    print(command, end="\n")

    if (command == 1):
       myTello.takeoff()
    elif (command == 2):
       myTello.move_up(30)
    elif (command == 3):
       myTello.move_down(30)
    elif (command == 4):
       myTello.land()
    else:
       break
print("Drone mission completed!")
```

실습 04 : input() 함수를 이용한 드론 조정기 만들기

1. Takeoff()
2. move_up(20)
3. move_down(20)
4. move_left(20)
5. move_right(20)
6. move_forward(20)
7. move_backward(20)
8. rotate_clockwise(90)
9. rotate_counter_clockwose(90)
10. flip_back()
11. flip_forward()
12. flip_left()
13. flip_right()
14. land()

Opencv를 이용한
드론의 이미지, 동영상 처리

https://opencv.org/

드론 사진 촬영, 저장하기

```
import cv2
from djitellopy import Tello

tello = Tello()
tello.connect()

tello.streamon()
frame_read = tello.get_frame_read()

tello.takeoff()
cv2.imwrite("picture.png", frame_read.frame)

tello.land()
```

드론 비디오 촬영, 전송

```
from djitellopy import tello
import cv2
import time

tello = tello.Tello()
tello.connect()

battery_level = tello.get_battery()
print("Battery Life Percentage”, battery_level")

time.sleep(2)

print("Turn Video Stream On")
tello.streamon()

# read a single image from the Tello video feed
print("Read Tello Image")
frame_read = tello.get_frame_read()
print(type(frame_read))

time.sleep(2)
```

```
while True:
    # read a single image from the Tello video feed
    print("Read Tello Image")

    tello_video_image = frame_read.frame

    # use opencv to write image
    if tello_video_image is not None:
        cv2.imshow("TelloVideo", tello_video_image)

    if cv2.waitKey(1) & 0xFF == ord('q'):
        break

tello.streamoff()
cv2.destroyWindow('TelloVideo')
cv2.destroyAllWindows()
```

드론 비디오 촬영, 전송 : 키보드 제어

```
from djitellopy import tello
import cv2
import time

tello = tello.Tello()
tello.connect()

battery_level = tello.get_battery()
print(battery_level)

time.sleep(2)
tello.streamon()

# read a single image from the Tello video feed
frame_read = tello.get_frame_read()
```

```
while True:
    frame_read = tello.get_frame_read()
    frame = frame_read.frame

    cv2.imshow('video', frame)
    k = cv2.waitKey(5) & 0xFF
    if k == 27:
        break
    elif k == ord('t'):
        tello.takeoff()
        tello.move_up(50)
        time.sleep(3)
        tello.rotate_clockwise(360)
        time.sleep(3)
    elif k == ord('l'):
        tello.land()
        tello.streamoff()

tello.streamoff()
cv2.destroyAllWindows()
```

드론 키보드 제어하기

- manual-control-opencv

```
from djitellopy import Tello
import cv2, math, time

tello = Tello()
tello.connect()

tello.streamon()
frame_read = tello.get_frame_read()
```

- 소스 코드 : https://github.com/damiafuentes/DJITelloPy/blob/master/examples/manual-control-opencv.py

```
while True:
    img = frame_read.frame
    cv2.imshow("drone", img)

    key = cv2.waitKey(1) & 0xff
    if key == 27: # ESC
        break
    elif key == ord('t'):
        tello.takeoff()
    elif key == ord('w'):
        tello.move_forward(30)
    elif key == ord('s'):
        tello.move_back(30)
    elif key == ord('a'):
        tello.move_left(30)
    elif key == ord('d'):
        tello.move_right(30)
    elif key == ord('e'):
        tello.rotate_clockwise(30)
    elif key == ord('q'):
        tello.rotate_counter_clockwise(30)
    elif key == ord('r'):
        tello.move_up(30)
    elif key == ord('f'):
        tello.move_down(30)
tello.land()
cv2.destroyAllWindows()
```