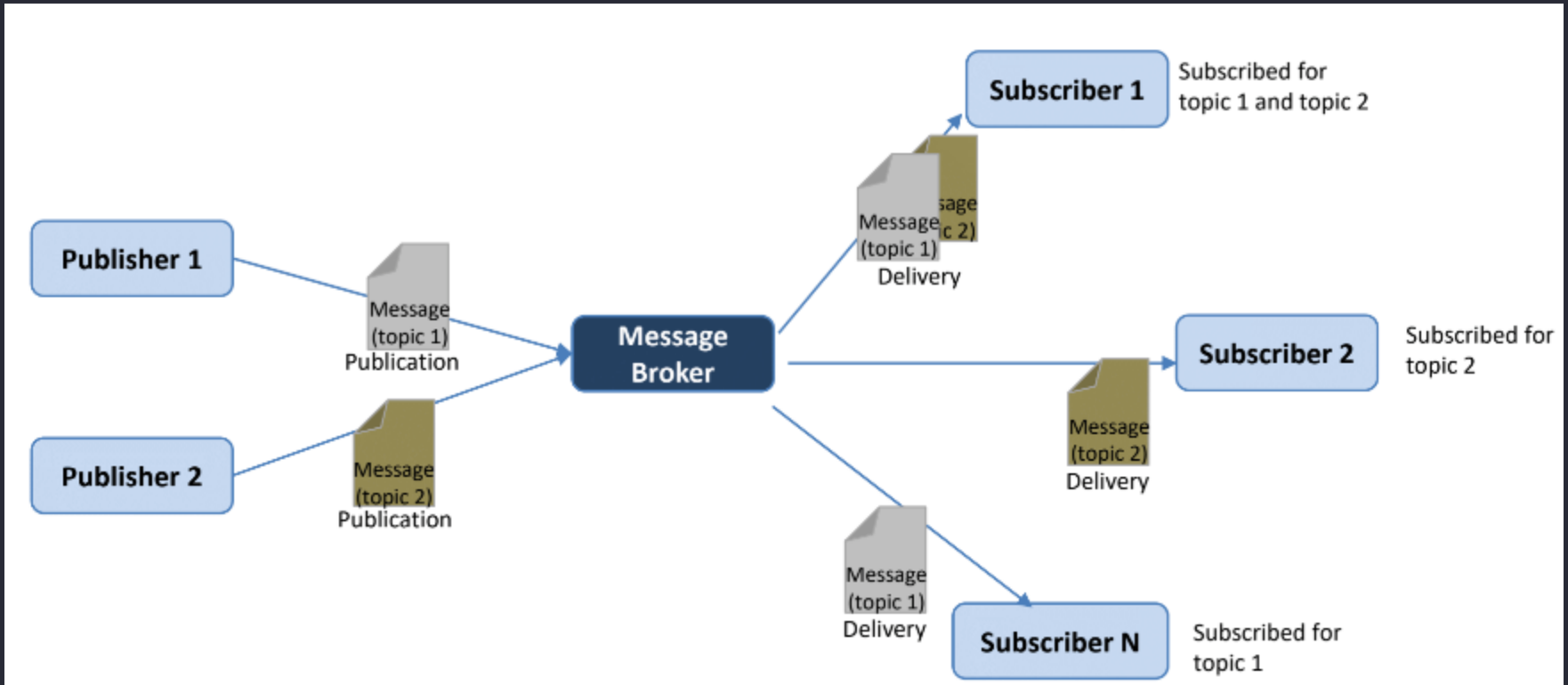
Polito giveth and Polito taketh

For all this exercises you will need to use a free MQTT broker.
Unfortunately if you are connected to the Polito wifi you are **NOT** able to reach it.
To solve this issue **you need to connect your pc to your mobile phone hotspot**.
This is not needed if you are at home, in that case you should not have any issue.
In case a broker stops working you can try with another one from this website (use one that does not require nor authentication nor apikey)

Introduction



We could briefly resume the structure of the MQTT communication paradigm in this way, there are 3 type of actors: ***Publisher***, ***Subscriber***, ***Broker***.

- The ***Publisher*** is the actor that wants to send messages tagged by a *topic*
- The ***Subsrciber*** is the actor that wants to receive messages that belong to variable number of topic.
- The ***Broker*** is the actor in the middle: it receives the messages from all the publisher and forwards each of them to the suscriber according to the *topic*.

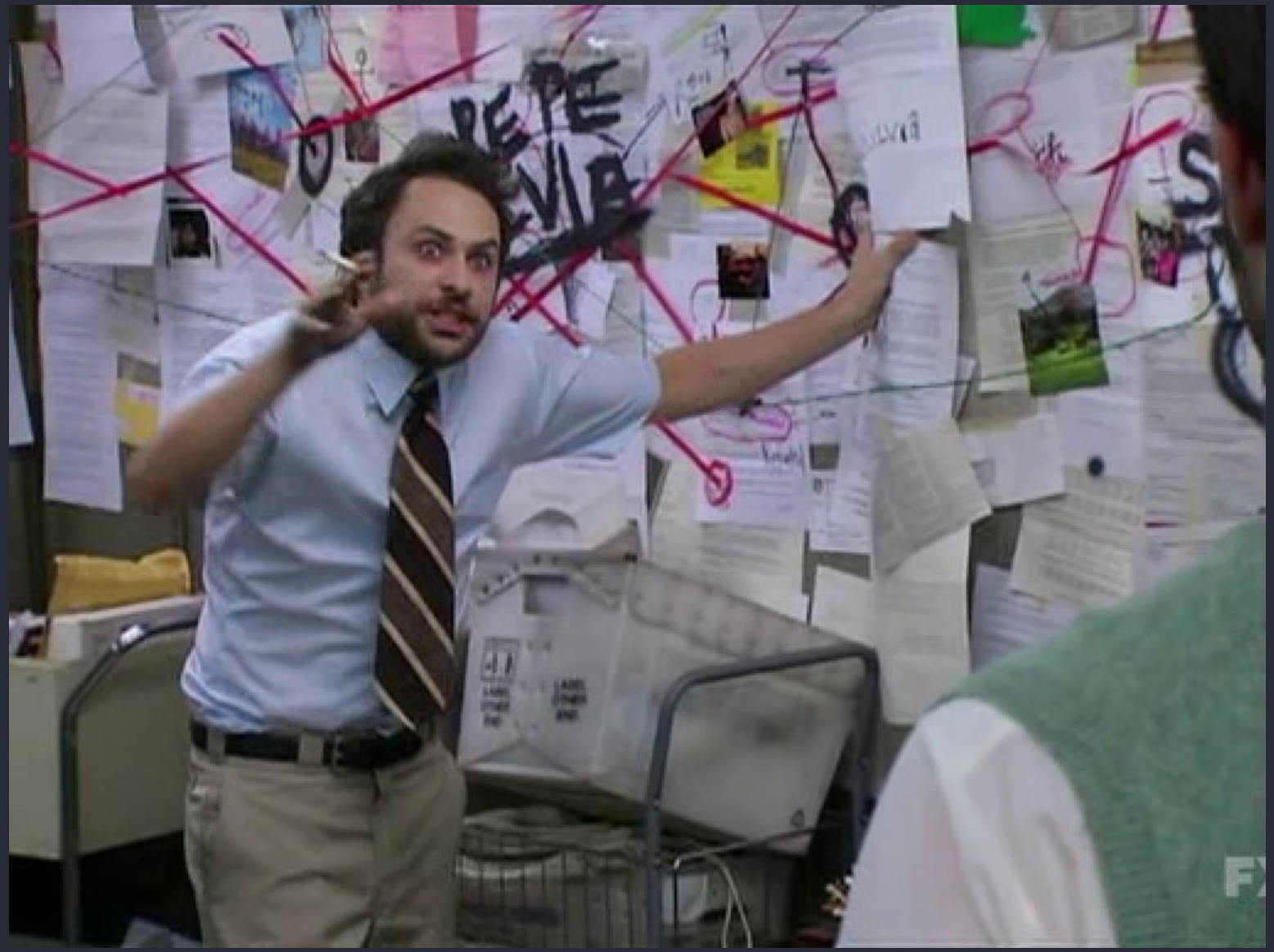
Here below you can find the examples for the implementation of a publisher and a subscriber

```python
import paho.mqtt.client as PahoMQTT

class MyPublisher:
    def __init__(self, clientID,broker):
        self.clientID = clientID
        # create an instance of paho.mqtt.client
        self._paho_mqtt = PahoMQTT.Client(self.clientID, True)
        # register the callback
        self._paho_mqtt.on_connect = self.myOnConnect
        self.messageBroker = broker

    def start (self):
        #manage connection to broker
        self._paho_mqtt.connect(self.messageBroker, 1883)
        self._paho_mqtt.loop_start()

    def stop (self):
        self._paho_mqtt.loop_stop()
        self._paho_mqtt.disconnect()

    def myOnConnect (self, paho_mqtt, userdata, flags, rc):
        print ("Connected to %s with result code: %d" % (self.messageBroker, rc))

    def myPublish(self, topic, message):
        # publish a message with a certain topic
        self._paho_mqtt.publish(topic, message, 2)
```

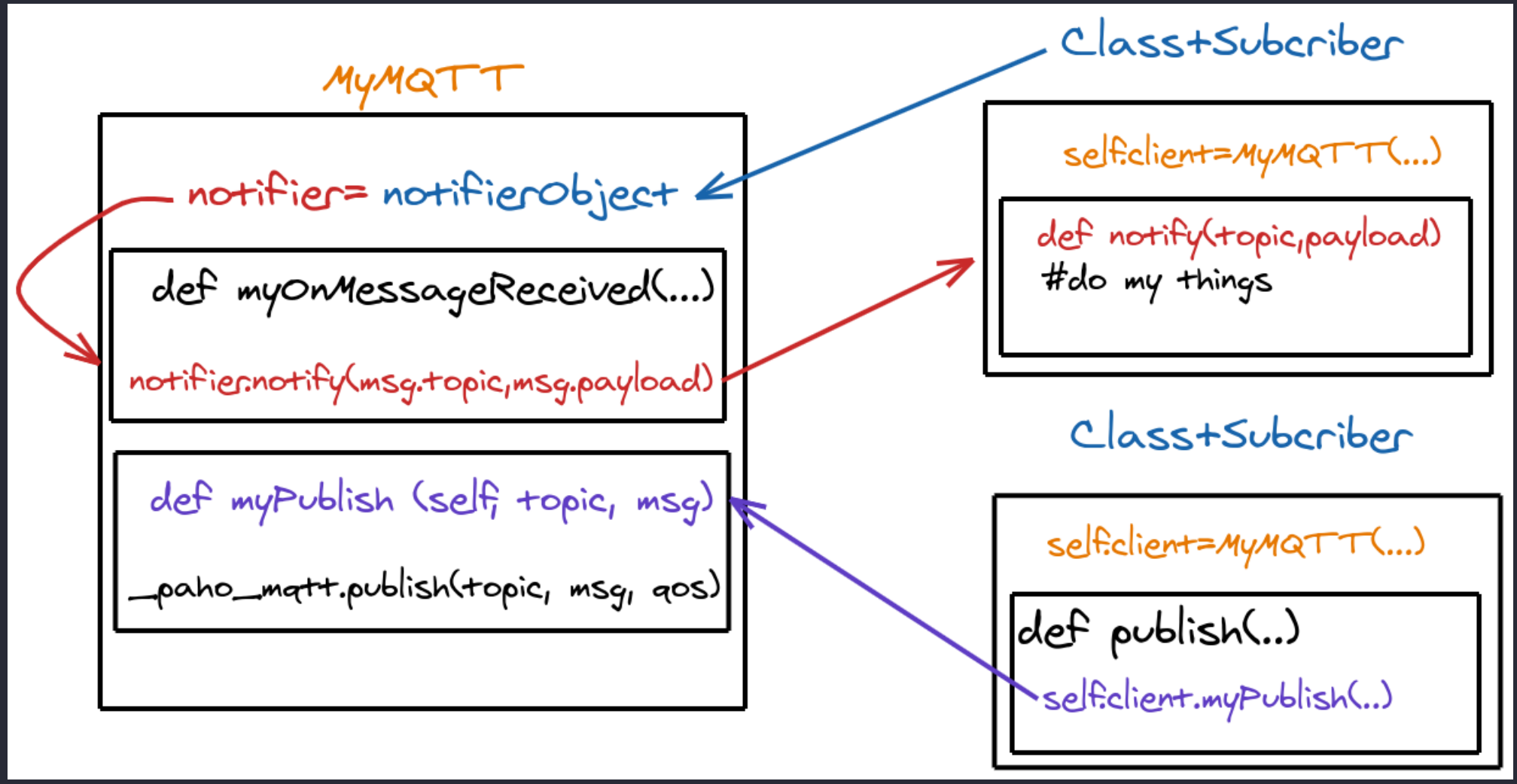
```
class MySubscriber:
        def __init__(self, clientID,topic,broker):
            self.clientID = clientID
            # create an instance of paho.mqtt.client
            self._paho_mqtt = PahoMQTT.Client(clientID, True)
            # register the callback
            self._paho_mqtt.on_connect = self.myOnConnect
            self._paho_mqtt.on_message = self.myOnMessageReceived
            self.topic = topic
            self.messageBroker = broker

        def start (self):
            #manage connection to broker
            self._paho_mqtt.connect(self.messageBroker, 1883)
            self._paho_mqtt.loop_start()
            # subscribe for a topic
            self._paho_mqtt.subscribe(self.topic, 2)

        def stop (self):
            self._paho_mqtt.unsubscribe(self.topic)
            self._paho_mqtt.loop_stop()
            self._paho_mqtt.disconnect()

        def myOnConnect (self, paho_mqtt, userdata, flags, rc):
            print ("Connected to %s with result code: %d" % (self.messageBroker, rc))

        def myOnMessageReceived (self, paho_mqtt , userdata, msg):
            # A new message is received
            print ("Topic:'" + msg.topic+"', QoS: '"+str(msg.qos)+"' Message: '"+str(msg.payload) + "'")
```

General MQTT client: why

Considering the implementations above, everytime we want to add mqtt capabilities to a class we should write everytime the same code to define all the function that an MQTT client needs. We would like to have a smarter way to do that, we would lik to have a **General purpose** MQTT client that we can reuse everytime without the needs to copypaste code.



General MQTT client: the idea



General MQTT client: the code

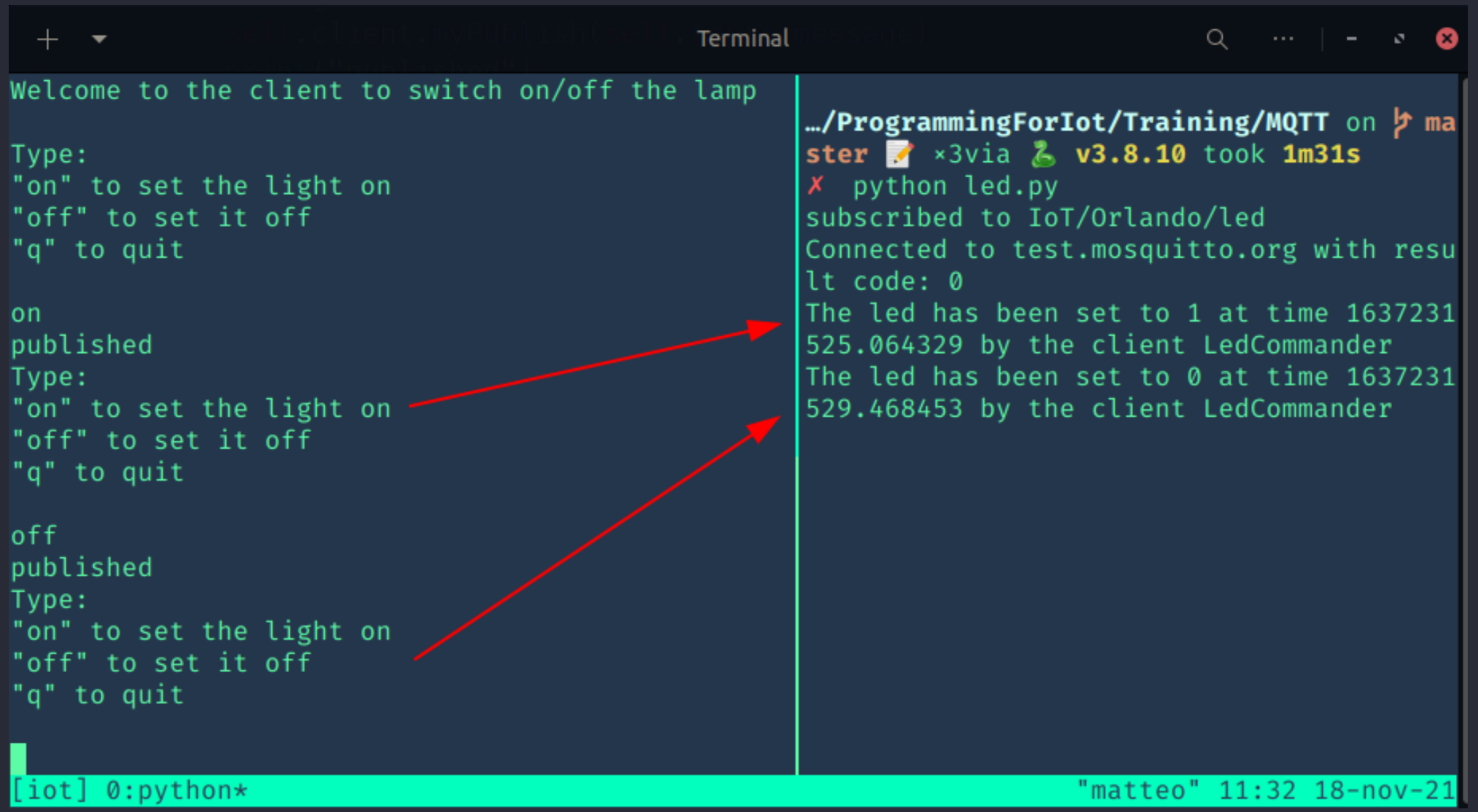
```python
import paho.mqtt.client as PahoMQTT

class MyMQTT:
    def __init__(self, clientID, broker, port, notifier=None):
        self.broker = broker
        self.port = port
        self.notifier = notifier
        self.clientID = clientID

        self._topic = ""
        self._isSubscriber = False

        # create an instance of paho.mqtt.client
        self._paho_mqtt = PahoMQTT.Client(clientID, False)

        # register the callback
        self._paho_mqtt.on_connect = self.myOnConnect
        self._paho_mqtt.on_message = self.myOnMessageReceived


    def myOnConnect (self, paho_mqtt, userdata, flags, rc):
        print ("Connected to %s with result code: %d" % (self.broker, rc))

    def myOnMessageReceived (self, paho_mqtt , userdata, msg):
        # A new message is received
        self.notifier.notify (msg.topic, msg.payload)
```

```python
    def myPublish (self, topic, msg):
        # if needed, you can do some computation or error-check before publishing
        print ("publishing '%s' with topic '%s'" % (msg, topic))
        # publish a message with a certain topic
        self._paho_mqtt.publish(topic, json.dumps(msg), 2)

    def mySubscribe (self, topic):
        # if needed, you can do some computation or error-check before subscribing
        print ("subscribing to %s" % (topic))
        # subscribe for a topic
        self._paho_mqtt.subscribe(topic, 2)

        # just to remember that it works also as a subscriber
        self._isSubscriber = True
        self._topic = topic

    def start(self):
        #manage connection to broker
        self._paho_mqtt.connect(self.broker , self.port)
        self._paho_mqtt.loop_start()

    def stop (self):
        if (self._isSubscriber):
            # remember to unsuscribe if it is working also as subscriber
            self._paho_mqtt.unsubscribe(self._topic)

        self._paho_mqtt.loop_stop()
        self._paho_mqtt.disconnect()
```

Exercise 1

Try to create a script that mimics a light that is an MQTT subscriber for the topic **IoT/<your-name>/led** and it has a status that can be on/off and . Then create a client that uses MQTT to set the status of the light from the terminal. USe the SenML format fro the MQTT payload.

In this case you will need to run both the script to make it work properly. In case you're connected to the Polito's network you need to run in on the same pc, otherwise this restriction does no apply.

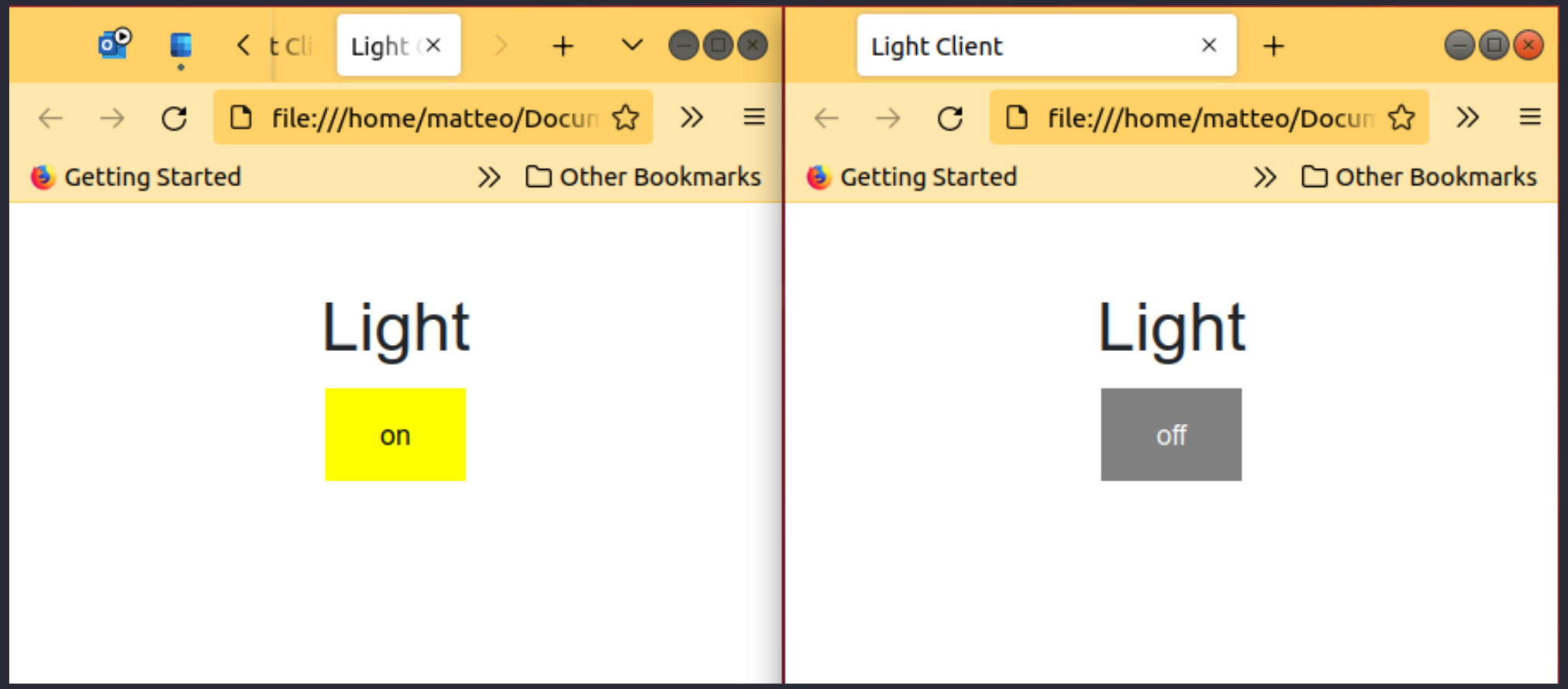

Terminal
Welcome to the client to switch on/off the lamp
Type:
"on" to set the light on
"off" to set it off
"q" to quit
on
published
Type:
"on" to set the light on
"off" to set it off
"q" to quit
off
published
Type:
"on" to set the light on
"off" to set it off
"q" to quit
…/ProgrammingForIot/Training/MQTT on master ×3via v3.8.10 took 1m31s
python led.py
subscribed to IoT/Orlando/led
Connected to test.mosquitto.org with result code: 0
The led has been set to 1 at time 1637231525.064329 by the client LedCommander
The led has been set to 0 at time 1637231529.468453 by the client LedCommander
[iot] 0:python*
"matteo" 11:32 18-nov-21

Exercise 2

Try to improve the previous exercise by creating a REST client to set the status of the light. You can use the file *'index.html'* as page for the GET request, when you will click on the button the page will execute a PUT request where the uri indicates the status we want to set (i.e. http://localhost:8080/on)

So we need to create a web service able to handle a **GET** request and a **PUT** request. The **GET** should return the index while the **PUT** should send an MQTT message to the proper topic with the status indicated in the URI of the request

This is the page you will see at the local url, when you will press the button the page will sent a PUT request as explained above



Exercise 3

For this exercise you've to make a client to follow the data coming from a group of sensors of temperature and humidity tht are on a building of the "IoT_project". The fake data are published from the script *"sensors.py"*, the building has 5 floors (from 0 to 4) with 3 room for each floor and one sensor in each room , for a total of 15 sensors. Each sensor publish the collected data on a topic of this kind:

```
buildingID/floorID/roomID/sensorID
```

so for example the sensor on the room 2 of the 3rd floor would publish it on :

```
IoT_project/2/3/dht_025
```

We want to create a client that give the possibility to choose how what data to retrieve according to three options

- Data from all the sensors of the building
- Data from all the sensor on a single floor
- Data from the sensor in a single room

If you feel bold enough you can try to give the user the possibility to change his idea and change what he wants to monitor on the fly