- **Laboratory 2b**
  - **Exercise 1**
    1. **Change the input test data and run the program to obtain the supervised learning result.**

       In this situation, we change the input test data from Temperature. When our input predict data is **30**, the output is **0**. When our input predict data is **25**, the output is **1**. In addition, when our input predict data is 25.5, the output is also 1. Because in our dataset, the data below 26 is classified as 1 and the data beyond 26 is classified as 0. This is different from our lab example. Because the KNeighborsClassifier's output is decided by its input dataset. The lab result is show below:

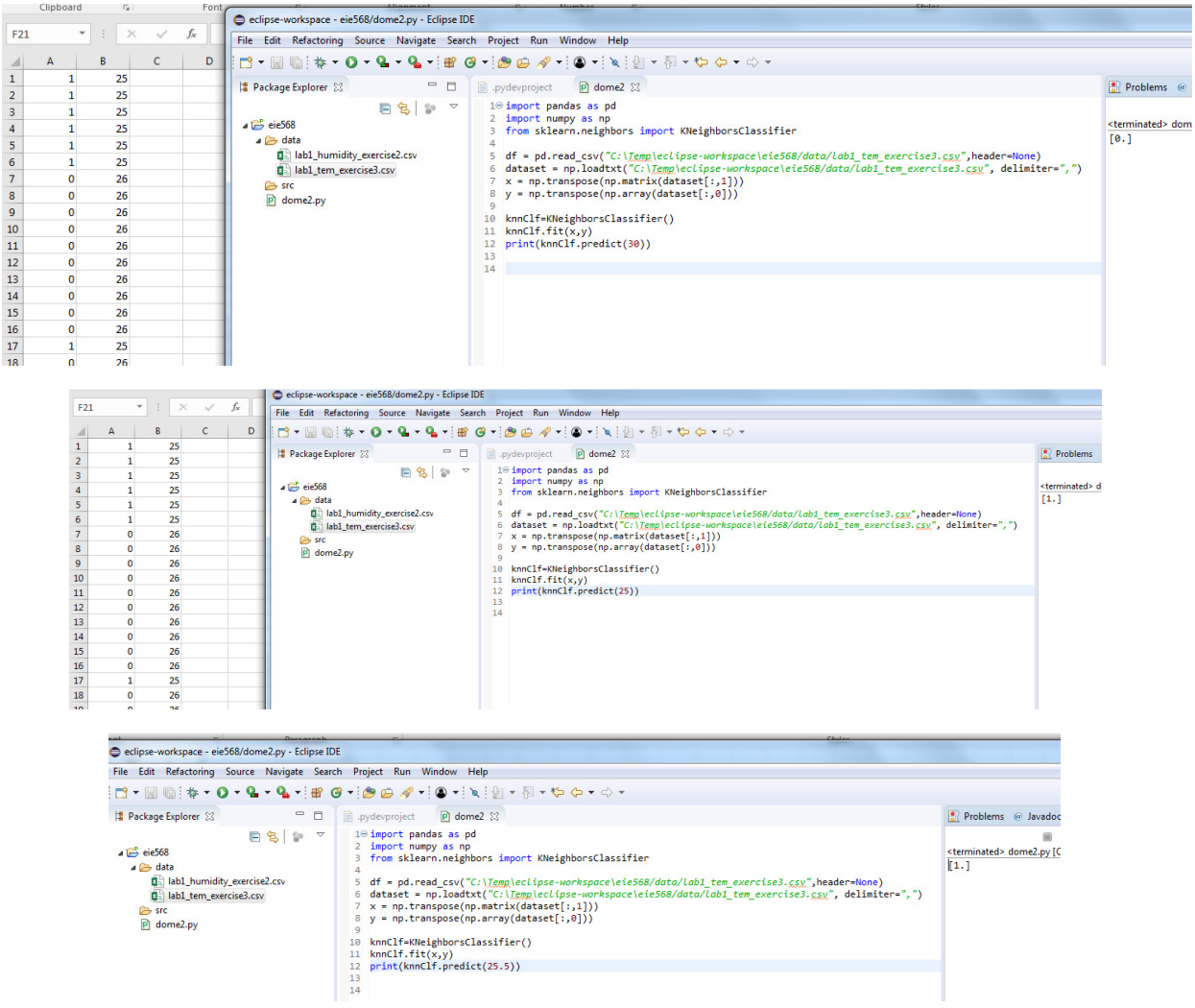

Fig2b_1. Temperature in KNeighborsClassifier

We Change our input data to Humidity. When our input predict data is 80, the output is 0. When our input predict data is 90, the output is 1. the result is showed as follow:

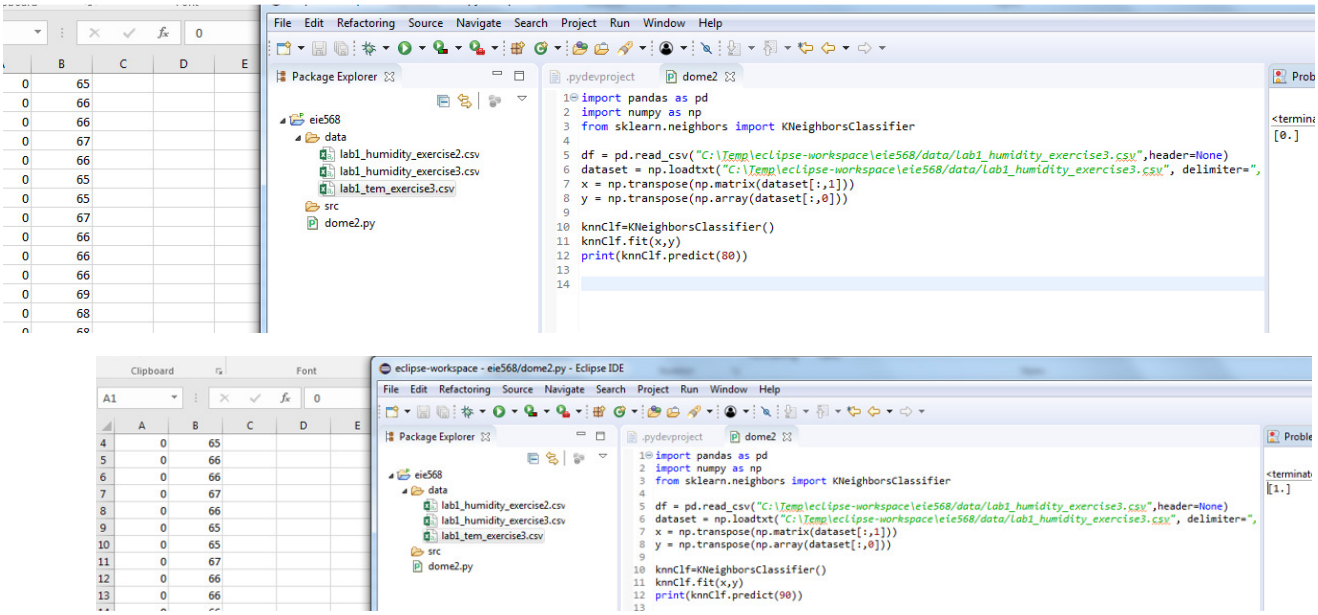

Fig2b_2. Humidity in KNeighborsClassifier

2. Change the supervised learning method (for example, SVM) and run the program to obtain the supervised learning result.

We change the classified method as **SVM**. In machine learning, support-vector machines (SVMs, also support-vector networks) are supervised learning models with associated learning algorithms that analyze data used for classification and regression analysis. Given a set of training examples, each marked as belonging to one or the other of two categories, an SVM training algorithm builds a model that assigns new examples to one category or the other, making it a non-probabilistic binary linear classifier (although methods such as Platt scaling exist to use SVM in a probabilistic classification setting).

We also use Temperature and Humidity as our training dataset. The predict output data is just similar as the KNeighborsClassifier. The Output result is just as follow:

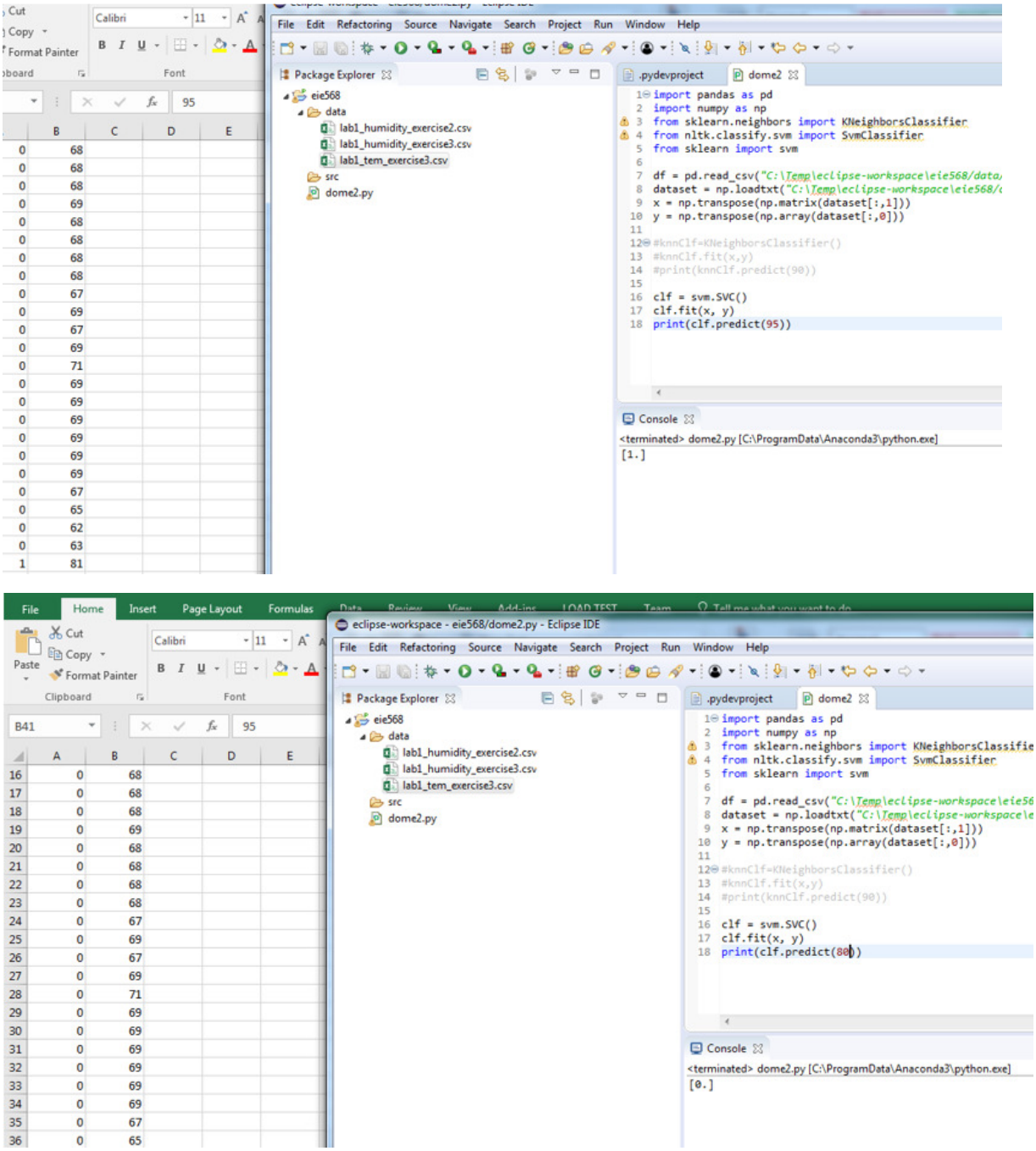

Fig2b_3. Humidity in SVM

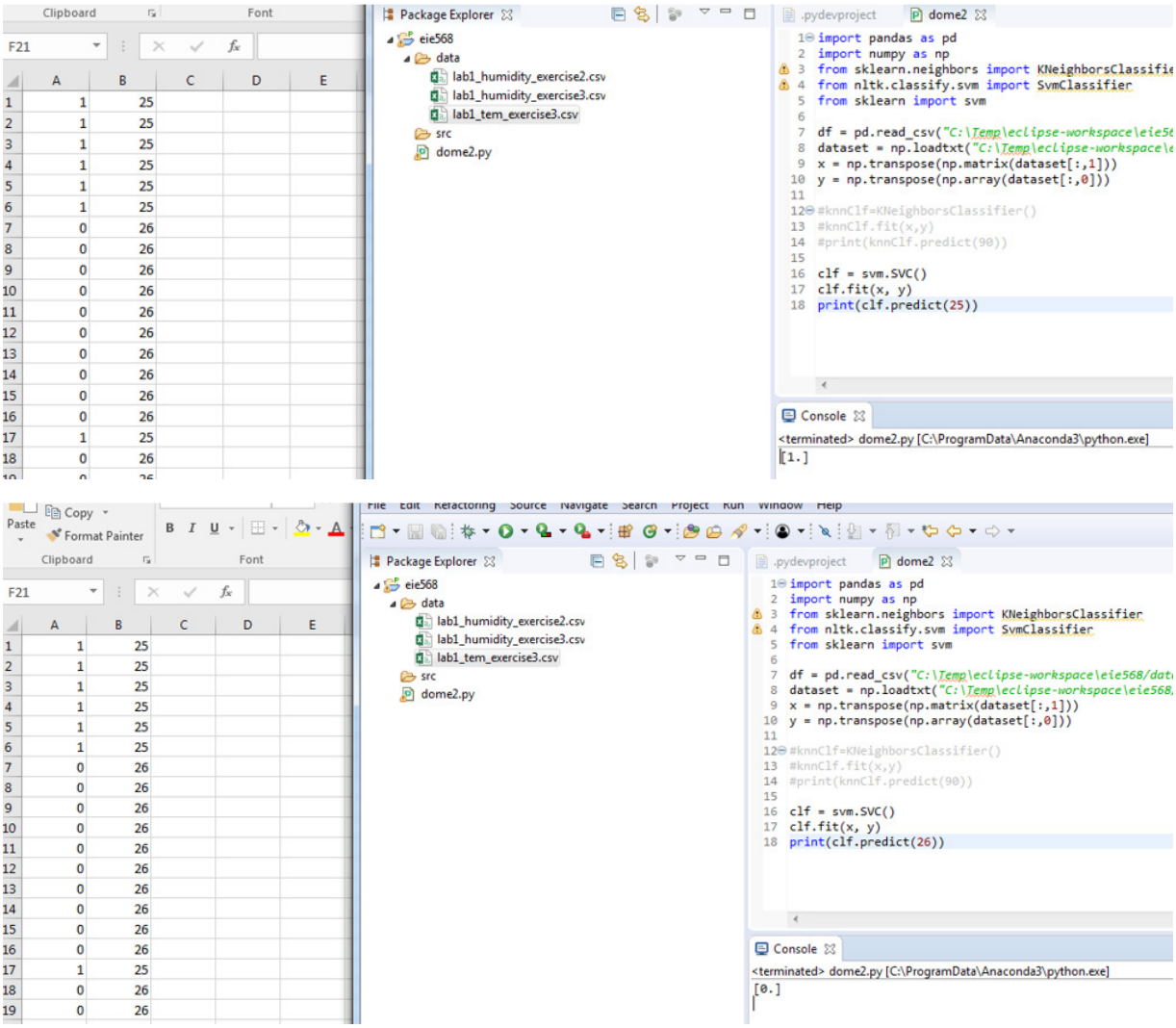

Fig2b_4. Temperature in SVM

In addition, we use K-means Classifier to classify our dataset. K-means clustering aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean, serving as a prototype of the cluster. This results in a partitioning of the data space into Voronoi cells. As for our dataset, we choose 2 cluster for K-Means method. For Temperature Dataset, when the input data is 22, the output data is 0. When the input data is 30, the output data is 1. From the result, we can see that the output is different from SVM and K-Neighbors. But why the result is different from other we do not know why.

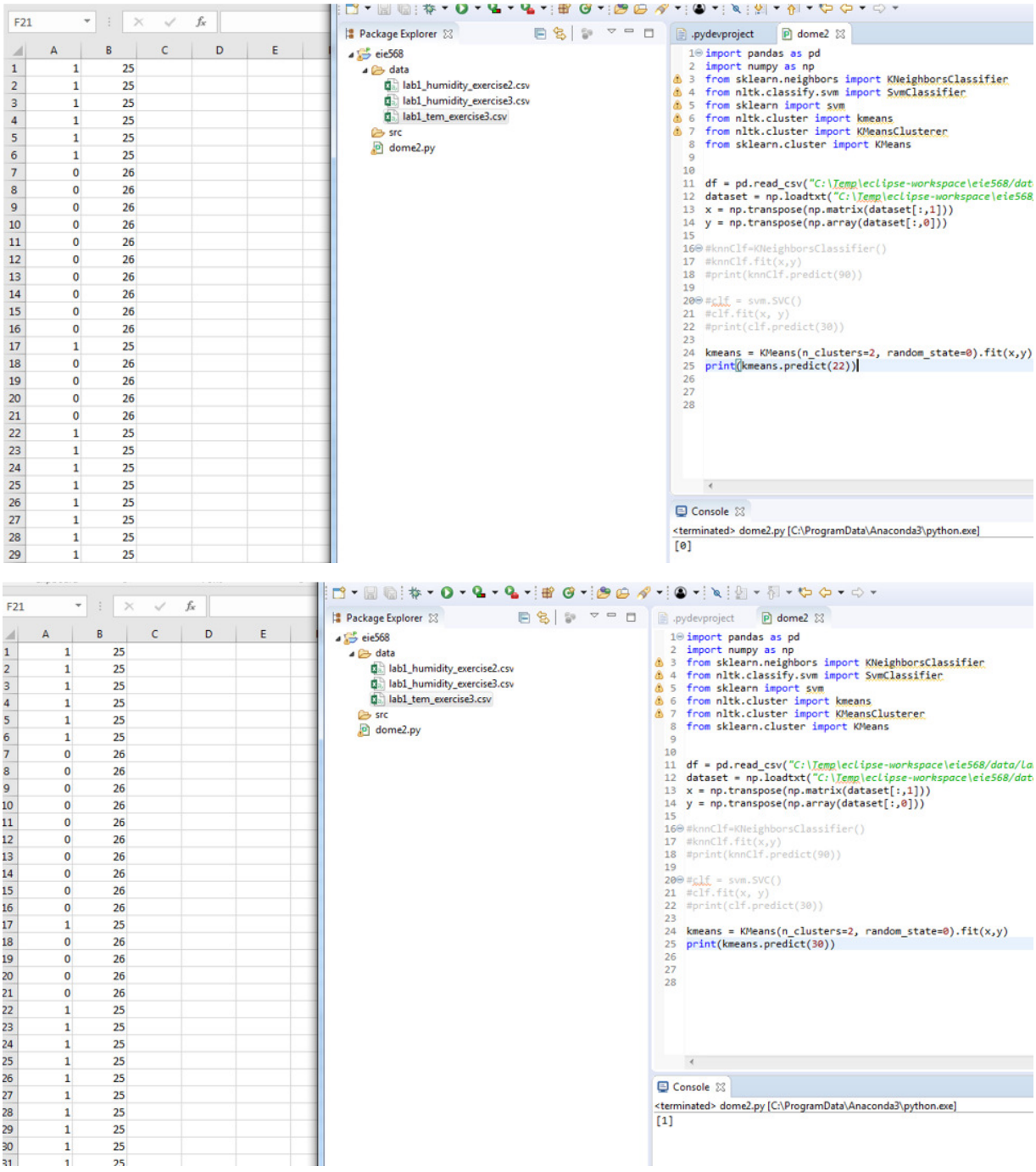

Fig2b_5. Temperature in K-means

- **Task 3. To design an IoT system application using the sensors in the demo system**

  We design a system to detect the laboratory's Voltage, Temperature and Humidity.

  The **voltage, temperature and humidity** management of the laboratory is very important for many laboratories. The stability of voltage, temperature and humidity is sufficient to ensure the stability and safety of the experiment. In the general chemical laboratory, the temperature is very important for the chemical reaction. The big influence, even the reaction product is not the product you want, and even worse, the temperature change of some chemicals can cause explosion and deterioration. In some situation, just as the data set Lab, the stability of voltage is very important. If the voltage change quickly, we must take action to handle it. Otherwise, it is very dangerous for our data set. The monitoring of temperature and humidity in biological laboratories is more important. Cells, tissues and organisms that are sensitive to temperature and humidity are very susceptible to irreversible damage caused by temperature and humidity changes.

  It is very important to establish a complete temperature and humidity monitoring system and use a temperature and humidity monitoring system. Many laboratories do not pay enough attention to this, and management is relatively confusing. Caused a lot of dangers.

  Actually, it is very easy to measure and analysis the lab's voltage, temperature and humidity at IOT technology nowadays. We are able to design a very simple and cheap **IOT system** with **Arduino** or others mini processor to detect and using machine learning to analysis those data. Using **LoRa or Sigfox** to transmit the collected data, and using machine learning to analysis it. When the temperature or humidity or voltage is beyond the normal level. The system will remind user to address it.

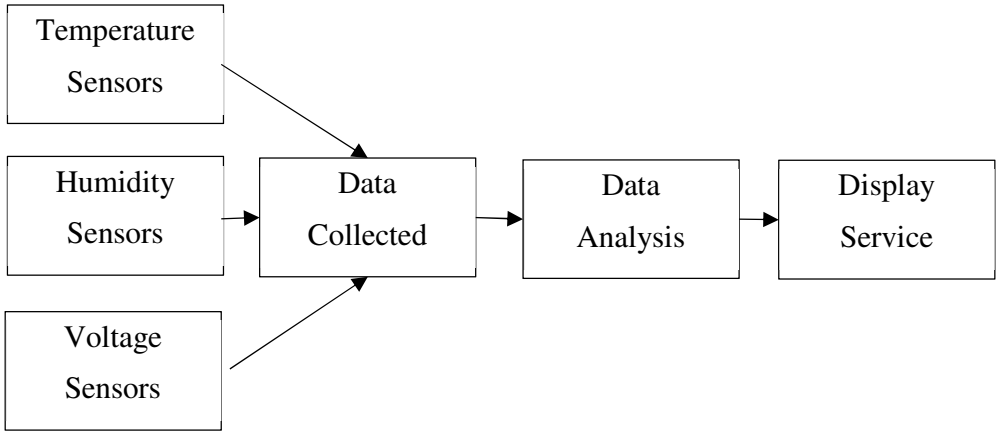

Fig2b_6. IOT system for Laboratory Voltage, Temperature and Humidity

- **Task 4. To analyze the designed IoT application data**
  1. **To illustrate the findings in the analysis based on unsupervised learning or supervised learning methods.**

Just as the data in our lab is supervised learning. Because the collected data has the label. Moreover, a function (model parameter) is learned from a given training data set, and when new data arrives, the result can be predicted based on this function. The training set requirements for supervised learning include input and output, and can also be said to be features and goals. The goal of the training set is marked by people. In our lab, we label the temperature for 0 or 1 and the humidity data just as the similar.

Supervised learning is the most common problem of classification (attention and clustering). An existing model is trained to obtain an optimal model (this model belongs to a set of functions, Optimal representation of the best under a certain evaluation criterion), and then use this model to map all the inputs to the corresponding output, and make a simple judgment on the output to achieve the purpose of classification. It also has the ability to classify unknown data. The goal of supervised learning is often to let computers learn the classification systems (models) we have created. Supervised learning is a common technique for training neural networks and decision trees. These two techniques are highly dependent on information given by a predetermined classification system. For neural networks, the classification system uses information to determine network errors and then constantly adjusts network parameters. For decision trees, the classification system uses it to determine which attributes provide the most information.

Common supervised learning algorithms: regression analysis and statistical classification. The most typical algorithms are KNN and SVM. It is also the method we use in our lab.

- ## Laboratory 3a

Step 1: Install Telegram on our phone

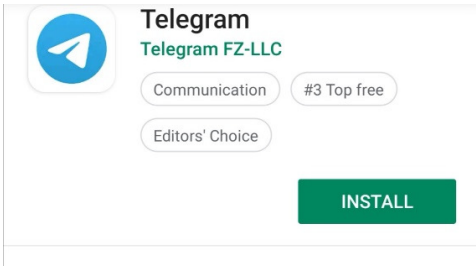

Fig3a_1. Install Telegram

Step 2: Creating a Telegram BOT and Getting our token for access. Our bot in Telegram is **IOT_group18_bot**.

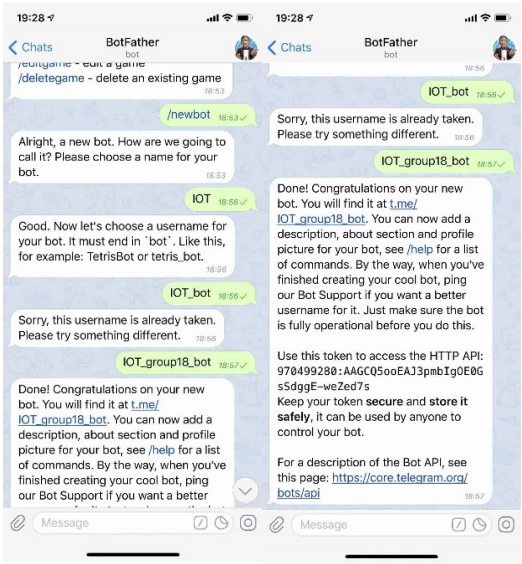

Fig3a_2. Telegram on our phone

Step 3: Telepot for installing Telegram on Raspberry Pi:

```
sudo apt-get update
sudo apt-get upgrade
sudo apt-get install python-pip
sudo pip3 install teleport
```

Step 4: Programming for Raspberry Pi

Task1: Messages receiver.

The code as follow:

```
import time
import telepot
from telepot.loop import MessageLoop
from pprint import pprint
# bot = telepot.Bot('TOKEN ')

bot = telepot.Bot('970499280:AAGCQ5ooEAJ3pmbIgOE0GsSdggE-weZed7s')

def handle(msg):
    pprint(msg)

MessageLoop(bot, handle).run_as_thread()
print('Listening ...')

while 1:
    time.sleep(1)
```

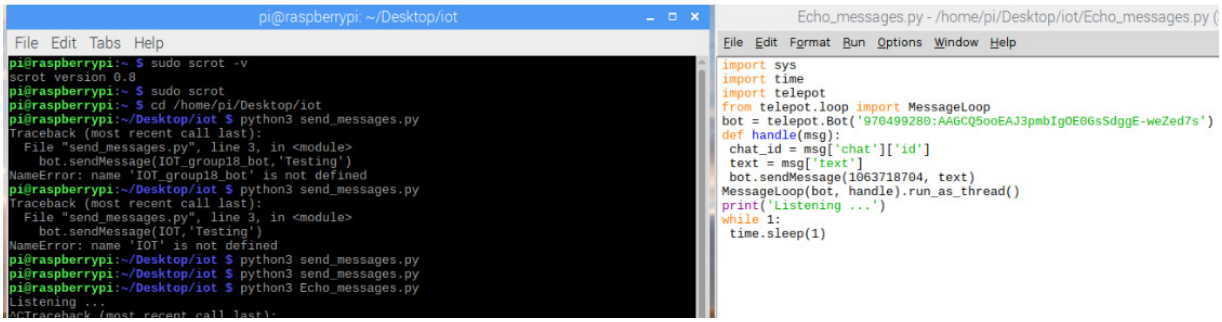

Fig3a_3. Messages receiver in Raspberry Pi

Task 2. Message transmitter

The code as follow:

```
import telepot
bot = telepot.Bot('970499280:AAGCQ5ooEAJ3pmbIgOE0GsSdggE-weZed7s')
bot.sendMessage(1063718704,'Hello_IOT')
```

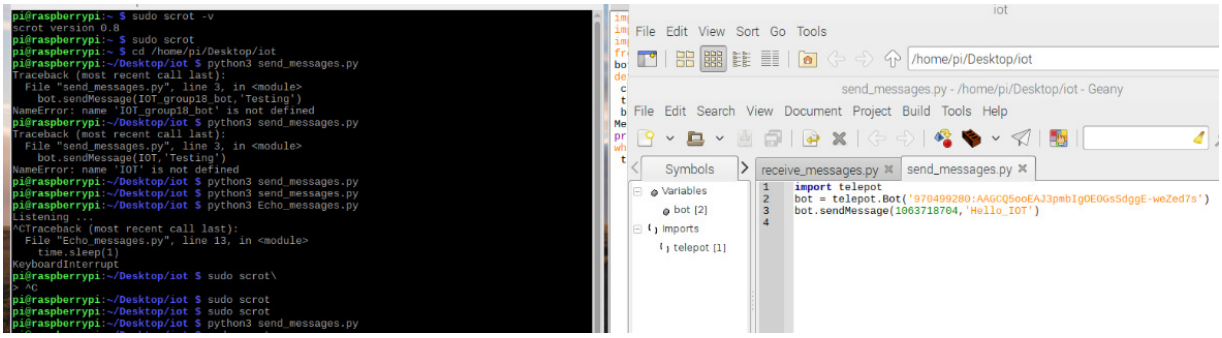

Fig3a_4. Messages transmitter in Raspberry Pi

Message echo:

The code as follow:

```
import sys
import time
import telepot
from telepot.loop import MessageLoop

bot = telepot.Bot('970499280:AAGCQ5ooEAJ3pmbIgOE0GsSdggE-weZed7s')
def handle(msg):
 chat_id = msg['chat']['id']
 text = msg['text']
 bot.sendMessage(1063718704, text)
MessageLoop(bot, handle).run_as_thread()

print('Listening ...')

while 1:
 time.sleep(1)
```

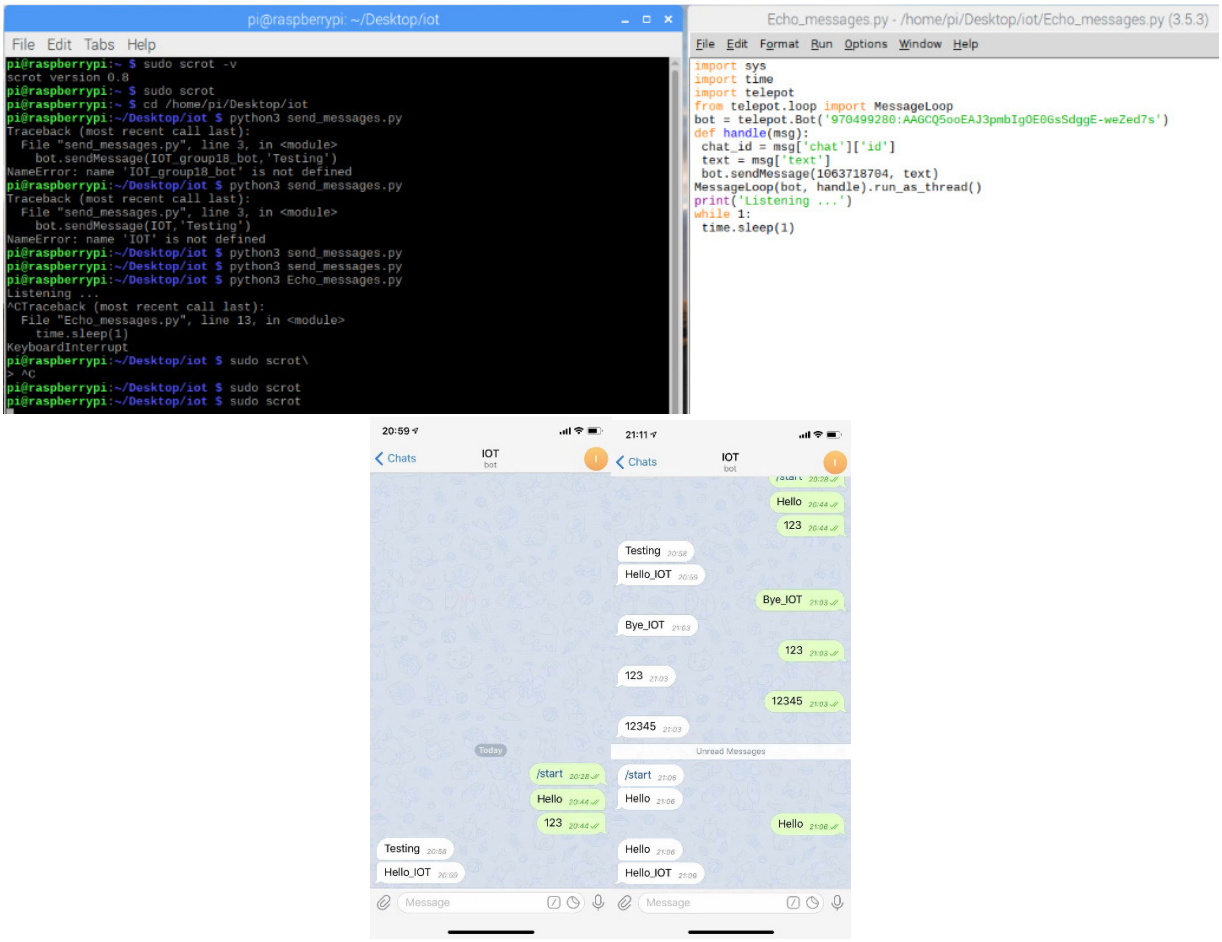

Fig3a_5. Messages Connectin between phone and Raspberry Pi

From this Communication, we know that Raspberry Pi and phone is very easily to connect throw Internet. Therefore, we can design some simple system in Pi, when the data is very large, we are able to transmit the dataset to service. In addition, we can send message to the user via phone easily.