

Configuration Manual

MSc Research Project
MSc Cloud Computing

Deva Loknathan Marri

Student ID: x21231346

School of Computing
National College of Ireland

Supervisor: Ahmed Makki

National College of Ireland
Project Submission Sheet
School of Computing



Student Name:	Deva Loknathan Marri
Student ID:	x21231346
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Configuration Manual

Deva Loknathan Marri
x21231346

1 Introduction

This guidebook tells you in great detail how to set up all the tools and software you'll need to build a whole system from scratch. With the help of the setup instructions, the study can be repeated in a more useful way. We are going to look at how the system works as a whole along with its user interface. In other words, how a person or a user will use the system user interface to connect with our system. This paper lists the steps that can be taken to replicate the implementation of the “ML model and Partial Homomorphic Encryption”.

The Configuration Manual will be segmented into the following parts.

- Environmental Setup
- Code Implementation

2 Environmental Setup

2.1 Hardware Requirements:

- 8GB RAM.
- 250 GB HDD.
- 2.6 GHz Intel. Core i5

2.2 Software Requirements:

- Windows 10
- Python 3.11.7

2.3 Programming Requirements:

- Python(Version 3.11.7)
- Jupyter Notebook
- Visual Studio Code

Library	Usage
pandas	Data manipulation and analysis. Used for reading and processing CSV files, as well as handling dataframes.
numpy	Numerical operations. Used for numerical computations and operations on arrays, such as converting data to arrays for machine learning models.
sklearn	Machine learning library. Used for linear regression modeling, data preprocessing (LabelEncoder), and splitting data into training and testing sets.
phe	Paillier homomorphic encryption library. Used for generating Paillier public and private keys, encrypting and decrypting data, and performing homomorphic computations.
json	JSON encoding and decoding. Used for serializing and deserializing data to and from JSON format, particularly for storing and loading keys and encrypted data.
matplotlib.pyplot seaborn	Plotting library for creating visualizations. Statistical data visualization library based on Matplotlib.
ipywidget	Interactive HTML widgets for Jupyter notebooks.

Table 1: Libraries and Their Usage

3 Libraries required:

The necessary libraries for constructing this research project are listed in table 1, along with their respective applications.

4 Coding Implementation:

This section presents the implementation of a Partial homomorphic encryption system. The whole system has been divided into fundamental functions, including Machine learning predictionModel, key generation, encryption, decryption, and evaluation. To execute the program, we must access the folder that contains the code in Visual Studio Code.

”Partial Homomorphic Encryption” Data encryption in classical cryptography relies on a public key. The two parties then trade private keys in order to decode it. For data processing to take place in the cloud, the secret key must be accessible to the cloud server. With homomorphic encryption, the cloud may securely conduct calculations on encrypted data or ciphertext, simplifying the process. Afterwards, provide the data owner with the encrypted findings. Therefore, data remains completely private regardless of its storage location as it is never decrypted.

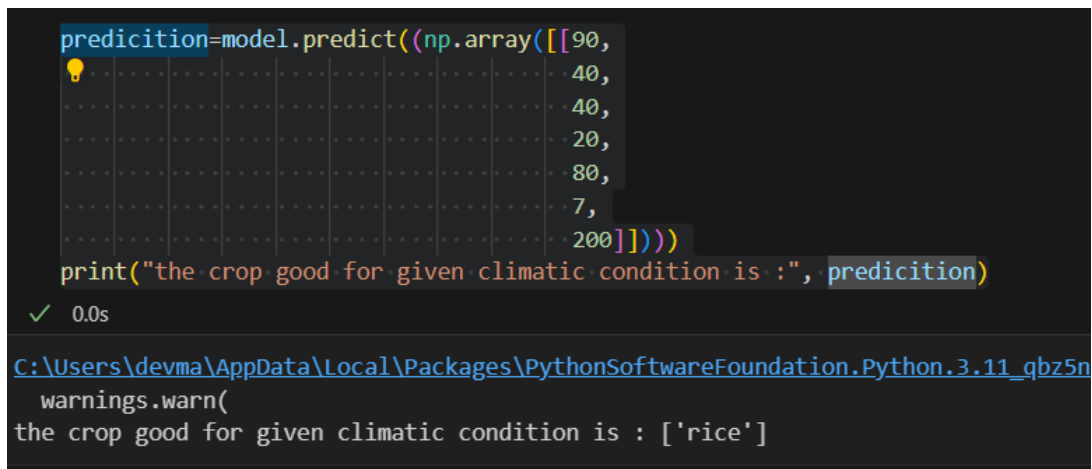
Partially Homomorphic Encryption is a kind of encryption that requires two conditions

to be satisfied: 1) The product of D and E, where D is the Decrypt function and E is the Encrypt function, and A and B are the ciphertexts, is equal to A+B. 2) $D(E(A) \cdot \text{scaler}) = A \cdot \text{scaler}$, where scaler is a constant number (the value's exponent according to this project).

1) I have included Pascal Paillier Homomorphic Encryption in the given code. This section of the code is structured as follows: first, `linmodel.py`: Using characteristics like N, P, K, temperature, humidity, ph, and rainfall, this website uses linear regression on the crop recommendation csv dataset to forecast results for certain conditions. Second, `log.py`: Using characteristics like N, P, K, temperature, humidity, ph, and rainfall, this website uses logistic regression on the crop recommendation csv dataset to forecast results for certain conditions.

2) `cust.py`: On the client side, this page uses Paillier Homomorphic encryption to generate public and private keys. It then uses the `encrypt()` function to serialize the data, producing an encrypted number that can be saved on the cloud. Finally, it creates a json file to be sent to the server or the cloud. Additionally, the `answer.json` file that the client gets from the server is loaded using the `loadAnswer()` method.

3) The third page, `servercalc.py`, is responsible for decrypting the data given by the customer. It does this by using the `EncryptedNumber()` function, which generates the client-side `EncryptedNumber` using the public key and ciphertext. The server-side serialization process continues by multiplying the encrypted number by the coefficients produced by linear regression on the data. This produces the expected outcomes for the related data. Last but not least, updating the `answer.json` file with the serialized forecast data.



```

prediction=model.predict((np.array([[90,
40,
40,
20,
80,
7,
200]])))
print("the crop good for given climatic condition is :", prediction)

```

✓ 0.0s

C:\Users\devma\AppData\Local\Packages\PythonSoftwareFoundation.Python.3.11_qbz5n
 warnings.warn(
 the crop good for given climatic condition is : ['rice']

Figure 1: ML output

References

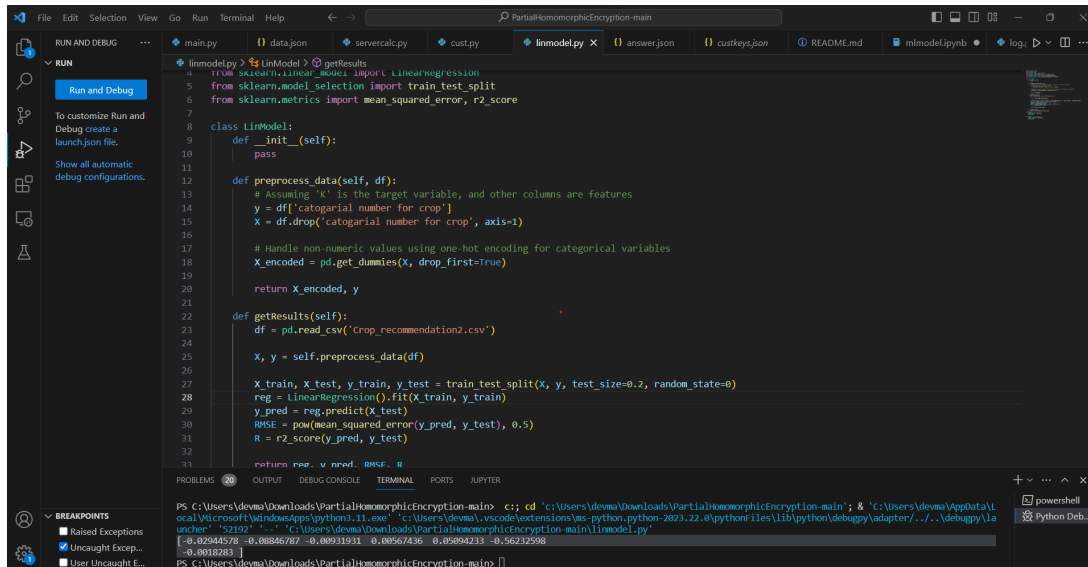


Figure 2: linear regression

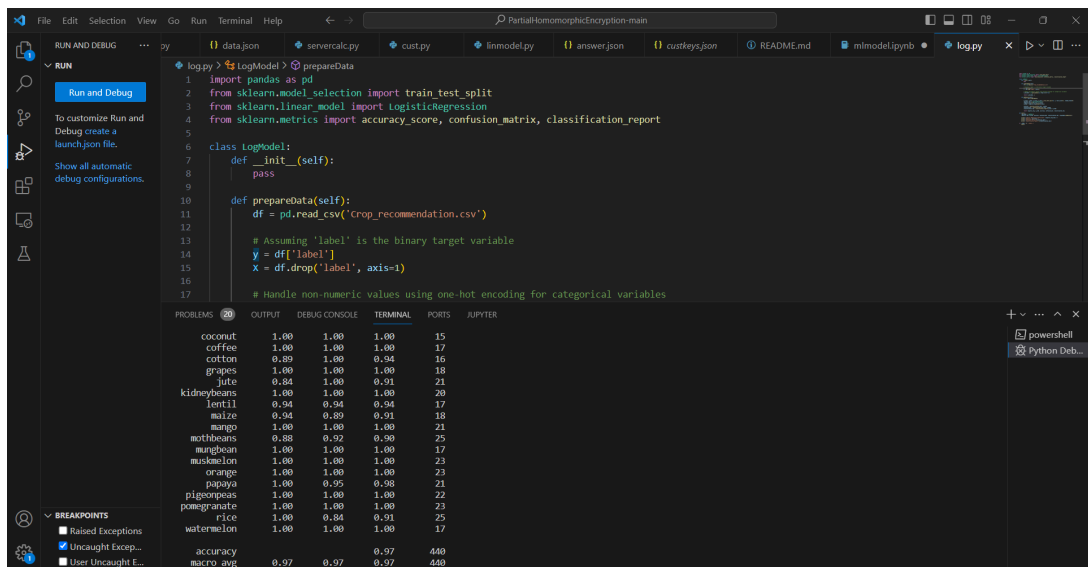
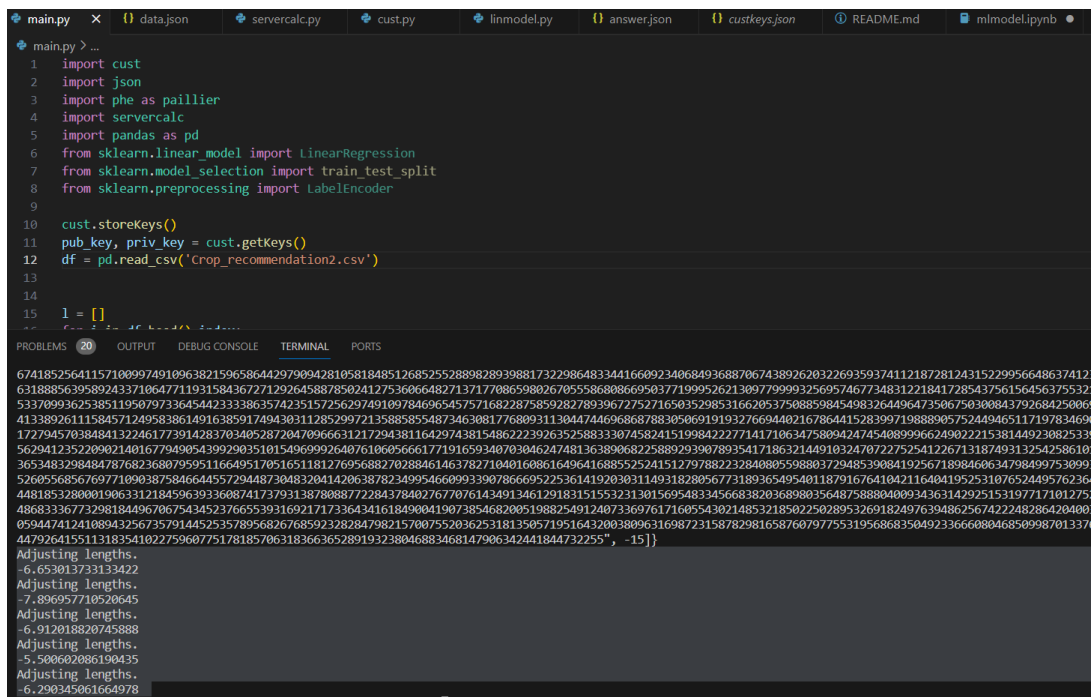


Figure 3: logistic regression



The image shows a code editor with a dark theme. The top bar displays several open files: main.py, data.json, servercalc.py, cust.py, linmodel.py, answer.json, custkeys.json, README.md, and mlmodel.lipynb. The main.py file is active, showing the following code:

```
1 import cust
2 import json
3 import phe as paillier
4 import servercalc
5 import pandas as pd
6 from sklearn.linear_model import LinearRegression
7 from sklearn.model_selection import train_test_split
8 from sklearn.preprocessing import LabelEncoder
9
10 cust.storeKeys()
11 pub_key, priv_key = cust.getKeys()
12 df = pd.read_csv('Crop_recommendation2.csv')
13
14
15 l = []
16 for i in df['Crop']:
17     l.append(i)
```

Below the code editor, the terminal window is open, displaying a large block of hexadecimal data, followed by several lines of text indicating the model's performance:

```
674185256411571009974910963821596586442979094281058184851268525528898289398817322986483344166092340684936887067438926203226935937411218728124315229956648637412
63188856395892433710647711931584367271292645887850241275360664827137177886598026705586808669503771999526213097799993256957467734831221841728543756156456375532
533709936253851195079733645442333386357423515725629749109784696545757168228758592827893967275271650352985316620537508859845498326449647350675030084379268425006
41338926111584571249583861491638591749430311285299721358858554873463081776809311304474469686878830506919193276694402167864415283997198889057524946511719783469
172794570384841322461773914283703405287204709666312172943811642974381548622239263525883330745824151998422277141710634758094247454089996624902221538144923082533
56294123522090214016779490543992903510154969992640761060566617719165934070304624748136389068225889293907893541718632144910324707227524122671318749313254258610
365348329848478768236807959511664951705165118127695688270288461463782710401608616496416885525241512797882232840805598803729485390841925671898460634798499753099
52605568567697710903875846644557294487304832041420638782349954660993390786695225361419203031149318280567731893654954011879167641042116404195253107652449576236
448185328000190633121845963933608741737931387808877228437840276770761434913461291831515532313015695483345668382036898035648758880400934363142925153197717101275
486833367732981844967067543452376655393169217173364341618490041907385468200519882549124073369761716055430214853218502250289532691824976394862567422248286420400
059447412410894325673579144525357895682676859232828479821570075520362531813505719516432003809631698723158782981658760797755319568683504923366608046850998701337
447926415511318354102275960775178185706318366365289193238046883468147906342441844732255", -15]]
Adjusting lengths.
-6.65301373313422
Adjusting lengths.
-7.896957710520645
Adjusting lengths.
-6.912018820745888
Adjusting lengths.
-5.500602086190435
Adjusting lengths.
-6.290345061664978
```

Figure 4: main.py