SMART FACE RECOGNITION TO IDENTIFY PREMIUM CUSTOMERS

SUBMITTED TO THE

THE SCHOOL OF ENGINEERING AND INFORMATION TECHNOLOGY

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TERM III

POST GRADUATE DIPLOMA

IN

DATA SCIENCE

BY

MOHAMED IDRIS A MARICAR

REGISTRATION NUMBER: 190114011

UNDER THE GUIDANCE AND SUPERVISION OF

DR. T. K. SENTHIL KUMAR

SCHOOL OF ENGINEERING AND INFORMATION TECHNOLOGY

MANIPAL ACADEMY OF HIGHER EDUCATION, DUBAI CAMPUS

DUBAI, UNITED ARAB EMIRATES

(OCTOBER 2020)

CERTIFICATE

This is to certify that the Report Titled

PROJECT REPORT

Describes the bona fide work done by

MOHAMED IDRIS A MARICAR

(Registration No. 190114011)

For the completion of the course

PROJECT WORK/INTERNSHIP (DSC 499)

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Dr. T.K.SENTHIL KUMAR

Faculty Guide

Internal Examiner **External Examiner**

External Exam held on: __08/11/2020__

DECLARATION

I hereby declare that the matter embodied in this Thesis/Project work entitled is the result of the analysis and research work carried out by me under the guidance of **Dr. T.K. SENTHIL KUMAR** School of Engineering and Information Technology, Manipal Academy of higher Education, Dubai campus, U.A.E. This work has not previously been submitted with, associates or any other similar title, to any candidate of any university.

MOHAMED IDRIS A MARICAR
Registration Number: 190114011

Post Graduate Diploma in Data Science,
Manipal Academy of Higher Education, Dubai campus,
United Arab Emirates.

ACKNOWLEDGEMENT

I would like to express my gratitude to many people who have helped me in different ways with the development of this project. My heartfelt gratitude goes to my parents for their continuing love and support.

The work I have performed in this project would never have been possible without the guidance, dedication and support of my supervisor Dr. T.K. Senthil Kumar for which I am eternally grateful.

I also wish to express my most sincere thanks to the Chairperson; Program Coordinator. all faculty members especially for their invaluable support. Their teachings and guidance have given me knowledge which I will treasure for the rest of my life

Lastly, I would also like to thank my family for their continued support and Hussain Challawala, my project group mate for his efforts.

MOHAMED IDRIS A MARICAR
Registration Number: 190114011

Post Graduate Diploma in Data Science,
Manipal Academy of Higher Education, Dubai campus,
United Arab Emirates.

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ABSTRACT

A facial recognition system is a technology capable of matching a human face from a digital image or a video frame against a database of faces. The identification process is based on a funnel that goes through collection, detection, pre-processing, and recognition stages. The focus of this study is on the last stage of the funnel with the assumption that images have already been collected and pre-processed. Traditional solutions use the entire facial image as the input to their algorithms in order to recognize the image. We have adopted a different approach where the input to the recognition algorithm is the individual segment of the face such as the left eye, the right eye, the nose, and the mouth.

For each run, accuracy and error rate of the results are tabulated and analyzed. In the second experiment, extracted facial feature segments are used as the input to the same algorithms. The output from each algorithm is subsequently labeled and placed in the appropriate feature class. Our analysis shows how the granularity of collected data for each segmented class can be leveraged to obtain an improved accuracy rate over the full face approach.

In automatic face recognition we desire to either identify or verify one or more persons in still or video images of a scene by means of a stored database of faces. One of the important features of face recognition is its non-intrusive and non-contact property that distinguishes it from other biometrics like iris or fingerprint recognition that require subjects' participation.

INTRODUCTION

Facial recognition has been an active area of research and exploration in the past several decades. Initially when the idea was in its infancy stage it was available to a selected scope of areas such as NASA and Pentagon, however today the availability of facial recognition is been available to individual's palm be it accessing mobile phone or laptop.

Especially facial recognition has emerged off lately as a more significant element in human recognition or human authentication. After Covid-19 pandemic it is evident that most of the humans are avoiding touching surfaces which exposed to people at large.

There are plenty of scope in facial recognition algorithms application and that itself is a research by itself. With the evolution of IOT, especially with the increase of CCTVs all over the place that is capable of high quality night vision, the scope of data science projects is increasing considerably

PROBLEM STATEMENT, OBJCETIVES & GOALS:

Automatic recognition of human faces has many commercial and security applications in identity validation and recognition.

Identifying premium customers walking into the showroom. There are many outlets of luxury stores where premium customers walks into the store expects a VIP treatment. With the growing number of stores for any luxury brand, premium customers could walk into any store in any part of the world an expect a similar treatment they received in their primary store.

We as students of Data Science worked to provide a solution to those luxury outlets.

The model is when a customer walks in the store, his picture is captured from CCTV footage, applying Face Recognition Algorithms in the most efficient way, the greeter at the store gets to see on their tablet the name

of the customer perhaps his/or her last transaction. It is the best customer experience if he or she is called by the name by the greeter/salesperson [details will follow in due course].

OBJECTIVE:

To provide the customers an excellent concierge level hospitality experience.

ADVANTAGES OF THE MODEL:

1) Scalability
2) Direct Business Implications
3) Accuracy ➔ 99%
4) Time taken to process 1 picture from the video ➔ less than 1 minute
5) Inexpensive
6) Universal Projects

CHALLENGES:

In today's world the facial recognition is a very mature technology being placed at various places.

The idea behind this is to provide an inexpensive solution, however following inherited challenges we have faced during the workings:

1) **In current Covid-19 situation:** wearing masks is a bottle neck which do not give full facial recognition from the algorithms used by us.
2) **Time complexity:** However, we have introduced Virtual Environment to curb down the time it takes to process, still a lot of improvement is needed.
3) **Infrastructure:** Hardware & Software needs to be ascertain to match and kill the requirements of Time Complexity , keeping it inexpensive.

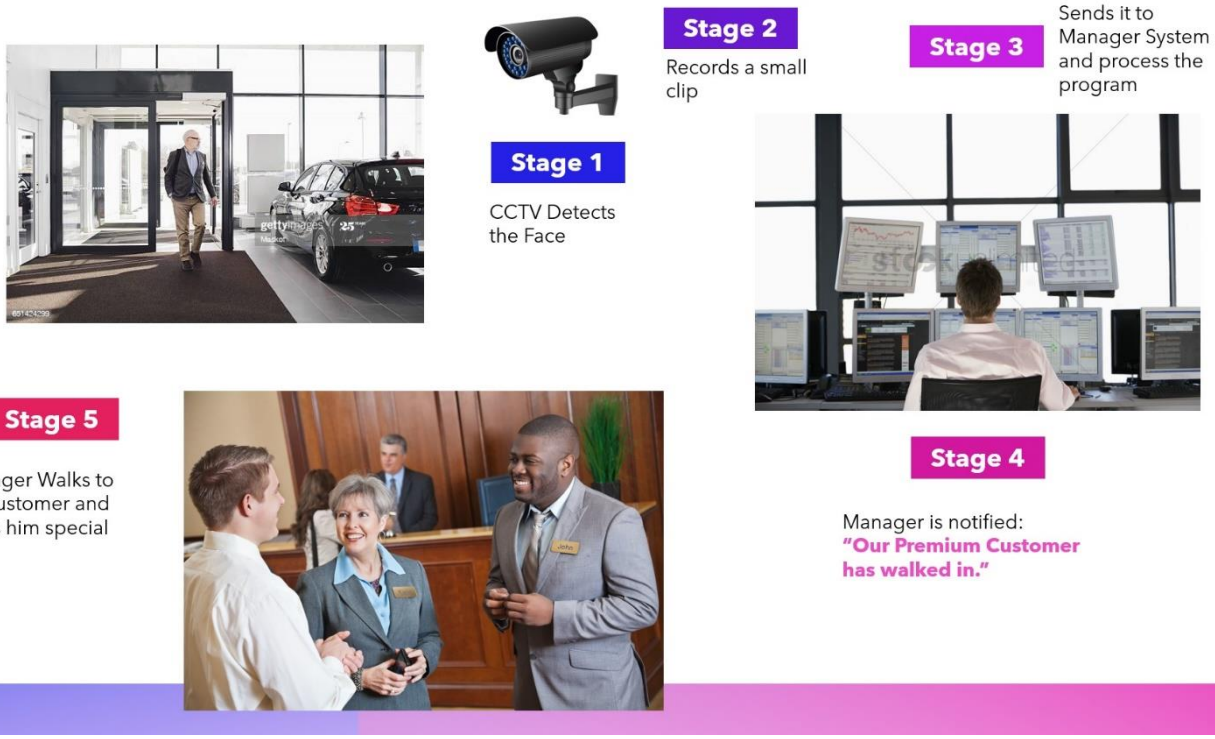
METHODLOGY USED:

The program is set to read a video file that would be recorded when customer walks in. This video file is then going to be sent to the Manager's system, which would process to identify the person who entered the showroom as a premium customer or not.

The most time taken in a face recognition project is to read the entire database of faces and compare it with the customer's face walking in. Ideally, a face first needs to be located from the image following which the encodings of the face is captured. This is then followed by extracting the encodings of the entering customer, which is then compared. Let's say the company has a database of 500 premium customers. If one face takes half a minute to extract the encoding, we are talking about hours of processing.

Hence, we had to take a different route to solve this. Instead of processing the 500 customers' faces (for example) at that moment in time, we can have those encodings stored in our database for ready comparison. Now, when the customer walks in, it is only his/her face that needs scanning. Once those encodings are extracted, we will run a loop on the registered encodings in our database. This would take much lesser time depending on the type of infrastructure the operation is being performed.

The encodings after being compared will yield a result as to whether the customer who walked in was from our premium customer list or not. This can be visualized as below diagram (Diagram 1.1)



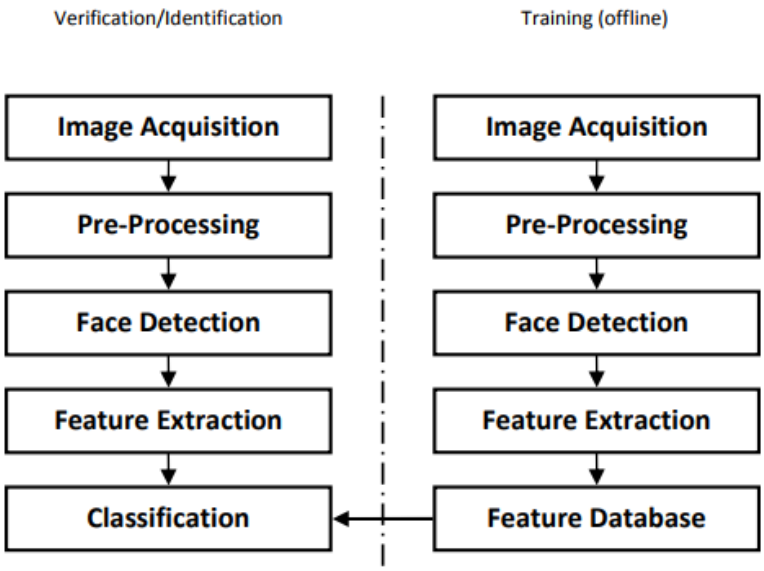
Algorithms and Mathematical equation

1. Prepare a “left eye” feature by running the left eye classifier on all the images in the training set.

2. Prepare a “right eye” feature by running the right eye classifier on all the images in the training set.

3. Prepare a “both-eye” feature by running both-eye classifier on all the images in the training set.

4. Prepare a “nose” feature by running the nose classifier on all the images in the training set



TECHNOLOGY USED

CCTV input of the camera capturing the face. 2 to 3 seconds video of every face will be saved in the folder. The program is written on python using Face Recognition along with DLIB and OpenCV

EXPERIMENTS, WORK DONE

We have processed a number of sample video with registered and unregistered faces and we found the accuracy to be almost close to 100% at a relaxed threshold of 0.5. The following codes can be used for the process and different stages of coding:

Stage 1: Capturing and sending video clip into the program

```
# Importing all necessary libraries
import dlib
import cv2
import face_recognition
import pandas as pd
import os

# Read the video from specified path
cam = cv2.VideoCapture(r"C:\Users\Idris\Desktop\facerecog\Final
Project\Video samples\VID00005.mp4")

try:

    # creating a folder named data
    if not os.path.exists('data'):
        os.makedirs('data')

# if not created then raise error
except OSError:
    print ('Error: Creating directory of data')

# frame
currentframe = 0

while(True):

    # reading from frame
    ret,frame = cam.read()

    if ret:
        # if video is still left continue creating images
        name = './data/frame' + str(currentframe) + '.jpg'
        print ('Creating...' + name)

        # writing the extracted images
```

```
        cv2.imwrite(name, frame)

        # increasing counter so that it will
        # show how many frames are created
        currentframe += 1
    else:
        break

# Release all space and windows once done
cam.release()
cv2.destroyAllWindows()
Creating..../data/frame0.jpg
Creating..../data/frame1.jpg
……
Creating..../data/frame35.jpg (SELECTED IMAGE FOR PROCESSING)
……
Creating..../data/frame90.jpg
Creating..../data/frame91.jpG
```

Stage 2: Fetching the Face from captured image of the video

```
image1 = cv2.imread(r'C:\Users\Idris\Desktop\facerecog\Fin
Project\data\frame35.jpg')
#image1 = cv2.resize(image1,(0,0), fx=0.2, fy=0.2)
image1 = cv2.imread(r'C:\Users\Idris\Desktop\facerecog\Final
Project\idrisusa.jpg')
image1 = cv2.resize(image1,(0,0), fx=0.2, fy=0.2)
cv2.imshow('a', image1)
cv2.waitKey(0)        OUTPUT
```

stage 3: Loading the encodings of the Premium Customers' faces

```
data = pd.read_csv(r'C:\Users\Idris\Desktop\facerecog\Final
Project\Encodings.csv')
data.shape


(11, 128)
encoding = data.values
```

Stage 4: Analysing input face image; extracting location of face, encodings and performing comparison with old encodings

```
loc1=face_recognition.face_locations(image1,number_of_times_to_upsample
=1,model="cnn")
face_encoding1 =
face_recognition.face_encodings(image1,known_face_locations=loc1)
for i in range(len(encoding)):
```

```
    results = face_recognition.compare_faces([face_encoding1[0]],
encoding[i], tolerance = 0.5)
```

Stage 5: Notifying the manager about the type of customer identified from the image: Premium or not.

```
if results[0] == True:
    print('\033[95m' + color.BOLD +'One of our Premium customer has
entered the showroom. Please welcome and make him comfortable.'
          + color.END)

else:
    print('The customer who entered is not among the Premium customer
list.')
```

FINAL OUTPUT

One of our Premium customers has entered the showroo m. Please welcome and make him comfortable.

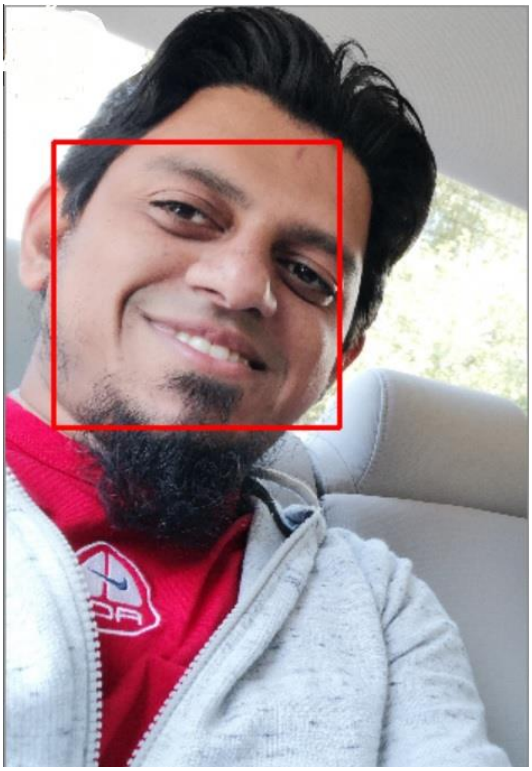
ANALYSIS PART

We can upscale this project to fetch the premium customers from multiple faces, if the registered customer is accompanied by someone. We would need to create a loop usually would take some more time. We can also make the whole process more seamless by enabling an automatic input of the video with the face image and automate the program upon receiving the file.

Additionally we can also link this project with other CLTV projects that may already exist in the company. Meaning, every a customer is declared a Premium customer, his or her face image is automatically updated to the system. Customer can be treated with a surprise as he or she enters the showroom the first time after being declared premium.

DATA SET SOURCE:

100% indigenous data is used in the testing, execution and obtaining results.



CONCLUSION:

A classification of face recognition algorithms into frontal, profile, and view-tolerant approaches was given. Most of the recognition systems available today have been demonstrated only on limited datasets, often recorded under restricted conditions. The data chose in this experiment assures the scalability of the model project.

REFERENCES & CITATION:

We have also used famous faces of political figures, sports to form a dataset of encodings

[1] Definitions from Wikipedia

[2] Project work of research done in 2011 and 2015 by Windsor and SJSU students

[3] Geekforgeeks.org for codes on how to read video file and save frames as files in a folder

[4] Kaggle

YOUR ROLE AND CONTRIBUTION IN CASE OF GROUP

I was involved in most of the coding and the technical aspect of the project. I had to create the virtual environment for the project that was needed to install the necessary libraries such as Face Recognition, DLIB and OpenCV

Setting up the virtual environment was very challenging. I had to perform many trial and errors in order to achieve the right platform. More on this topic of how we got the whole environment setup is covered under the Annexure

RESULTS

The results for our project was achieved on the video files we had run. Wherever, the file had image of registered person, it detected that the person was a premium customer. In other cases, it predicted False, which meant the face was not matching existing

We can also increase the scope of Results simply by storing the encoding of unmatching customers. This could serve us for further analysis. Ideally customers are happy when they are treated well. In luxury stores, it is a must have for customers. The more customer feels welcomed and honored the more he/she will get inclined towards the brand.

OUTCOME DISCUSSION

The outcome expected from this project was to confirm whether an input face was available in the database of faces. The project yield us favorable outcome when the system was given inputs. By enabling live streaming features can we will come to know how this feature performs in real time.

The CCTV feeds have automatic saving option but that depends on version and option. We had the chance to access a few CCTV using web application to see how the videos were recorded and stored. There was more manual storing of data in those models. Hence, the way video footage could be retrieved automatically as a face comes by it, still remains a topic of research and development.

But the project if effected well, could attract many business owners investing in it since, additional projects such customer frequency, customer monitoring can add more value to the organization.

CONCLUSION

Face recognition may seem like an easy to do project. But from the setting up of necessary packages for the machine to run a face recognition project to designing the right process to execute this project, face recognition take a lot of time, energy and patience to put together as one piece.

On top of that, plenty of testing is required to make sure project accuracy is maintained.

REFERENCES

H. Wang, S.Z. Li and Y. Wang. **Face recognition under varying lighting conditions using self quotient image**. In IEEE International Conference on Automatic Face and Gesture Recognition (AFGR), pages 819-824. 2004.

G. Heusch, Y. Rodriguez, and S. Marcel. **Local Binary Patterns as an Image Preprocessing for Face Authentication**. In IEEE International Conference on Automatic Face and Gesture Recognition (AFGR), 2006.

B. Moghaddam, W. Wahid and A. Pentland. **Beyond eigenfaces: probabilistic matching for face recognition**.

ANNEXURES

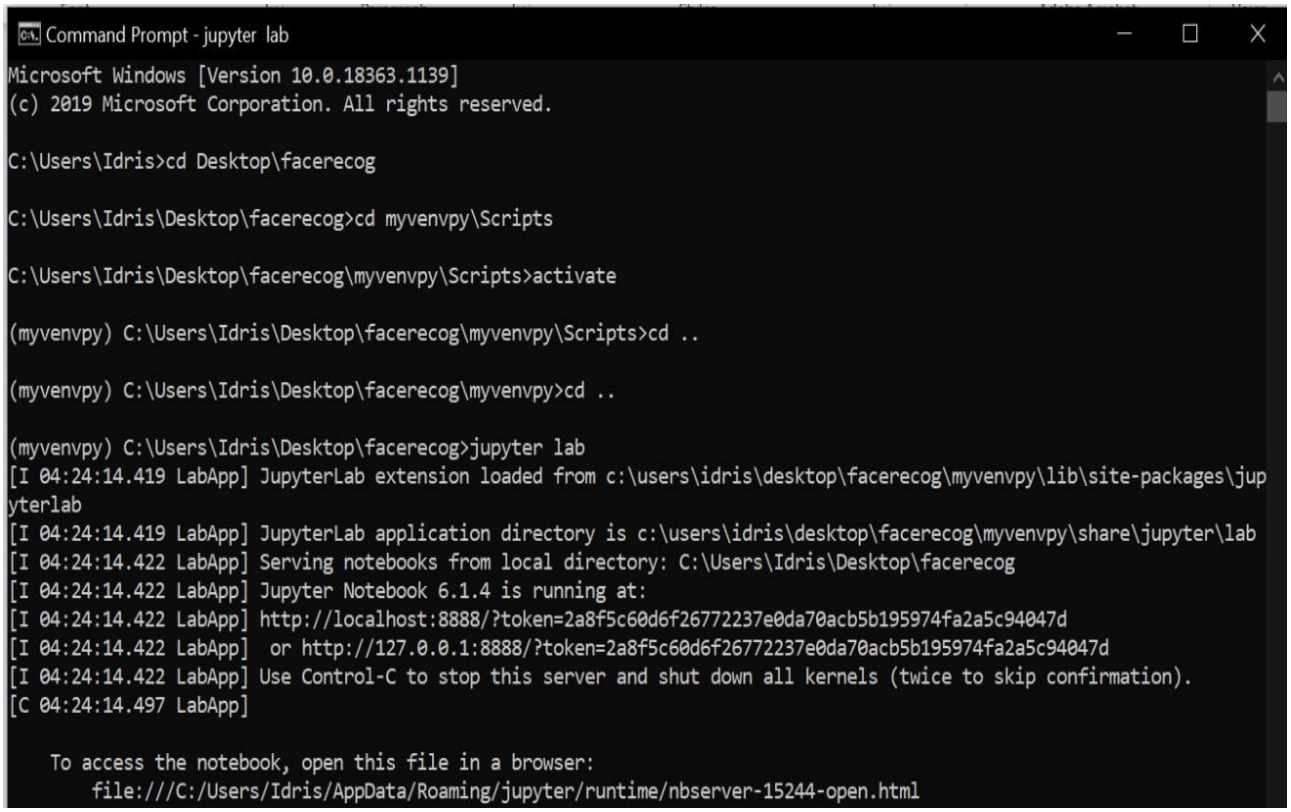
Setting up the virtual environment for face recognition project

The packages Dlib and Face Recognition was not working in our Jupyter lab notebook. It was also not installing with pip install. So, we had to follow certain online procedure to reinstall python from scratch, make sure the pathways were well defined. Then we had to install Visual Studio 2019 along with all the necessary packages to run Dlib, CMAKE that was fundamental to do face recognition project.

After creating a virtual environment, the face recognition library had to be installed from the github repository for which github had to be installed and configured.

Finally, we followed an article on medium.com that explained how we could install jupyter lab on virtual environment

These scripts can only be run after activate the virtual environment in our laptops.


Command Prompt - jupyter lab
Microsoft Windows [Version 10.0.18363.1139]
(c) 2019 Microsoft Corporation. All rights reserved.
C:\Users\Idris>cd Desktop\facerecog
C:\Users\Idris\Desktop\facerecog>cd myvenvpy\Scripts
C:\Users\Idris\Desktop\facerecog\myvenvpy\Scripts>activate
(myvenvpy) C:\Users\Idris\Desktop\facerecog\myvenvpy\Scripts>cd ..
(myvenvpy) C:\Users\Idris\Desktop\facerecog\myvenvpy>cd ..
(myvenvpy) C:\Users\Idris\Desktop\facerecog>jupyter lab
[I 04:24:14.419 LabApp] JupyterLab extension loaded from c:\users\idris\desktop\facerecog\myvenvpy\lib\site-packages\jupyterlab
[I 04:24:14.419 LabApp] JupyterLab application directory is c:\users\idris\desktop\facerecog\myvenvpy\share\jupyter\lab
[I 04:24:14.422 LabApp] Serving notebooks from local directory: C:\Users\Idris\Desktop\facerecog
[I 04:24:14.422 LabApp] Jupyter Notebook 6.1.4 is running at:
[I 04:24:14.422 LabApp] http://localhost:8888/?token=2a8f5c60d6f26772237e0da70acb5b195974fa2a5c94047d
[I 04:24:14.422 LabApp] or http://127.0.0.1:8888/?token=2a8f5c60d6f26772237e0da70acb5b195974fa2a5c94047d
[I 04:24:14.422 LabApp] Use Control-C to stop this server and shut down all kernels (twice to skip confirmation).
[C 04:24:14.497 LabApp]
To access the notebook, open this file in a browser:
file:///C:/Users/Idris/AppData/Roaming/jupyter/runtime/nbserver-15244-open.html