INTERNSHIP REPORT

A report submitted in partial fulfilment of the requirements for the Award of Degree of

BACHELOR OF TECHNOLOGY in COMPUTER SCIENCE AND ENGINEERING

By

D VENKATA HANUMA TEJA

Regd.No:199Y1A0537

Under Supervision of

Indian Servers , Vijayawada.

(Duration: 24th March, 2022 to 26th May,2022)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

K.S.R.M. COLLEGE OF ENGINEERING

(An Autonomous Institution)

(Approved by AICTE, Permanently Affiliated to JNTUA, Ananthapuramu)

KADAPA – 516005 (A.P.)

2021- 2022

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CERTIFICATE

This is to certify that the "**Internship report"** submitted by **D.VENKATA HANUMA TEJA (Regd. No.: 199Y1A0537)** is work done by his and submitted during 2021 – 2022 academic year, in partial fulfillment of the requirements for the award of the degree of **BACHELOR OF TECHNOLOGY** in **COMPUTER SCIENCE AND ENGINEERING**, at **INDIAN SERVERS** ,**Vijayawada.**

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CERTIFICATION

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Vijayawada,
Dt..26-05-2022

Internship Completion Certificate

This is to certify that **Mr. DAGGUPATI VENKATA HANUMA TEJA**
Successfully completed "8+ weeks Internship" at ***Indian Servers Private Limited***, *Vijayawada from 24-Mar-2022 to 26-May-2022*, as ***"Trainee - Machine Learning".***

During the period of Internship Program with us, DAGGUPATI VENKATA HANUMA TEJA has been exposed to various concepts like *Basic Python Programming, Statistics Machine Learning Algorithms (Supervised and Unsupervised), basics of Deep Learning using Keras, OpenCV, basics of transfer learning.*

During this period the contribution of DAGGUPATI VENKATA HANUMA TEJA in development of our company projects using Machine Learning is "Good".
UID: INDSER2022ML025

This certificate can verified on request

With warm regards,

Sai Satish
D. Sai Satish
CEO, Indian Servers

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Learning Objectives/Internship Objectives:-

- Internships are generally thought of to be reserved for college students looking to gain experience in a particular field. However, a wide array of people can benefit from Training Internships in order to receive real world experience and develop theirskills.
- An objective for this position should emphasize the skills you already possess in the area and your interest in learningmore
- Internships are utilized in a number of different career fields, including architecture, engineering, healthcare, economics, advertising and many more.
- Some internships are used to allow individuals toperform scientific research while others are specifically designed to allow people to gain first-hand experience working.
- Utilizing internships is a great way to build your resume and develop skills that can be emphasized in your resume for future jobs. When you are applying for a Training Internship, make sure to highlight any special skills or talents that can make you stand a part from the rest of the applicants so that you have an improved chance of landing the position.

ACKNOWLEDGEMENT

First I would like to thank the CEO of **INDIAN SERVERS , Vijayawada** for giving me the opportunity to do an internship within the organization.

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It is indeed with a great sense of pleasure and immense sense of gratitude that I acknowledge the help of these individuals.

I am highly indebted to Managing Director **Dr.K.Chandra Obul Reddy** and Principal **Dr.V.S.S.Murthy**, for the facilities provided to accomplish this internship.

I would like to thank my Head of the Department **Dr. V.Lokeswara Reddy** for his constructive criticism throughout my internship.

I would like to thank **Sri.S.Khaja Khizar** and **Dr. M. Sreenivasulu**, Internship coordinator, Department of CSE for their support and advices to get and complete internship in above said organization.

I am extremely great full to my department staff members and friends who helped me in successful completion of this internship.

D .VENKATA HANUMA TEJA
(199Y1A0537)

ABSTRACT

Digit Recognition is a noteworthy and important issue. As the manually written digits are not of a similar size, thickness, position and direction, in this manner, various difficulties must be considered to determine the issue of handwritten digit recognition. The uniqueness and assortment in the composition styles of various individuals additionally influence the example and presence of the digits. It is the strategy for perceiving and arranging transcribed digits. It has a wide range of applications, for example, programmed bank checks, postal locations and tax documents and so on.

The aim of this project is to implement a classificatio n algorithm to recognize the handwritten digits. The after effects of probably the most broadly utilized Machine Learning Algorithms like SVM, KNN and RFC and with Deep Learning calculation like multilayer CNN utilizing Keras with Theano and Tensorflow. Utilizing these, the accuracy of 98.70% utilizing CNN (Keras + Theano) when contrasted with 97.91% utilizing SVM, 96.67% utilizing KNN, 96.89% utilizing RFC was obtained.

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1.INTRODUCTION

Recognition is identifying or distinguishing a thing or an individual from the past experiences or learning. Similarly, Digit Recognition is nothing but recognizing or identifying the digits in any document. Digit recognition framework is simply the working of a machine to prepare itself or interpret the digits. Handwritten Digit Recognition is the capacity of a computer to interpret the manually written digits from various sources like messages, bank cheques, papers, pictures, and so forth and in various situations for web based handwriting recognition on PC tablets, identifying number plates of vehicles, handling bank cheques, digits entered in any forms etc.

Machine Learning provides various methods through which human efforts can be reduced in recognizing the manually written digits. Deep Learning is a machine learning method that trains computers to do what easily falls into place for people: learning through examples. With the utilization of deep learning methods, human attempts can be diminished in perceiving, learning, recognizing and in a lot more regions. Using deep learning, the computer learns to carry out classification works from pictures or contents from any document. Deep Learning models can accomplish state-of-art accuracy, beyond the human level performance. The digit recognition model uses large datasets in order to recognize digits from distinctive sources.

Handwriting recognition of characters has been around since the 1980s. The task of handwritten digit recognition, using a classifier, has extraordinary significance and use such as – online digit recognition on PC tablets, recognize zip codes on mail, processing bank check amounts, numeric sections in structures filled up by hand (for example - tax forms) and so on. There are diverse challenges faced while attempting to solve this problem. The handwritten digits are not always of the same size, thickness, or orientation and position relative to the margins. The main objective was to actualize a pattern characterization method to perceive the handwritten digits provided in the MINIST data set of images of handwritten digits (0-9).

2.HISTORY

History of Machine Learning :

The history of machine learning is quite impressive. Let's see where it all began and how it has evolved over the years.

1949 – Donald Hebb published "The Organization of Behavior," introducing theories on the interaction between neurons, which were later crucial in developing machine learning.
1950 – Alan Turing invented the Turing Test, or the imitation game, to determine if a computer can pass for a human-based on its written linguistic fluency.
1951 – Dean Edmonds and Marvin Minsky built the SNARC machine, the first machine with an artificial neural network, based on Hebb's model.
1952 – Arthur Samuel developed a computer game of checkers.
1957 – Frank Rosenblatt used Hebb's model and Samuel's ML algorithms to develop the perceptron, a computer program with human-like thought processes, primarily designed for image recognition.
1967 – Thomas Cover and Peter E. Hart came up with the nearest neighbor algorithm, which later became the foundation for pattern recognition.
1979 – Stanford students built the Stanford Cart, a remotely-controlled, autonomous cart that could navigate on its own and avoid bumping into objects. It was designed to help study the remote control of a Moon rover.
1979 – Kunihiko Fukushima published a research paper on the Neocognitron, an artificial neural network (ANN) with multiple layers for detecting complex patterns. His work later inspired a convolution neural network (CNN) for deep learning.
1981 – Gerald DeJong proposed EBL (Explanation-Based Learning), a method that an ML algorithm can use when analyzing data to create general rules and ignore irrelevant data points.
1985 – Terrence Sejnowski invented NETtalk, an ML-based computer program that could perform cognitive tasks like a human. With written English text and phonetic transcriptions as input, it learned to "talk" like a baby.
1986 – Paul Smolensky invented the restricted Boltzmann machine (RBM) for predicting probabilities of various possible outcomes based on input data. Today, this algorithm is commonly used for AI-driven recommendations and price predictions.
1990 – Robert Schapire introduced boosting algorithms for improving AI models.They consist of multiple weak classifiers that together create a strong learning model. Boosting algorithms are used today to analyze massive amounts of data and drive insights from the results.
1995 – Tin Kam Ho introduced a random forest algorithm that creates decision trees from multiple AI-powered predictions. Nowadays, it helps in driving accurate predictions from data and enhancing decision-making.
1997 – IBM's supercomputer beat Garry Kasparov in chess.
2006 – Geoffrey Hinton invented fast-learning algorithms based on an RBM and came up with the term "Deep Learning" to explain how AI-based on ML can learn like a human.
2009 – Fei-Fei Li developed ImageNet, an image-based database for improving ML and AI, enabling them to learn from real-world data.

3.DEFINITION

“**Machine learning** (**ML**) is the study of computer algorithms that improve automatically through experience and by the use of data. It is seen as a part of artificial intelligence. Machine learning algorithms build a model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to do so. Machine learning algorithms are used in a wide variety of applications, such as in medicine, email filtering, speech recognition, and computer vision, where it is difficult or unfeasible to develop conventional algorithms to perform the needed tasks.

A subset of machine learning is closely related to computational statistics, which focuses on making predictions using computers; but not all machine learning is statistical learning. The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning. Data mining is a related field of study, focusing on exploratory data analysis through unsupervised learning. In its application across business problems, machine learning is also referred to as predictive analytics.

4.ARCHITECTURE OF MACHINE LEARNING

1. Data Acquisition:

As machine learning is based on available data for the system to make a decision hence the first step defined in the architecture is data acquisition. This involves data collection, preparing and segregating the case scenarios based on certain features involved with the decision-making cycle and forwarding the data to the processing unit for carrying out further categorization. This stage is sometimes called the data preprocessing stage. The data model expects reliable, fast and elastic data which may be discrete or continuous in nature. The data is then passed into stream processing systems (for continuous data) and stored in batch data warehouses (For discrete data) before being passed on to data modeling or processing stages.

2. Data Processing:

The received data in the data acquisition layer is then sent forward to the data processing layer where it is subjected to advanced integration and processing and involves normalization of the data, data cleaning, transformation, and encoding. The data processing is also dependent on the type of learning being used. For e.g., if supervised learning is being used the data shall be needed to be segregated into multiple steps of sample data required for training of the system and the data thus created is called training sample data or simply training data. Also, the data processing is dependent upon the kind of processing required and may involve choices ranging from action upon continuous data which will involve the use of specific function-based architecture, for example, lambda architecture, also it might involve action upon discrete data which may require memory-bound processing. The data processing layer defines if the memory processing shall be done to data in transit or in rest.

3. Data Modeling:

This layer of the architecture involves the selection of different algorithms that might adapt the system to address the problem for which the learning is being devised, these algorithms are being evolved or being inherited from a set of libraries. The algorithms are used to model the data accordingly, this makes the system ready for the execution step.

4. Execution:

This stage in machine learning is where the experimentation is done, testing is involved and tunings are performed. The general goal behind being to optimize the algorithm in order to extract the required machine outcome and maximize the system performance, The output of the step is a refined solution capable of providing the required data for the machine to make decisions.

5. Deployment:

Like any other software output, ML outputs need to be operationalized or be forwarded for further exploratory processing. The output can be considered as a non-deterministic query which needs to be further deployed into the decision-making system.

It is advised to seamlessly move the ML output directly to production where it will enable the machine to directly make decisions based on the output and reduce the dependency on the further exploratory steps.

5.APPLICATIONS

There are several application domains which will be impacted by the emerging machine learning.

- Social Media Features
- Product Recommendations
- Image Recognition
- Sentiment Analysis

1. Social Media Features:

Social media platforms use machine learning algorithms and approaches to create some attractive and excellent features. For instance, Facebook notices and records your activities, your chats, likes, and comments, and the time you spend on specific kinds of posts. Machine learning learns from your own experience and makes friends and page suggestions for your profile.

2. Product Recommendations

One of the most popular and known applications of machine learning is Product Recommendation. Product recommendation is one of the stark features of almost every e-commerce website today, which is an advanced application of machine learning techniques. Using machine learning and AI, websites track your behavior based on your previous purchase, your searching pattern, your cart history, and make product recommendations.

3. Image Recognition:

Image Recognition is one of the most significant and notable Machine Learning and AI techniques: an approach for cataloging and detecting a feature or an object in the digital image. This technique is being adopted for further analysis, such as pattern recognition, face detection, or face recognition.

4. Sentiment Analysis

Sentiment analysis is a real-time machine learning application that determines the emotion or opinion of the speaker or the writer. For instance, if someone has written a review or email (or any form of a document), a sentiment analyzer will instantly find out the actual thought and tone of the text. This sentiment analysis application can are used to analyze a review-based website, decision-making applications, etc.

6.BASIC CONCEPTS IN MACHINE LEARNING

Machine Learning is continuously growing in the IT world and gaining strength in different business sectors. Although Machine Learning is in the developing phase, it is popular among all technologies. It is a field of study that makes computers capable of automatically learning and improving from experience. Hence, Machine Learning focuses on the strength of computer programs with the help of collecting data from various observations

6.1 What is Machine Learning?

Machine Learning is defined as a technology that is used to train machines to perform various actions such as predictions, recommendations, estimations, etc., based on historical data or past experience.Machine Learning enables computers to behave like human beings by training them with the help of past experience and predicted data.
There are three key aspects of Machine Learning, which are as follows:

Task: A task is defined as the main problem in which we are interested. This task/problem can be related to the predictions and recommendations and estimations, etc.

Experience: It is defined as learning from historical or past data and used to estimate and resolve future tasks.

Performance: It is defined as the capacity of any machine to resolve any machine learning task or problem and provide the best outcome for the same. However, performance is dependent on the type of machine learning problems.

6.2 Techniques in Machine Learning:

Machine Learning techniques are divided mainly into the following 4 categories:

1. Supervised Learning:

Supervised learning is applicable when a machine has sample data, i.e., input as well as output data with correct labels. Correct labels are used to check the correctness of the model using some labels and tags. Supervised learning technique helps us to predict future events with the help of past experience and labeled examples. Initially, it analyses the known training dataset, and later it introduces an inferred function that makes predictions about output values. Further, it also predicts errors during this entire learning process and also corrects those errors through algorithms.

2. Unsupervised Learning:

In unsupervised learning, a machine is trained with some input samples or labels only, while output is not known. The training information is neither classified nor labeled;

hence, a machine may not always provide correct output compared to supervised learning.Although Unsupervised learning is less common in practical business settings, it helps in exploring the data and can draw inferences from datasets to describe hidden structures from unlabeled data.

3. **Reinforcement Learning:**
Reinforcement Learning is a feedback-based machine learning technique. In such type of learning, agents
(computer programs) need to explore the environment, perform actions, and on the basis of their actions, they get rewards as feedback. For each good action, they get a positive reward, and for each bad action, they get a negative reward. The goal of a Reinforcement learning agent is to maximize the positive rewards. Since there is no labeled data, the agent is bound to learn by its experience only.

4. Semi-supervised Learning:
Semi-supervised Learning is an intermediate technique of both supervised and unsupervised learning. It performs actions on datasets having few labels as well as unlabeled data. However, it generally contains unlabeled data. Hence, it also reduces the cost of the machine learning model as labels are costly, but for corporate purposes, it may have few labels. Further, it also increases the accuracy and performance of the machine learning model.

6.3 Basic performing tasks:

There are 5 basic steps used to perform a machine learning task:

Collecting data: Be it the raw data from excel, access, text files etc., this step (gathering past data) forms the foundation of the future learning. The better the variety, density and volume of relevant data, better the learning prospects for the machine becomes.
Preparing the data: Any analytical process thrives on the quality of the data used. One needs to spend time determining the quality of data and then taking steps for fixing issues such as missing data and treatment of outliers. Exploratory analysis is perhaps one method to study the nuances of the data in details thereby burgeoning the nutritional content of the data.
Training a model: This step involves choosing the appropriate algorithm and representation of data in the form of the model. The cleaned data is split into two parts – train and test (proportion depending on the prerequisites); the first part (training data) is used for developing the model. The second part (test data), is used as a reference.
Evaluating the model: To test the accuracy, the second part of the data (holdout / test data) is used. This step determines the precision in the choice of the algorithm based on the outcome. A better test to check accuracy of model is to see its performance on data which was not used at all during model build.
Improving the performance: This step might involve choosing a different model altogether or introducing more variables to augment the efficiency. That’s why significant amount of time needs to be spent in data collection and preparation.

6.4 Algorithms:

An algorithm as a mathematical or logical program that turns a data set into a model. There are different types of algorithms that can be chosen, depending on the type of problem that the model is trying to solve, resources available, and the nature of data.
Various types of machine learning algorithms including:

- Linear Regression,Logistic Regression,K Nearest Neighbour (KNN),K-Means,Decision Tree,Random Forest,Support Vector Machines(SVM),Naïve Bayes
- Deep Neural Networks is a more specialized form of Machine learning.

7. ADVANTAGES & DISADVANTAGES:

Advantages :

1. Easily identifies trends and patterns
2. No human intervention needed (automation)
3. Continuous Improvement
4. Handling multi-dimensional and multi-variety data
5. Wide Applications

DisAdvantages :

1. Data Acquisition
2. Time and Resources
3. Interpretation of Results
4. High error-susceptibility

8.REQUIREMENTS

8.1.Hardware Requirements

RAM: At least 4 GB.
Processor: Intel core i3 or more.
Internet connectivity: Yes.

8.2.Software Requirements

OS : Windows 7 or above.
Python : Python 2.7 or above.

9.SOURCE CODE

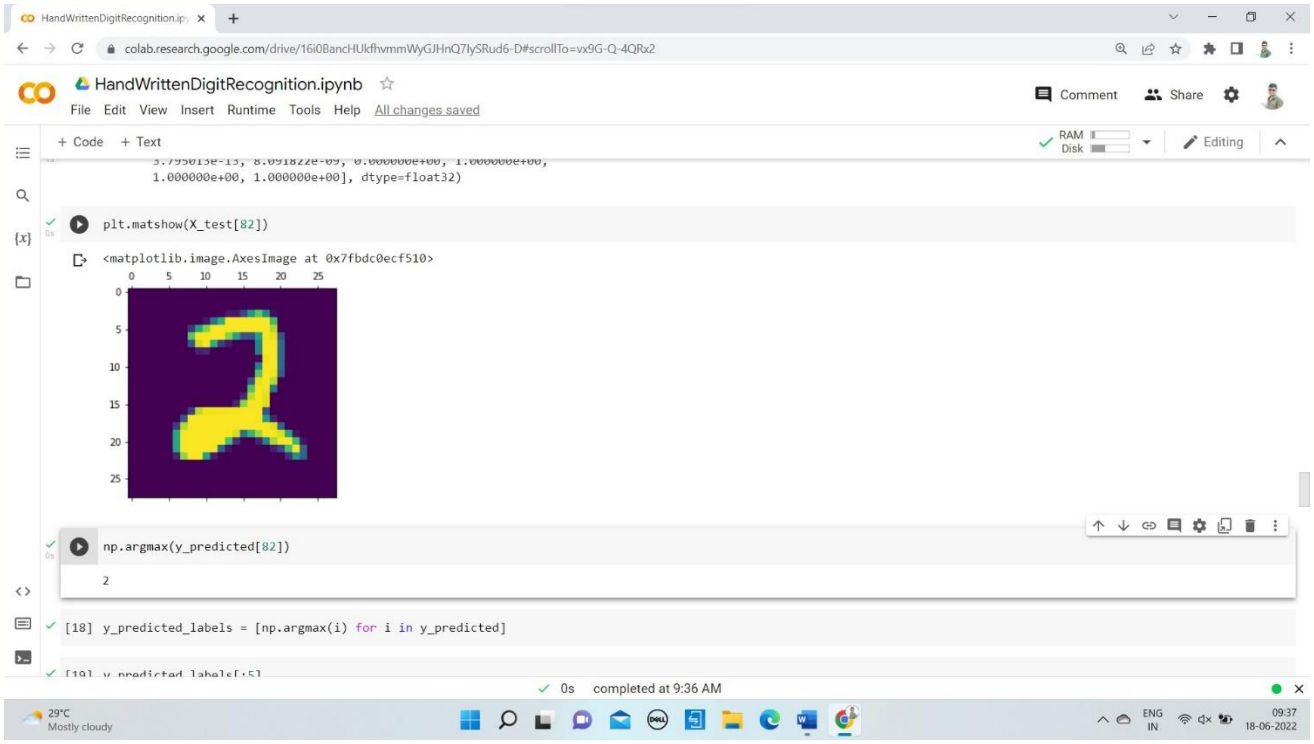
```
import tensorflow as tf
from tensorflow import keras
import matplotlib.pyplot as plt
%matplotlib inline
import numpy as np


(X_train, y_train) , (X_test, y_test) = keras.datasets.mnist.load_da
ta()


len(X_train)
len(X_test)


X_train[0].shape
X_train[0]

plt.matshow(X_train[0])
y_train[0]

X_train = X_train / 255
X_test = X_test / 255

X_train[0]

X_train_flattened = X_train.reshape(len(X_train), 28*28)
X_test_flattened = X_test.reshape(len(X_test), 28*28)


   X_train_flattened.shape

X_train_flattened[0]

model = keras.Sequential([
    keras.layers.Dense(10, input_shape=(784,), activation='sigmoid')
])

model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])

model.fit(X_train_flattened, y_train, epochs=5)

model.evaluate(X_test_flattened, y_test)

y_predicted = model.predict(X_test_flattened)
y_predicted[0]
```

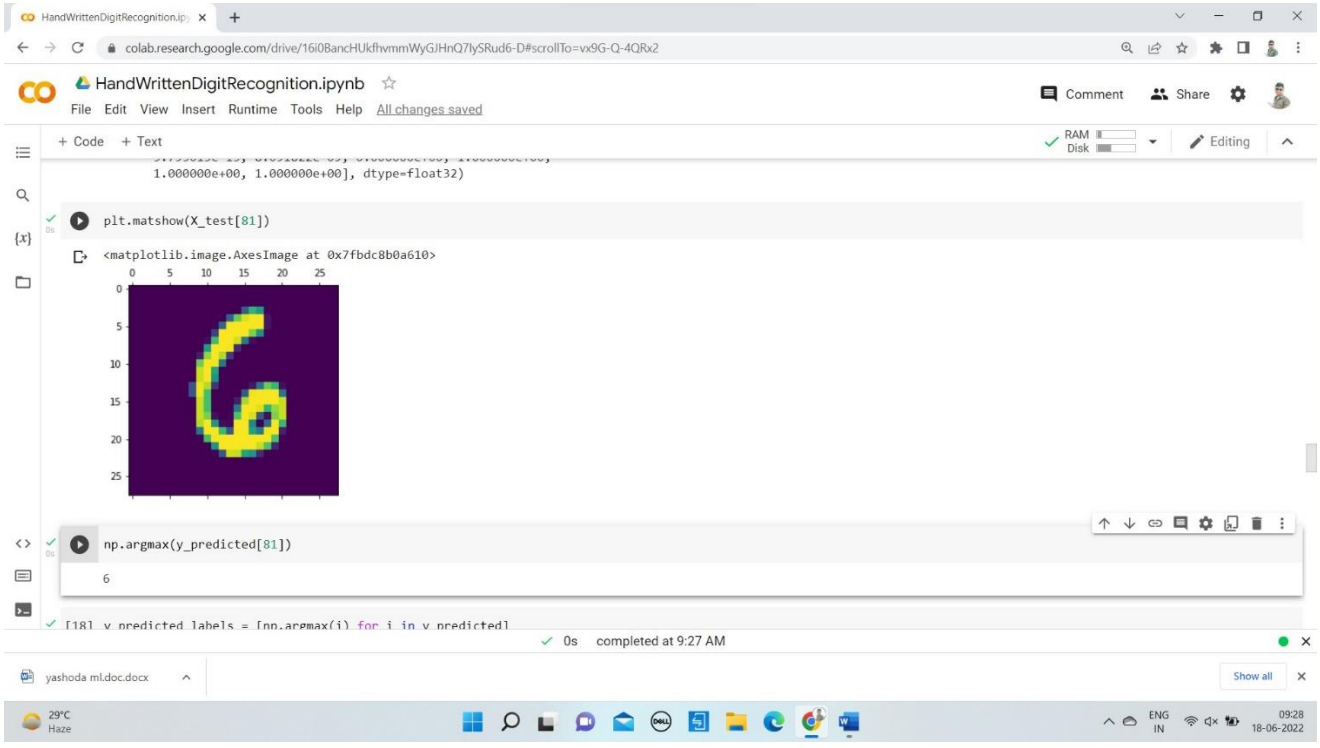
```
plt.matshow(X_test[80])

np.argmax(y_predicted[80])

y_predicted_labels = [np.argmax(i) for i in y_predicted]

y_predicted_labels[:5]

import seaborn as sn
plt.figure(figsize = (10,7))
sn.heatmap(cm, annot=True, fmt='d')
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

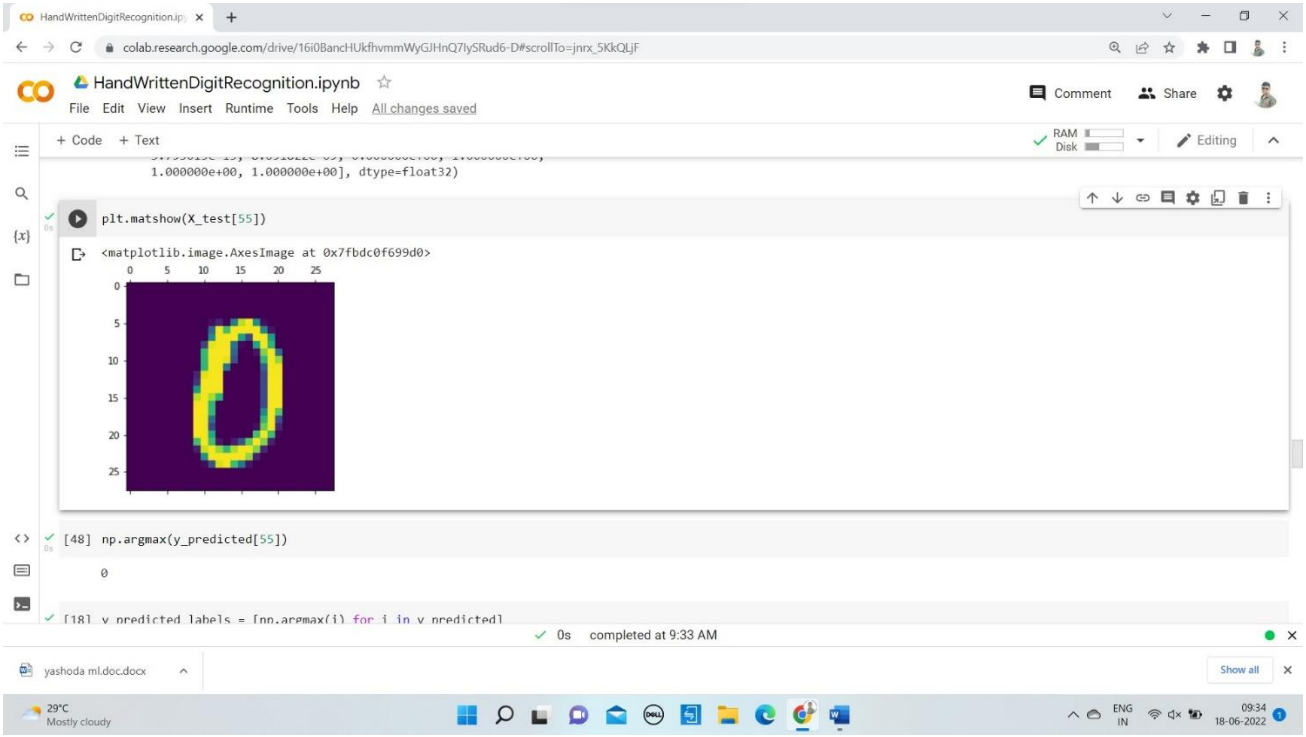
- **Using Hidden Layer**

```
model = keras.Sequential([
    keras.layers.Dense(100, input_shape=(784,), activation='relu'),
    keras.layers.Dense(10, activation='sigmoid')
])

model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])

model.fit(X_train_flattened, y_train, epochs=10)


model.evaluate(X_test_flattened,y_test)

y_predicted = model.predict(X_test_flattened)
y_predicted_labels = [np.argmax(i) for i in y_predicted]
cm = tf.math.confusion_matrix(labels=y_test,predictions=y_predicted_
labels)

plt.figure(figsize = (10,7))
sn.heatmap(cm, annot=True, fmt='d')
plt.xlabel('Predicted')
plt.ylabel('Truth')
```

10.OUTPUT :


HandWrittenDigitRecognition.ipynb
File Edit View Insert Runtime Tools Help All changes saved
Comment Share
+ Code + Text
RAM Disk
Editing
1.000000e+00, 1.000000e+00], dtype=float32)
plt.matshow(X_test[82])
<matplotlib.image.AxesImage at 0x7fbdc0ecf510>
np.argmax(y_predicted[82])
2
[18] y_predicted_labels = [np.argmax(i) for i in y_predicted]
0s completed at 9:36 AM
29°C
Mostly cloudy
ENG
IN
09:37
18-06-2022


HandWrittenDigitRecognition.ipynb
File Edit View Insert Runtime Tools Help All changes saved
Comment Share
+ Code + Text
RAM Disk
Editing
1.000000e+00, 1.000000e+00], dtype=float32)
plt.matshow(X_test[81])
<matplotlib.image.AxesImage at 0x7fbdc8b0a610>
np.argmax(y_predicted[81])
6
0s completed at 9:27 AM
yashoda ml.doc.docx
Show all
29°C
Haze
ENG
IN
09:28
18-06-2022


HandWrittenDigitRecognition.ipynb
File Edit View Insert Runtime Tools Help All changes saved
Comment Share
+ Code + Text
RAM Disk
Editing
1.000000e+00, 1.000000e+00], dtype=float32)
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0
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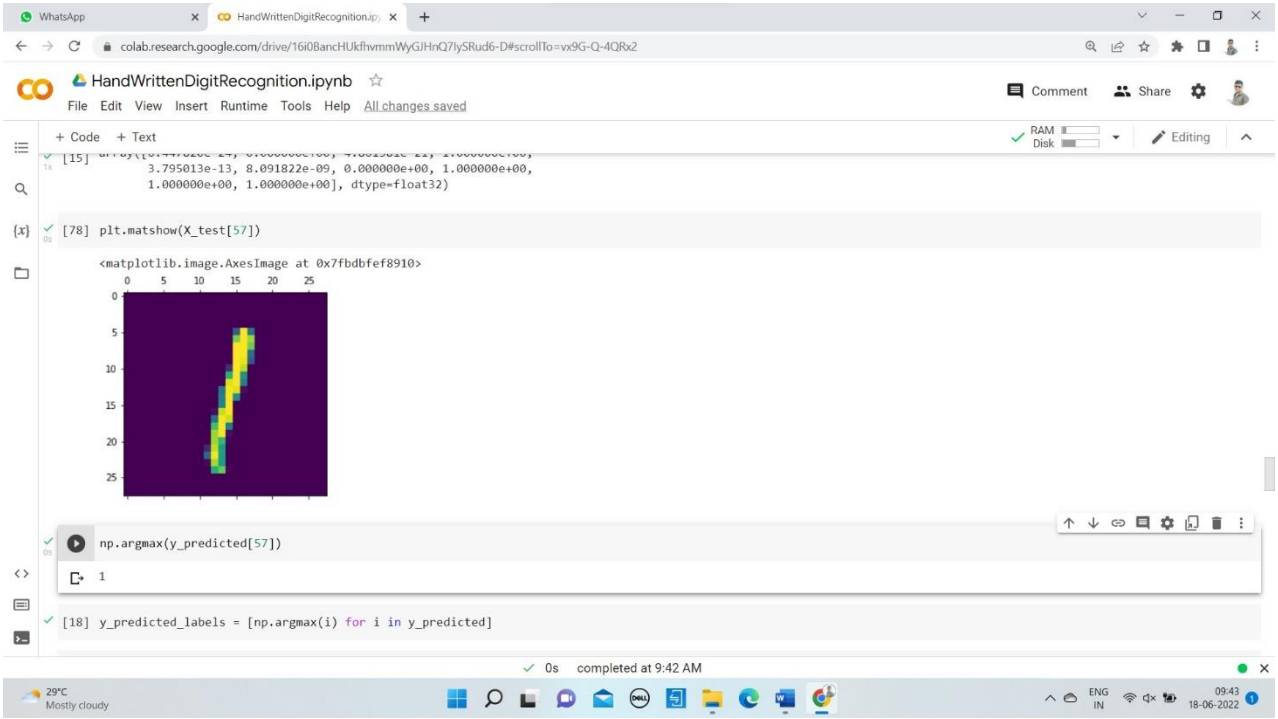
Show all
29°C
Mostly cloudy
ENG
IN
09:34
18-06-2022


WhatsApp
HandWrittenDigitRecognition.ipynb
colab.research.google.com/drive/16i0BancHUkfhvmmWyGJHnQ7lySRud6-D#scrollTo=vx9G-Q-4QRx2
HandWrittenDigitRecognition.ipynb
File Edit View Insert Runtime Tools Help All changes saved
Comment Share
+ Code + Text
RAM Disk
Editing
3.795013e-13, 8.091822e-09, 0.000000e+00, 1.000000e+00,
1.000000e+00, 1.000000e+00], dtype=float32)
[78] plt.matshow(X_test[57])
<matplotlib.image.AxesImage at 0x7fbdbfef8910>
np.argmax(y_predicted[57])
1
[18] y_predicted_labels = [np.argmax(i) for i in y_predicted]
0s completed at 9:42 AM
29°C
Mostly cloudy
ENG
IN
09:43
18-06-2022

11.CONCLUSION

In this project, the Handwritten Digit Recognition using Deep learning methods has been implemented. The most widely used Machine learning algorithms, KNN, SVM, RFC and CNN have been trained and tested on the same data in order acquire the comparison between the classifiers.

Here we demonstrate a model which can recognize handwritten digit. Later it can be extended for character recognition and real-time person's handwriting. Handwritten digit recognition is the first step to the vast field of Artificial Intelligence and Computer Vision. As seen from the results of the experiment, CNN proves to be far better than other classifiers. The results can be made more accurate with more convolution layers and more number of hidden neurons. It can completely abolish the need for typing. Digit recognition is an excellent prototype problem for learning about neural networks and it gives a great way to develop more advanced techniques of deep learning. In future, we are planning to develop a real-time handwritten digit recognition system.

12.BIBLIOGRAPHY & REFERENCES

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- Bertsekas and Tsitsiklis, *Neuro-Dynamic Programming*, Athena Scientific, 1996.

Other machine learning courses

- Andrew Ng
- Max Welling

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