Sinhgad Institutes

# Sinhgad Academy of Engineering, Kondhwa(Bk), Pune- 48

## DEPARTMENTOF

## COMPUTER ENGINEERING

# LAB MANUAL

**PRACTICAL- Laboratory Practice V**

**B.E 2019 Pattern**

**Prepared by**

Prof. M.E.Sanap

## 1. Vision of the Institute:

उत्तमपुरूषान् उत्तमाभियंतृन् निर्मातुं कटीबध्दाःवयम

We are committed to produce not only good engineers but good human beings, also.

## 2. Mission of the Institute:

Holistic development of student and teacher is what we believe in and work for. We strive to achieve this by imbibing a unique value system, transparent work culture, excellent academic and physical environment conducive to learning, creativity and technology transfer. Our mandate is to generate, preserve and share knowledge for developing a vibrant Society.

## 3. Vision of the Department:

"To build the Department as a Centre of Excellence for students in Computer Engineering."

## 4. Mission of the Department:

We believe in developing value based system for student and staff by providing healthy and transparent work culture to cultivate new ideas in the field of engineering and technology which will contribute to build a vibrant Society.

## 5. Programme Education/Specific Outcomes:

Computer Engineering graduate will be able to,

**PSO1**: **Project Development:** Successfully complete hardware and/or software related system or Application projects, using the phases of project development life cycle to meet the requirements of serviceand product industries; government projects; and automate other engineering stream projects.

**PSO2: Domain Expertise:** Demonstrate effective application of knowledge gained from different computer domains like, data structures, data bases, operating systems, computer networks, security,parallel programming, in project development, research and higher education.

**PSO3: Career Development:** Achieve successful Career and Entrepreneurship- The ability to employ modern computer languages, environments, and platforms in creating innovative career paths to be an entrepreneur, anda zest for higher studies.

## 6. Programme Outcomes:

**a.** An ability to apply knowledge of computing, mathematics, science and engineering fundamentals appropriate to Computer Engineering.

**b.** An ability to define the problems and provide solutions by designing and conducting experiments, interpreting, and analysing data.

**c.** An ability to design, implement and evaluate a system, process, component, and programme to meet desired needs within realistic constraints.

**d.** An ability to investigate, formulate, analyze, and provide appropriate solution to the engineering problems.

**e.** An ability to use modern engineering tools and technologies necessary for engineering practice.

**f.** An ability to analyze the local and global impact of computing on individuals, organizations, and society.

**g.** An ability to understand the environmental issues and provide the sustainable system.

**h.** An ability to understand professional and ethical responsibility.

**i.** An ability to function effectively as an individual or as a team member to accomplish the goal.

**j.** An ability to communicate effectively at different levels.

**k.** An ability to understand engineering, management, financial aspects, performance, optimizations and time complexity necessary for professional practice.

**l.** An ability to keep abreast with contemporary technologies through lifelong learning.

## 7. Graduate Attributes and Program Outcomes

| Graduate Attributes | Program Outcomes |
|---|---|
| 1. Engineering Knowledge | a. An ability to apply knowledge of computing, mathematics, science, and engineering fundamentals appropriate to Computer Engineering. |
| 2. Problem Analysis | b. An ability to define the problems and provide solutions by designing and conducting experiments, interpreting and analyzing data. |
| 3. Design & Development of Solutions | c. An ability to design, implement and evaluate a system, process, component, and program to meet desired needs within realistic constraints. |
| 4. Investigation of Complex Problem | d. An ability to investigate, formulates, analyze, and provide appropriate solution to the engineering problems. |
| 5. Modern Tools Usage | e. An ability to use modern engineering tools and technologies necessary for engineering practices. |
| 6. Engineer and Society | f. An ability to analyze the local and global impact of computing on individuals, organizations, and society. |
| 7. Environment & Sustainability | g. An ability to understand the environmental issues and provide the sustainable system. |
| 8. Ethics | h. An ability to understand professional and ethical responsibility. |
| 9. Individual & Teamwork | i. An ability to function effectively as an individual or as a team member to accomplish the goal. |
| 10.Communication | j. An ability to communicate effectively at different levels. |
| 11.Project management & Finance | k. An ability to understand engineering, management, financial aspects, performance, optimization, and time complexity necessary for profession practice. |
| 12.Lifelong Learning | l. An ability to keep abreast with contemporary technologies through lifelong learning. |

## DATA STRUCTURES AND ALGORITHMS LAB (210256)

# COURSE OBJECTIVES:

Course Objectives:

- To understand and implement searching and sorting algorithms.
- To learn the fundamentals of GPU Computing in the CUDA environment.
- To illustrate the concepts of Artificial Intelligence/Machine Learning (AI/ML).
- To understand Hardware acceleration.
- To implement different deep learning models.

# COURSE OUTCOMES:

CO1: Analyze and measure performance of sequential and parallel algorithms.

CO2: Design and Implement solutions for multicore/Distributed/parallel environment.

CO3: Identify and apply the suitable algorithms to solve AI/ML problems.

CO4: Apply the technique of Deep Neural network for implementing Linear regression and classification.

CO5: Apply the technique of Convolution (CNN) for implementing Deep Learning models.

CO6: Design and develop Recurrent Neural Network (RNN) for prediction

410251 : Deep Learning

Group 1

1. Linear regression by using Deep Neural network: Implement Boston housing price prediction problem by Linear regression using Deep Neural network. Use Boston House price prediction dataset.

2. Classification using Deep neural network (Any One from the following)

1. Multiclass classification using Deep Neural Networks: Example: Use the OCR letter recognition dataset https://archive.ics.uci.edu/ml/datasets/letter+recognition

2. Binary classification using Deep Neural Networks Example: Classify movie reviews into positive" reviews and "negative" reviews, just based on the text content of the reviews. Use IMDB dataset

3. Convolutional neural network (CNN) (Any One from the following) □ Use any dataset of plant disease and design a plant disease detection system using CNN. □ Use MNIST Fashion Dataset and create a classifier to classify fashion clothing into categories.

4. Recurrent neural network (RNN) Use the Google stock prices dataset and design a time series analysis and prediction system using RNN. Group 2 5. Mini Project: Human Face Recognition 6. Mini Project: Gender and Age Detection: predict if a person is a male or female and also their age 7. Mini Project: Colorizing Old B&W Images: color old black and white images to colorful images

Group 2 (Any One)

5. Mini Project: Human Face Recognition

6. Mini Project: Gender and Age Detection: predict if a person is a male or female and also their age 7. Mini Project: Colorizing Old B&W Images: color old black and white images to colorful images

| @The CO-PO Mapping Matrix | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO/PO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | 1 | - | 1 | 1 | - | 2 | 1 | - | - | - | - | - |
| CO2 | 1 | 2 | 1 | - | - | 1 | - | - | - | - | - | 1 |
| CO3 | - | 1 | 1 | 1 | 1 | 1 | - | - | - | - | - | - |
| CO4 | 3 | 3 | 3 | - | 3 | - | - | - | - | - | - | - |
| CO5 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - |
| CO6 | 3 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | - |
| CO7 | 3 | 3 | 3 | 3 | 3 | | - | - | - | - | - | - |

# Assignment 1

**Tittle:** Linear regression by using Deep Neural network: Implement Boston housing price prediction problem by linear regression using Deep Neural network. Use Boston House price prediction dataset.

**Aim:** To implement Boston housing price prediction using linear regression

**Theory:**

Here, we are going to do implementing a saleable model for predicting the houseprice prediction using some of the regression techniques based of some of featuresin the dataset which is called Boston House Price Prediction.

Housing prices are an important reflection of the economy, and housing price ranges are of great interest for both buyers and sellers. Ask a home buyer to describe their dream house, and they probably won't begin with the height of thebasement ceiling or the proximity to an east-west railroad. But this playground competition's data-set proves that much more influences price negotiations thanthe number of bedrooms or a white-picket fence.

**About the Dataset**

Housing prices are an important reflection of the economy, and housing price ranges are of great interest for both buyers and sellers. In this project, house prices will be predicted given explanatory variables that cover many aspects of

residential houses. The goal of this project is to create a regression model that isable to accurately estimate the price of the house given the features

The major aim of in this project is to predict the house prices based on the featuresusing some of the regression techniques and algorithms.

**Linear Regression**

It's a Supervised Learning algorithm which goal is to predict continuous, numerical values based on given data input. From the geometrical perspective, each data sample is a point. Linear Regression tries to find parameters of the linear function, so the distance between the all the pointsand the line is as small as possible. Algorithm used for parameters update is called Gradient Descent.

As a running example, suppose that we wish to estimate the prices of

To develop a model for predicting house prices, we need to get our hands on data consisting of sales, including the sales price, area, and age for each home. In the terminology of machine learning, the dataset is called a *training dataset* or *training set*, and each row (containing the data corresponding to one sale) is called an *example* (or *data point*, *instance*, *sample*). The thing we are trying to predict (price) is called a *label* (or *target*). The variables (age and area) upon which the predictions houses (in dollars) based on their area (in square feet) and age (in years) are based are called *features* (or *covariates*).

**Machine Learning Packages are used for in this assignment.**

### Data Collection

This Dataset consist several features such as Number of Rooms, Crime Rate, and Tax and so on. Let's know about how to read the dataset into the Jupyter Notebook. You can download the dataset from Kaggle in csv file format.

## Data Preprocessing

In this Boston Dataset we need not to clean the data. The dataset already cleanedwhen we download from the Kaggle. For your satisfaction i will show to numberof null or missing values in the dataset. As well as we need to understand shape of the dataset.

## Exploratory Data Analysis

In statistics, exploratory data analysis (***EDA***) is an approach to analyzing data setsto summarize their main characteristics, often with visual methods. A statistical model can be used or not, but primarily ***EDA*** is for seeing what the data can tell us beyond the formal modeling or hypothesis testing task.

**Feature Selection**: **It** is the process where you automatically or manually **select** those **features** which contribute most to your prediction **variable** or output in which you are interested in. Having irrelevant **features** in your data can decrease the accuracy of the models and makeyour model learn based on irrelevant **features**.

**Conclusion:** And thus, we have successfully implemented model using Linear Regression.

# Assignment 2

**Tittle:** Binary classification using Deep Neural Networks Example: Classify movie reviews into positive" reviews and "negative" reviews, just based on the text content of the reviews. Use IMDB dataset

**Aim:** To implement movie reviews into positive" reviews and "negative" reviews, just based on the text content of the reviews.

**Theory:**

Binary Classification refers to classifying samples in one of two categories. We will design a neural network to perform two-class classification, or *binaryclassification*, of reviews, from the IMDB movie reviews dataset, to determine whether the reviews are positive or negative. We will use the Python library, Keras.

### The IMDB Dataset

The IMDB dataset is a set of 50,000 highly polarized reviews from the Internet Movie Database. They are split into 25000 reviews each for training and testing.Each set contains an equal number (50%) of positive and negative reviews.

The IMDB dataset comes packaged with Keras. It consists of reviews and their corresponding labels (0 for *negative* and 1 for *positive* review). The reviews are asequence of words. They come preprocessed as a sequence of integers, where eachinteger stands for a specific word in the dictionary.

The IMDB dataset can be loaded directly from Keras and will usually downloadabout 80 MB on your machine.

### Loading the Data

Let's load the prepackaged data from Keras. We will only include 10,000 of the most frequently occurring words.

### Preparing the Data

We cannot feed a list of integers into our deep neural network. We will need to convert them into tensors.

To prepare our data, we will One-hot Encode our lists and turn them into vectorsof 0's and 1's. This would blow up all of our sequences into 10,000-dimensionalvectors containing 1 at all indices corresponding to integers present in that sequence. This vector will have element 0 at all index, which is not present in theinteger sequence.

Simply put, the 10,000-dimensional vector corresponding to each review will have

- Every index corresponding to a word
- Every index with value 1, is a word that is present in the review and is denotedby its integer counterpart.
- Every index containing 0 is a word not present in the review.

We will vectorize our data manually for maximum clarity. This will result in a tensor of shape (25000, 10000).

Model Architecturewe

will use

1. Two intermediate layers with 16 hidden units each
2. Third layer that will output the scalar sentiment prediction
3. Intermediate layers will use the *relu* activation function. *relu* or Rectified linear unit function will zero out the negative values.
4. Sigmoid activation for the final layer or *output layer*. A sigmoid function "*squashes"* arbitrary values into the [0,1] range.

Compiling the model

In this step, we will choose an *optimizer*, a *loss function*, and *metrics* to observe. We will go forward with

- *binary_crossentropy* loss function, commonly used for Binary Classification
- *rmsprop* optimizer and
- *accuracy* as a measure of performance

We can pass our choices for optimizer, loss function and metrics as *strings* to the compile function because rmsprop, binary_crossentropy and accuracy come packaged with Keras.

**Conclusion**

And thus, we have successfully classified reviews on IMDB.

## Assignment 3

**Tittle:** Convolutional neural network (CNN). Use any dataset of plant diseaseand design a plant disease detection system using CNN.

**Aim:** To implement plant disease and design a plant disease detection systemusing CNN

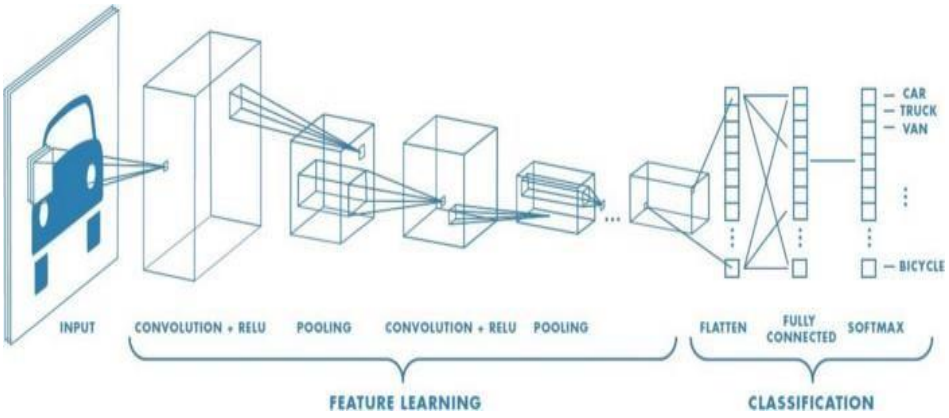
**Theory:**

Agricultural production is a very old means of obtaining food. It is a vital sourceof income for people all around the world. No one can exist in our world withoutfood. Plants are crucial not only for humans, but also for animals who rely on them for food, oxygen, and other necessities. The government and experts are taking significant initiatives to enhance food production, and they are working successfully in the real world. When a plant becomes afflicted with a disease, allliving organisms in the environment are affected in some way. This plant diseasecan affect anywhere on the plant, including the stem, leaf, and branch. Even the types of illnesses that impact plants, such as bacterial and fungal diseases .etc. can differ. The illness that impacts the crops will be determined by factors such as climate. There are a large number of people that are food insecure. This occursas a result of insufficient food crop output.

The goal of study of Leaf Disease Classification using Artificial Neural. Networkis to acquire and analyse data from leaf photos in order to determine healthy or diseased leaves of medical plants using image processing methods. To extract pictures and get data, an algorithm of adjusted contrast, segmentation, and features extraction is employed from the image processing approach. The Artificial Neural Network was used to analyse the findings of the experiment.

The architecture of the network used to classify healthy or unhealthy leaves is multilayer feed-forward Neural Networks, which are multilayer perceptron and radial basis function RBF. The end outcome of the experiment demonstrates thatthe RBF network outperforms the MLP network. At present, the conventional technique of visual inspection in humans by visual inspection makes it impossibleto characterize plant diseases. Advances in computer vision models offer fast, normalized, and accurate answers to these problems. Classifiers can also be sentas attachments during preparation.

CNN




CNN

A **Convolutional Neural Network (CNN)** is a Deep Learning algorithm that cantake in an input image, assign importance (learnable weights and biases) to variousaspects/objects in the image, and be able to differentiate one from the other. Thepre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNets have the ability to learn these filters/characteristics. he objective of the Convolution Operation is to **extract thehigh-level features** such as edges, from the input image. ConvNets need not be

limited to only one Convolutional Layer. Conventionally, the first ConvLayer isresponsible for capturing the Low-Level features such as edges, color, gradient orientation, etc.

Convolutional neural networks are distinguished from other neural networks by their superior performance with image, speech, or audio signal inputs. They havethree main types of layers, which are:

- Convolutional layer
- Pooling layer
- Fully-connected (FC) layer

let's take an example by running a covnets on of image of dimension 32 x 32 x 3.

1. **Input Layer:** This layer holds the raw input of the image with width 32, height 32, and depth 3.
2. **Convolution Layer:** This layer computes the output volume by computing the dot product between all filters and image patches. Suppose we use a totalof 12 filters for this layer we'll get output volume of dimension 32 x 32 x 12.
3. **Activation Function Layer:** This layer will apply an element-wise activation function to the output of the convolution layer. Some common activation functions are RELU: max(0, x), Sigmoid: 1/(1+e^-x), Tanh, LeakyRELU, etc. The volume remains unchanged hence output volume will have dimension 32 x 32 x 12.
4. **Pool Layer:** This layer is periodically inserted in the covnets and its main function is to reduce the size of volume which makes the computation fast reduces memory and also prevents overfitting. Two common types of pooling layers are **max pooling** and **average pooling**. If we use a max pool with 2 x 2 filters and stride 2, the resultant volume will be of dimension 16x16x12.

Convolutional neural networks (CNN) are one of the most popular models used today. This neural network computational model uses a variation of multilayer perceptrons and contains one or more convolutional layers that can be either entirely connected or pooled. These convolutional layers create feature mapsthat record a region of image which is ultimately broken into rectangles and sentout for nonlinear processing.**Advantages:**

- Very High accuracy in image recognition problems.
- Automatically detects the important features without any human supervision.
- Weight sharing.

**Disadvantages:**

- CNN do not encode the position and orientation of object.
- Lack of ability to be spatially invariant to the input data.
- Lots of training data is required.

Some common applications of this computer vision today can be seen in:

- **Marketing:** Social media platforms provide suggestions on who might be in photograph that has been posted on a profile, making it easier to tag friends in photo albums.
- **Healthcare:** Computer vision has been incorporated into radiology technology, enabling doctors to better identify cancerous tumors in healthy anatomy.
- **Retail:** Visual search has been incorporated into some e-commerce platforms, allowing brands to recommend items that would complement an existing wardrobe.

**Conclusion:**We have successful in creating disease classification techniquesused for plant leaf disease detection.

Assignment 4

**Tittle:** Recurrent neural network (RNN) Use the Google stock prices dataset anddesign a time series analysis and prediction system using RNN

**Aim:** To implement Google stock prices prediction system using RNN and designa time series analysis.

**Theory:**Imagine living in a world where you know the exact prices of the stocksyou invested in, but ahead of time. When you know exactly when they're headingup. When you know exactly when they're going down. You'll be on your path tobecoming a millionaire.

This may sound superficial, because for so many years, investors have been doinga ton of market research, and then conducting their own analysis, simply becausenobody is able to predict the future. However, we are able to predict the future.

# Understanding Recurrent Neural Networks (RNN)

RNNs are widely known for their ability to memorize previous inputs in memory,when a huge amount of sequential data is fed to them. These are different from the classic feedforward neural networks which have no memory of the input theyreceived just a second ago.

For example, if you provide the feed forward neural network with a sequence ofletters like "N-E-U-R-O-N", by the time it gets to 'R', it will most likely have forgotten that it just read "U". This is a big issue, and doesn't make these neuralnetworks too useful.

However, RNNs continuously collect the inputs they just passed, and store themas well. For example, in “N-E-U-R-O-N”, they will be able to remember “R” butalso the “U” it just passed. This is very useful at the model will do a better job at

predicted what is next in the sequence.

Recurrent Neural Network (RNN):

Recurrent neural networks (RNN) are more complex. They save the output of processing nodes and feed the result back into the model (they did not pass the information in one direction only). This is how the model is said to learn to predict the outcome of a layer. Each node in the RNN model acts as a memory cell, continuing the computation and implementation of operations. If the network’s prediction is incorrect, then the system self-learns and continues working towards the correct prediction during backpropagation. **Advantages:**

- An RNN remembers each and every information through time. It is useful in time series prediction only because of the feature to remember previous inputs as well. This is called Long Short Term Memory.
- Recurrent neural network are even used with convolutional layers to extend the effective pixel neighborhood.

## Disadvantages:

- Gradient vanishing and exploding problems.
- Training an RNN is a very difficult task.
- It cannot process very long sequences if using tanh or relu as an activation function

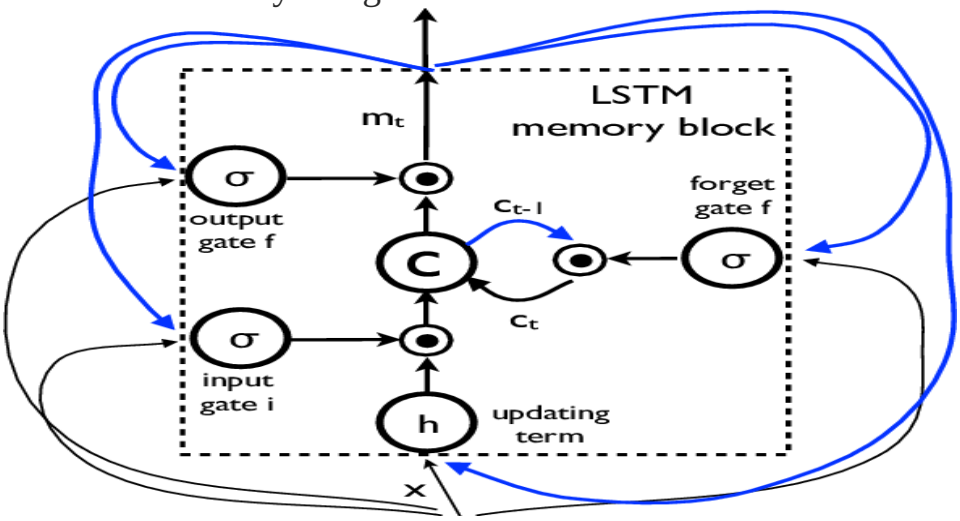
Long Short Term Memory (LSTM) Networks

LSTM networks have unique units along with their standard units, which have **memory cells**. It allows the network to maintain information in memory foran extensive period of time. The model includes multiple **gates** which control thetime at which information enters the memory, when it is outputted, and when thatinformation is disregarded.

To apply this new lens to stock predictions, a simple feed forward neural networkwould forget the earlier years stock prices as soon as the neural network is fed with more recent stock prices from this year.

However, with the LSTM network:

- The **memory gate** is able to collect potential outputs, and also stores the relevant ones.
- The **selection gate** is the one *selecting* the single output being sent out from the possible outputs that the memory gate had gathered.
- The **forget the ignore gate** is responsible for deciding which data memories are unnecessary and gets rid of them- as the name indicates.




LSTM

Now that you've gained some background knowledge on RNNs, let's start building!

## Importing Necessary Packages

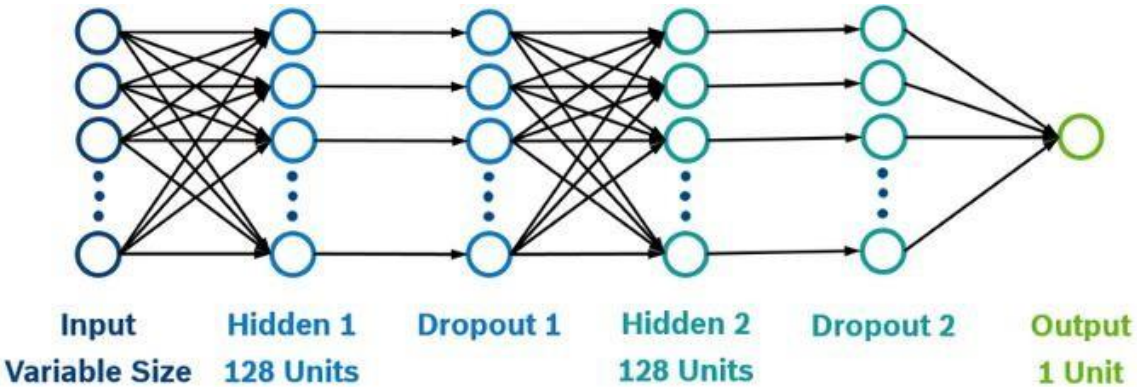
Python libraries needed for this model include:

**Numpy:** used for performing basic array operations. It is widely used in trainingmachine learning models as it supports multidimensional arrays compared to lists

**Pyplot from matplotlib:** required for visualizing the predicted values after testing it

**Pandas:** most commonly used to read the dataset

**MinMaxScaler from sklearn:** used to scale the data. It is used in the data normalization step and essentially what it does is, takes the large numbers, and transforms the values into the range between 0 to 1 range in order for the model to be trained.



Referring to this diagram could help you fully understand the process of buildingthis neural network. The output layer will only consist of 1 value, as we have 1 predicted value.

Conclusion: Thus, We have successfully implemented Google stock prices prediction system using RNN.

Mini Project: Human Face Recognition 6. Mini Project: Gender and Age Detection: predict if a person is a male or female and also their age 7. Mini Project: Colorizing Old B&W Images: color old black and white images to colorful images

Group 2

5. Mini Project: Human Face Recognition

6. Mini Project: Gender and Age Detection: predict if a person is a male or female and also their age 7. Mini Project: Colorizing Old B&W Images: color old black and white images to colorful images