



# Keshav Memorial Institute of Technology

(Approved by AICTE, Affiliated to JNTUH & Accredited by NBA)  
Narayanguda, Hyderabad, Telangana 500029  
(Autonomous)



## B.Tech. III Year SEM II Syllabus (R18 Regulations) COMPUTER SCIENCE AND ENGINEERING (MACHINE LEARNING)

### CS604PC MACHINE LEARNING LAB MANUAL

#### III YEAR B.TECH CSE II-SEM

L	T	P	C
0	0	3	1.5

#### Course Objectives:

- The objective of this lab is to get an overview of the various machine learning techniques and can able to demonstrate them using python.

#### Course Outcomes: After learning the student must be able to

- understand complexity of Machine Learning algorithms and their limitations;
- understand modern notions in data analysis-oriented computing;
- be capable of confidently applying common Machine Learning algorithms in practice and implementing their own;
- Be capable of performing experiments in Machine Learning using real-world data.

#### LIST OF EXPERIMENTS:

1. The probability that it is Friday and that a student is absent is 3 %. Since there are 5 school days in a week, the probability that it is Friday is 20 %. What is the probability that a student is absent given that today is Friday? Apply Bayes rule in python to get the result. (Ans: 15%)

2. Extract the data from database using python

3. Implement k-nearest neighbours classification using python

4.. Given the following data, which specify classifications for nine combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of k-means clustering with 3 means (i.e., 3 centroids)

VAR1	VAR2	CLASS
1.713	1.586	0
0.180	1.786	1
0.353	1.240	1
0.940	1.566	0
1.486	0.759	1
1.266	1.106	0
1.540	0.419	1
0.459	1.799	1
0.773	0.186	1

5. The following training examples map descriptions of individuals onto high, medium and low credit-worthiness.

medium	skiing	design	single	twenties	no	-> highRisk
high	golf	trading	married	forties	yes	-> lowRisk
low	speedway	transport	married	thirties	yes	-> medRisk
medium	football	banking	single	thirties	yes	-> lowRisk
high	flying	media	married	fifties	yes	-> highRisk
low	football	security	single	twenties	no	-> medRisk
medium	golf	media	single	thirties	yes	-> medRisk
medium	golf	transport	married	forties	yes	-> lowRisk
high	skiing	banking	single	thirties	yes	-> highRisk
low	golf	unemployed	married	forties	yes	-> highRisk

Input attributes are (from left to right) income, recreation, job, status, age-group, home-owner. Find the unconditional probability of 'golf' and the conditional probability of 'single' given 'medRisk' in the dataset?

6. Implement linear regression using python.

7. Implement Naïve Bayes theorem to classify the English text

8. Implement the finite words classification system using Back-propagation algorithm.



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NARAYANAGUDA, HYDERABAD – 500 029

**Certificate**

This is to certify that following is a Bonafide Record of the practical work done by

\_\_\_\_\_ bearing Roll  
No. \_\_\_\_\_ of \_\_\_\_\_ Branch of \_\_\_\_\_ year B.Tech  
Course in the \_\_\_\_\_ Laboratory during the Academic year  
\_\_\_\_\_ & \_\_\_\_\_ under our supervision.

Number of experiments conducted: \_\_\_\_\_

Signature of Staff Member Incharge

Signature of Head of the Dept.

Signature of Internal Examiner

Signature of External Examiner

# INDEX

## PARTICULARS OF THE EXPERIMENT PERFORMED

[illegible]

# INDEX

## PARTICULARS OF THE EXPERIMENT PERFORMED

[illegible]

**KESHAV MEMORIAL INSTITUTE OF TECHNOLOGY**

## Daily Laboratory Assessment Sheet

**Name of the Lab:**

**Name of the Student:**

**Class:**

**Roll No:**

[illegible]

# **KESHAV MEMORIAL INSTITUTE OF TECHNOLOGY**

(Approved by AICTE & Govt of T.S and Affiliated to JNTUH)

3-5-1026, Narayanaguda, Hyderabad-29. Ph: 040-23261407

## **Vision & Mission of the Department**

### **Vision of the Department**

To be among the region's premier teaching and research Computer Science and Engineering departments producing globally competent and socially responsible graduates in the most conducive academic environment.

### **Mission of the Department**

- To provide faculty with state of the art facilities for continuous professional development and research, both in foundational aspects and of relevance to emerging computing trends.
- To impart skills that transform students to develop technical solutions for societal needs and inculcate entrepreneurial talents.
- To inculcate an ability in students to pursue the advancement of knowledge in various specializations of Computer Science and Engineering and make them industry-ready.
- To engage in collaborative research with academia and industry and generate adequate resources for research activities for seamless transfer of knowledge resulting in sponsored projects and consultancy.
- To cultivate responsibility through sharing of knowledge and innovative computing solutions that benefit the society-at-large.
- To collaborate with academia, industry and community to set high standards in academic excellence and in fulfilling societal responsibilities.



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### Department of Computer Science and Engineering

#### PROGRAM OUTCOMES (POs)

1. **Engineering Knowledge:** Apply knowledge of mathematics and science, with fundamentals of Computer Science & Engineering to be able to solve complex engineering problems related to CSE.
2. **Problem Analysis:** Identify, Formulate, review research literature and analyze complex engineering problems related to CSE and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences
3. **Design/Development of solutions:** Design solutions for complex engineering problems related to CSE and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural societal and environmental considerations
4. **Conduct Investigations of Complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, Select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to computer science related complex engineering activities with an understanding of the limitations
6. **The Engineer and Society:** Apply Reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the CSE professional engineering practice
7. **Environment and Sustainability:** Understand the impact of the CSE professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development
8. **Ethics:** Apply Ethical Principles and commit to professional ethics and responsibilities and norms of the engineering practice
9. **Individual and Team Work:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary Settings



10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large such as able to comprehend and with write effective reports and design documentation, make effective presentations and give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments
12. **Life-Long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning the broadest context of technological change



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### **Department of Computer Science and Engineering**

#### **PROGRAM SPECIFIC OUTCOMES (PSOs)**



**PSO1:** An ability to analyze the common business functions to design and develop appropriate Computer Science solutions for social upliftments.

**PSO2:** Shall have expertise on the evolving technologies like Python, Machine Learning, Deep Learning, Internet of Things (IOT), Data Science, Full stack development, Social Networks, Cyber Security, Big Data, Mobile Apps, CRM, ERP etc.



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**Department of Computer Science and Engineering**

**PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

**PEO 1:** Graduates will endeavor to excel in their chosen careers as professionals, researchers and entrepreneurs on a global platform.

**PEO 2:** Graduates will demonstrate the ability to solve challenges in the fields of Engineering and Technology simultaneously catering to societal needs.

**PEO 3:** Graduates will strive to improve their learning curve by practising Continuing Professional Development (CPD)

**PEO 4:** Graduates will, at all times, adopt a professional demeanor by communicating effectively, working collaboratively, and maintaining the ethics & core values as befitting their education in interdisciplinary and emerging fields.



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### **Department of Computer Science and Engineering**

#### **COURSE OUTCOMES (COs)**



**CO1:** Understand the implementation procedures for the machine learning algorithms

**CO2:** Design python programs for various learning algorithm.

**CO3:** Apply appropriate data sets to the machine learning algorithms.

**CO4:** Identify and apply machine learning algorithms to solve real world problems.



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### Department of Computer Science and Engineering

#### CO-PO-PSO MAPPING

Mapping of CO to PO												
	POs											
COs	1	2	3	4	5	6	7	8	9	10	11	12
1. Understand the implementation procedures for the ML algorithms.	3	3	3	3	2	1	1	-	3	3	2	1
2. Design python programs for various learning algorithms.	3	3	3	3	3	1	-	-	3	2	1	1
3. Apply appropriate data sets to the machine learning algorithms.	3	3	3	3	2	2	-	-	3	1	-	-
4. Identify and apply machine learning algorithms to solve real world problems.	3	3	3	3	3	3	1	2	3	3	2	1

Mapping of CO to PSO		
	PSOs	
COs	1	2
1. Understand the implementation procedures for the ML algorithms.	3	-
2. Design python programs for various ML algorithms.	3	-
3. Apply appropriate data sets to the ML algorithms.	3	-
4. Identify and apply ML algorithms to solve real world problems.	3	-

AIM:1.The probability that it is Friday and that a student is absent is 3 %. Since there are 5 school days in a week, the probability that it is Friday is 20 %. What is the probability that a student is absent given that today is Friday? Apply Baye's rule in python to get the result.

THEORY:

**Bayes' Theorem** is a way of finding a [probability](#) when we know certain other probabilities.

The formula is:

$$P(A|B) = \frac{P(A) P(B|A)}{P(B)}$$

Which tells us: how often A happens *given that B happens*, written **P(A|B)**,  
 When we know: how often B happens *given that A happens*, written **P(B|A)**  
 and how likely A is on its own, written **P(A)**  
 and how likely B is on its own, written **P(B)**

### Statement of theorem [\[edit\]](#)

Bayes' theorem is stated mathematically as the following equation:<sup>[3]</sup>

$$P(A | B) = \frac{P(B | A)P(A)}{P(B)}$$

where  $A$  and  $B$  are [events](#) and  $P(B) \neq 0$ .

- $P(A | B)$  is a [conditional probability](#): the probability of event  $A$  occurring given that  $B$  is true. It is also called the [posterior probability](#) of  $A$  given  $B$ .
- $P(B | A)$  is also a conditional probability: the probability of event  $B$  occurring given that  $A$  is true. It can also be interpreted as the [likelihood](#) of  $A$  given a fixed  $B$  because  $P(B | A) = L(A | B)$ .
- $P(A)$  and  $P(B)$  are the probabilities of observing  $A$  and  $B$  respectively without any given conditions; they are known as the [marginal probability](#) or [prior probability](#).
- $A$  and  $B$  must be different events.

**Proof** [\[ edit \]](#)**For events** [\[ edit \]](#)

Bayes' theorem may be derived from the definition of [conditional probability](#):

$$P(A | B) = \frac{P(A \cap B)}{P(B)}, \text{ if } P(B) \neq 0,$$

$$P(B | A) = \frac{P(B \cap A)}{P(A)}, \text{ if } P(A) \neq 0,$$

where  $P(A \cap B)$  is the [joint probability](#) of both A and B being true. Because

$$P(B \cap A) = P(A \cap B),$$

$$\Rightarrow P(A \cap B) = P(A | B)P(B) = P(B | A)P(A)$$

$$\Rightarrow P(A | B) = \frac{P(B | A)P(A)}{P(B)}, \text{ if } P(B) \neq 0.$$


---

SOURCE CODE:

```
# calculate the probability that a student is absent given that today is Friday

# calculate P(A|F) given P(F), P(F^A)
def bayes_theorem(p_f, p_f_and_a):
    p_a_given_f = (p_f_and_a) / p_f
    return p_a_given_f

# P(F) p_f = 0.2
# P(F^A)
p_f_and_a = 0.03
# calculate P(A|F)
result = bayes_theorem(p_f, p_f_and_a)
# summarize
print('P(A|F) = %.3f%%' % (result * 100))
```

OUTPUT:

P(A|F) = 15.000%

AIM: 2. Extract the data from database using python.

THEORY:

## SQLite Database

It is a disk-based database that does not need any separate server process and installation of anything on your computer.

You even don't need to install any package in your Python distribution.

The package `sqlite3` is part of the standard library since Python 2.5. We will use this `sqlite3` package to create our own database.

What is a database?

How to create a database table using SQLite database?

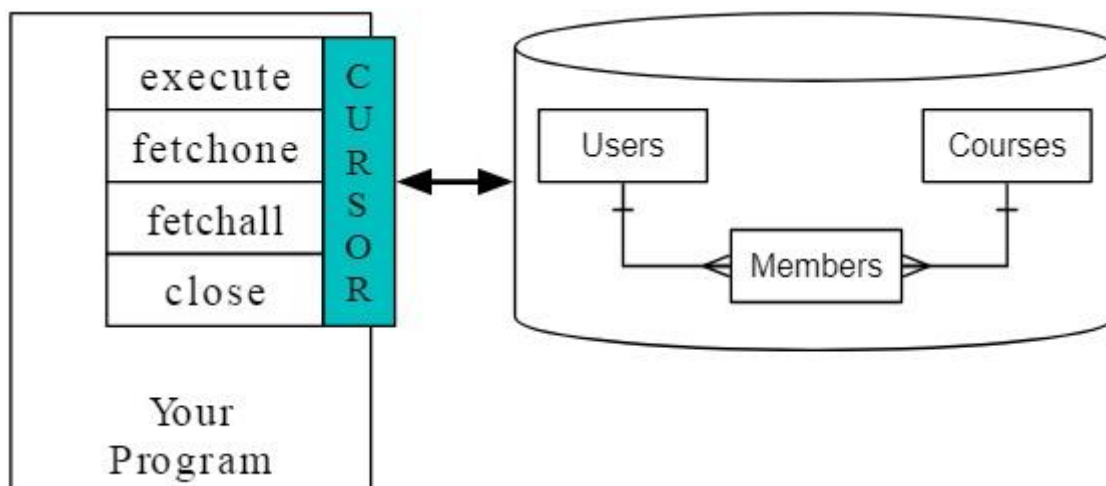
How to insert data into a database table using SQLite database?

What are the methods to retrieve data from the database table using SQLite database?

What is a database? A database is a file that is organized for storing data. Data in the database is arranged in the form of tables, rows, and columns.

There are many different database systems available such as Oracle, MySQL, Microsoft SQL Server, PostgreSQL, and SQLite. Each of these databases is used for a variety of purposes. This tutorial discusses how to use SQLite in Python, as it is inbuilt in Python and easy to use.

What are the Functions available in SQLite? The following diagram shows the functions available in SQLite database.





First, we need to connect to the database using connect() function. connect() function accepts one parameter that is the name of the database. If the database is already present in the system then connect() function open the database. Otherwise, the connect() function creates a new database. Once the database is created using connect() function. The database looks like a file to our program. We open the normal file using an open() function and then perform read and write operations. Similarly, the cursor() function is used to open the database.

After the database is opened using cursor() function, we can perform different operations on the database. Like, we can create a new table, add new data into the table. We can update the data in the table and delete the rows of the table. Also, we can drop the entire table. Finally, we can fetch the content of the table using fetchone() or fetchall() function and display it to the user.

How to create a database table using an SQLite database? In the following fragment of Python code, we have established the connection to the database using connect() function. Then the database was opened using cursor() function. Later, we have created a table by executing a CREATE TABLE query using the execute() function. Finally, we have closed the connection using the close() function.

How to insert data into database table? The next Fragment of Python code shows how to insert data into database.

How to retrieve data from the database table using SQLite? The data from the database is extracted using a SELECT query. Then three methods are used to demonstrate how to display the results to the user. First, The return value of the SELECT query was stored into a variable, data in this example. Then the one row from the data is extracted using the for loop and displayed to the user. Second, the fetchone() function is used to extract the first rows from the cursor and displayed. Third, fetchall() function is used to extract all the rows from the cursor and displayed.

#### **SOURCE CODE:**

```
#write your python program here by reading the problem statement
import sqlite3
conn = sqlite3.connect('StudentInfo')
cur = conn.cursor()
cur.execute('DROP TABLE IF EXISTS student')
cur.execute('CREATE TABLE student (name TEXT, rno INTEGER)')
cur.execute('INSERT INTO student (name, rno) VALUES (?, ?),('Mahesh', 45))
cur.execute('INSERT INTO student (name, rno) VALUES (?, ?),('Rahul', 30))
cur.execute('SELECT * FROM student')
#print ("Data in the table using fetchall() function:")
print (cur.fetchall())
conn.close()
```

**OUTPUT:** [('Mahesh', 45), ('Rahul', 30)]

AIM:3.Implement k-nearest neighbours classification using python.

THEORY:

## K-Nearest Neighbor Algorithm

---

Training algorithm:

For each training example  $(x, f(x))$ , add the example to the list training examples

Classification algorithm:

Given a query instance  $x_q$  to be classified,

Let  $x_1 \dots x_k$  denote the  $k$  instances from training examples that are nearest to  $x_q$

Return  $\hat{f}(x_q) \leftarrow \frac{\sum_{i=1}^k f(x_i)}{k}$  Where,  $f(x_i)$  function to calculate the mean value of the  $k$  nearest training examples.

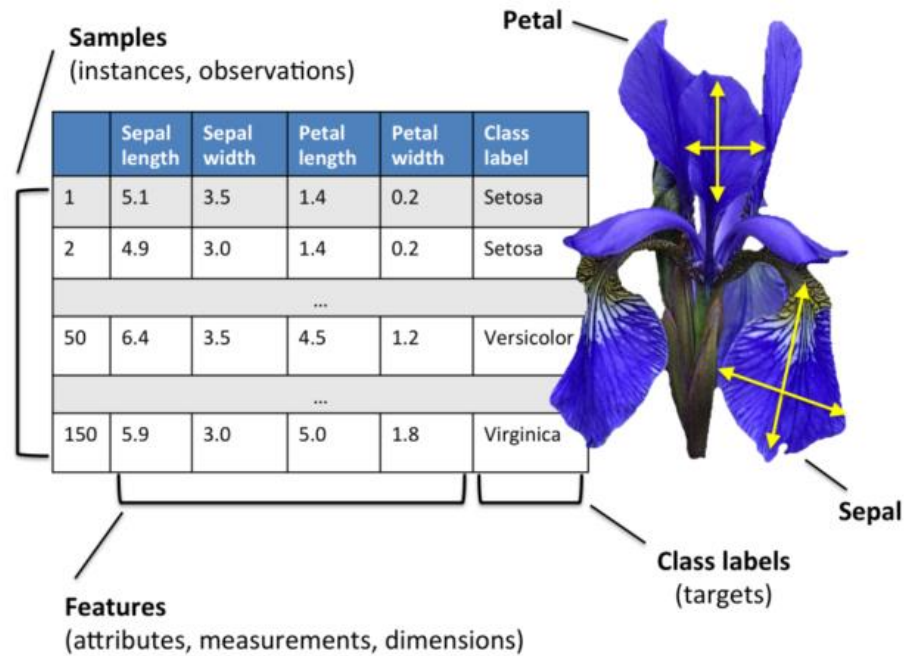
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## Data Set:

Iris Plants Dataset: Dataset contains 150 instances (50 in each of three classes)

Number of Attributes: 4 numeric, predictive attributes and the Class.





	sepal-length	sepal-width	petal-length	petal-width	Class
0	5.1	3.5	1.4	0.2	Iris-setosa
1	4.9	3.0	1.4	0.2	Iris-setosa
2	4.7	3.2	1.3	0.2	Iris-setosa
3	4.6	3.1	1.5	0.2	Iris-setosa
4	5.0	3.6	1.4	0.2	Iris-setosa

#### SOURCE CODE:

```
from sklearn.datasets import load_iris
iris = load_iris()
#print("Feature Names:",iris.feature_names,"Iris Data:",iris.data,"Target
Names:",iris.target_names,"Target:",iris.target)
from sklearn.model_selection import train_test_split
```

```

X_train, X_test, y_train, y_test = train_test_split( iris.data, iris.target, test_size =
.25,random_state=42)
from sklearn.neighbors import KNeighborsClassifier
clf = KNeighborsClassifier() clf.fit(X_train, y_train)
print(" Accuracy=",clf.score(X_test, y_test))
print("Predicted Data")
print(clf.predict(X_test))
prediction=clf.predict(X_test)
print("Test data :")
print(y_test) diff=prediction-y_test
print("Result is ") print(diff)
print('Total no of samples misclassified =', sum(abs(diff)))

```

### OUTPUT:

```

Accuracy= 1.0
Predicted Data
[1 0 2 1 1 0 1 2 1 1 2 0 0 0 0 1 2 1 1 2 0 2 0 2 2 2 2 2 0 0 0 0 1 0 0 2
1
0]
data :
[1 0 2 1 1 0 1 2 1 1 2 0 0 0 0 1 2 1 1 2 0 2 0 2 2 2 2 2 0 0 0 0 1 0 0 2
1
0]
Result is
[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0
0]
Total no of samples misclassified = 0

```

Test

AIM:4. Given the following data, which specify classifications for nine combinations of VAR1 and VAR2 predict a classification for a case where VAR1=0.906 and VAR2=0.606, using the result of kmeans clustering with 3 means (i.e., 3 centroids)

VAR1	VAR2	CLASS
1.713	1.586	0
0.180	1.786	1
0.353	1.240	1
0.940	1.566	0
1.486	0.759	1
1.266	1.106	0
1.540	0.419	1
0.459	1.799	1
0.773	0.186	1

THEORY:

Introduction to K-means Clustering:

**k-means** is one of the simplest unsupervised learning algorithms that solve the clustering problems. The procedure follows a **simple** and easy way to classify a given data set through a certain number of clusters (assume **k** clusters). The main idea is to define **k** centers, one for each cluster.

**K-Means is applied in:**

The *K*-means clustering algorithm is used to find groups which have not been explicitly labeled in the data and to find patterns and make better decisions.. Once the algorithm has been run and the groups are defined, any new data can be easily assigned to the most relevant group.

Customer Profiling:

market segmentation,

computer vision

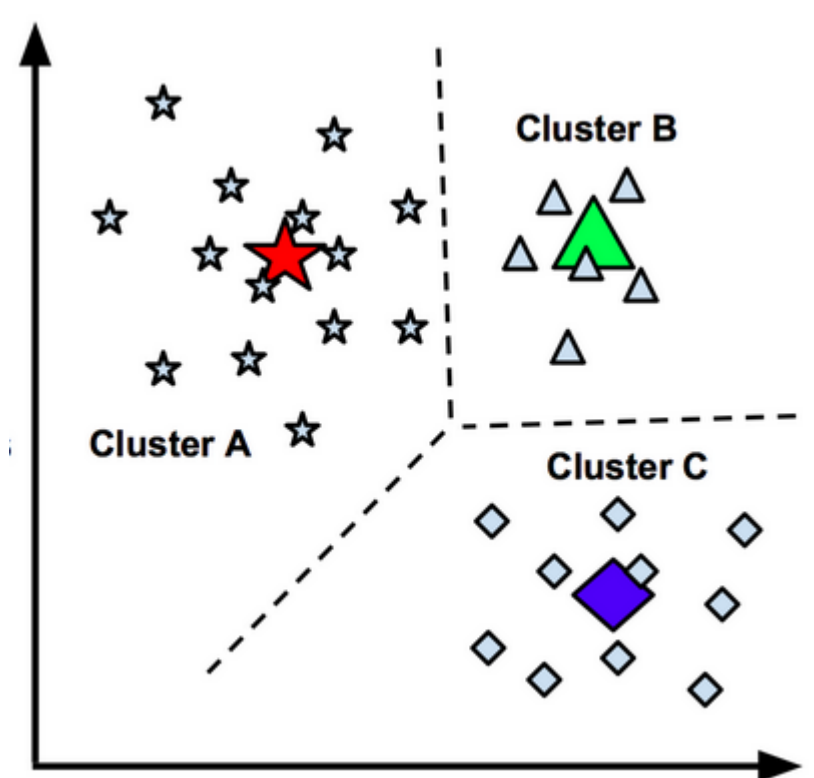
Geo-statistics

Astronomy

**Algorithm:**

To start with k-means algorithm, you first have to randomly initialize points called the cluster centroids (**K**). K-means is an **iterative algorithm** and it does two steps:

1. **Cluster assignment** 2. **Move centroid step.**



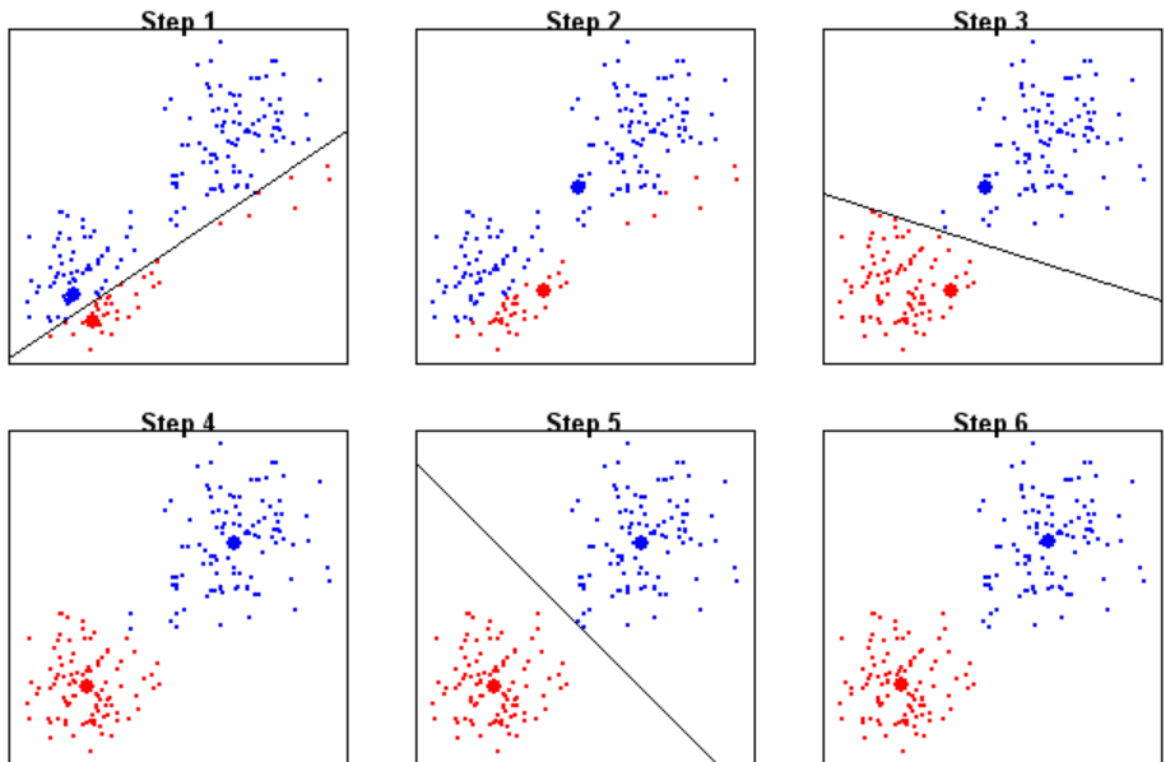
### 1. Cluster assignment

the algorithm goes through each of the data points and depending on which cluster is closer, It assigns the data points to one of the three cluster centroids.

### 2. Move centroid

Here, K-means moves the centroids to the average of the points in a cluster. In other words, the algorithm calculates the average of all the points in a cluster and moves the centroid to that average location.

This process is repeated until there is no change in the clusters (or possibly until some other stopping condition is met). K is chosen randomly or by giving specific initial starting points by the user.



K-Means at work

**SOURCE CODE:**

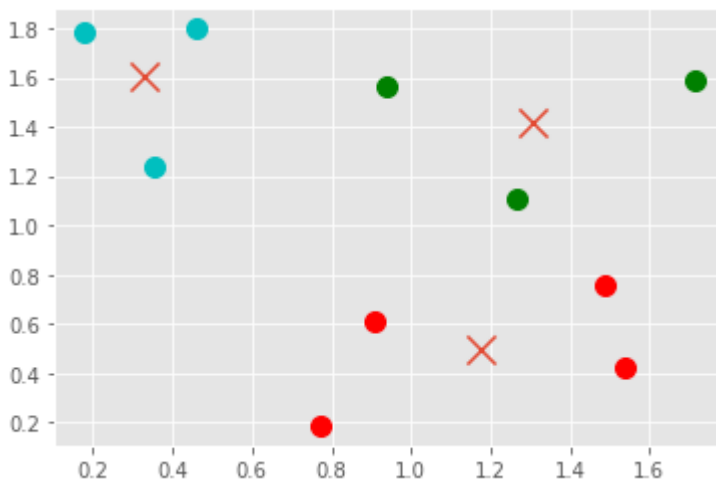
```
import numpy as np
from sklearn.cluster
import KMeans
X2=
np.array([[1.713,1.586],[0.18,1.786],[0.353,1.24],[0.94,1.566],[1.486,0.759],[1.266,1.106],[1.5
4,0.419],[0.459,1.799],[0.773,0.186],[0.906,0.606]])
#print(X2)
kmeans = KMeans(n_clusters=3,random_state=13) kmeans.fit(X2)
centroid = kmeans.cluster_centers_
labels = kmeans.labels_
print(centroid)
print(labels)
for i in range(len(X2)):
    print ("coordinate:" , X2[i], "label:" , labels[i])
```

**OUTPUT:**

```
[[1.30633333 1.41933333]
 [1.17625  0.4925  ]
 [0.33066667 1.60833333]]
2 2 0 1 0 1 2 1 1]
```

[0

```
coordinate: [1.713 1.586] label: 0
coordinate: [0.18  1.786] label: 2
coordinate: [0.353 1.24 ] label: 2
coordinate: [0.94  1.566] label: 0
coordinate: [1.486 0.759] label: 1
coordinate: [1.266 1.106] label: 0
coordinate: [1.54  0.419] label: 1
coordinate: [0.459 1.799] label: 2
coordinate: [0.773 0.186] label: 1
coordinate: [0.906 0.606] label: 1
```





AIM: 5. Find the unconditional probability of 'golf' and the conditional probability of 'single' given 'medRisk' in the following dataset?

The following training examples map descriptions of individuals onto high, medium and low credit-worthiness.

medium	skiing	design	single	twenties	no	-> highRisk
high	golf	trading	married	forties	yes	-> lowRisk
low	speedway	transport	married	thirties	yes	-> medRisk
medium	football	banking	single	thirties	yes	-> lowRisk
high	flying	media	married	fifties	yes	-> highRisk
low	football	security	single	twenties	no	-> medRisk
medium	golf	media	single	thirties	yes	-> medRisk
medium	golf	transport	married	forties	yes	-> lowRisk
high	skiing	banking	single	thirties	yes	-> highRisk
low	golf	unemployed	married	forties	yes	-> highRisk

Input attributes are (from left to right) income, recreation, job, status, age-group, home-owner.

THEORY:

### CONDITIONAL PROBABILITY WITH EXAMPLES:

As the name suggests, Conditional Probability is the probability of an event under some given condition. And based on the condition our sample space reduces to the conditional element.

For example, find the probability of a person subscribing for the insurance given that he has taken the house loan. Here sample space is restricted to the persons who have taken house loan.

To understand Conditional probability, it is recommended to have an understanding of probability basics like Mutually Exclusive and Independent Events, Joint, Union and Marginal Probabilities and Probability vs Statistics etc.

*In probability theory, conditional probability is a measure of the probability of an event occurring given that another event has occurred. If the event of interest is A and the event B is known or assumed to have occurred, "the conditional probability of A given B", or "the probability of A under the condition B", is usually written as  $P(A | B)$ , or sometimes  $PB(A)$  or  $P(A / B)$*

**Now the question may come like why use conditional probability and what is its significance in Data Science?**

Let's take a real-life example. Probability of selling a TV on a given normal day may be only 30%. But if we consider that given day is Diwali, then there are much more chances of selling a TV. The conditional Probability of selling a TV on a day given that Day is Diwali might be 70%. We can represent those probabilities as  $P(\text{TV sell on a random day}) = 30\%$ .  $P(\text{TV sell given that today is Diwali}) = 70\%$ .

So Conditional Probability helps Data Scientists to get better results from the given data set and for Machine Learning Engineers, it helps in building more accurate models for predictions.

**SOURCE CODE:**

```
import pandas as pd
df=pd.read_csv("https://raw.githubusercontent.com/KMITDS/CS601PC/main/individual.csv")
#print(df.head(10))
# we need to find P(recreation=golf) and P(status=single/credit-worthiness=medRisk)
# Pr(status='single' | credit-worthiness='medRisk') = Pr(status='single' &
creditworthiness='medRisk') / Pr(credit-worthiness='medRisk') df[(df.status=='single')
& (df.cw=='medRisk')] df.columns df[(df.cw=='medRisk')]
print("P(recreation=golf)") print(df[(df.recreation=='golf')].shape[0]/df.shape[0])
print(" P(status=single/credit-worthiness=medRisk)")
print(df[(df.status=='single') & (df.cw=='medRisk')].shape[0]/df[(df.cw=='medRisk')].shape[0])
```

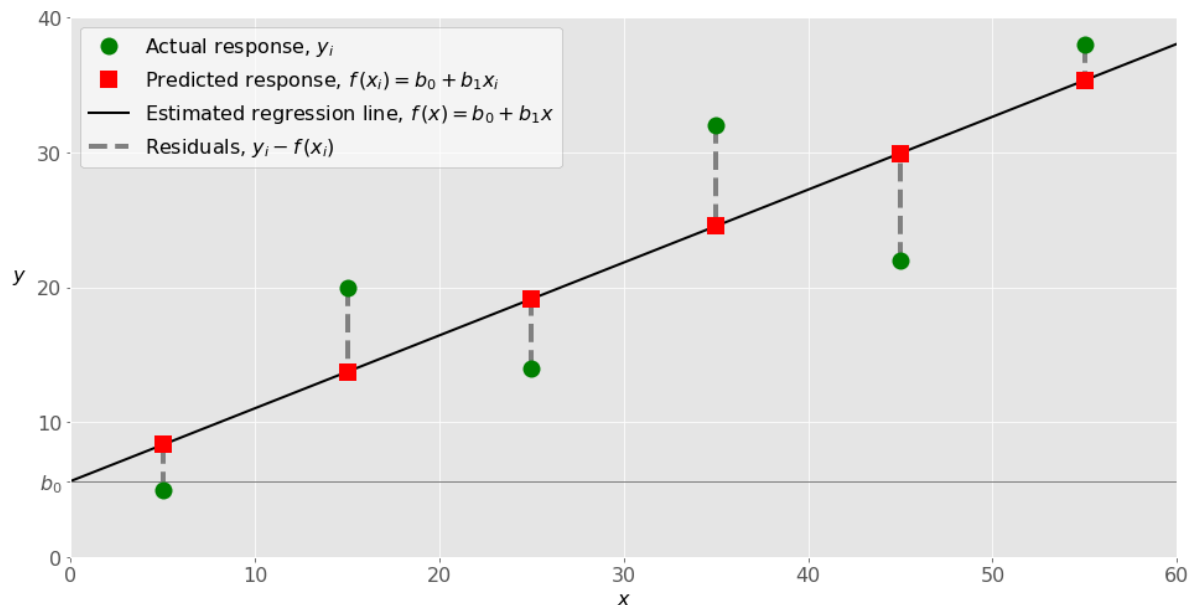
**OUTPUT:**

```
P(recreation=golf)
0.4
P(status=single/credit-
worthiness=medRisk)
0.6666666666666666
```

AIM:6. Implement linear regression using python.

THEORY:

The following figure illustrates simple linear regression:



### Python Packages for Linear Regression

The package **NumPy** is a fundamental Python scientific package that allows many high-performance operations on single- and multi-dimensional arrays.

It also offers many mathematical routines. Of course, it's open source.

The package **scikit-learn** is a widely used Python library for machine learning, built on top of NumPy and some other packages.

It provides the means for preprocessing data, reducing dimensionality, implementing regression, classification, clustering, and more.

Like NumPy, scikit-learn is also open source.

### Simple Linear Regression With scikit-learn

Let's start with the simplest case, which is simple linear regression.

There are five basic steps when you're implementing linear regression:

- 1.Import the packages and classes you need.
- 2.Provide data to work with and eventually do appropriate transformations.
- 3.Create a regression model and fit it with existing data.
- 4.Check the results of model fitting to know whether the model is satisfactory.

5. Apply the model for predictions.

These steps are more or less general for most of the regression approaches and implementations.

**SOURCE CODE:**

```
import numpy as np
from sklearn.linear_model import LinearRegression
x = np.array([5, 15, 25, 35, 45, 55]).reshape((-1, 1))
y = np.array([5, 20, 14, 32, 22, 38])
model = LinearRegression().fit(x, y)
r_sq = model.score(x, y)
print('coefficient of determination:', r_sq)
print('intercept:', model.intercept_)
print('slope:', model.coef_)
y_pred = model.predict(x)
print('predicted response:', y_pred, sep='\n')
```

**OUTPUT:**

coefficient of determination:

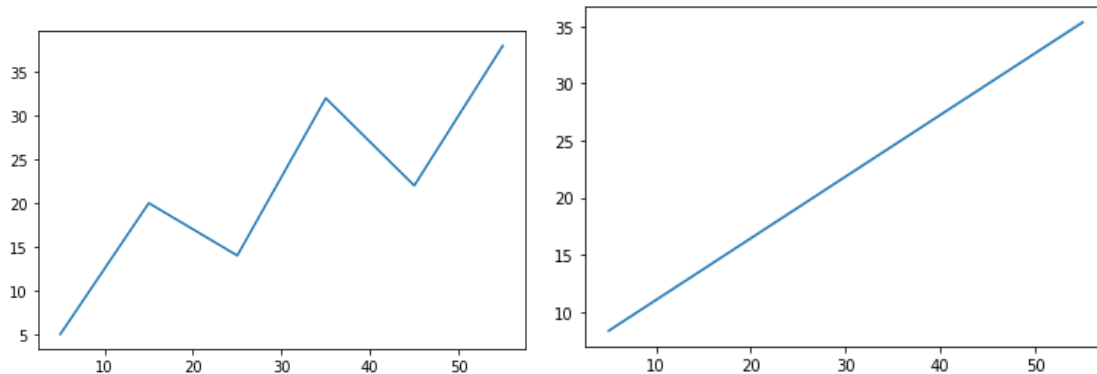
0.715875613747954

intercept: 5.633333333333333

slope: [0.54]

predicted response:

[ 8.33333333 13.73333333 19.13333333 24.53333333 29.93333333 35.33333333]



AIM:7. Implement Naïve Bayes theorem to classify the English text

THEORY:

---

### LEARN\_NAIVE\_BAYES\_TEXT (Examples, V)

*Examples* is a set of text documents along with their target values. *V* is the set of all possible target values. This function learns the probability terms  $P(w_k | v_j)$ , describing the probability that a randomly drawn word from a document in class  $v_j$  will be the English word  $w_k$ . It also learns the class prior probabilities  $P(v_j)$ .

1. collect all words, punctuation, and other tokens that occur in *Examples*
  - *Vocabulary*  $\leftarrow c$  the set of all distinct words and other tokens occurring in any text document from *Examples*
2. calculate the required  $P(v_j)$  and  $P(w_k | v_j)$  probability terms
  - For each target value  $v_j$  in *V* do
    - *docs<sub>j</sub>*  $\leftarrow$  the subset of documents from *Examples* for which the target value is  $v_j$
    - $P(v_j) \leftarrow |docs_j| / |Examples|$
    - *Text<sub>j</sub>*  $\leftarrow$  a single document created by concatenating all members of *docs<sub>j</sub>*
    - $n \leftarrow$  total number of distinct word positions in *Text<sub>j</sub>*
    - for each word  $w_k$  in *Vocabulary*
      - $n_k \leftarrow$  number of times word  $w_k$  occurs in *Text<sub>j</sub>*
      - $P(w_k | v_j) \leftarrow (n_k + 1) / (n + |Vocabulary|)$

### CLASSIFY\_NAIVE\_BAYES\_TEXT (Doc)

Return the estimated target value for the document *Doc*.  $a_i$  denotes the word found in the  $i^{th}$  position within *Doc*.

- *positions*  $\leftarrow$  all word positions in *Doc* that contain tokens found in *Vocabulary*
- Return  $V_{NB}$ , where

$$v_{NB} = \underset{v_j \in V}{\operatorname{argmax}} P(v_j) \prod_{i \in \text{positions}} P(a_i | v_j)$$

**Data set:**

	Text Documents	Label
1	I love this sandwich	pos
2	This is an amazing place	pos
3	I feel very good about these beers	pos
4	This is my best work	pos
5	What an awesome view	pos
6	I do not like this restaurant	neg
7	I am tired of this stuff	neg
8	I can't deal with this	neg
9	He is my sworn enemy	neg
10	My boss is horrible	neg
11	This is an awesome place	pos
12	I do not like the taste of this juice	neg
13	I love to dance	pos
14	I am sick and tired of this place	neg
15	What a great holiday	pos
16	That is a bad locality to stay	neg
17	We will have good fun tomorrow	pos
18	I went to my enemy's house today	neg

**Basic knowledge****Confusion Matrix**

		Actual	
		Positive	Negative
Predicted	Positive	<b>True Positive</b>	<b>False Positive</b>
	Negative	<b>False Negative</b>	<b>True Negative</b>

**True positives:** data points labelled as positive that are actually positive

**False positives:** data points labelled as positive that are actually negative

**True negatives:** data points labelled as negative that are actually negative

**False negatives:** data points labelled as negative that are actually positive

$$\text{Recall} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Negative}}$$

$$= \frac{\text{True Positive}}{\text{Total Actual Positive}}$$

		Actual	
		Positive	Negative
Predicted	Positive	<b>True Positive</b>	<b>False Positive</b>
	Negative	<b>False Negative</b>	<b>True Negative</b>

$$\text{Precision} = \frac{\text{True Positive}}{\text{True Positive} + \text{False Positive}}$$

$$= \frac{\text{True Positive}}{\text{Total Predicted Positive}}$$

		Actual	
		Positive	Negative
Predicted	Positive	True Positive	False Positive
	Negative	False Negative	True Negative

**Example:**

		Actual	
		Positive	Negative
Predicted	Positive	1 TP	3 FP
	Negative	0 FN	1 TN

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{1}{1+3} = 0.25$$

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{1}{1+0} = 1$$

**Accuracy:** how often is the classifier correct?

$$\text{Accuracy} = \frac{TP + TN}{\text{Total}} = \frac{1 + 1}{5} = 0.4$$

**SOURCE CODE:**

```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.naive_bayes import MultinomialNB
from sklearn import metrics
msg=pd.read_csv('https://raw.githubusercontent.com/KMITDS/CS601PC/main/naivetext.csv',
names=['message','label']) print('The
dimensions of the dataset',msg.shape)
msg['labelnum']=msg.label.map({'pos':1,'neg':0})
X=msg.message
y=msg.labelnum
#splitting the dataset into train and test data
xtrain,xtest,ytrain,ytest=train_test_split(X,y,random_state=42)
print ('\n the total number of Training Data :',ytrain.shape)
print ('\n the total number of Test Data :',ytest.shape)
#output the words or Tokens in the text documents
```



```
cv = CountVectorizer() xtrain_dtm = cv.fit_transform(xtrain)
xtest_dtm=cv.transform(xtest)
#print('\n The words or Tokens in the text documents \n')
#print(cv.get_feature_names())
df=pd.DataFrame(xtrain_dtm.toarray(),columns=cv.get_feature_names())
# Training Naive Bayes (NB) classifier on training data.
clf = MultinomialNB().fit(xtrain_dtm,ytrain)
predicted = clf.predict(xtest_dtm)
#printing accuracy, Confusion matrix, Precision and Recall
print('\n Accuracy of the classifier is',metrics.accuracy_score(ytest,predicted))
print('\n Confusion matrix')
print(metrics.confusion_matrix(ytest,predicted))
print('\n The value of Precision', metrics.precision_score(ytest,predicted))
print('\n The value of Recall', metrics.recall_score(ytest,predicted))
```

#### OUTPUT:

```
The dimensions of the dataset (18, 2)
the total number of Training Data : (13,)
the total number of Test Data : (5,)
Accuracy of the classifier is 0.6
Confusion matrix
[[2 0]
 [2 1]]
The value of Precision 1.0
The value of Recall 0.3333333333333333
```

AIM: 8. Build an ANN by implementing the Back-propagation algorithm.

THEORY:

**BACKPROPAGATION Algorithm**

**BACKPROPAGATION (training\_example,  $\eta$ ,  $n_{in}$ ,  $n_{out}$ ,  $n_{hidden}$ )**

Each training example is a pair of the form  $(\vec{x}, \vec{t})$ , where  $(\vec{x})$  is the vector of network input values,  $(\vec{t})$  and is the vector of target network output values.

$\eta$  is the learning rate (e.g., .05).  $n_{in}$  is the number of network inputs,  $n_{hidden}$  the number of units in the hidden layer, and  $n_{out}$  the number of output units.

The input from unit  $i$  into unit  $j$  is denoted  $x_{ji}$ , and the weight from unit  $i$  to unit  $j$  is denoted  $w_{ji}$

- Create a feed-forward network with  $n_{in}$  inputs,  $n_{hidden}$  hidden units, and  $n_{out}$  output units.
- Initialize all network weights to small random numbers
- Until the termination condition is met, Do

- For each  $(\vec{x}, \vec{t})$ , in training examples, Do

*Propagate the input forward through the network:*

1. Input the instance  $\vec{x}$  to the network and compute the output  $o_u$  of every unit  $u$  in the network.

*Propagate the errors backward through the network:*

2. For each network output unit  $k$ , calculate its error term  $\delta_k$

$$\delta_k \leftarrow o_k(1 - o_k)(t_k - o_k)$$

3. For each hidden unit  $h$ , calculate its error term  $\delta_h$

$$\delta_h \leftarrow o_h(1 - o_h) \sum_{k \in \text{outputs}} w_{h,k} \delta_k$$

4. Update each network weight  $w_{ji}$

$$w_{ji} \leftarrow w_{ji} + \Delta w_{ji}$$

Where

$$\Delta w_{ji} = \eta \delta_j x_{i,j}$$

**Training Examples:**

Example	Sleep	Study	Expected % in Exams
1	2	9	92
2	1	5	86
3	3	6	89

Normalize the input

Example	Sleep	Study	Expected % in Exams
1	$2/3 = 0.66666667$	$9/9 = 1$	0.92
2	$1/3 = 0.33333333$	$5/9 = 0.55555556$	0.86
3	$3/3 = 1$	$6/9 = 0.66666667$	0.89

**SOURCE CODE:**

```
import numpy as np
X = np.array([[2, 9], [1, 5], [3, 6]], dtype=float)
# two inputs [sleep,study] y = np.array([[92], [86], [89]], dtype=float)
# one output [expected % in exams]
X = X/np.amax(X,axis=0)
#maximum of X array longitudinally
y = y/100
#Sigmoid Function
def sigmoid (x): return 1/(1 + np.exp(-x))
#Derivative of Sigmoid Function
def derivatives_sigmoid(x): return x * (1 - x)
#Variable initialization
epoch=5 #Setting training iterations
lr=0.1 #Setting learning rate
np.random.seed(1)
inputlayer_neurons = 2 #number of features in data set
hiddenlayer_neurons = 3 #number of hidden layers neurons
output_neurons = 1 #number of neurons at output layer
#weight and bias initialization
wh=np.random.uniform(size=(inputlayer_neurons,hiddenlayer_neurons))
bh=np.random.uniform(size=(1,hiddenlayer_neurons))
wout=np.random.uniform(size=(hiddenlayer_neurons,output_neurons))
bout=np.random.uniform(size=(1,output_neurons))
#draws a random range of numbers uniformly of dim x*y
```

```

for i in range(epoch):
    #Forward Propagation
    hinp1=np.dot(X,wh)
    hinp=hinp1 + bh
    hlayer_act = sigmoid(hinp)
    outinp1=np.dot(hlayer_act,wout)
    outinp= outinp1+bout
    output = sigmoid(outinp)
    #Backpropagation
    EO = y-output
    outgrad = derivatives_sigmoid(output)
    d_output = EO * outgrad
    EH = d_output.dot(wout.T)
    hiddengrad = derivatives_sigmoid(hlayer_act)
    #how much hidden layer wts contributed to error
    d_hiddenlayer = EH * hiddengrad
    wout += hlayer_act.T.dot(d_output) *lr
    # dotproduct of nextlayererror and currentlayerop
    wh += X.T.dot(d_hiddenlayer) *lr
    print("Input: \n" + str(X))
    print("Actual Output: \n" + str(y))
    print("Predicted Output: \n" ,output)

```

OUTPUT:

Input:

```

[[0.66666667 1. ]
 [0.33333333 0.55555556]
 [1. 0.66666667]]

```

Actual Output:

```

[[0.92]
 [0.86]
 [0.89]]

```

Predicted Output:

```

[[0.79107772]
 [0.77932172]
 [0.79358328]

```

**VIVA Questions :**

1. What is machine learning?
2. Define supervised learning
3. Define unsupervised learning
4. Define semi supervised learning
5. Define reinforcement learning
6. What do you mean by hypotheses?
7. What is classification?
8. What is clustering?
9. Define precision, accuracy and recall
10. Define entropy
11. Define regression
12. How Knn is different from k-means clustering
13. What is concept learning?
14. Define specific boundary and general boundary
15. Define target function
16. Define decision tree
17. What is ANN
18. Explain gradient descent approximation
19. State Bayes theorem
20. Define Bayesian belief networks
21. Differentiate hard and soft clustering
22. Define variance
23. What is inductive machine learning?
24. Why K nearest neighbor algorithm is lazy learning algorithm
25. Why naïve Bayes is naïve
26. Mention classification algorithms
27. Define pruning
28. Differentiate Clustering and classification
29. Mention clustering algorithms
30. Define Bias
31. What is learning rate? Why it is needed

