

# APPLIED ARTIFICIAL INTELLIGENCE

A PRACTICAL REPORT  
ON  
Applied Artificial Intelligence

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University of Mumbai  
Department of Information Technology

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**Department of Information Technology**

**M.Sc. (IT - SEMESTER III)**

This is to certify that Applied Artificial Intelligence Practicals performed at  
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holding Seat No. \_\_\_\_\_ studying Master of Science in Information  
Technology Semester – III has been satisfactorily completed as  
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# INDEX

<b>Sr. No</b>	<b>Date</b>	<b>Practical</b>	<b>Page No.</b>	<b>Sign</b>
1	6/09/2023	Design an Expert System using AIML	1	
2	13/09/2023	Design a bot using AIML	4	
3	27/09/2023	Implement Bayes Theorem using Python	8	
4	4/10/2023	Implement Conditional Probability and joint probability using Python	11	
5	11/10/2023	A program to implement Rule Based System	15	
6	25/10/2023	Design a Fuzzy based application using Python	22	
7	1/11/2023	Write an application to simulate supervised and un-supervised learning model.	27	
8	8/11/2023	Write an application to implement clustering algorithm	32	
9	22/11/2023	Write a program to implement BFS algorithm	35	
10	29/11/2023	Write a program to implement DFS algorithm	41	

## Practical: 1

**Aim: Design an Expert System using AIML**

**Writeup:**

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

**Description:****Car health expert system?**

A car health expert system is a computer program that uses artificial intelligence to diagnose car problems based on a set of symptoms.

The system is typically rule-based, meaning that it contains a set of rules that define the relationships between symptoms and problems.

When the user enters a set of symptoms, the system uses the rules to determine the most likely problem.

This expert system can be used to determine if a car is healthy based on its symptoms.

If the car is not healthy the system will recommend a repair.

If the car is healthy the the system will recommend a your is healthy.

**Step 1:** Platform used to build a car health expert system

- Python is a powerful language that can be used to build car health expert systems

**Step 2:****Source Code:**

```
print("Car health expert system by Rahul")

def is_car_healthy(symptoms):

    if "engine_light_on" in symptoms or "low_oil_pressure" in symptoms:
        return False
    else:
        return True

car = input('Enter car issue:')
def get_car_repair(symptoms):

    if is_car_healthy(symptoms):
        return "Your car is healthy"
    elif "engine_light_on" in symptoms:
        return "Get your engine checked"
    elif "low_oil_pressure" in symptoms:
        return "Add oil to your car"
    else:
        return "I don't know what's wrong with your car"
def main():
    symptoms = [ "low_oil_pressure",]

    if is_car_healthy(symptoms):
        print("Your car is healthy")
```

```
    else:
        print("Your car needs repair")
        print("The repair is:", get_car_repair(symptoms))
main()
```

**Step 3:****Output:**

```
PS C:\Users\Dell\Desktop\MSC IT Part 1> & C:/Users/Dell/AppData/Local/Programs/Python/Python310/python.exe "c
Car health expert system by Rahul
Enter car issue:engine_light_on
Your car needs repair
● The repair is: Get your engine checked
PS C:\Users\Dell\Desktop\MSC IT Part 1> & C:/Users/Dell/AppData/Local/Programs/Python/Python310/python.exe "c
:/Users/Dell/Desktop/MSC IT Part 1/expert2.py"
Car health expert system by Rahul
Enter car issue:check_break
Your car is healthy
● PS C:\Users\Dell\Desktop\MSC IT Part 1> & C:/Users/Dell/AppData/Local/Programs/Python/Python310/python.exe "c
:/Users/Dell/Desktop/MSC IT Part 1/expert2.py"
Car health expert system by Rahul
Enter car issue:low_oil_pressure
Your car needs repair
○ The repair is: Add oil to your car
PS C:\Users\Dell\Desktop\MSC IT Part 1> □
```

## Practical: 2

## Aim: Design a bot using AIML

**Writeup:**

[illegible]



## Description:

### What is AIML?

AIML stands for Artificial Intelligence Modelling Language. AIML is an XML based markup language meant to create artificial intelligent applications. AIML makes it possible to create human interfaces while keeping the implementation simple to program, easy to understand and highly maintainable.

### AIML Tags/Description

- `<aiml>`– defines the beginning and end of a AIML document.
- `<category>`– defines the unit of knowledge in bot's knowledge base.
- `<pattern>`– defines the pattern to match what a user may input to an bot.
- `<template>`– defines the response of a bot to user's input.

### Step 1: install aiml

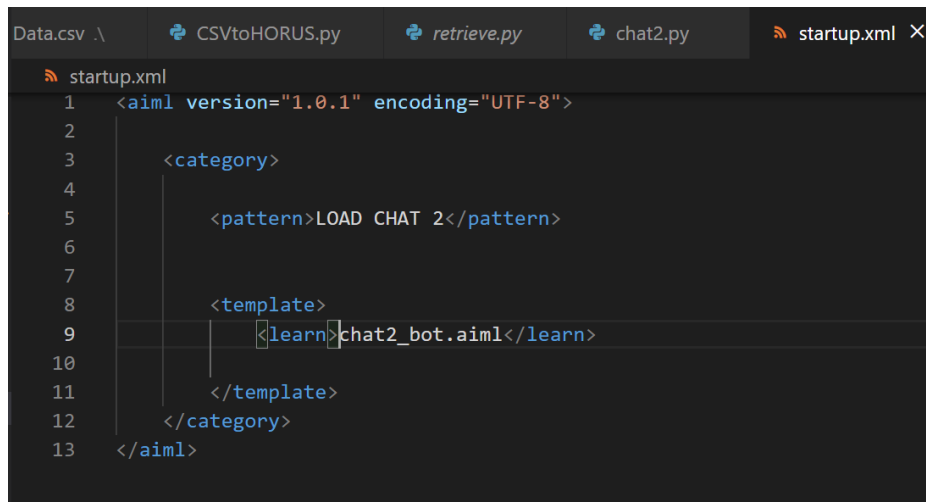
```
[notice] A new release of pip is available: 23.2 -> 23.2.1
[notice] To update, run: python.exe -m pip install --upgrade pip
PS C:\Users\Dell\Desktop\MSC IT Part 1> python.exe -m pip install --upgrade pip
Requirement already satisfied: pip in c:\users\dell\appdata\local\programs\python\python310\lib\site-packages (23.2)
Collecting pip
  Obtaining dependency information for pip from https://files.pythonhosted.org/packages/50/c2/e06851e8cc28dcad7c155f4753da8833ac06a5c704c109313b8d5a62968a/pip-23.2.1-py3-none-any.whl.metadata
  Downloading pip-23.2.1-py3-none-any.whl.metadata (4.2 kB)
    2.1/2.1 MB 2.7 MB/s eta 0:00:00
Attempting uninstall: pip
  Found existing installation: pip 23.2
  Uninstalling pip-23.2:
    Successfully uninstalled pip-23.2
Successfully installed pip-23.2.1
PS C:\Users\Dell\Desktop\MSC IT Part 1> pip install aiml
Collecting aiml
  Downloading aiml-0.9.2-py2.py3-none-any.whl (2.1 MB)
    2.1/2.1 MB 1.1 MB/s eta 0:00:00
Requirement already satisfied: setuptools in c:\users\dell\appdata\local\programs\python\python310\lib\site-packages (from aiml) (63.2.0)
Installing collected packages: aiml
Successfully installed aiml-0.9.2
PS C:\Users\Dell\Desktop\MSC IT Part 1> pip install python -aiml

Usage:
  pip install [options] <requirement specifier> [package-index-options] ...

no such option: -a
PS C:\Users\Dell\Desktop\MSC IT Part 1> pip install python - aiml
ERROR: Invalid requirement: '-'
PS C:\Users\Dell\Desktop\MSC IT Part 1> pip install python-aiml
Collecting python-aiml
  Downloading python-aiml-0.9.3.zip (2.1 MB)
    2.1/2.1 MB 3.7 MB/s eta 0:00:00
Installing build dependencies ... done
Getting requirements to build wheel ... done
Preparing metadata (pyproject.toml) ... done
Requirement already satisfied: setuptools in c:\users\dell\appdata\local\programs\python\python310\lib\site-packages (from python-aiml) (63.2.0)
Building wheels for collected packages: python-aiml
  Building wheel for python-aiml (pyproject.toml) ... done
  Created wheel for python-aiml: filename=python_aiml-0.9.3-py3-none-any.whl size=2122500 sha256=8d629dbb19ef61594494af0de1bf53ea487cedd930cf72b18ec064227cef6c66
  Stored in directory: c:\users\dell\appdata\local\pip\cache\wheels\0d\62\6e\815540b0e885fca8b9fe6ba52b09baae4937e2bde000615f70
Successfully built python-aiml
Installing collected packages: python-aiml
Successfully installed python-aiml-0.9.3
PS C:\Users\Dell\Desktop\MSC IT Part 1>
```

### Step 2: write code for startup.xml

### Code:



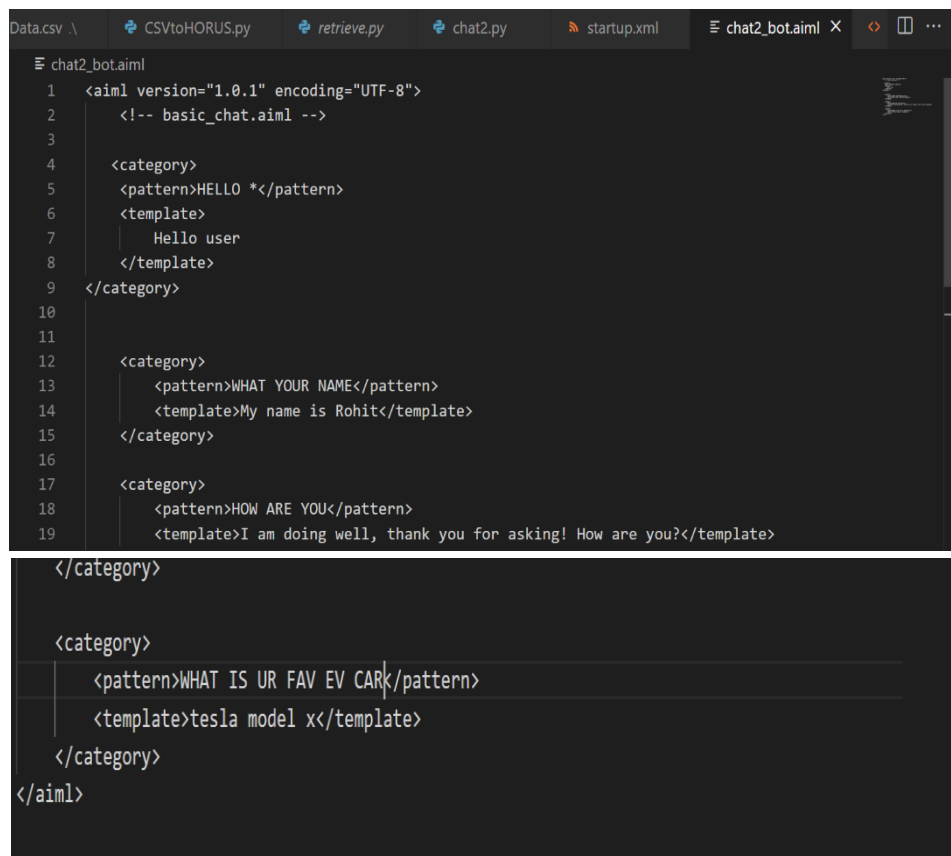
```

1 <aiml version="1.0.1" encoding="UTF-8">
2
3   <category>
4
5     <pattern>LOAD CHAT 2</pattern>
6
7
8     <template>
9       <learn>chat2_bot.aiml</learn>
10
11     </template>
12   </category>
13 </aiml>

```

**Step 3:** write code for chat2\_bot.aiml

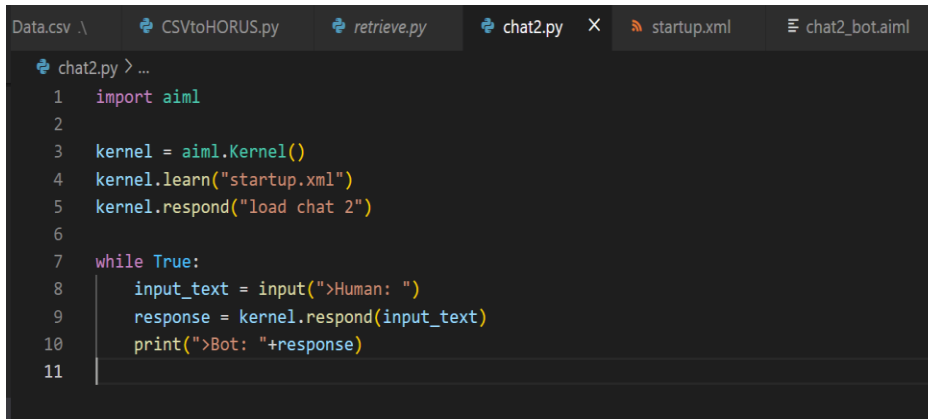
**Code:**



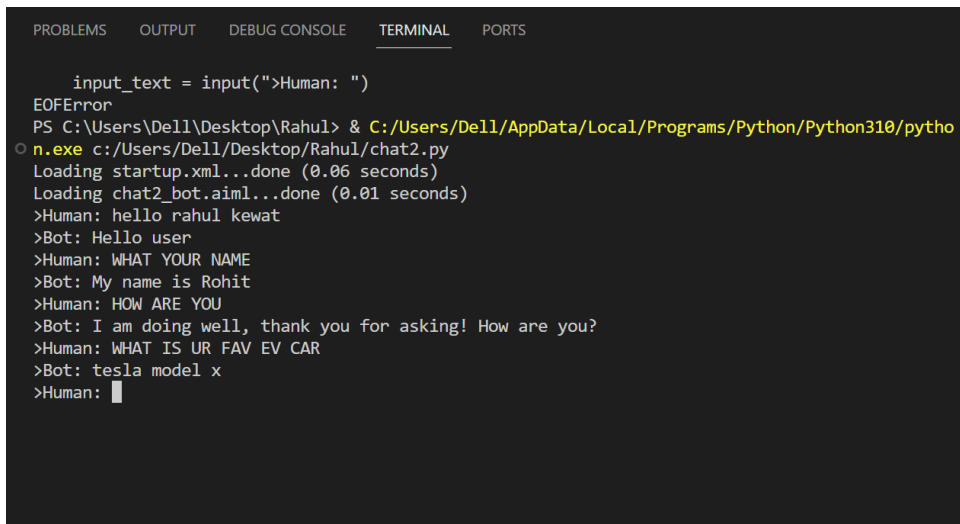
```

1 <aiml version="1.0.1" encoding="UTF-8">
2   <!-- basic_chat.aiml -->
3
4   <category>
5     <pattern>HELLO *</pattern>
6     <template>
7       Hello user
8     </template>
9   </category>
10
11
12   <category>
13     <pattern>WHAT YOUR NAME</pattern>
14     <template>My name is Rohit</template>
15   </category>
16
17   <category>
18     <pattern>HOW ARE YOU</pattern>
19     <template>I am doing well, thank you for asking! How are you?</template>
20
21   </category>
22
23   <category>
24     <pattern>WHAT IS UR FAV EV CAR</pattern>
25     <template>tesla model x</template>
26   </category>
27 </aiml>

```

**Step 4:** write code for chat.py**Code:**

```
chat2.py > ...
1  import aiml
2
3  kernel = aiml.Kernel()
4  kernel.learn("startup.xml")
5  kernel.respond("load chat 2")
6
7  while True:
8      input_text = input(">Human: ")
9      response = kernel.respond(input_text)
10     print(">Bot: "+response)
11
```

**Step 5****Output:**

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

input_text = input(">Human: ")
EOFError
PS C:\Users\Dell\Desktop\Rahul> & C:/Users/Dell/AppData/Local/Programs/Python/Python310/pytho
n.exe c:/Users/Dell/Desktop/Rahul/chat2.py
Loading startup.xml...done (0.06 seconds)
Loading chat2_bot.aiml...done (0.01 seconds)
>Human: hello rahul kewat
>Bot: Hello user
>Human: WHAT YOUR NAME
>Bot: My name is Rohit
>Human: HOW ARE YOU
>Bot: I am doing well, thank you for asking! How are you?
>Human: WHAT IS UR FAV EV CAR
>Bot: tesla model x
>Human: █
```

## Practical: 3

## Aim: Implement Bayes Theorem using Python

**Writeup:**

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

**Description:**

**Bayes' Theorem** states the following for any two events H and E:

Bayes' Theorem is stated as

$$P(H/E) = \frac{P(E/H) * P(H)}{P(E)}$$

- $P(H|E)$ : The probability of event H, given event E has occurred.
- $P(E|H)$ : The probability of event E, given event H has occurred.
- $P(H)$ : The probability of event H.
- $P(E)$ : The probability of event E.

For example, suppose the probability of the weather being cloudy is 40%.

Also suppose the probability of rain on a given day is 43%.

Also suppose the probability of clouds on a rainy day is 85%.

If it's cloudy outside on a given day, what is the probability that it will rain that day?

**Solution:**

- $P(H) = P(\text{cloudy}) = 0.40$
- $P(E/H) = P(\text{cloudy} | \text{rain}) = 0.85$
- $P(\sim H) = 1 - P(H)$   
 $1 - 0.40$   
 $P(\sim H) = 0.6$
- $P(E/\sim H) = 1 - P(E/H)$   
 $1 - 0.85$   
 $P(E/\sim H) = 0.15$
- $P(E) = P(E/H) * P(H) + P(E/\sim H) * P(\sim H)$   
 $0.85 * 0.40 + 0.15 * 0.6$

$$P(E) = P(\text{rain}) = 0.43$$

- $P(H/E) = P(\text{rain/cloud}) ?$
- Thus we can calculate:

$$P(H/E) = \frac{P(E/H) * P(H)}{P(E)}$$

$$0.34/0.43$$

$$0.79$$

$$P(H/E) = P(\text{rain/cloud}) \text{ is : } 0.79$$

**Example: Bayes Theorem in python**

Suppose we know the following probabilities:

- $P(H)=P(\text{cloudy}) = 0.40$
- $P(E/H)=P(\text{cloudy} | \text{rain}) = 0.85$
- $P(E) = P(\text{rain}) = 0.43$

To Calculate  $P(H/E)$  or  $P(\text{rain/cloud})$  we use following code:

**Code:**

```
def bayes_theorem(p_h,p_e_given_h, p_e_given_not_h):

    not_h=1-p_h
    # p_e is prob of rain
    p_e=p_e_given_h*p_h+p_e_given_not_h*not_h
    # p(h/e) is prob of rain/cloud
    p_h_given_e=(p_e_given_h*p_h)/p_e
    return p_h_given_e
# p(h)
p_h = float(input("Enter prob of cloudiness given humidity : "))
# p(e/h)
p_e_given_h=float(input("Enter prob of cloudiness or raininess given humidity : "))
# p(e/~h)
p_e_given_not_h=float(input("Enter prob of cloud/rain not given humidity : "))
result=bayes_theorem(p_h, p_e_given_h, p_e_given_not_h)
print("The prob of rain/cloud that is P(H/E)=", round(result,2))
```

**Output:**

```
PS C:\Users\De11\Desktop\Rahul> & C:/Users/De11/AppData/Local/Programs/Python/Python310/pytho
n.exe "c:/Users/De11/Desktop/Rahul/bayes theorem.py"
Enter prob of cloudiness given humidity : 0.40
Enter prob of cloudiness or raininess given humidity : 0.85
Enter prob of cloud/rain not given humidity : 0.15
The prob of rain/cloud that is P(H/E)= 0.79
PS C:\Users\De11\Desktop\Rahul>
```

## Practical: 4

### Aim: Implement Conditional Probability and joint probability using Python

**Writeup:**

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

#### 4A: Joint Probability

##### Description:

##### What is Joint Probability?

The probability of two (or more) events is called the joint probability. The joint probability of two or more random variables is referred to as the joint probability distribution. The joint probability for events A and B is calculated as the probability of event A given event B multiplied by the probability of event B.

This can be stated formally as follows:

$$P(A \text{ and } B) = P(A \text{ given } B) * P(B)$$

The calculation of the joint probability is sometimes called the fundamental rule of probability or the “product rule” of probability or the “chain rule” of probability

$$P(A \text{ and } B) = P(A \text{ given } B) * P(B) = P(B \text{ given } A) * P(A)$$

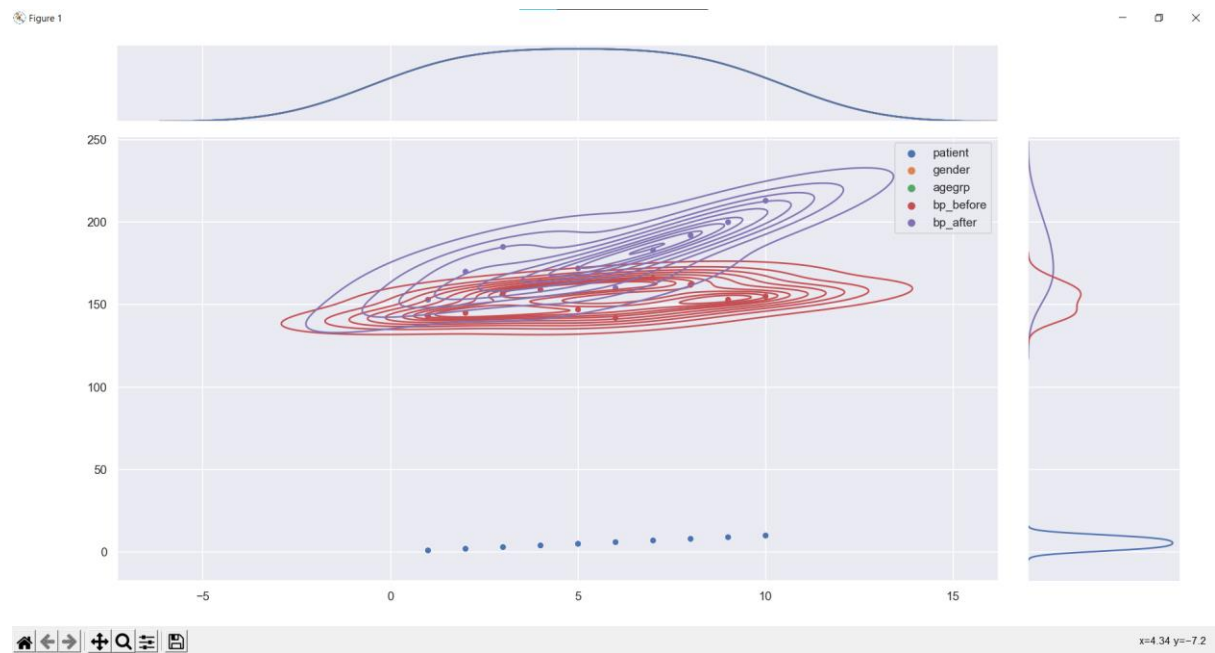
##### Code:

```
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import pandas as pd

sns.set()
data=pd.read_csv('bloodpressure.csv',header=None,names=['patient','gender','agegrp',
                                                         'bp_before','bp_after'
])
data['patient']=pd.to_numeric(data['patient'],errors='coerce')
data['gender']=pd.to_numeric(data['gender'],errors='coerce')
data['agegrp']=pd.to_numeric(data['agegrp'],errors='coerce')
data['bp_before']=pd.to_numeric(data['bp_before'],errors='coerce')
data['bp_after']=pd.to_numeric(data['bp_after'],errors='coerce')

sns.jointplot(data=data,patient='patient',gender='gender',agegrp='agegrp',
              bpbefore='bp_before',bpafter='bp_after',
              kind='kde').plot_joint(sns.scatterplot)
plt.show()
```



**Output:**

## 4B: Conditional Probability

### Description:

The probability of one event given the occurrence of another event is called the conditional probability. The conditional probability of one to one or more random variables is referred to as the conditional probability distribution.

For example, the conditional probability of event A given event B is written formally as:

- $P(A \text{ given } B)$

The “given” is denoted using the pipe “|” operator; for example:

- $P(A | B)$

The conditional probability for events A given event B is calculated as follows:

- $P(A \text{ given } B) = P(A \text{ and } B) / P(B)$

### Code:

```
import numpy as np
import pandas as pd
df=pd.read_csv('student-mat.csv')
print(df.head(3))
num_rows=len(df)
df['grade_A'] = np.where(df['G3']*5 >= 80, 1, 0)
df['high_absences'] = np.where(df['absences'] >= 10, 1, 0)
df['Count'] = 1
df=df[['grade_A','high_absences','Count']]
print(df.head())
pivot_table=pd.pivot_table(df,values='Count',index=['grade_A'],columns=['high_absences'],aggfunc=np.size,fill_value=0)
print(pivot_table)
```

### Output:

```
PS & C:/Users/Dell/AppData/Local/Programs/Python/Python310/python.exe "c:/Users/Dell/OneDrive/Documents/Rahul Kewat/python file/conditional.py"
  school sex  age address famsize Pstatus  Medu  ...  Dalc Walc health absences G1  G2  G3
0      GP   F   18      U      GT3      A    4  ...    1    1    3    6  5  6  6
1      GP   F   17      U      GT3      T    1  ...    1    1    3    4  5  5  6

[2 rows x 33 columns]
  grade_A  high_absences  Count
0        0              0      1
1        0              0      1
high_absences  0
grade_A
0              2
PS C:\Users\Dell\OneDrive\Documents\Rahul Kewat\python file>
```

## Practical: 5

**Aim: A program to implement Rule Based System.**

**Writeup:**

[illegible]

**Description:****What is Rule Based System?**

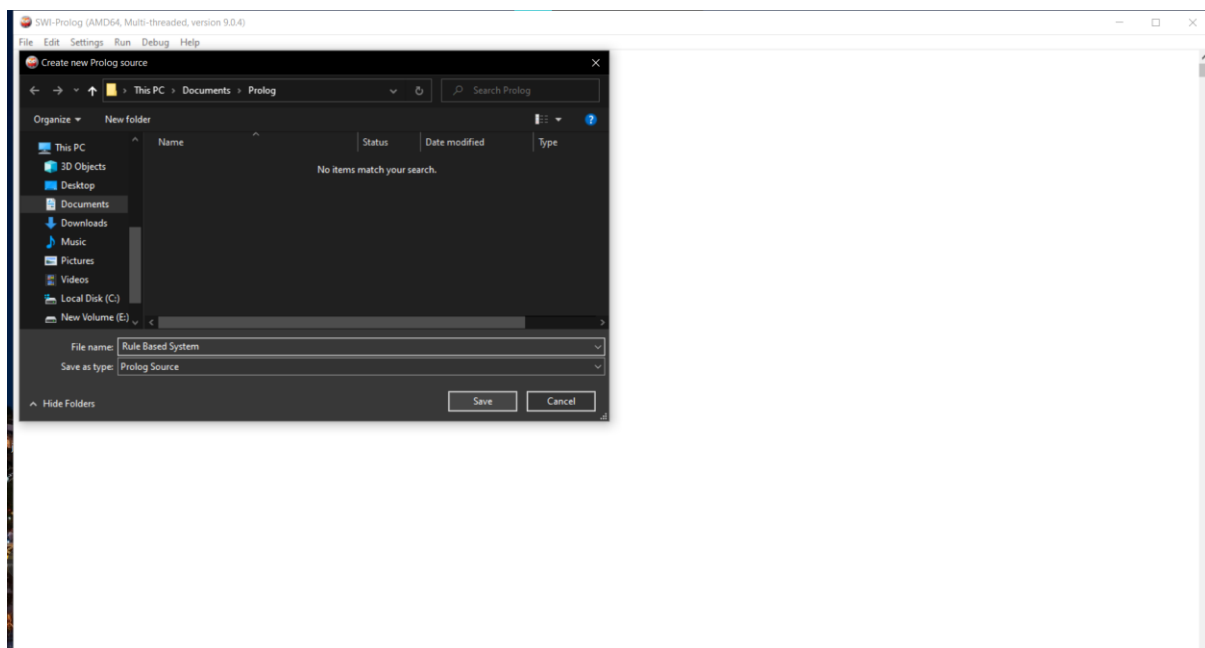
A rule-based system is a system that applies human-made rules to store, sort and manipulate data. In doing so, it mimics human intelligence.

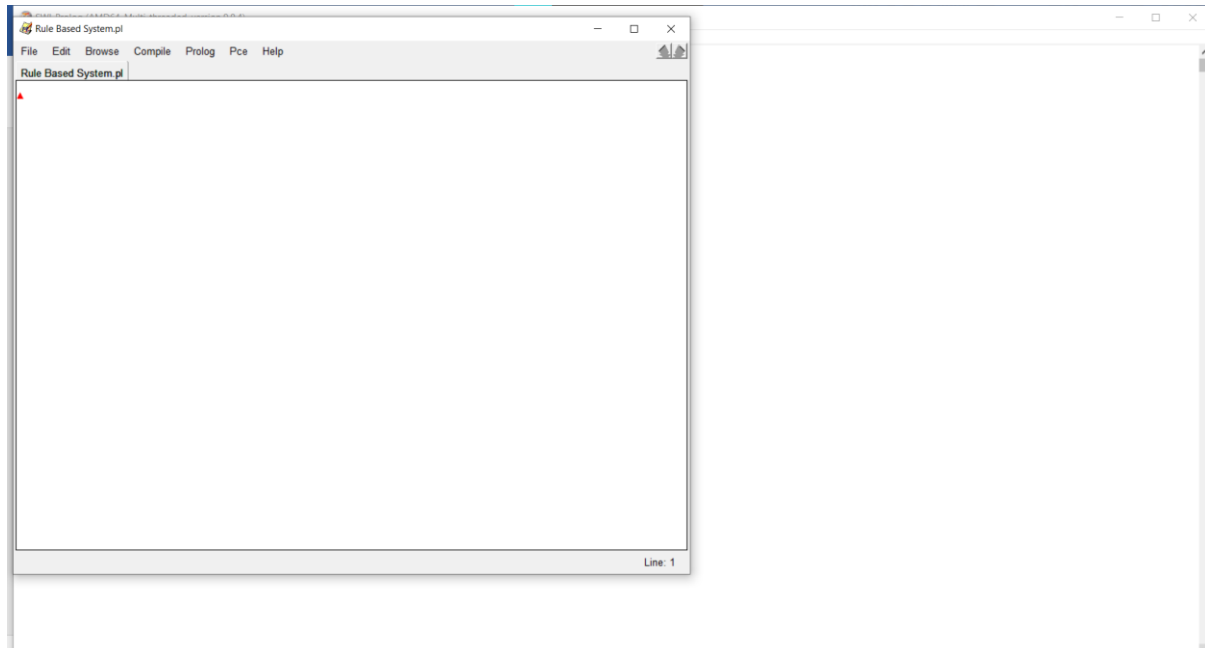
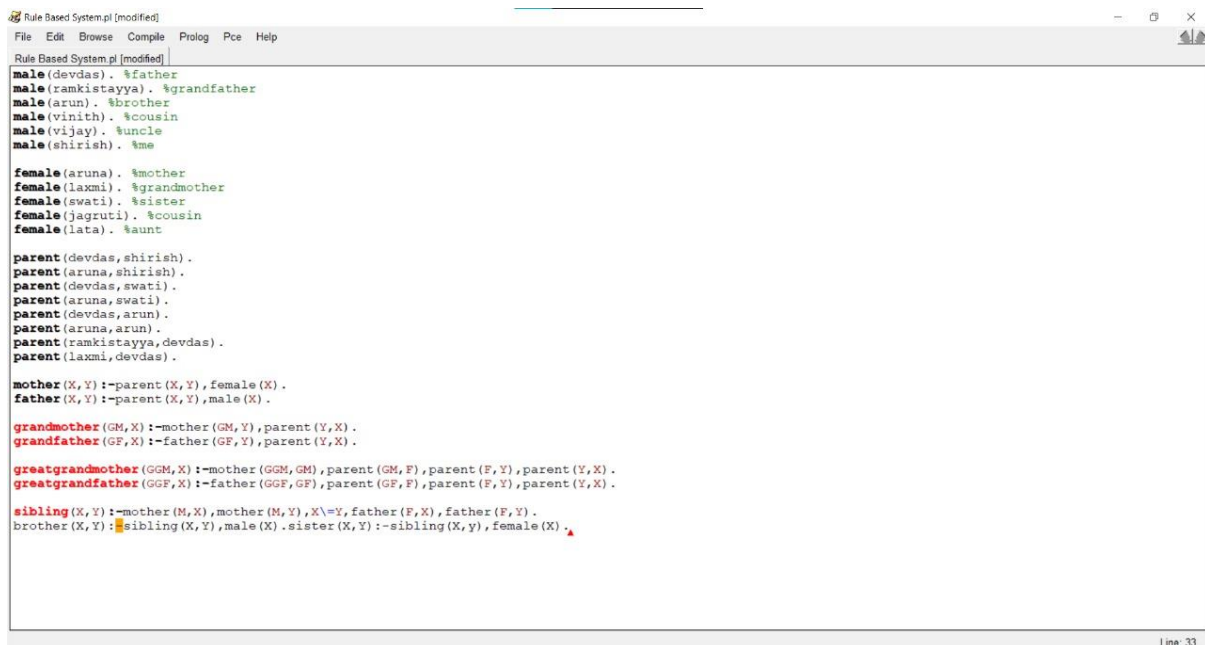
To work, rule-based systems require a set of facts or source of data, and a set of rules for manipulating that data. These rules are sometimes referred to as 'If statements' as they tend to follow the line of 'IF X happens THEN do Y'.

Automation software like Think Automation is a good example. It automates processes by breaking them down into steps.

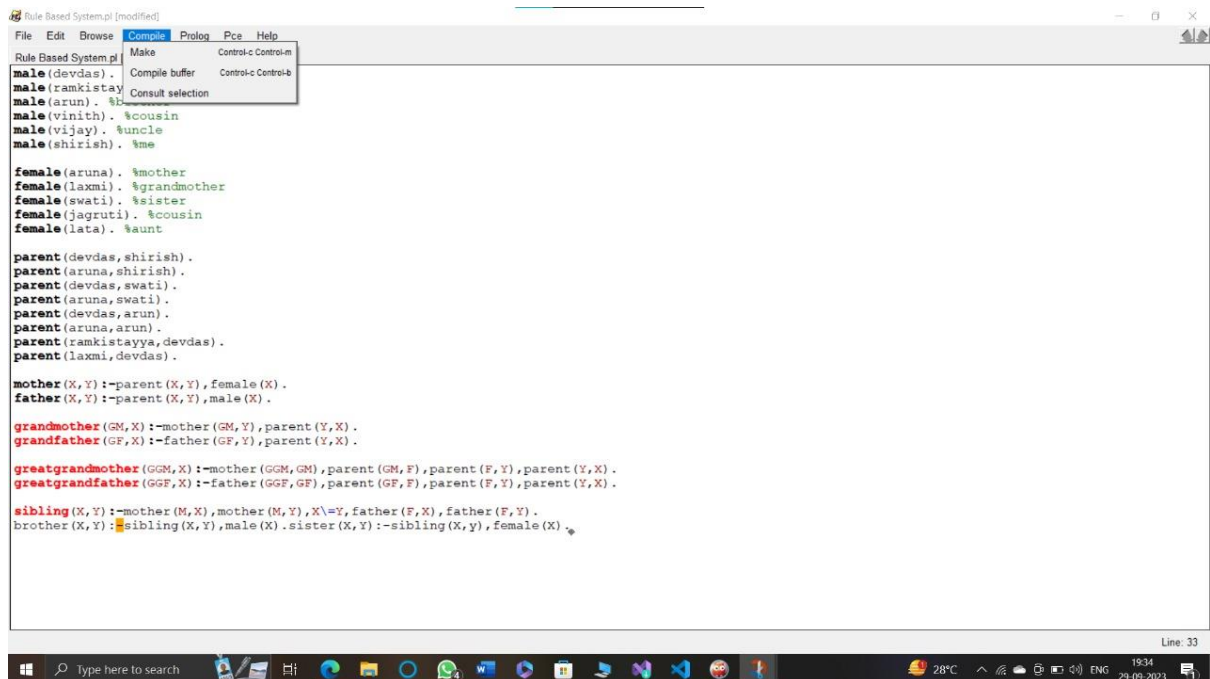
- First comes the data or new business event
- Then comes the analysis: the part where the system conditionally processes the data against its rules
- Then comes any subsequent automated follow-up actions

**Step 1: Open Prolog Window**

**Step 2: Click on File and Select New..****Step 3: Create new Prolog source (Here it is Rule Based System) And Click on Save**

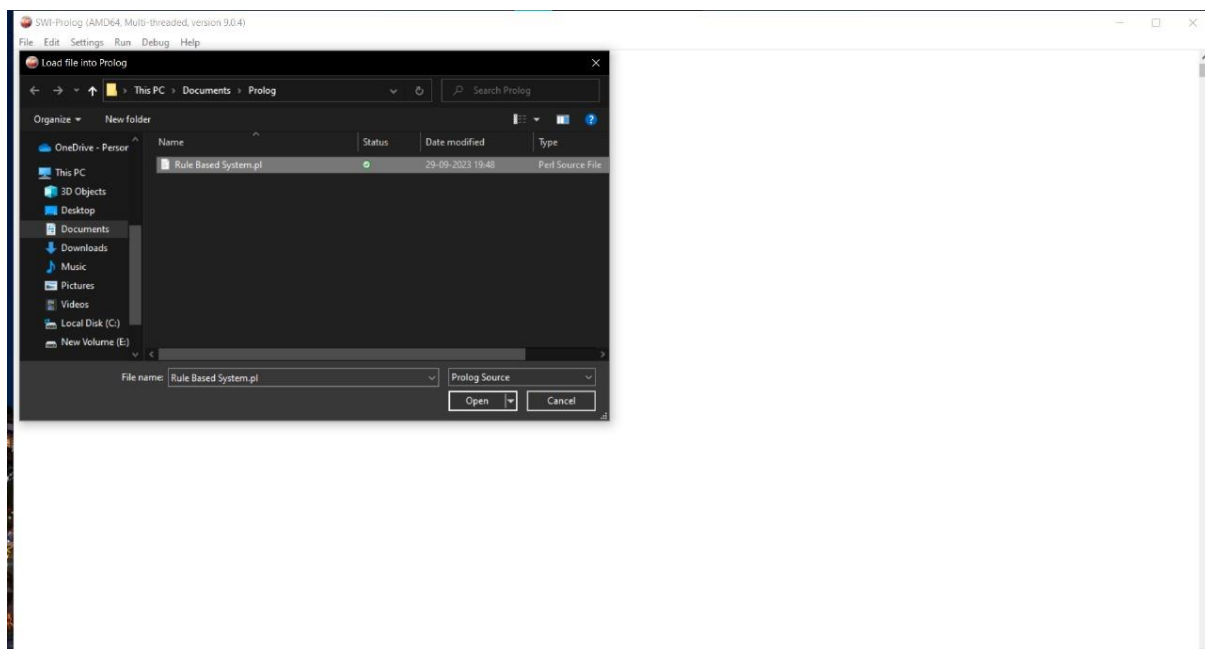
**Step 4: New Window Open****Step 5: Type Code:**

### Step 6: Click on Compile and Select Compile buffer



### Step 7: Go to Console Window



**Step 8: Click on File and Select Consult****Step 9: Select Rule Based System.pl and Click on Open**



## Step 10: Output



```
SWI-Prolog (AMD64, Multi-threaded version 9.0.4)
File Edit Settings Run Debug Help
Welcome to SWI-Prolog (threaded, 64 bits, version 9.0.4)
SWI-Prolog comes with ABSOLUTELY NO WARRANTY. This is free software.
Please run ?- license, for legal details.

For online help and background, visit https://www.swi-prolog.org
For built-in help, use ?- help(Topic), or ?- apropos(Word).

?-
?- c:/Users/Tell/OneDrive/Documents/Prolog/Rule Based System.pl compiled 0.00 sec, -1 clauses
?-
?- devdas(X.shirish).
ERROR: Unknown procedure: devdas/2 (DWIM could not correct goal)
?- father(X.devdas).
X = rankistayya .
?- mother(X.shirish).
X = aruna .
?- grandfather(X.shirish).
X = rankistayya .
?- grandmother(X.shirish).
X = laxmi .
?- father(X.shirish).
X = devdas .
?- brother(X.shirish).
X = arun .
?- sister(X.shirish).
X = swati .
?- sister(Y.devdas).
false.
?-
```

## Practical: 6

### **Aim: Design a Fuzzy based application using Python**

**Writeup:**

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

**Description:****What is Fuzzy based application?**

Fuzzy sets were introduced by Lotfi Zadeh (1921–2017) in 1965.

Unlike crisp sets, a fuzzy set allows partial belonging to a set, that is defined by a degree of membership, denoted by  $\mu$ , that can take any value from 0 (element does not belong at all in the set) to 1 (element belongs fully to the set).

It is evident that if we remove all the values of belonging except from 0 and 1, the fuzzy set will collapse to a crisp set that was described in the previous section.

**Code:**

```
import numpy as np
import skfuzzy as fuzzy
from skfuzzy import control as ctrl
import matplotlib.pyplot as plt

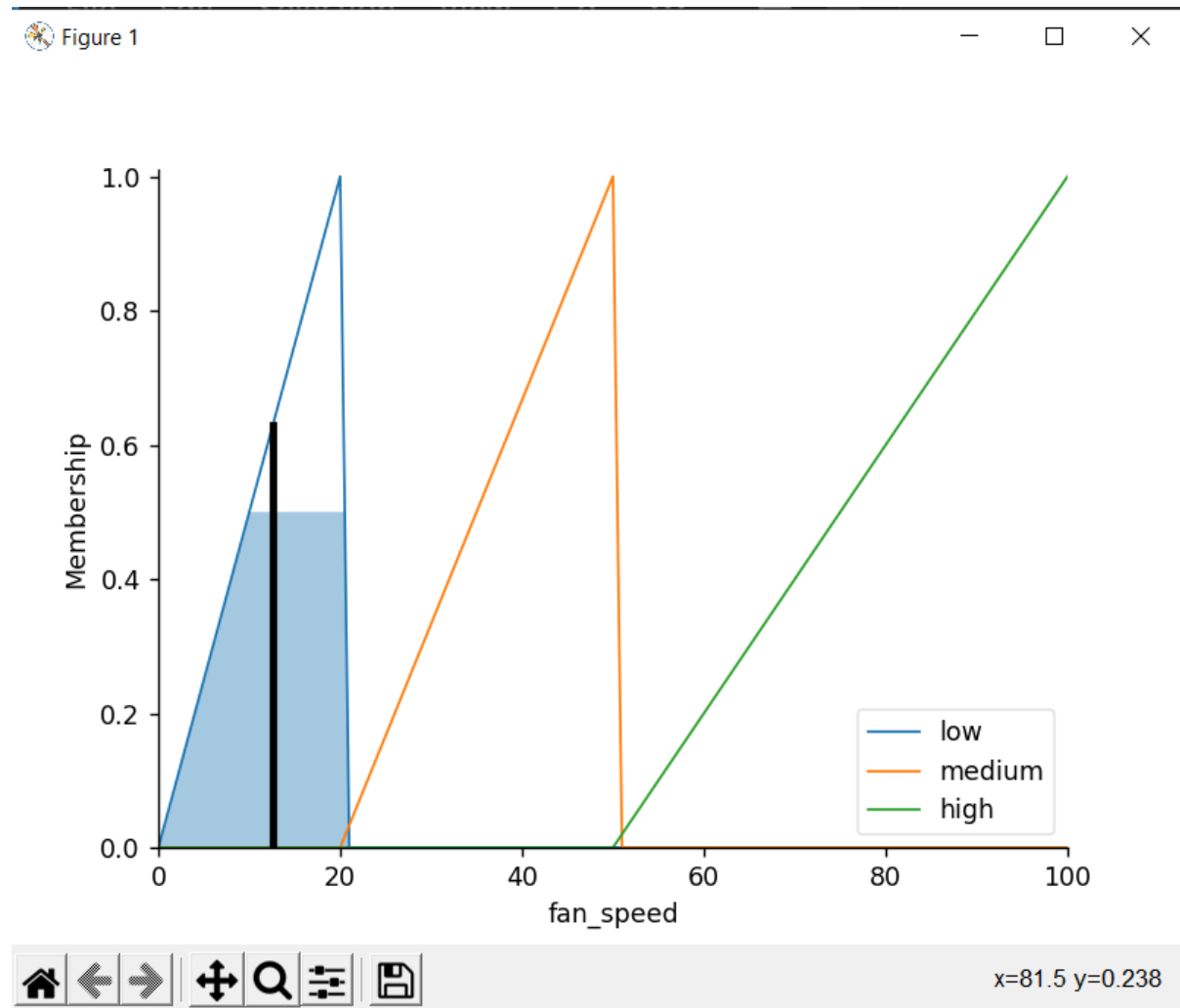
temperature = ctrl.Antecedent(np.arange(0, 101, 1), 'temperature')
humidity = ctrl.Antecedent(np.arange(0, 101, 1), 'humidity')
fan_speed = ctrl.Consequent(np.arange(0, 101, 1), 'fan_speed')

temperature['cold'] = fuzzy.trimf(temperature.universe, [0, 20,20])
temperature['medium'] = fuzzy.trimf(temperature.universe, [20,50,50])
temperature['hot'] = fuzzy.trimf(temperature.universe, [50,100,100])

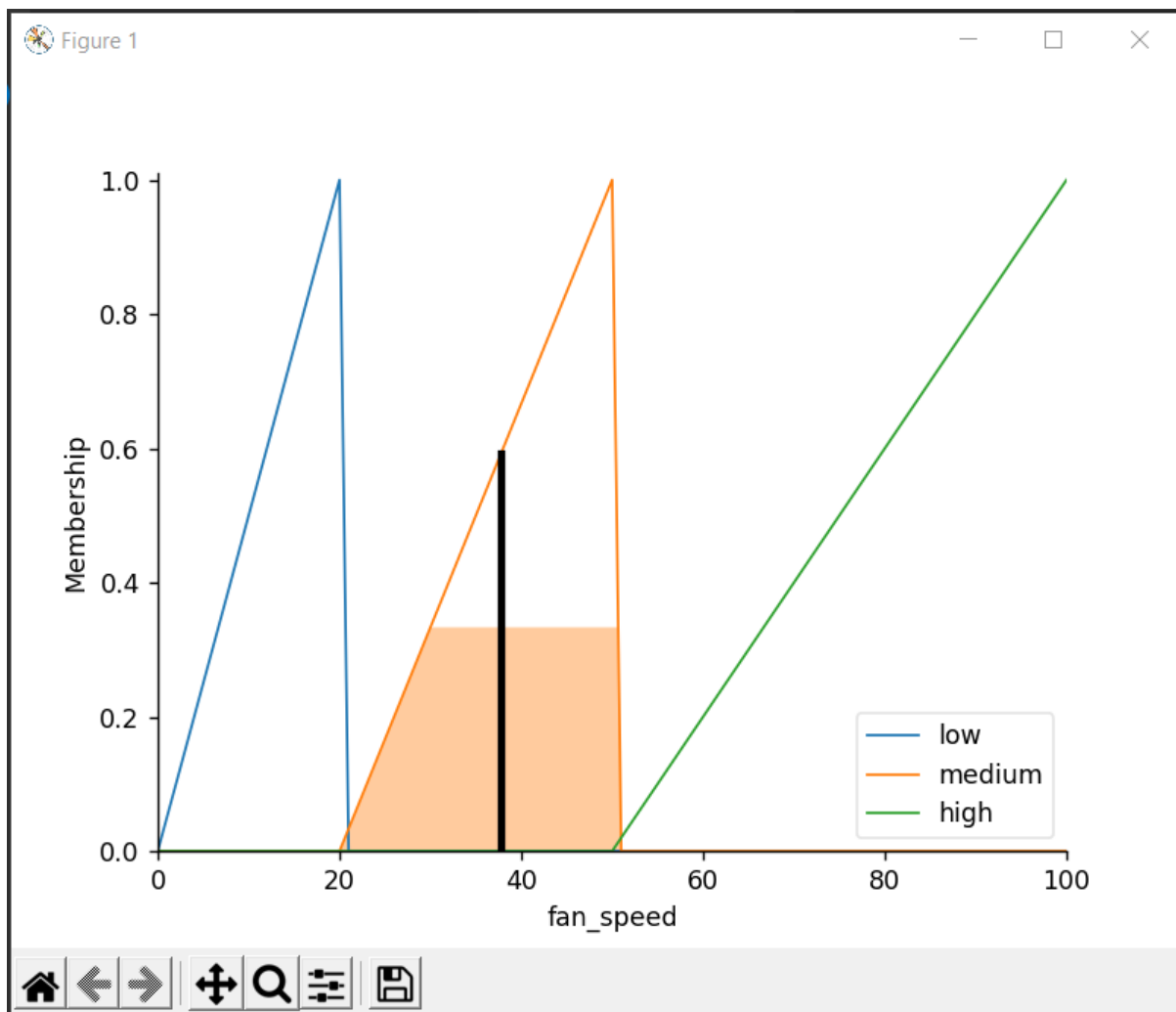
humidity['low'] = fuzzy.trimf(humidity.universe, [0, 20,20])
humidity['medium'] = fuzzy.trimf(humidity.universe, [20,50,50])
humidity['high'] = fuzzy.trimf(humidity.universe, [50,100,100])

fan_speed['low'] = fuzzy.trimf(fan_speed.universe, [0, 20,20])
fan_speed['medium'] = fuzzy.trimf(fan_speed.universe, [20,50,50])
fan_speed['high'] = fuzzy.trimf(fan_speed.universe, [50,100,100])

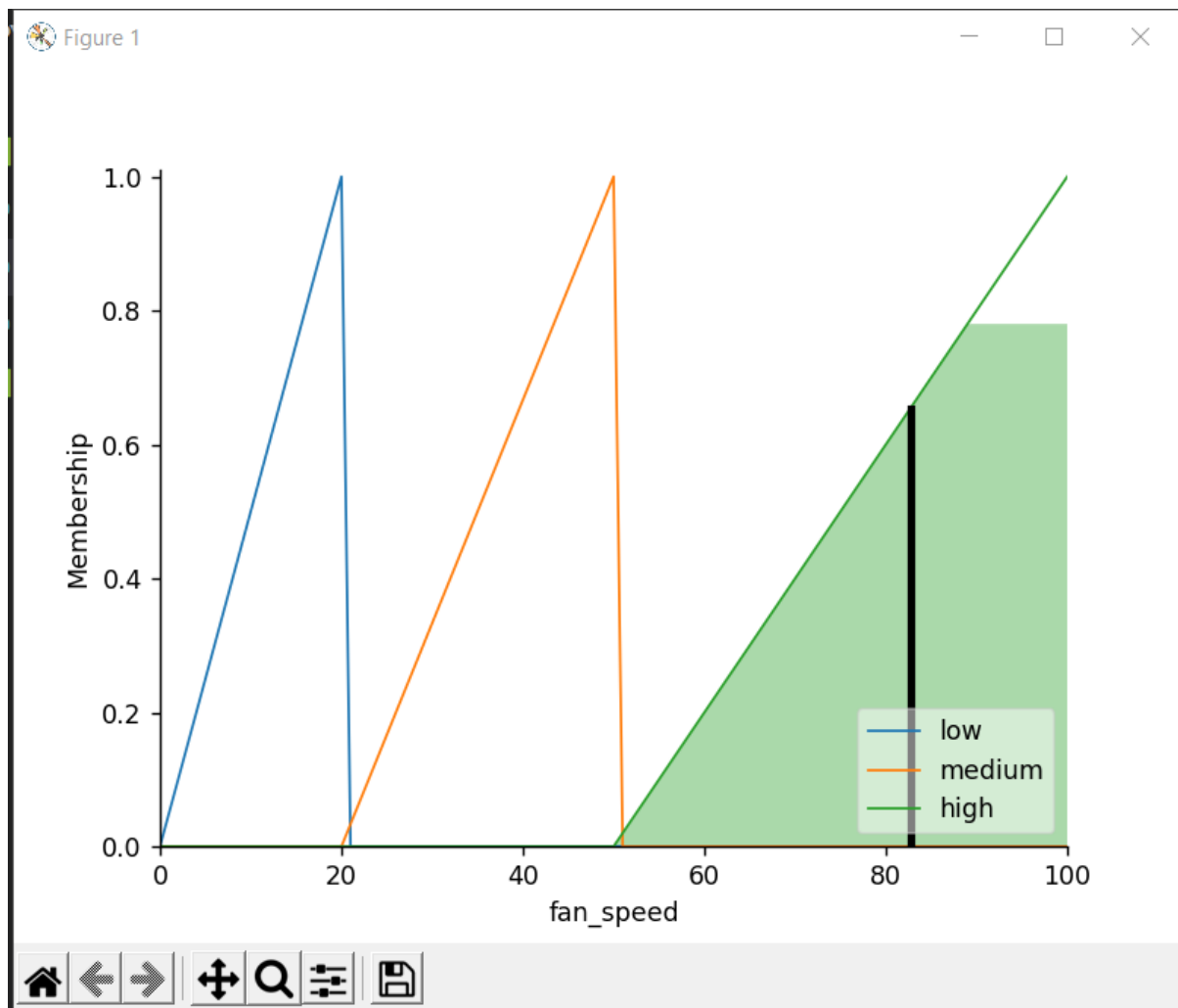
rule1 = ctrl.Rule(temperature['cold'] & humidity['low'], fan_speed['low'])
rule2 = ctrl.Rule(temperature['medium'] & humidity['medium'],
fan_speed['medium'])
rule3 = ctrl.Rule(temperature['hot'] & humidity['high'], fan_speed['high'])
fan_speed_ctrl = ctrl.ControlSystem([rule1, rule2, rule3])
fan_speed_simulation = ctrl.ControlSystemSimulation(fan_speed_ctrl)
fan_speed_simulation.input['temperature'] = int(input('Enter temperature:'))
fan_speed_simulation.input['humidity'] = int(input('Enter humidity:'))
fan_speed_simulation.compute()
output_speed = fan_speed_simulation.output['fan_speed']
fan_speed.view(sim=fan_speed_simulation)
plt.show()
print(f"Fan Speed: {output_speed}")
```

**Output:**

```
ograms/Python/Python310/python.exe "c:/Users/Dell/OneDrive/Documents/Rahul Kewat/python file/  
Fuzzy Based Application.py"  
Enter temperature:15  
Enter humidity:10  
Fan Speed: 12.611111111111109
```



```
o grams/Python/Python310/python.exe "c:/Users/Dell/OneDrive/Documents/Rahul Kewat/python file/
Fuzzy Based Application.py"
Enter temperature:35
Enter humidity:30
Fan Speed: 37.75555555555557
```



```
● ograms/Python/Python310/python.exe "c:/Users/Dell/OneDrive/Documents/Rahul Kewat/python file/  
Fuzzy Based Application.py"  
Enter temperature:95  
Enter humidity:89  
Fan Speed: 82.67213114754095
```

## Practical: 7

**Aim: Write an application to simulate supervised and un-supervised learning model.**

**Writeup:**

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

**Description:****What is supervised learning?**

Supervised learning is a type of machine learning where the algorithm is trained using labeled data. This means that the data used to train the algorithm has already been tagged with the correct answer.

The algorithm then uses this labeled data to learn how to classify new, unlabeled data.

Supervised learning is used in two types of problems: **classification** and **regression**.

In a **classification problem**, the output variable is a category, such as “Red” or “Blue”.

In a **regression problem**, the output variable is a real value, such as “dollars” or “weight”

**Code:**

```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.datasets import make_classification
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score, classification_report

# Create a simulated dataset for classification
X, y = make_classification(
    n_samples=2000,
    n_features=2,      # Total number of features
    n_informative=2,   # Number of informative features
    n_redundant=0,     # Number of redundant features
    random_state=50
)

# Split the dataset into a training and testing set
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,
                                                    random_state=42)

# Create and train a supervised learning model (Logistic Regression)
classifier = DecisionTreeClassifier()
classifier.fit(X_train, y_train)

# Make predictions using the trained classifier
y_pred = classifier.predict(X_test)

# Calculate and display the accuracy of the classifier
accuracy = accuracy_score(y_test, y_pred)
print(f"Supervised Learning Accuracy: {accuracy:.2f}")

classification_rep = classification_report(y_test, y_pred)
print("Classification Report\n", classification_rep)

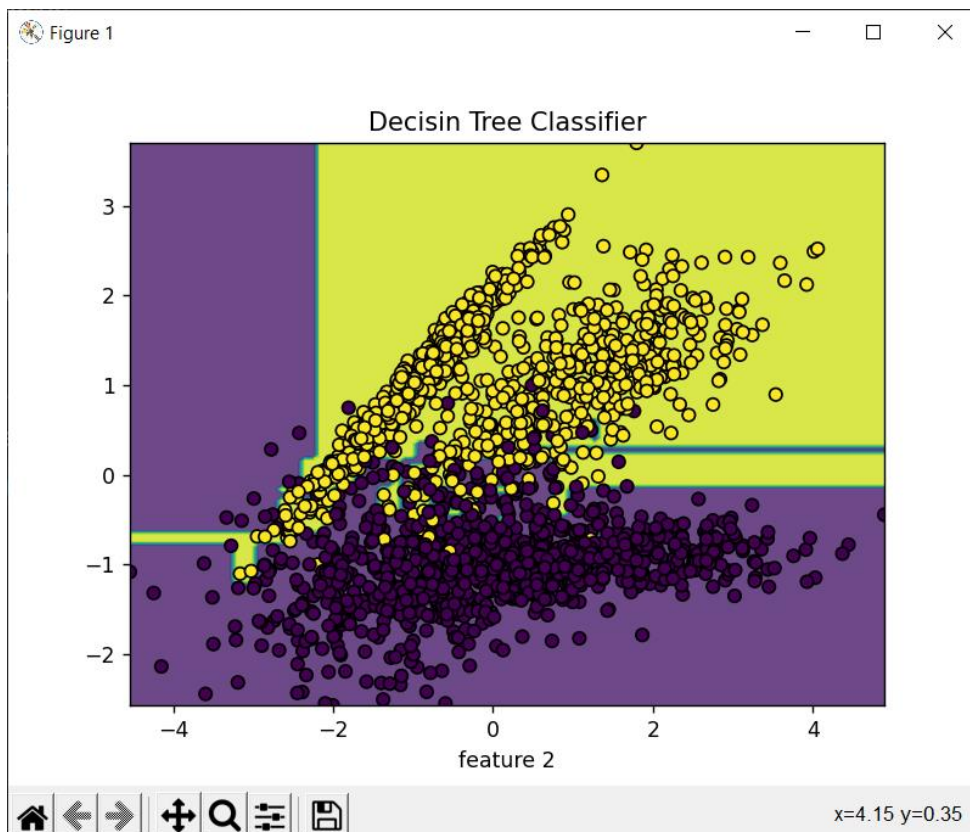
xx, yy = np.meshgrid(np.linspace(X[:,0].min(), X[:,0].max(), 100),
```



```
np.linspace(X[:,1].min(),X[:,1].max(),100))
Z = classifier.predict(np.c_[xx.ravel(),yy.ravel()])
Z = Z.reshape(xx.shape)

plt.contourf(xx,yy,Z,alpha=0.8)
plt.scatter(X[:, 0], X[:, 1], c = y, marker='o',edgecolors='k')
plt.xlabel('feature 1')
plt.xlabel('feature 2')
plt.title('Decisin Tree Classifier')
plt.show()
```

**Output:**



```

PS C:\Users\Dell\OneDrive\Documents\Rahul Kewat\python file> & C:/Users/Dell/AppData/Local/Programs/Python/Python310/python.exe "c:/Users/Dell/OneDrive/Documents/Rahul Kewat/python file/Supervised.py"
Supervised Learning Accuracy: 0.95
Classification Report

```

	precision	recall	f1-score	support
0	0.95	0.94	0.95	186
1	0.95	0.96	0.95	214
accuracy			0.95	400
macro avg	0.95	0.95	0.95	400
weighted avg	0.95	0.95	0.95	400

### Description:

#### What is unsupervised learning?

Unsupervised learning is the training of machine using information that is neither classified nor labelled and allowing the algorithm to act on that information without guidance. Here the task of machine is to group unsorted information according to similarities, patterns and differences without any prior training of data. Unsupervised learning classified into two categories of algorithms:

- **Clustering:** A clustering problem is where you want to discover the inherent groupings in the data, such as grouping customers by purchasing behaviour.
- **Association:** An association rule learning problem is where you want to discover rules that describe large portions of your data, such as people that buy X also tend to buy Y.

Types of Unsupervised Learning:

#### Clustering:

- Exclusive (partitioning)
- Agglomerative
- Overlapping
- Probabilistic

#### Clustering Types:

- Hierarchical clustering
- K-means clustering
- Principal Component Analysis
- Singular Value Decomposition
- Independent Component Analysis

**Code:**

```
import numpy as np
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
from sklearn.datasets import make_blobs

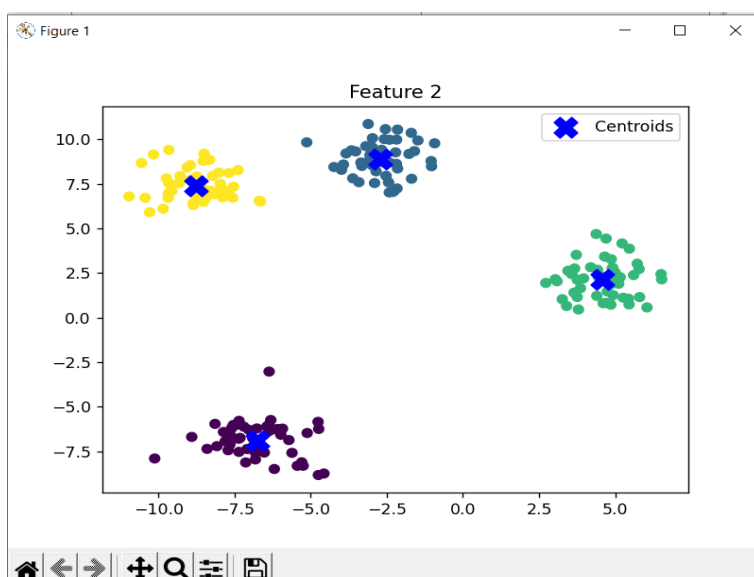
n_samples=200
n_features=2
n_clusters=4

X, _ = make_blobs(n_samples=n_samples, n_features=n_features,
centers=n_clusters, random_state=42)

n_init_value=10
kmeans=KMeans(n_clusters=n_clusters, n_init=n_init_value)
kmeans.fit(X)

cluster_labels=kmeans.predict(X)
centroids = kmeans.cluster_centers_

plt.scatter(X[:, 0], X[:, 1], c = cluster_labels, cmap='viridis')
plt.scatter(centroids[:, 0], centroids[:, 1], c='blue', marker='X', s=200,
label='Centroids')
plt.legend()
plt.title('K-Means Clustering')
plt.title('Feature 1')
plt.title('Feature 2')
plt.show()
```

**Output:**

## Practical: 8

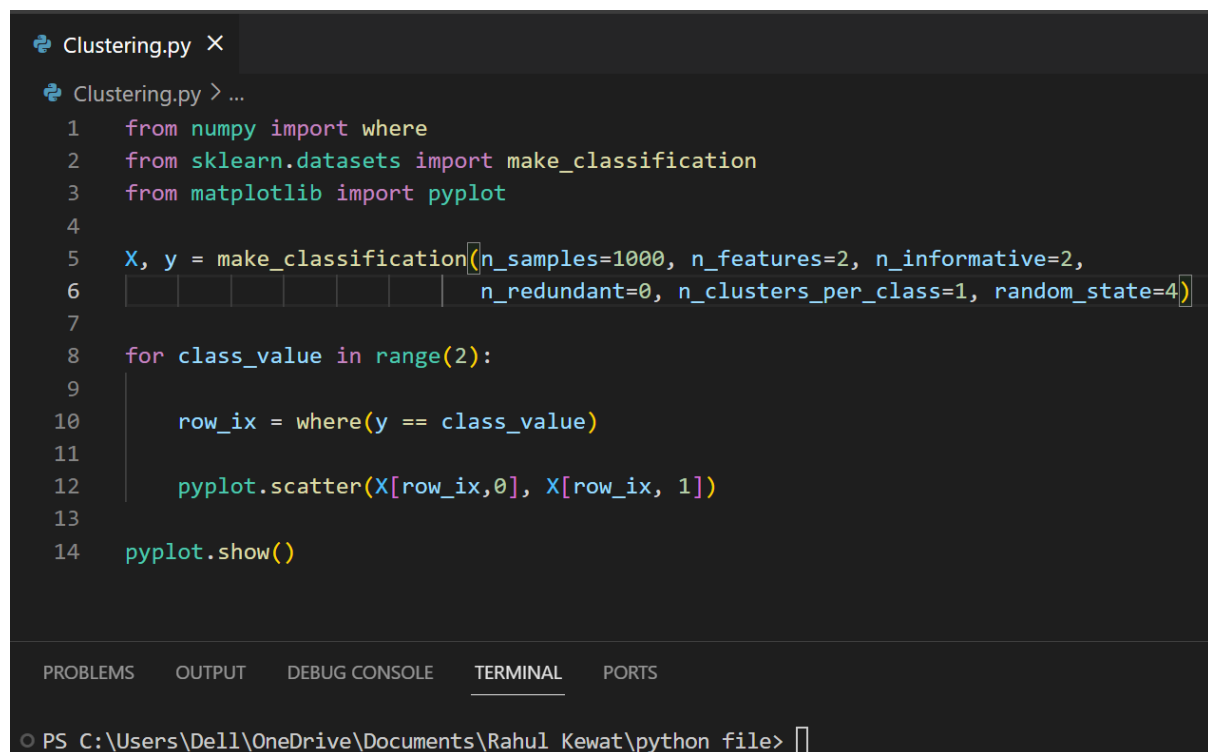
**Aim: Write an application to implement Clustering algorithm.**

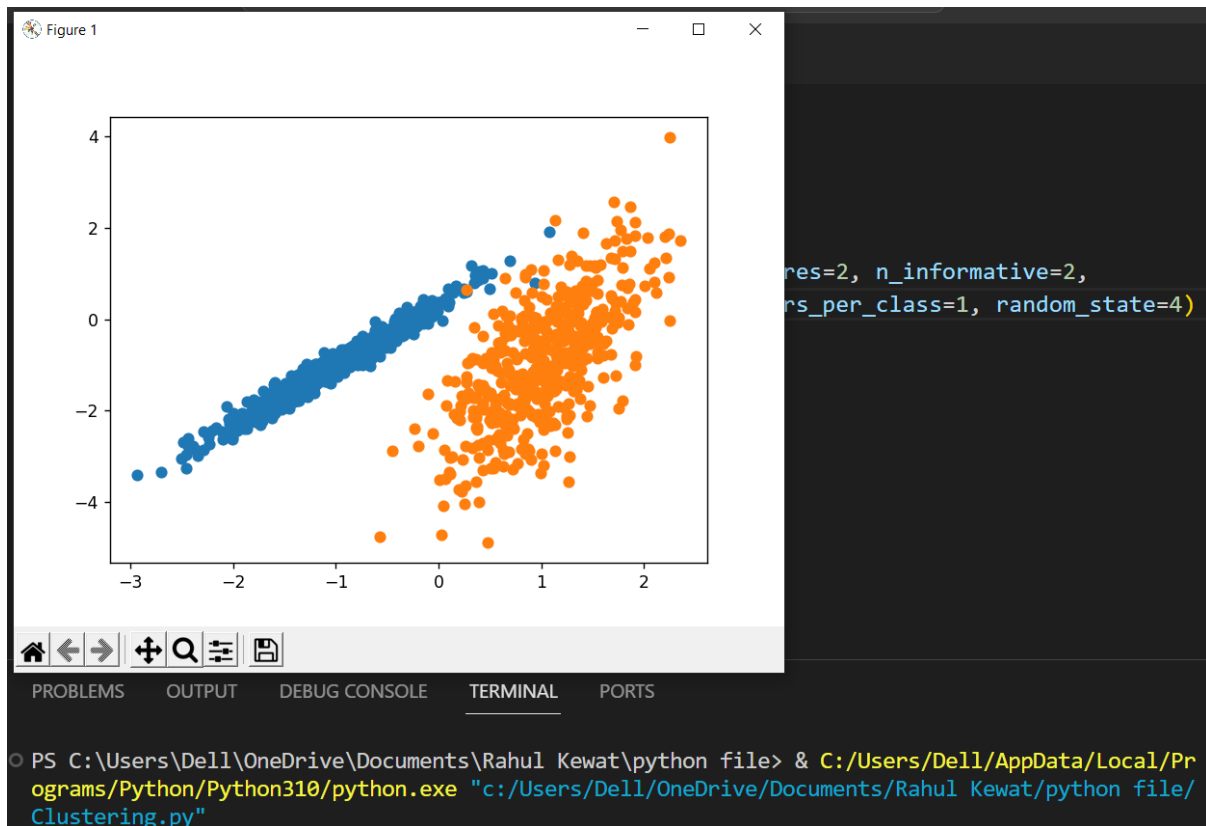
**Writeup:**

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

**Description:****What is Clustering?**

Clustering is a technique in artificial intelligence and machine learning that involves grouping similar data points together based on certain features or characteristics they share. The goal of clustering is to identify patterns or structures within a dataset, where data points within the same cluster are more similar to each other than to those in other clusters. Clustering is an unsupervised learning method, meaning that it does not require labeled data and does not involve making predictions; instead, it focuses on discovering inherent structures within the data.

**Code:**A screenshot of a Python IDE window titled 'Clustering.py'. The code defines a function 'make\_classification' from sklearn.datasets and imports 'where' from numpy and 'pyplot' from matplotlib. It then generates a dataset with 1000 samples, 2 features, and 2 informative features. A loop iterates over two class values (0 and 1), using 'where' to find indices of data points belonging to each class. These points are then plotted as scatter points on a 2D plane using 'pyplot.scatter'. Finally, 'pyplot.show()' is called to display the plot. The IDE interface includes tabs for 'PROBLEMS', 'OUTPUT', 'DEBUG CONSOLE', 'TERMINAL', and 'PORTS'. The terminal shows the command prompt 'PS C:\Users\Dell\OneDrive\Documents\Rahul Kewat\python file>'.

**Output:**

## Practical: 9

**Aim: Write a Program to implement BFS algorithm.**

**Writeup:**

[illegible]

**Description:****What is Breadth-First Search?**

The Breadth First Search (BFS) algorithm is used to search a graph data structure for a node that meets a set of criteria. It starts at the root of the graph and visits all nodes at the current depth level before moving on to the nodes at the next depth level.

**Relation between BFS for Graph and Tree traversal:**

Breadth-First Traversal (or Search) for a graph is similar to the Breadth-First Traversal of a tree. The only catch here is, that, unlike trees, graphs may contain cycles, so we may come to the same node again. To avoid processing a node more than once, we divide the vertices into two categories:

- Visited and
- Not visited.

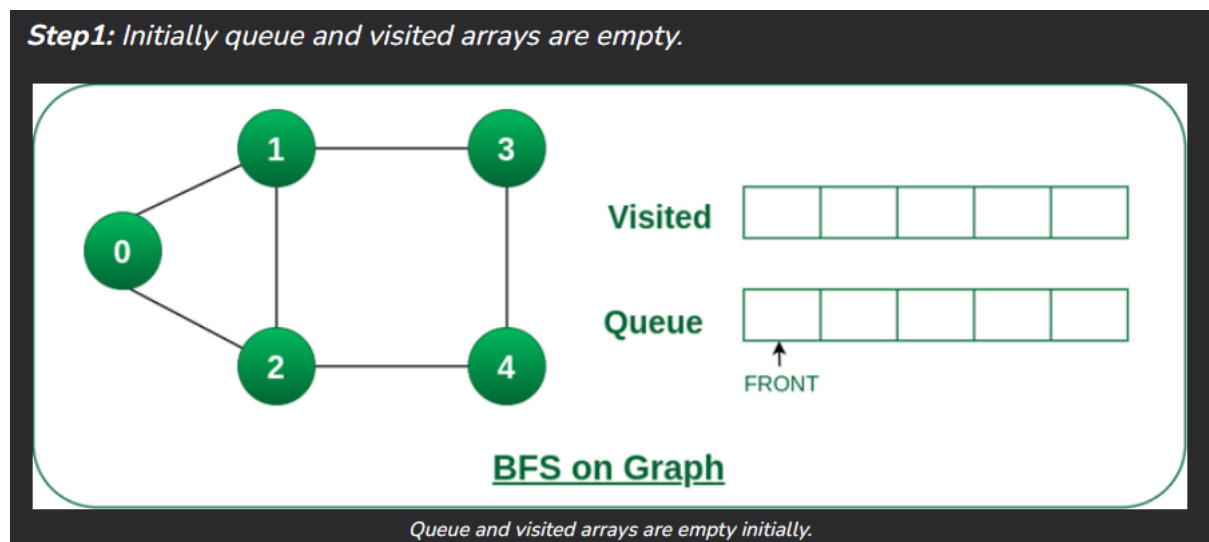
**How does BFS work?**

Starting from the root, all the nodes at a particular level are visited first and then the nodes of the next level are traversed till all the nodes are visited.

To do this a queue is used. All the adjacent unvisited nodes of the current level are pushed into the queue and the nodes of the current level are marked visited and popped from the queue.

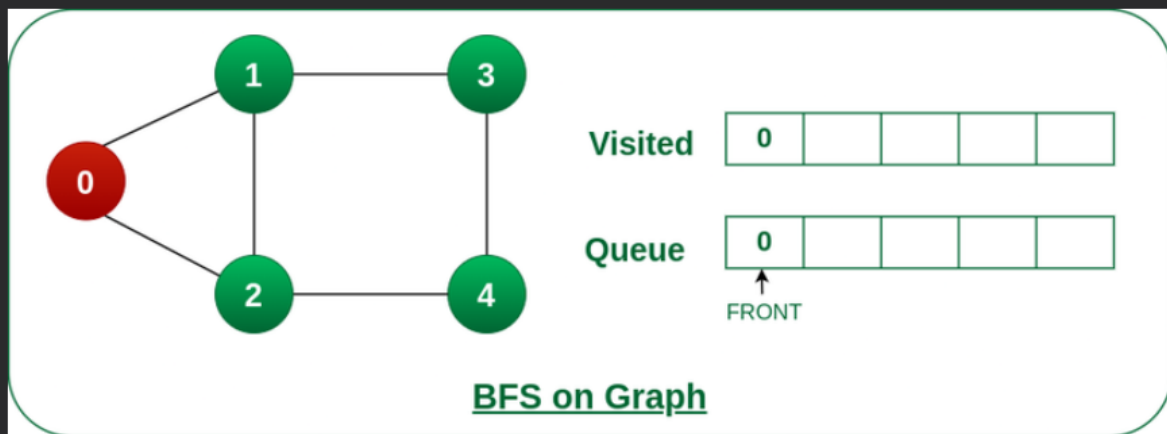
**Illustration:**

Let us understand the working of the algorithm with the help of the following example.



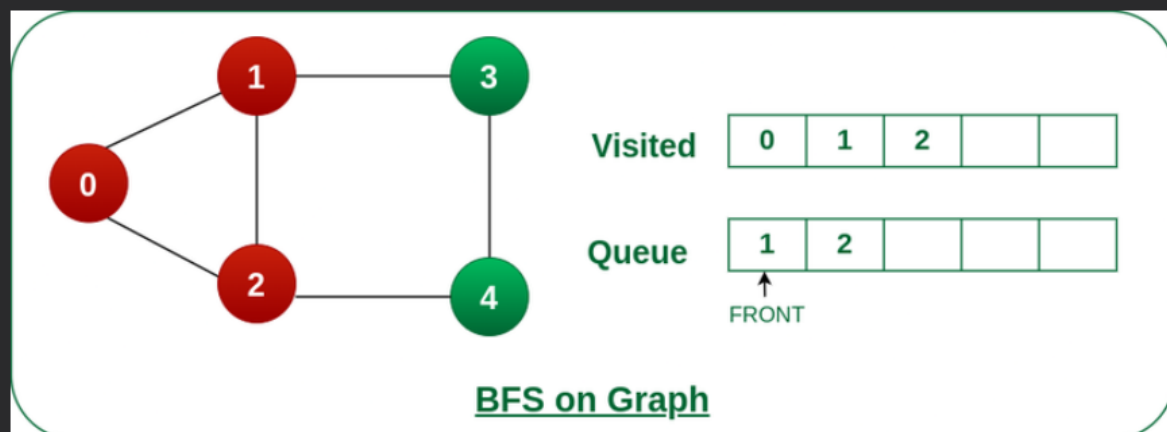


**Step2:** Push node 0 into queue and mark it visited.



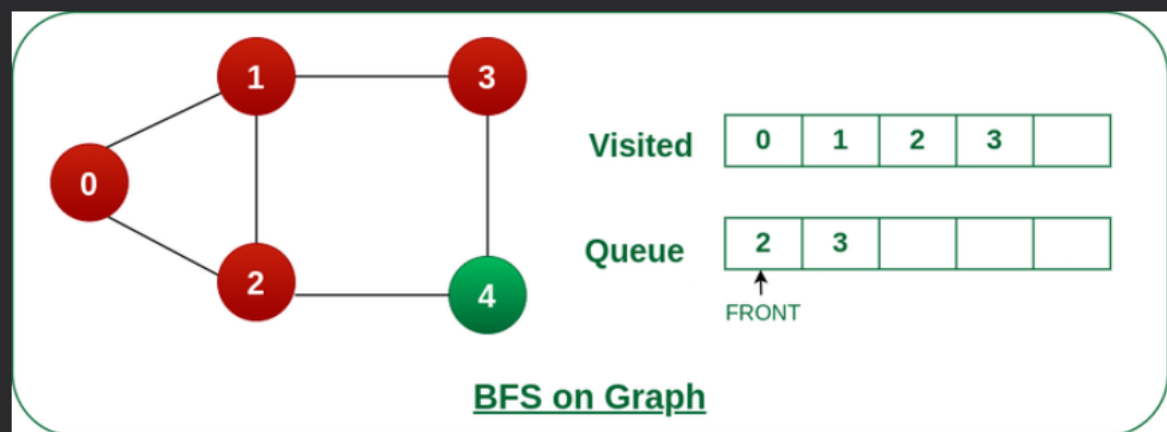
Push node 0 into queue and mark it visited.

**Step 3:** Remove node 0 from the front of queue and visit the unvisited neighbours and push them into queue.



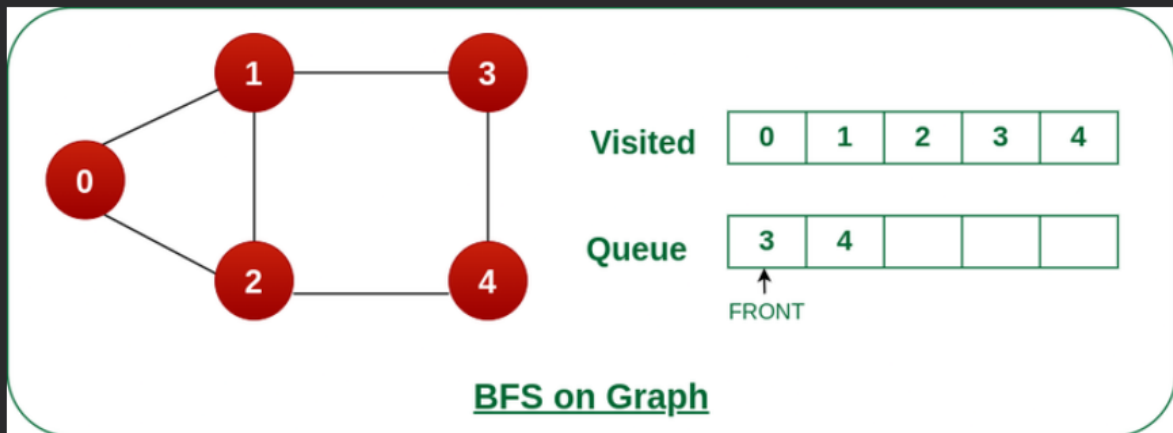
Remove node 0 from the front of queue and visited the unvisited neighbours and push into queue.

**Step 4:** Remove node 1 from the front of queue and visit the unvisited neighbours and push them into queue.



Remove node 1 from the front of queue and visited the unvisited neighbours and push

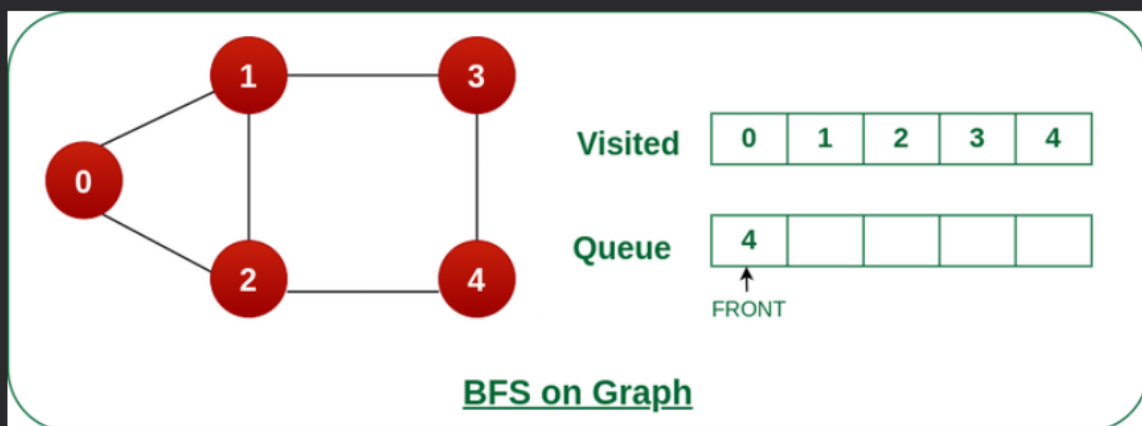
**Step 5:** Remove node 2 from the front of queue and visit the unvisited neighbours and push them into queue.



Remove node 2 from the front of queue and visit the unvisited neighbours and push them into queue.

**Step 6:** Remove node 3 from the front of queue and visit the unvisited neighbours and push them into queue.

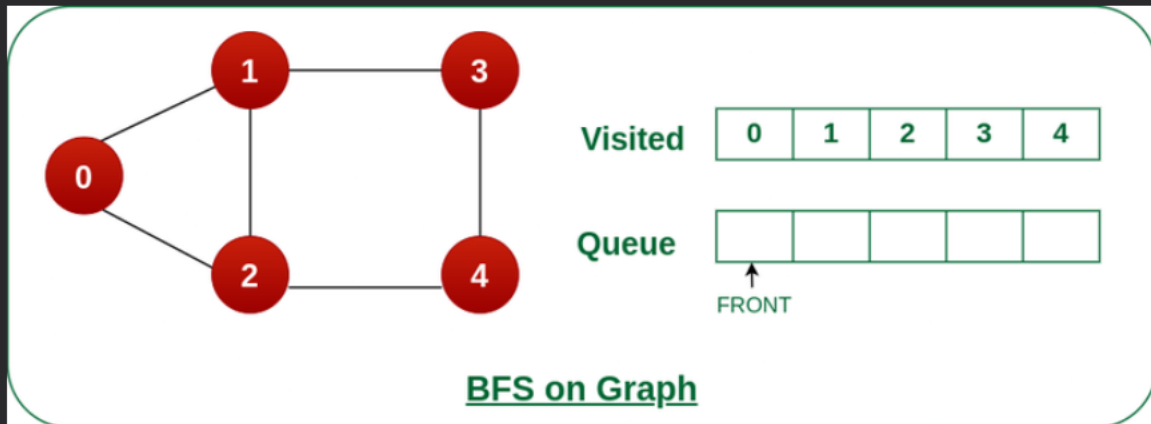
As we can see that every neighbours of node 3 is visited, so move to the next node that are in the front of the queue.



Remove node 3 from the front of queue and visit the unvisited neighbours and push them into queue.

**Steps 7:** Remove node 4 from the front of queue and visit the unvisited neighbours and push them into queue.

As we can see that every neighbours of node 4 are visited, so move to the next node that is in the front of the queue.



Remove node 4 from the front of queue and visit the unvisited neighbours and push them into queue.

Now, Queue becomes empty, So, terminate these process of iteration.

Code:

Breadth-First Search.py ×

Breadth-First Search.py > ...

```

1  def bfs(graph, start):
2      visited = set()
3      queue = [start]
4      visited.add(start)
5
6      while queue:
7          vertex = queue.pop(0)
8          print(vertex, end=' ')
9          for neighbor in graph[vertex]:
10             if neighbor not in visited:
11                 queue.append(neighbor)
12                 visited.add(neighbor)
13
14 if __name__ == '__main__':
15     graph = {0: [1, 2], 1: [2], 2: [3], 3: [1, 2]}
16     print("Following is the breadth-first traversal:")
17     bfs(graph, 0)

```

**Output:**

```
● ograms/Python/Python310/python.exe "c:/Users/Dell/OneDrive/Documents/Rahul Kewat/python file/  
Breadth-First Search.py"  
Following is the breadth-first traversal:  
0 1 2 3
```

## Practical: 10

**Aim: Write a Program to implement DFS algorithm.**

**Writeup:**

This image shows a full page of blank, lined paper. It features approximately 28 horizontal blue or grey lines spaced evenly apart, typical of notebook paper. The lines extend across the entire width of the page, leaving small margins at the top and bottom. There are no vertical lines, text, or other markings on the page.

**Description:**

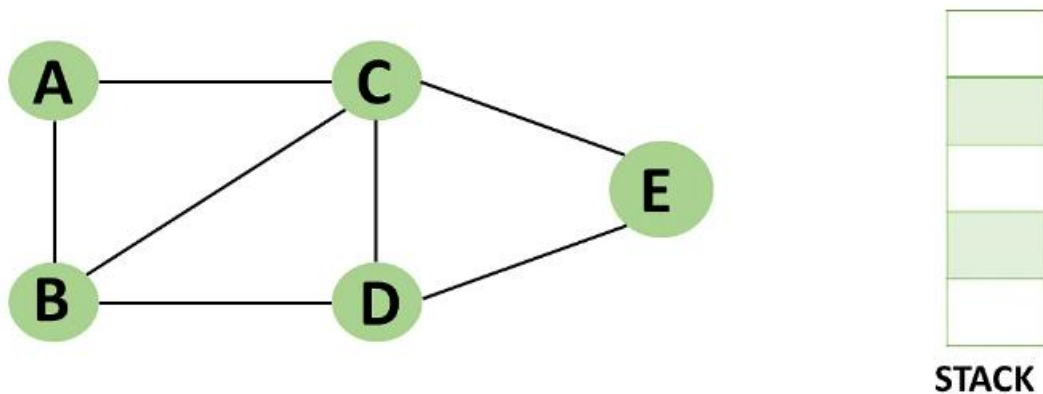
Depth-First Search (DFS) is a fundamental graph traversal algorithm used to explore and navigate through the nodes and edges of a graph or tree data structure. It starts at a designated "root" node and explores as far as possible along each branch before backtracking.

The basic idea behind DFS can be summarized as follows

1. Start at the root node.
2. Explore a neighboring node connected to the current node. If there are multiple neighboring nodes, choose one.
3. Continue the process recursively by moving to the neighboring node and repeating step 2.
4. If there are no unvisited neighboring nodes, backtrack to the previous node and explore other unvisited branches.
5. Repeat steps 2-4 until all nodes have been visited or until you've found the target node if you are searching for a specific node in the graph.

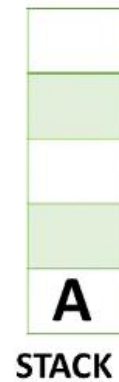
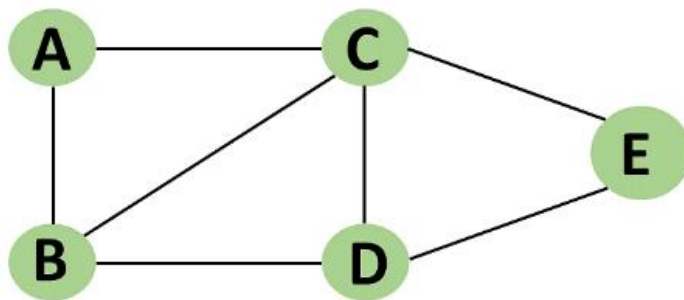
DFS is often implemented using a stack (or the call stack in a recursive implementation) to keep track of nodes to be explored. When using recursion, each recursive call corresponds to a step deeper into the graph, and the backtracking occurs automatically when a branch is fully explored.

Consider the following graph as an example of how to use the dfs algorithm.



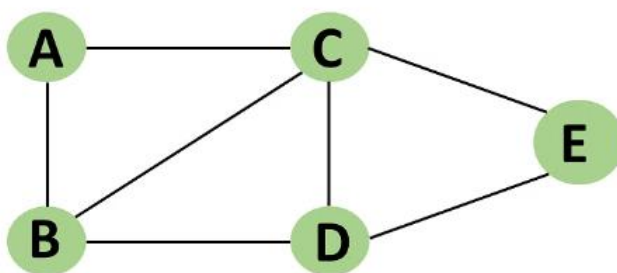
Step 1: Mark vertex A as a visited source node by selecting it as a source node.

- You should push vertex A to the top of the stack.



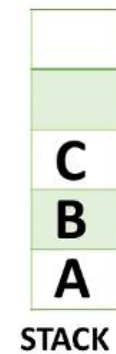
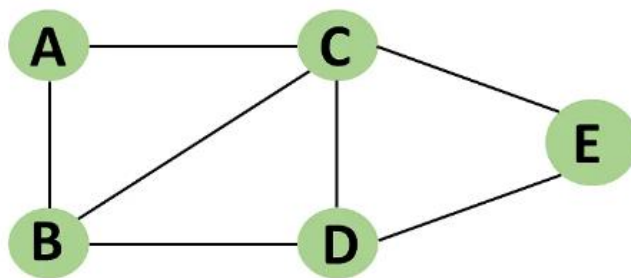
Step 2: Any nearby unvisited vertex of vertex A, say B, should be visited.

- You should push vertex B to the top of the stack.



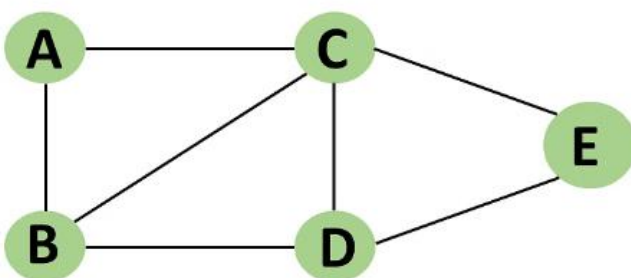
Step 3: From vertex C and D, visit any adjacent unvisited vertices of vertex B. Imagine you have chosen vertex C, and you want to make C a visited vertex.

- Vertex C is pushed to the top of the stack.

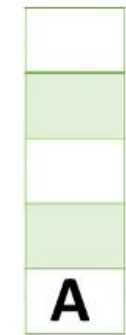
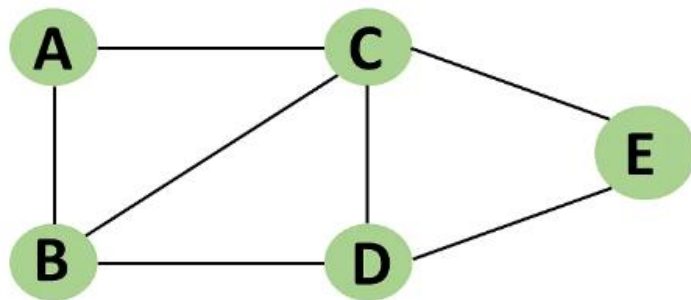


Step 4: You can visit any nearby unvisited vertices of vertex C, you need to select vertex D and designate it as a visited vertex.

- Vertex D is pushed to the top of the stack.



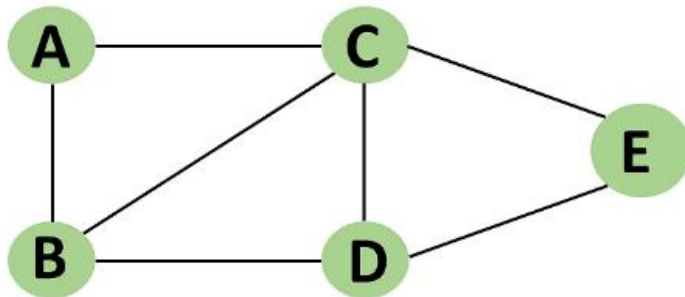




STACK

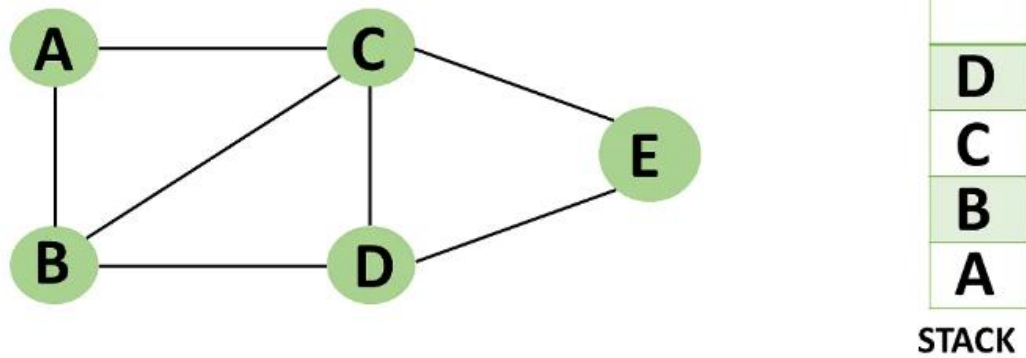
Step 5: Vertex E is the lone unvisited adjacent vertex of vertex D, thus marking it as visited.

- Vertex E should be pushed to the top of the stack.

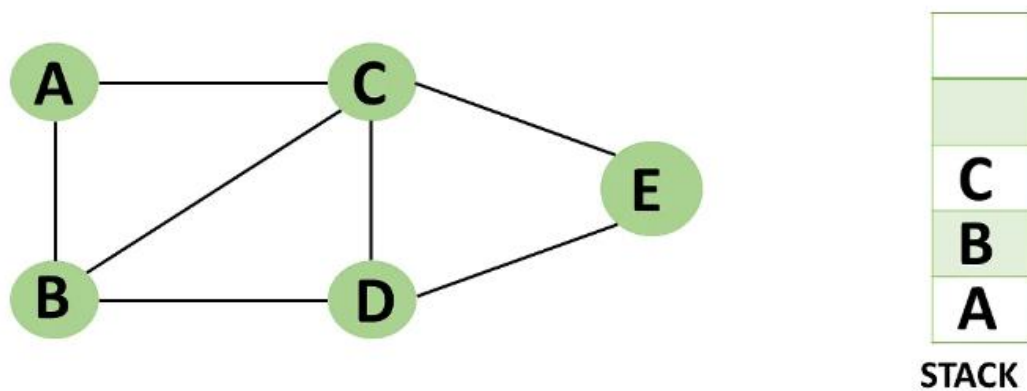


STACK

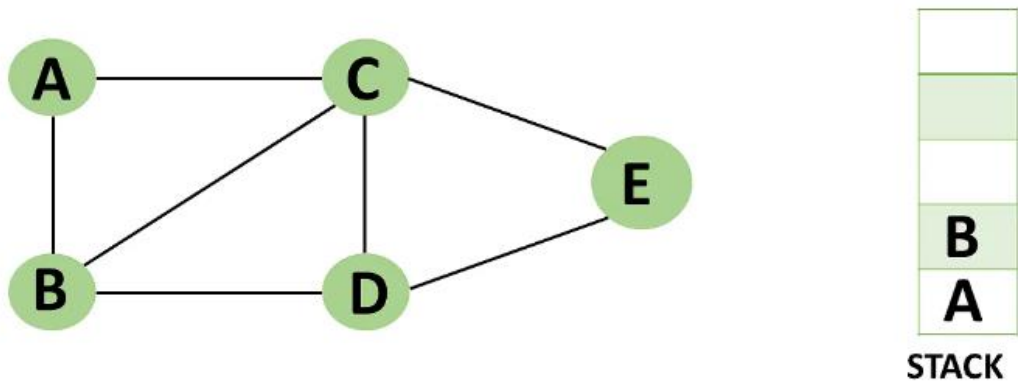
Step 6: Vertex E's nearby vertices, namely vertex C and D have been visited, pop vertex E from the stack.



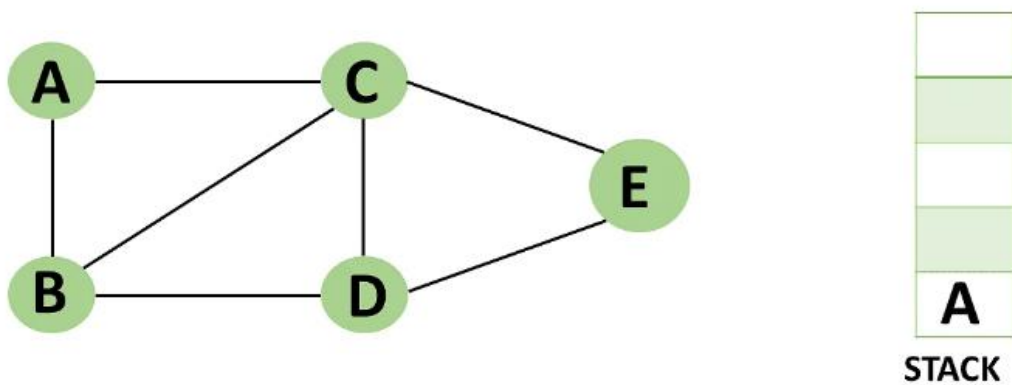
Step 7: Now that all of vertex D's nearby vertices, namely vertex B and C, have been visited, pop vertex D from the stack.



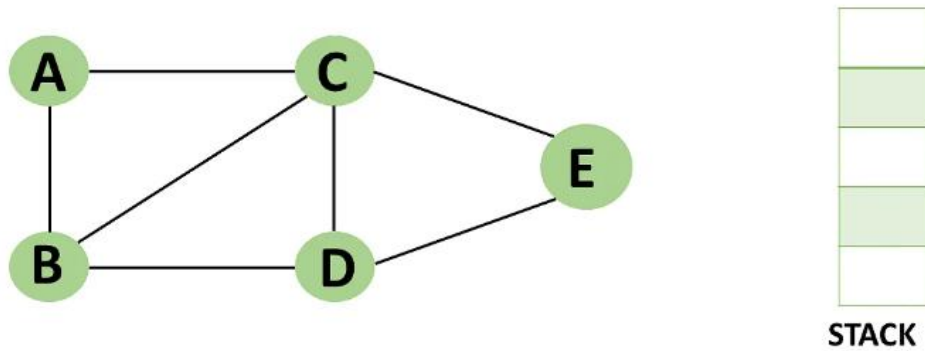
Step 8: Similarly, vertex C's adjacent vertices have already been visited; therefore, pop it from the stack.



Step 9: There is no more unvisited adjacent vertex of b, thus pop it from the stack.

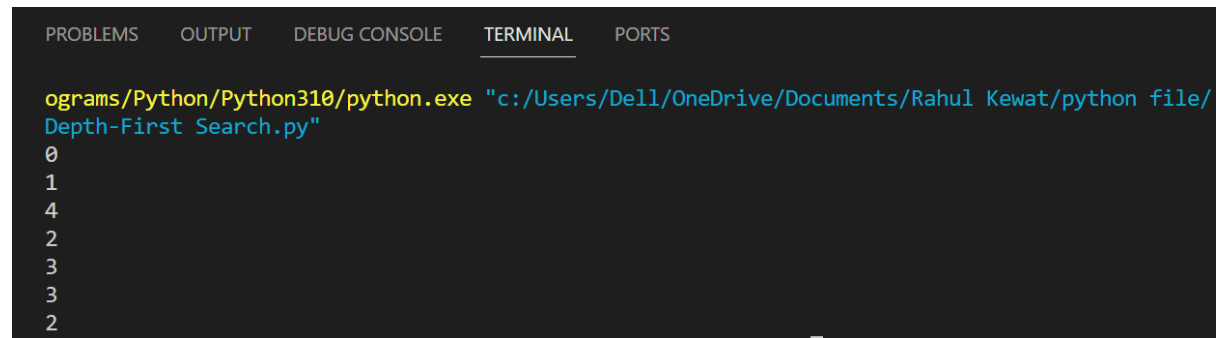


Step 10: All of the nearby vertices of Vertex A, B, and C, have already been visited, so pop vertex A from the stack as well.



Code:

```
Depth-First Search.py X
Depth-First Search.py > ...
1  def dfs(graph, start, visited=None):
2      if visited is None:
3          visited = set()
4          visited.add(start)
5          print(start)
6
7      for next in graph[start] - visited:
8          dfs(graph, next, visited)
9      return visited
10 graph = {'0':set(['1','2']),
11          '1':set(['0','3','4']),
12          '2':set(['0']),
13          '3':set(['1']),
14          '4':set(['2','3'])}
15 dfs(graph, '0')
```

**Output:**

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
ograms/Python/Python310/python.exe "c:/Users/Dell/OneDrive/Documents/Rahul Kewat/python file/
Depth-First Search.py"
0
1
4
2
3
3
2
```