EXPERIMENT NO:7

Aim: To implement different clustering algorithms.
Problem Statement: a) Clustering algorithm for unsupervised classification (K-means, density based
(DBSCAN), Hierarchical clustering)
b) Plot the cluster data and show mathematical steps.

Theory:

1. **Importing Libraries**

```
import pandas as pd
import numpy as np
from sklearn.cluster import KMeans
from sklearn.preprocessing import StandardScaler
from sklearn.decomposition import PCA
from sklearn.preprocessing import LabelEncoder
from sklearn.cluster import DBSCAN
import scipy.cluster.hierarchy as sch
import matplotlib.pyplot as plt
import seaborn as sns
```

2. **Importing dataset**

```
df=pd.read_csv('diabetes_dataset_with_notes.csv')
df = pd.DataFrame(df)
```

3. **Transformation**

```
label_encoder = LabelEncoder()
df['gender_encoded'] = label_encoder.fit_transform(df['gender'])
df['smoking_history_encoded'] = label_encoder.fit_transform(df['smoking_history'])

features = ['age', 'race:AfricanAmerican', 'race:Asian', 'race:Caucasian', 'race:Hispanic',
            'race:Other', 'hypertension', 'heart_disease', 'smoking_history_encoded', 'bmi',
            'hbA1c_level', 'blood_glucose_level']

scaler = StandardScaler()
df_scaled = scaler.fit_transform(df[features])
```

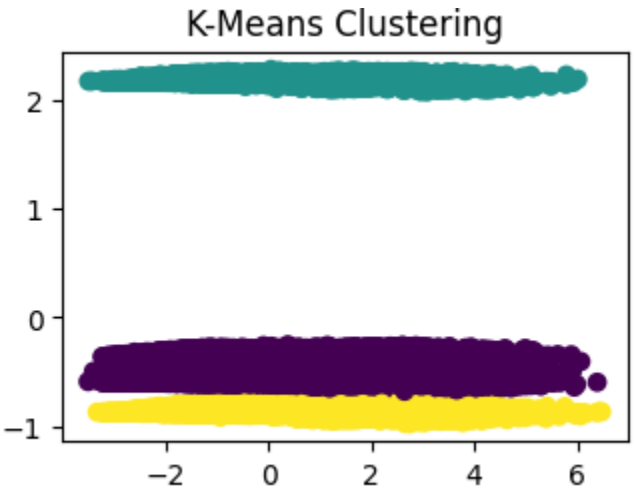
4. **K Means** :-K-Means Clustering: A centroid-based clustering algorithm that partitions data into k clusters by minimizing the distance between data points and their respective cluster centers. It works well with well-separated clusters but assumes a spherical shape.

```
kmeans = KMeans(n_clusters=3, random_state=42)
df['kmeans_cluster'] = kmeans.fit_predict(df_scaled)

pca = PCA(n_components=2)
df_pca = pca.fit_transform(df_scaled)

plt.subplot(2, 2, 1)
plt.scatter(df_pca[:, 0], df_pca[:, 1], c=df['kmeans_cluster'], cmap='viridis')
plt.title("K-Means Clustering")

plt.tight_layout()
plt.show()
```



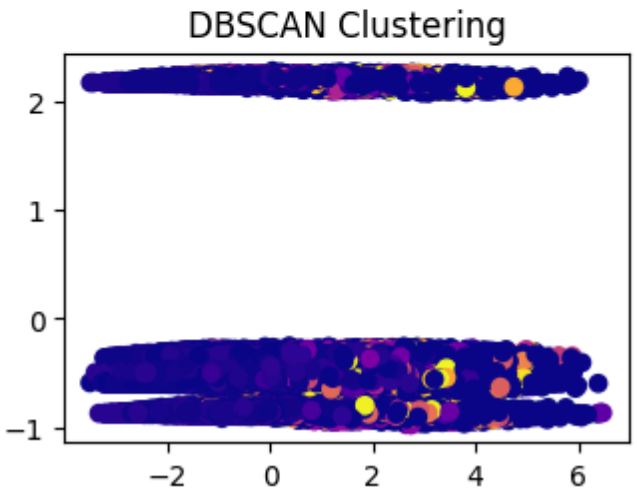
- Successfully identified three distinct clusters.
- The clusters are horizontally aligned, suggesting that one or two dominant features are driving the segmentation.
- Works well for structured, well-separated data but may struggle with complex patterns.

5. **DBSCAN Clustering:-**DBSCAN (Density-Based Spatial Clustering of Applications with Noise): A clustering algorithm that groups data points based on density rather than predefined clusters. It can detect arbitrarily shaped clusters and outliers but is sensitive to parameter selection (eps, min_samples).

```
dbscan = DBSCAN(eps=0.5, min_samples=2)
df['dbscan_cluster'] = dbscan.fit_predict(df_scaled)

plt.subplot(2, 2, 2)
plt.scatter(df_pca[:, 0], df_pca[:, 1], c=df['dbscan_cluster'], cmap='plasma')
plt.title("DBSCAN Clustering")

plt.tight_layout()
plt.show()
```



- Identified dense regions, but the separation is not as clear as K-Means.
- Some points were classified as noise (outliers).
- Suitable for non-linear and arbitrarily shaped clusters, but parameter tuning (eps, min_samples) is crucial for better results.

Conclusion:

- K-Means performed better in this case, successfully grouping data into well-defined clusters.
- DBSCAN struggled with clear separation and produced noisy clusters, likely due to dataset structure or parameter settings.
- The choice of clustering algorithm depends on data distribution – K-Means is ideal for structured clusters, while DBSCAN is useful for detecting complex patterns and outliers.