MAJOR ASSIGNMENT 3

Task-1: Data Preprocessing

```
print('''Name: Sidhanta Barik, RegNo: 2241002049
-------------------------------------------------------''')

import tensorflow as tf
import numpy as np

from tensorflow.keras.datasets import fashion_mnist
(train_images, train_labels), (test_images, test_labels) =
fashion_mnist.load_data()

print("Training data shape:", train_images.shape)
print("Test data shape:", test_images.shape)

train_images = train_images / 255.0
test_images = test_images / 255.0

train_images_flat = train_images.reshape(len(train_images), -1)
test_images_flat = test_images.reshape(len(test_images), -1)

assert not np.isnan(train_images_flat).any(), "Missing values in
training images!"
assert not np.isnan(test_images_flat).any(), "Missing values in test
images!"
assert not np.isnan(train_labels).any(), "Missing values in training
labels!"
assert not np.isnan(test_labels).any(), "Missing values in test
labels!"

print("Preprocessing complete. Ready for training.")
```

```
Name: Sidhanta Barik, RegNo: 2241002049
-------------------------------------------------------
Training data shape: (60000, 28, 28)
Test data shape: (10000, 28, 28)
Preprocessing complete. Ready for training.
```

Task-2: K-Nearest Neighbors (KNN) Classification

```
print('''Name: Sidhanta Barik, RegNo: 2241002049
-------------------------------------------------------''')

from sklearn.neighbors import KNeighborsClassifier
```

```python
from sklearn.metrics import accuracy_score
from sklearn.decomposition import PCA

# Reduced dimensions from 784 to 100 for faster training
pca = PCA(n_components=100)
train_pca = pca.fit_transform(train_images_flat)
test_pca = pca.transform(test_images_flat)

def evaluate_knn(k):
    knn = KNeighborsClassifier(n_neighbors=k, algorithm='auto',
n_jobs=-1)
    knn.fit(train_pca[:10000], train_labels[:10000])  # Use 10k
samples to reduce runtime
    predictions = knn.predict(test_pca[:2000])
    accuracy = accuracy_score(test_labels[:2000], predictions)
    print(f"KNN (k={k}) Accuracy: {accuracy:.4f}")
    return accuracy

for k in [3, 5, 7]:
    evaluate_knn(k)
```

```
Name: Sidhanta Barik, RegNo: 2241002049
-------------------------------------------------------
KNN (k=3) Accuracy: 0.8160
KNN (k=5) Accuracy: 0.8320
KNN (k=7) Accuracy: 0.8300
```

Task-3: Support Vector Machine (SVM) Classification

```python
print('''Name: Sidhanta Barik, RegNo: 2241002049
-------------------------------------------------------''')

from sklearn.svm import SVC

def evaluate_svm(kernel_type):
    svm = SVC(kernel=kernel_type, C=1.0)
    svm.fit(train_pca[:10000], train_labels[:10000])
    predictions = svm.predict(test_pca[:2000])
    accuracy = accuracy_score(test_labels[:2000], predictions)
    print(f"SVM ({kernel_type} kernel) Accuracy: {accuracy:.4f}")
    return accuracy

for kernel in ['linear', 'poly', 'rbf']:
    evaluate_svm(kernel)
```

```
Name: Sidhanta Barik, RegNo: 2241002049
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SVM (linear kernel) Accuracy: 0.8430
SVM (poly kernel) Accuracy: 0.8430
SVM (rbf kernel) Accuracy: 0.8600
```
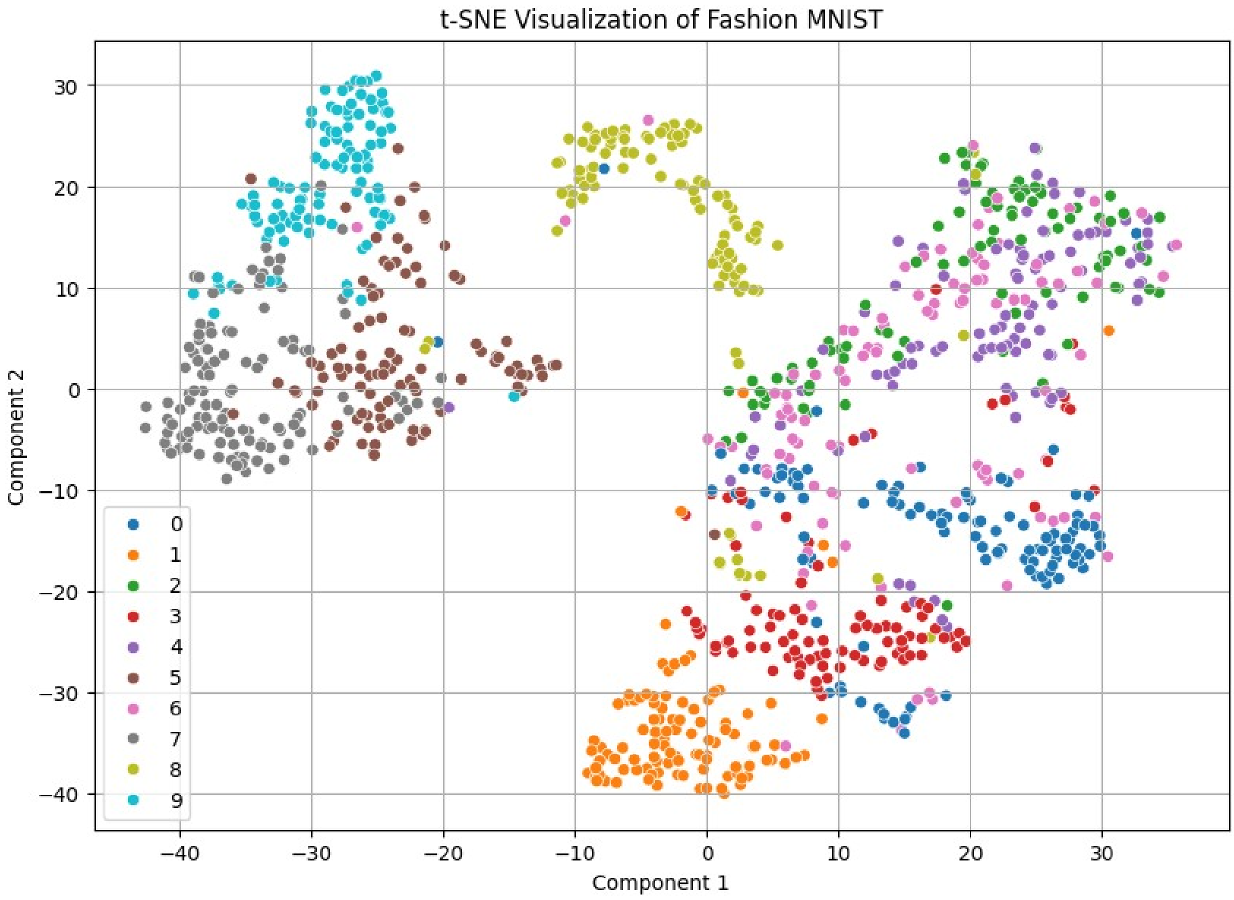

Task-4: Data Visualization with t-SNE

```python
print('''Name: Sidhanta Barik, RegNo: 2241002049
-------------------------------------------------------''')

from sklearn.manifold import TSNE
import matplotlib.pyplot as plt
import seaborn as sns

sample_data = train_images_flat[:1000]
sample_labels = train_labels[:1000]

pca_for_tsne = PCA(n_components=50).fit_transform(sample_data)

tsne = TSNE(n_components=2, perplexity=30, random_state=42)
X_tsne = tsne.fit_transform(pca_for_tsne)

# Plot
plt.figure(figsize=(10, 7))
sns.scatterplot(x=X_tsne[:, 0], y=X_tsne[:, 1], hue=sample_labels,
palette='tab10', legend='full')
plt.title("t-SNE Visualization of Fashion MNIST")
plt.xlabel("Component 1")
plt.ylabel("Component 2")
plt.grid(True)
plt.show()
```

```
Name: Sidhanta Barik, RegNo: 2241002049
-------------------------------------------------------
```



Task-5: Model Evaluation and Reporting

```
print('''Name: Sidhanta Barik, RegNo: 2241002049
---------------------------------------------------------------------''')

from sklearn.metrics import classification_report, confusion_matrix

best_knn = KNeighborsClassifier(n_neighbors=5)
best_knn.fit(train_pca[:10000], train_labels[:10000])
knn_preds = best_knn.predict(test_pca[:2000])

best_svm = SVC(kernel='rbf', C=1.0)
best_svm.fit(train_pca[:10000], train_labels[:10000])
svm_preds = best_svm.predict(test_pca[:2000])

print("\nKNN Evaluation Report (k=5):")
print(classification_report(test_labels[:2000], knn_preds))
print("Confusion Matrix:\n", confusion_matrix(test_labels[:2000],
knn_preds))

print("\nSVM Evaluation Report (rbf kernel):")
```

```python
print(classification_report(test_labels[:2000], svm_preds))
print("Confusion Matrix:\n", confusion_matrix(test_labels[:2000],
svm_preds))
```

```
Name: Sidhanta Barik, RegNo: 2241002049
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KNN Evaluation Report (k=5):
              precision    recall  f1-score   support

           0       0.77      0.81      0.79       200
           1       0.99      0.95      0.97       203
           2       0.75      0.76      0.75       214
           3       0.85      0.87      0.86       190
           4       0.77      0.75      0.76       219
           5       0.96      0.82      0.88       195
           6       0.58      0.59      0.59       197
           7       0.85      0.93      0.89       200
           8       0.97      0.94      0.96       194
           9       0.87      0.94      0.90       188

    accuracy                           0.83      2000
   macro avg       0.84      0.83      0.83      2000
weighted avg       0.84      0.83      0.83      2000

Confusion Matrix:
 [[163   0   2   7   1   0  27   0   0   0]
 [  3 192   0   6   1   0   1   0   0   0]
 [  5   0 162   1  24   0  22   0   0   0]
 [ 10   1   0 165   4   0   9   0   1   0]
 [  0   0  25   8 164   0  20   0   2   0]
 [  0   0   0   1   0 159   0  20   0  15]
 [ 31   0  26   5  17   0 116   0   2   0]
 [  0   0   0   0   0   3   0 185   0  12]
 [  0   0   1   0   3   2   4   2 182   0]
 [  0   0   0   0   0   2   0  10   0 176]]

SVM Evaluation Report (rbf kernel):
              precision    recall  f1-score   support

           0       0.84      0.79      0.81       200
           1       0.98      0.95      0.96       203
           2       0.78      0.81      0.79       214
           3       0.81      0.88      0.84       190
           4       0.80      0.78      0.79       219
           5       0.93      0.92      0.93       195
           6       0.65      0.66      0.66       197
           7       0.90      0.95      0.93       200
           8       0.98      0.95      0.96       194
           9       0.97      0.93      0.95       188
    accuracy                           0.86      2000
   macro avg       0.86      0.86      0.86      2000
weighted avg       0.86      0.86      0.86      2000

Confusion Matrix:
 [[157   0   2  15   1   0  25   0   0   0]
 [  0 192   0  11   0   0   0   0   0   0]
 [  2   0 173   2  21   0  16   0   0   0]
 [  5   3   1 167   4   0   9   0   1   0]
 [  0   0  27   5 170   0  16   0   1   0]
 [  0   0   0   0   0 180   0  12   0   3]
 [ 23   0  20   5  16   0 131   0   2   0]
 [  0   0   0   0   0   6   0 191   0   3]
 [  0   1   0   1   1   3   4   0 184   0]
 [  0   0   0   0   0   4   0   9   0 175]]
```