Week 4: Introduction to Deep Learning

Task 4.1: Building a Simple Neural Network

Objective: Introduce the basics of neural networks and build a simple model using TensorFlow and Keras for image classification.

Dataset: **Fashion MNIST dataset**, which is a dataset of Zalando's article images, consisting of a training set of 60,000 examples and a test set of 10,000 examples. Each example is a 28x28 grayscale image, associated with a label from 10 classes.

- **Dataset URL**: Directly available in TensorFlow/Keras datasets. You can load it using the following command:

```
from tensorflow.keras.datasets import fashion_mnist

(train_images, train_labels), (test_images, test_labels) = fashion_mnist.load_data()
```

Activities:

1. **Data Preparation**:
   o Load the dataset.
   o Normalize the image data to the range [0, 1].
   o Reshape the data if necessary and prepare it for training.
2. **Model Building**:
   o Create a simple neural network architecture using Keras with at least one hidden layer.
   o Compile the model with an appropriate loss function and optimizer.
3. **Training**:
   o Train the model on the training data with validation using a portion of the training set.
   o Use callbacks like ModelCheckpoint or EarlyStopping to enhance training.
4. **Evaluation**:
   o Evaluate the model on the test set to check its performance.
   o Use metrics such as accuracy and create a confusion matrix to visualize the classification performance.

Expected Output:

- A Jupyter notebook that includes the full workflow of loading data, building, training, and evaluating the neural network.
- Visualizations of the model's training progress and final results.

Documentation:

- Document the design choices for the neural network including layer choices, activation functions, and the rationale behind each decision.

- Provide a detailed analysis of the model's performance and any steps taken to improve it.

General Guidelines for Tasks:

- **Code Documentation**: Ensure all code is well-commented to explain the purpose and functionality of each section.
- **Visualization**: Include visualizations for both the architecture of the neural network and its performance metrics to aid in understanding.
- **Testing and Iteration**: Do testing different architectures and hyperparameters to see their effect on model performance.