AI Assignment - Part 1: Theoretical Understanding

# 1. Short Answer Questions

## Q1: Explain the primary differences between TensorFlow and PyTorch. When would you choose one over the other?

TensorFlow and PyTorch are both popular deep learning frameworks, but they differ in how they are designed and used.  
  
- TensorFlow:  
 - Developed by Google.  
 - Uses static computational graphs (with tf.function) — this means the model structure is defined first, then executed.  
 - Offers strong support for deployment with tools like TensorFlow Lite, TensorFlow Serving, and TensorFlow.js.  
 - Ideal for production and mobile/embedded deployment.  
  
- PyTorch:  
 - Developed by Facebook (Meta).  
 - Uses dynamic computational graphs — models are defined and executed line by line, similar to regular Python code.  
 - Easier to debug and more Pythonic.  
 - Preferred for research and prototyping due to its flexibility.  
  
When to choose:  
- Choose PyTorch for research, experimentation, and quick development.  
- Choose TensorFlow for large-scale production deployment and mobile integration.

## Q2: Describe two use cases for Jupyter Notebooks in AI development.

1. Exploratory Data Analysis (EDA):  
 Jupyter Notebooks allow data scientists to visually explore datasets, generate plots, and run code in chunks, making it easier to understand patterns before building models.  
  
2. Model Prototyping and Experimentation:  
 AI developers can build and test machine learning models interactively, tune hyperparameters, and view results immediately, making iteration faster and more intuitive.

## Q3: How does spaCy enhance NLP tasks compared to basic Python string operations?

spaCy is a powerful NLP library that provides advanced language processing features beyond basic string manipulation.  
  
- Pre-trained language models: spaCy includes built-in models for tasks like tokenization, part-of-speech tagging, named entity recognition (NER), and dependency parsing.  
- Efficient and fast: It is optimized for performance and large-scale text processing.  
- Linguistic context: Unlike basic string methods (split(), find(), etc.), spaCy understands grammar and structure, which is crucial for accurate NLP analysis.

# 2. Comparative Analysis

Compare Scikit-learn and TensorFlow in terms of:

## a) Target applications

- Scikit-learn: Focuses on classical machine learning like regression, classification, clustering, and preprocessing. It doesn’t support neural networks well.  
- TensorFlow: Designed for deep learning and building neural networks — ideal for image recognition, NLP, and complex AI applications.

## b) Ease of use for beginners

- Scikit-learn: Easier for beginners. It has a simple, consistent API and works well for structured/tabular data.  
- TensorFlow: Has a steeper learning curve, especially for those new to deep learning concepts.

## c) Community support

- Both have strong communities, but:  
 - TensorFlow has wider global industry adoption, especially for production.  
 - Scikit-learn has a strong academic and educational presence for classical ML.