Part 1: Theoretical Understanding (40%)

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

TensorFlow and PyTorch are leading deep learning frameworks, differing mainly in computation graph structure and usability. TensorFlow uses a static computation graph, optimized for production, while PyTorch uses a dynamic computation graph, built at runtime, offering flexibility and ease of debugging.

TensorFlow integrates well with Keras, TensorBoard, and TensorFlow Lite, making it ideal for deployment. PyTorch is more Pythonic and intuitive, favored in academic and research settings. In short, TensorFlow is best for production-scale projects, while PyTorch excels in rapid prototyping and research.

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

1. Interactive Model Development – Jupyter Notebooks enable developers to build and test AI models step by step, providing instant feedback and visualization capabilities.

2. Data Exploration and Visualization – Notebooks allow seamless integration of code, visualizations, and commentary, making them ideal for analyzing datasets and presenting findings.

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

spaCy significantly enhances natural language processing tasks compared to basic string manipulation in Python. It provides features like tokenization, POS tagging, dependency parsing, and named entity recognition using pretrained models.

While Python string methods handle only literal text operations, spaCy offers semantic and syntactic understanding, making it faster, context-aware, and suitable for complex NLP pipelines.

Comparative Analysis: Scikit-learn vs TensorFlow

Scikit-learn and TensorFlow serve different purposes in the AI ecosystem. Scikit-learn is ideal for classical machine learning such as regression, clustering, and classification, while TensorFlow is specialized for deep learning and neural network models.

Scikit-learn is beginner-friendly with simple APIs, whereas TensorFlow has a steeper learning curve but provides greater control and scalability. Both have large, active communities, with Scikit-learn popular in academia and TensorFlow backed by Google for enterprise-level applications.