AI Tools Assignment Report

Theme: Mastering the AI Toolkit ■■■

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Assignment Objective & Tools

This report showcases the implementation and analysis of AI tools across classical ML, deep learning, and NLP. The frameworks used include Scikit-learn, TensorFlow, and spaCy. Platforms: Google Colab & Jupyter. Datasets: Iris, MNIST, Amazon Reviews.

Part 1: Theoretical Understanding

Q1: Explain the primary differences between TensorFlow and PyTorch.

TensorFlow uses static computation graphs by default, making it more suitable for production environments. PyTorch, on the other hand, uses dynamic computation graphs, which are easier for debugging and experimentation. TensorFlow is often chosen for deployment, while PyTorch is preferred in research.

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

1. Rapid prototyping and visualization of AI models. 2. Interactive data exploration and real-time code execution.

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

spaCy offers linguistic features such as tokenization, POS tagging, and named entity recognition, providing deeper contextual understanding than simple string methods, which only manipulate text at a surface level.

Comparative Analysis: Scikit-learn vs TensorFlow

Criteria	Scikit-learn	TensorFlow
Target Applications	Classical ML (e.g., SVM, Decision Trees)	Deep Learning (e.g., CNNs, RNNs)
Ease of Use	Beginner-friendly with high-level APIs	Moderate – more verbose
Community Support	Strong in ML research	Strong in industry & deep learning

Part 2: Practical Implementation

Task 1: Classical ML with Scikit-learn

Used the Iris dataset. Applied preprocessing and trained a decision tree classifier.

Metrics: Accuracy: 0.96, Precision: 0.95, Recall: 0.95

Task 2: CNN with TensorFlow on MNIST

Trained a CNN model achieving >95% accuracy on test data.

Layers: Conv2D, MaxPooling, Flatten, Dense. Used ReLU and softmax.

Task 3: NLP with spaCy

Extracted entities such as product names and brands from Amazon reviews.

Used rule-based sentiment analysis to determine polarity.

Part 3: Ethics & Optimization

Ethical Consideration:

Bias in MNIST may arise from digit styles across demographics. Amazon reviews may reflect cultural bias or imbalanced opinions. Tools like TensorFlow Fairness Indicators and spaCy's rule-based systems help monitor and reduce such biases.

Troubleshooting Challenge:

Debugged a TensorFlow model with a shape mismatch issue. Adjusted input shape in Conv2D and replaced loss function to SparseCategoricalCrossentropy.

Bonus Task: Deployment

Used Streamlit to create a simple web app for digit classification using the MNIST model. Interface allows image upload and prediction.

Demo Link: [Insert link here]

Report Completed by: stephenongisa97
GitHub Repo: https://github.com/stephenongisa97/AI-assignment