# Mastering the AI Toolkit – Group Report

### Group Members

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# Part 1: Theoretical Understanding

### Q1 – TensorFlow vs PyTorch

TensorFlow is developed by **Google** and is ideal for large-scale, production-level machine learning and deep-learning projects.
PyTorch, created by **Meta's AI Research Lab**, is preferred for research and experimentation because it supports **dynamic computation graphs**.

You would choose **TensorFlow** when deploying a model into production (for example, mobile or web apps).
You would choose **PyTorch** when you need flexibility, fast prototyping, or frequent debugging during research.

### Q2 – Two Use Cases for Jupyter Notebooks

1. **Interactive AI Development:** Run and debug small blocks of code to test algorithms quickly.
2. **Documentation and Visualization:** Combine code, graphs, and explanations in one notebook for teaching, collaboration, or sharing research results.
3.

### Q3 – spaCy Enhancement of NLP Tasks

spaCy provides pre-trained language models for **Named Entity Recognition (NER)**, **Part-of-Speech Tagging**, and **Dependency Parsing**, making NLP much faster and more accurate than manual Python string operations.

### Comparative Analysis: Scikit-learn vs TensorFlow

| Feature | Scikit-learn | TensorFlow |
|---|---|---|
| **Target Application** | Classical Machine Learning (e.g. regression, clustering) | Deep Learning and Neural Networks |
| **Ease of Use** | Very beginner-friendly | Slightly complex, requires more setup |
| **Community Support** | Excellent for ML basics | Very strong for DL and AI research |

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# Part 2: Practical Implementation

## Task 1 – Classical ML with Scikit-learn

We trained a **Decision Tree Classifier** using the **Iris Species Dataset**.
The model predicts the type of iris flower based on petal and sepal measurements.
Performance metrics: Accuracy, Precision, and Recall.

**Sample Output:**

```
Accuracy: 0.97
Precision: 0.96
Recall: 0.95
```

**Screenshot of Model Output: https://drive.google.com/drive/folders/11M-oIZZVlX3k0TC5zTBQs8AT7BHuuAu-?usp=sharing**

## Task 2 – Deep Learning with TensorFlow / PyTorch

We built a **Convolutional Neural Network (CNN)** on the **MNIST Handwritten Digits Dataset**.
The model achieved > 95 % test accuracy.

**Sample Predictions:**

### Task 3 – NLP with spaCy

We analyzed **Amazon Product Reviews** for **Named Entity Recognition (NER)** and **sentiment analysis**.
spaCy extracted product names and brands; a rule-based approach classified sentiment as positive or negative.

**NER Results:**

**Sentiment Analysis Result:**

# Part 3: Ethics & Optimization

## Ethical Considerations

Potential bias may arise from imbalanced training data (e.g., digit styles in MNIST or language tone in reviews).
Tools like **TensorFlow Fairness Indicators** and spaCy's rule-based systems can detect and reduce bias by evaluating model outputs across different groups or contexts.

## Troubleshooting Challenge

We identified and fixed TensorFlow code errors such as incorrect input dimensions and mismatched loss functions by verifying the training and test data shapes and adjusting the model compilation parameters.

## Bonus Task – Model Deployment

Our CNN model was deployed via **Streamlit** to create an interactive web interface for handwritten-digit recognition.

**Deployment Screenshot:**

**Live Demo Link:** [Insert Streamlit or GitHub Pages Link Here]

**Presentation Video: https://drive.google.com/file/d/1d-ISDXnKhTnRlBqC5LbuhKz5IKdLLA2j/view?usp=drive_link**

**Title:** Mastering the AI Toolkit – Group Presentation
**Duration:** 3 minutes
**Members Featured:** All five group members

**Presentation Link: https://drive.google.com/file/d/1d-ISDXnKhTnRlBqC5LbuhKz5IKdLLA2j/view?usp=drive_link**

# Conclusion

This project helped us understand how different AI frameworks work together to build real-world solutions.
From Scikit-learn’s simplicity to TensorFlow and PyTorch’s deep learning power and spaCy’s language processing capabilities, we have mastered a complete AI toolkit for future innovation.

## □ How to Use

1. Upload your screenshots with the same names into Colab.
2. Paste this entire template into a **Text cell** (Markdown cell).
3. Replace placeholders with your actual text or links.
4. Export the notebook as **PDF** via `File → Print → Save as PDF`