

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 open-source deep learning frameworks, but they differ in how they execute operations and their ease of use.

Execution Model: TensorFlow uses a static computation graph (defined and then run), while PyTorch uses dynamic computation graphs (define-by-run), which are more intuitive for debugging and experimentation.

Syntax & Usability: PyTorch is considered more Pythonic and easier to use, especially for research and prototyping. TensorFlow, especially with Keras, is often preferred for production-level deployment and scalability.

Choose PyTorch when you need flexibility for research or experimenting with novel architectures. Choose TensorFlow for deploying large-scale models in production environments, especially when using tools like TensorFlow Serving or TensorFlow Lite.

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

Data Exploration and Visualization: Jupyter Notebooks allow interactive exploration of datasets using Python libraries like Pandas, Matplotlib, and Seaborn. This is useful for understanding patterns, correlations, and outliers in the data before training models.

Model Prototyping and Documentation: Developers can write, test, and tweak machine learning models in small, manageable code blocks while documenting each step. This improves reproducibility and collaboration, especially in research and education.

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

Answer: spaCy is an advanced NLP library that offers pre-trained models and efficient algorithms for linguistic processing tasks like tokenization, part-of-speech tagging, named entity recognition, and dependency parsing.

Unlike basic Python string operations (e.g., `.split()`, `.replace()`), spaCy understands the grammatical structure and meaning of text, enabling more accurate and context-aware text processing. It handles complex language rules, supports multiple languages, and is optimized for performance and scalability.

2. Comparative Analysis: Scikit-learn vs TensorFlow

Feature	Scikit-learn	TensorFlow
Target Applications	Classical ML (e.g., regression, classification, clustering)	Deep learning (e.g., neural networks, NLP, computer vision)
Ease of Use	Very beginner-friendly with a simple and intuitive API	More complex, but easier with Keras and good documentation
Community Support	Mature and well-established community with many tutorials and examples	Large and active community, widely used in industry and research

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Wk3_AI_Tools > wk3as.ipynb > # Task 2: MNIST Digit Classification using a CNN in TensorFlow
Generate + Code + Markdown | Run All | Restart | Clear All Outputs | Jupyter Variables | Outline | Python 3.12.0

... Epoch 1/5
1688/1688 26s 13ms/step - accuracy: 0.8963 - loss: 0.3360 - val_accuracy: 0.9865 - val_loss: 0.0484
Epoch 2/5
1688/1688 23s 13ms/step - accuracy: 0.9842 - loss: 0.0504 - val_accuracy: 0.9895 - val_loss: 0.0387
Epoch 3/5
1688/1688 21s 12ms/step - accuracy: 0.9899 - loss: 0.0338 - val_accuracy: 0.9872 - val_loss: 0.0486
Epoch 4/5
1688/1688 26s 15ms/step - accuracy: 0.9914 - loss: 0.0250 - val_accuracy: 0.9912 - val_loss: 0.0352
Epoch 5/5
1688/1688 20s 12ms/step - accuracy: 0.9948 - loss: 0.0156 - val_accuracy: 0.9922 - val_loss: 0.0322
313/313 3s 8ms/step - accuracy: 0.9835 - loss: 0.0497

Test Accuracy: 0.9882
313/313 3s 9ms/step

...
Pred: 0 Pred: 5 Pred: 2 Pred: 8 Pred: 0

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Wk3_AI_Tools > wk3as.ipynb > # Task 3: NLP with spaCy - Named Entity Recognition & Rule-based Sentiment
Generate + Code + Markdown | Run All | Restart | Clear All Outputs | Jupyter Variables | Outline | Python 3.12.0

[7] ✓ 2.5s

... Named Entities (Product Names & Brands):

Review: I love my new Apple AirPods Pro - the sound is amazing and the fit is perfect!
> Entity: Apple AirPods Pro | Label: ORG
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Review: This Samsung TV has terrible image quality. I'm really disappointed.
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Review: Logitech MX Master 3 is the best mouse I've ever used. Super smooth and ergonomic.
> Entity: Logitech | Label: ORG
> Entity: MX | Label: PRODUCT
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Review: Avoid this Sony phone at all costs - it's buggy and slow.
> Entity: Sony | Label: ORG
-----
Review: The Kindle Paperwhite is excellent for reading, especially in bright sunlight!
> Entity: The Kindle Paperwhite | Label: ORG
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Sentiment Analysis Results:

Review: I love my new Apple AirPods Pro - the sound is amazing and the fit is perfect!
> Sentiment: Positive
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Review: This Samsung TV has terrible image quality. I'm really disappointed.
> Sentiment: Negative
-----
```

3. Ethical Considerations

- MNIST Bias: Dataset limited to one demographic
- Amazon Review Bias: Rule-based methods may ignore sarcasm, culture

Mitigation:

- Use TensorFlow Fairness Indicators
- Customize spaCy rule sets for better neutrality