Generative AI and its Applications

Name : Amrutha P J	SRN : PES2UG23CS059	Section : A

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1. Introduction & Setup

In this lab, I explored the basics of using the Hugging Face transformers library. My first takeaway was learning about the pipeline() function. I realized that this single function is essentially a wrapper that handles all the complex preprocessing (converting text to numbers) and post-processing (converting numbers back to text) for us. It made running state-of-the-art models surprisingly easy.

2. Generative AI: Size & Reproducibility

I conducted experiments to understand two key concepts: model size and reproducibility.

- **The Seed Experiment:** I started by generating text with a fixed seed value. I observed that as long as the seed stayed the same, the model produced the exact same text every time. However, when I changed the seed value, the output completely changed, even though the prompt was identical. This proved that the "creativity" in AI is actually controlled randomness, and setting a seed is crucial for debugging and reproducibility.
- **Model Comparison (DistilGPT2 vs. GPT2):** I then compared a distilled model against a standard one using the prompt Generative AI is a revolutionary technology that.
    - The distilgpt2 model was fast, but the text it generated quickly became repetitive and slightly incoherent. It felt like it was rambling.
    - The gpt2 model, while still an older model, stayed on topic much better. It discussed solving complex problems and learning from humans, which made logical sense in context.

3. Looking Under the Hood: NLP Fundamentals

The most interesting part for me was breaking down the magic of the pipeline. I learned that models don't actually read English; they read math.

- **Tokenization:** I saw how the tokenizer takes a sentence like Transformers revolutionized NLP and chops it into sub-words (tokens) and then converts them into IDs (like 41762). This is the only language the model speaks.
- **POS Tagging & NER:** I used NLTK and BERT to analyze the grammatical structure.
    - **POS Tagging** showed me how the computer differentiates between a noun and a verb, which is important for understanding context.
    - **NER (Named Entity Recognition)** was particularly impressive. The model correctly identified PES University as an Organization and AI as a Miscellaneous entity with very high confidence scores (0.99).

4. Advanced Applications: Summarization & QA

I moved on to testing specific tasks that go beyond simple text generation.

- **Summarization:** I compared distilbart (fast) vs. bart-large (quality).
    - I noticed that the fast summarizer just grabbed chunks of the text and pasted them together.
    - The quality summarizer actually rewrote the text, creating a concise sentence that captured the main idea of the Transformer architecture perfectly.
- **Question Answering:** I was able to build a simple study buddy by feeding the model a context (the course text). When I asked What are the risks?, it correctly extracted specific answers like data privacy, intellectual property, and academic integrity directly from the text.

5. Conclusion

This hands-on session bridged the gap between theory and practice for me. I now understand that while Generative AI feels like magic, it is actually a structured process of Tokenization -> Model Inference -> Decoding. The choice of model (Distilled vs. Large, Encoder vs. Decoder) drastically changes the results, and picking the right tool for the right task is the most important skill for an AI engineer.

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