Multifunctional NLP and Image Generation Tool using Hugging Face Models

1. Introduction

This project presents an integrated NLP and image generation tool built using Hugging Face's transformers and diffusers libraries, with a user-friendly frontend powered by Streamlit. The application allows users to interact with multiple state-of-the-art pretrained models from Hugging Face for various NLP and image synthesis tasks.

2. Approach

The development process followed a modular and scalable design, implemented in the following steps:

Step 1: Environment Setup

- Installed necessary Python libraries: streamlit, transformers, diffusers, torch
- Configured environment to use CPU (or GPU if available) for model inference.

Step 2: Frontend Design (Streamlit UI)

- Developed a sidebar for task selection.
- Created interactive UI elements for user input
- Used real-time feedback (st.success, st.image) for outputs.

Step 3: Backend Implementation

- Used Hugging Face's pipeline() to load pretrained models for:
    - Text Summarization
    - Text Generation
    - Chatbot
    - Sentiment Analysis

    - Question Answering

- Used StableDiffusionPipeline for generating images from text prompts.

Step 4: Caching and Optimization

- Applied @st.cache_resource to avoid reloading models on every interaction.
- Managed chatbot history using st.session_state for a conversational experience.

Step 5: Evaluation and Testing

- Manually tested each model's functionality.
- Observed model behavior for various input prompts.

3. Results and Observations

Task	Model Used	Observations
Text Summarization	BART (facebook/bart-large-cnn)	Provides high-quality, concise summaries of long inputs.
Next Word Prediction / Story Generation	GPT-2	Generates creative continuations, context-limited for short prompts.
Chatbot	DialoGPT-small	Effective for short dialogue, but lacks long memory context.
Sentiment Analysis	DistilBERT SST-2	High accuracy on binary sentiment (positive/negative).
Question Answering	BERT fine-tuned on SQuAD	Performs well on factual context-based questions.
Image Generation	Stable Diffusion v1.4	Generates stunning images with descriptive prompts; slower on CPU.

4. Conclusions

This project demonstrates the successful integration of diverse NLP and image generation models into a single interactive web application. The use of Hugging Face’s transformers and diffusers APIs enabled fast prototyping and high-quality outputs across tasks. Streamlit provided a smooth and interactive frontend that required no backend deployment.