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Final Project –

Generating Product Image from Customer Reviews

Overview: This project invites you to delve into the intersection of text and image generation by collecting product reviews using an LLM API, conducting text analysis to extract valuable information, and generating images from the text using an Image Generation model.

Outcome Goal: The outcome goal of this project is to use a LLM to extract valuable information from the textual content of the product customer reviews, followed by leveraging diffusion models to re-create product images based on the customer reviews.

Learning Objective: Learn how to assess the generative capabilities of AI in its understanding and interpretative abilities in extracting visual cues from texts, and also its ability in producing relevant visual content based on these visual cues.

Instructions:

Q1. Product Selection and Customer Review Data Collection (5').

- **(required)** Select 3 different products from different categories on a digital marketplace (e.g., Amazon).
    - Please take into consideration different factors (e.g., product categories, popularity levels) when making your selection.
- **(required)** Explain the rationale of your choices.
- **(required)** Collect the corresponding product descriptions (textual content) and customer reviews (textual content) for each product.

Note: It is okay to use a public / open-source datasets pertaining to 3 different products if the product reviews your team would like to analyze are published to a platform that does not allow or permit web scraping but there is an existing public dataset of the reviews.

Q2. Analysis of Customer Reviews with LLM (7.5').

- **(required)** Use an LLM API to conduct text analysis to extract valuable information from the textual data collected above and build a more holistic understanding about the product.
    - **Examples of information features that could be created from the product reviews:**
        - Information about the sentiment of the reviews.
        - Information about what aspects of the product need improvement based on the customer reports.

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        - What feature(s) of the product is most valuable to the customer, e.g. the price, usability, design, etc..
    - **Some analyses that are relevant to consider include, but not limited to, for example:**
        - Text summarization.
        - Extraction of particular product features (e.g., visual information).
        - Topic extraction.
        - Sentiment analysis.

- **(required)** Conduct your analyses using prompt engineering (with different prompt strategies), RAG, or a combination of both.
    - **Note**: it is not required to use both prompt engineering and RAG, it is permissible to use one of these methods. You may choose to use both.
- **Guidance or considerations to think about when designing & deciding on your approach:**
    - When doing the analysis, you may need to consider different documentation chunking strategies given the input token limit LLM API has.
        - **Note**: If you're using a RAG, it is important to consider how the document chunking strategy could impact what the embeddings in a RAG vector store represent.
    - You could consider using a vector database to store your text embedding if necessary.
    - You also need to think about what is an effective output from this step, given that your goal next step is to send this output into the diffusion model for meaningful product image generation.

Q3. Image Generation with Diffusion Model (7.5').

- **Prompt Engineering (required)**: For each product, based on the information extracted from the product description and customer reviews, craft prompts to guide the image generation process effectively.
- **Model Selection (required)**: Use **two different image generation models** (e.g., OpenAI's DALLE, Midjourney, Stable Diffusion) to generate 3~5 images for each product based on your crafted prompts.
    - **Experiment with different prompts and settings to best visualize what you believe is a good illustration of the product based on product description and customer reviews.**
    - If necessary, iterate on your prompts based on initial results to refine the illustrations.

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- **Analysis (required)**: Compare AI-generated product images with the actual product images posted in the real world. **Provide analyses and explanations of your findings.**
    - Are they similar or different?
    - In what dimensions?
    - Do you think AI is able to illustrate the products well?
    - Why or why not?
    - Do you see any significant differences across different image generation models? Which one do you like better? Why?

(Bonus) Q4. Build an AI Agentic Workflow (5').

- Design and build an AI Agentic workflow to connect all the above steps.
    - **(Optional)** Add a decision-making or planning mechanism (e.g. 'agent') into the workflow.
        - **Example**: the mechanism decides when to stop collecting data.

Deliverables:

- **Final report (required)**:: Submit a final report documenting all your analyses, findings, and explanations.
    - **(required)** Include a detailed description of your methodology and analysis for each of the steps described in **Q1, Q2, Q3**, and **if applicable, Q4**.
    - **(required)** Include links or files for any data you collected, code you wrote, prompts you designed, and images generated.
    - **(required)** In your final report, include a reflective discussion on the main challenges faced and lessons learned.
- **Final presentation (required)**: create a presentation/slide deck to present your method and findings. **In your final presentation, include:**
        - **(required)** Overview/description of your method/approach.
        - **(required)** A reflective discussion on the main challenges faced and lessons learned.
- Every team only needs to submit **one final package**. This final package must include:
    - **(required)** Final report.
    - **(required)** Final presentation.
- Every team will do a **15-20 mins presentation** during week 7.

Deadlines:

- Final presentation: 12/01 and 12/03
- Final report and package due: 12/05.

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Grading Rubric on next page.

Grading

Grade Component	Weight of Total Grade 20%
Q1	5%
Q2	7.5%
Q3	7.5%
Q4	5%

Grade Rubrics	Share of Assignment
Have you understood the question correctly?	10%
Experiment Design (*e.g., Creativity and diversity in product selection, prompt design, novelty in tasks*)	20%
Analytics (*e.g., Is there a clear rationale for why certain things worked or didn't work?*)	30%
Insights (*Do you arrive at meaningful and informative insights?)*	30%
Scientific Rigor (e.g., *Code quality, documentation, and reproducibility of the results*)	10%