

Generating Product Images from Customer Reviews

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Generative AI Lab – Final Project

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Final Project Report – Generating Product Images from Customer Reviews

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Introduction:

This project experiments with the ability of Large Language Models (LLMs) to extract valuable information from the descriptions of a range of commercially available products, along with their respective customer reviews, to use as input to a diffusion model with the intent of recreating product images. For this experiment, we made use of the LLM gpt-3.5-turbo and the diffusion model DALL-E 3 as made available through the OpenAI API. Our efforts and analysis were conducted with the aim of assessing the generative capabilities of both models, along with their ability to interpret and understand features of importance pertaining to the products.

Product Selection:

We selected three products for evaluation and analysis, each representing a different market with different target audiences and varying levels of customer reviews.

Product 1: Diabetes Continuous Glucose Monitoring

Product 2: La Roche-Posay Toleriane Double Repair Face Moisturizer

Product 3: Boxing Gloves

Rationale:

- Product 1: Is a healthcare product that is in high demand due to its ability to assist in the treatment of diabetes. It has numerous defining technical features and customer reviews that concern the product's uses. This product serves as a good example to test whether generative AI products can identify important technical features and derive accurate visualizations from usage context.

- Product 2: Is just one example of a skin moisturizing product that exists within a market that is saturated with similar products and sub-products from different brands. This product serves as a good example for testing the ability of generative AI products to highlight brand specific details and create visualizations that ensure product differentiation.
- Product 3: Is an example of a high demand product for a particular sport that values both the functionality and appearance of the boxing gloves. This product serves as a test for whether generative AI products can identify features based on functionality and visual appeal.

Execution & Analysis:

Product 1: Diabetes Continuous Glucose Monitoring

Product Selection and Customer Review Data Collection

For this project, the first product is Diabetes Continuous Glucose Monitoring (CGM). This decision stems from the widespread use of CGM devices in managing diabetes, offering a rich source of reviews for analysis. In 2021, 38.4 million Americans, accounting for 11.6% of the population, were diagnosed with diabetes. Of this population, 2 million individuals have type 1 diabetes, including approximately 304,000 children and adolescents. Additionally, given the significance of healthcare in everyone's lives, selecting a healthcare product like CGM adds a compelling dimension to our project.



Data Introduction

Our dataset comprises 37,000 reviews, providing a comprehensive insight into user experiences and perceptions.

Example 1: This system was able to automatically stop the Insulin delivery if the algos showed that the glucose was close to such low levels that can lead to hypoglycemia (very useful specially at nights in order to prevent lows which lead to hypoglycemia -and saving parents from waking up in order to treat their children, give them some juice in order to rise the glucose levels again etc-) So Medtronics pumps were the best till now. Mainly because of this so called closed loop system or "artificial pancreas" as they also call it.

Example 2: Since I have very good control I don't expect to switch to a pump anytime soon. I think for most people a pump leads to better control but its not for everyone. I think the Dexcom CGM is much more important for good control. Reading others comments on the pen needles. I normally change my needle once per-day so I use it 3-6 times before replacing.

Example 3: When I was using Dexcom, I used the Dexcom G6 app to manage the sensor, transmitter, etc. I connected Sugarmate (iOS app) to my Dexcom account as it provided insights in a way that I liked better.

Example 4: This happens to me when I connect to a few other Bluetooth devices. Like if I use my hearing aids to take a call, have my rileylink connected, my dexcom almost always cuts out if I'm on the call for awhile. Maybe see how many BT devices you're connected to? I'm running iOS 15.2 and dexcom 1.9.1 if that helps troubleshoot any. Might just be a crap sensor too? I hope you figure it out soon, good luck.

Example 5: yeah, I had to switch to iOS for my CGM (diabetes monitor) as it would not support the Pixel 4 at the time. I am so badly wanting to go back to Android. Gonna wait for the pixel 6a and second gen of their tensor stuff.

Analysis of Customer Reviews with LLM

A. For the initial analysis phase, we employed OpenAI's Language Learning Model (LLM) to summarize information from each review within our dataset, focusing on a sample of 100 reviews.

a. Prompt 1

This prompt is designed to extract information from customer reviews. It sets the context for the AI model to understand its goal, which is to summarize and extract insights from the provided text. The model is instructed to utilize the text provided in the variable {text_to_summarize} for analysis.

Python

```
def analyze_text(text, openai_api_key):
    client = openai.OpenAI(api_key=openai_api_key)
    chat_completion = client.chat.completions.create(
        messages=[
            {
                "role": "user",
```

```

    "content": f"""
        your goal is to extract information from customer
reviews. Please utilize the text provided in {text_to_summarize}.
"""

    },
],
model="gpt-3.5-turbo",
)
return chat_completion.choices[0].message.content

```

Python

```

# Output
"I'm unable to provide medical advice or specific information about Tymlos, as
I am not a medical professional. It's always best to consult with a healthcare
provider or pharmacist regarding concerns about how specific medications or
medical devices may be affected by procedures such as x-rays. It's good to hear
that your child's diabetes management devices are taken into consideration
during security procedures. If you have any further questions or concerns, it's
recommended to reach out to a healthcare professional for guidance."

```

b. Prompt 2

Similar to Prompt 1, this prompt instructs the AI model to extract information from customer reviews. However, it specifies that the generated text will serve as input for generating images of the products mentioned in the reviews later using DALL·E-2. The model is again directed to utilize the text provided in {text_to_summarize} for analysis.

Python

```

def analyze_text_2(text, openai_api_key):
    client = openai.OpenAI(api_key=openai_api_key)
    chat_completion = client.chat.completions.create(
        messages=[
            {
                "role": "user",
                "content": f"""
                    your goal is to extract information from customer
reviews.

```

The generated text will be serve as input for generating images of the products mentioned in the reviews later using DALL·E-2.

Please utilize the text provided in {text_to_summarize}.

```
        """
    }
],
model="gpt-3.5-turbo",
)
return chat_completion.choices[0].message.content
```

Python

```
# Output
"From the customer reviews provided, we can extract the following
information:\n\n1. The customer has a Dexcom G6 continuous glucose monitor
(CGM) and uses it along with the Tandem insulin pump system, which they find
superior.\n2. The customer also uses the Omnipod system and is looking to
upgrade to the new closed-loop Omnipod system.\n3. They enjoy a healthy lunch
that requires very little insulin, especially on hot days.\n4. The customer
mentions that staying in a hot tub can lower blood sugar levels and advises
monitoring closely if in a hot tub.\n5. They express a desire for a new
pancreas given their insulin-dependent diabetic status.\n6. The customer shares
their experiences with various diabetic treatments, from needles to pens to
pumps and CGMs, stating that closed-loop systems have significantly improved
convenience..."
```

i. Dalle

Python

Error

```
BadRequestError: Error code: 400 - {'error': {'code':
'content_policyViolation', 'message': 'Your request was rejected as a result
of our safety system. Your prompt may contain text that is not allowed by our
safety system.', 'param': None, 'type': 'invalid_request_error'}}
```

DALL·E-2 does not allow the use of the words 'Insulin' and 'dose' in its input for image generation.

c. Prompt 3

This prompt further refines the goal of extracting information from customer reviews for generating images using DALL·E-2. It instructs the

model to focus on the function of the product, such as whether it includes a monitor or system, while excluding irrelevant information for image generation. Additionally, it specifies a word limit of 250 words and prohibits the inclusion of certain terms like "insulin" and "dose".

Python

```
def analyze_text_2(text, openai_api_key):
    client = openai.OpenAI(api_key=openai_api_key)
    chat_completion = client.chat.completions.create(
        messages=[
            {
                "role": "user",
                "content": f"""
                    your goal is to extract information from customer reviews.
                    The generated text will be serve as input for generating images of the products mentioned in the reviews later using DALL·E-2.
                    Focus on the function of the product, such as if there is monitor, system, etc.
                    Exclude information that is not helpful for generating product image.
                    Utilize the text provided in {text_to_summarize}.
                    Only generate 250 words
                    Do not include words such as "insulin", "dose".
                    """
            }
        ],
        model="gpt-3.5-turbo",
    )
    return chat_completion.choices[0].message.content
```

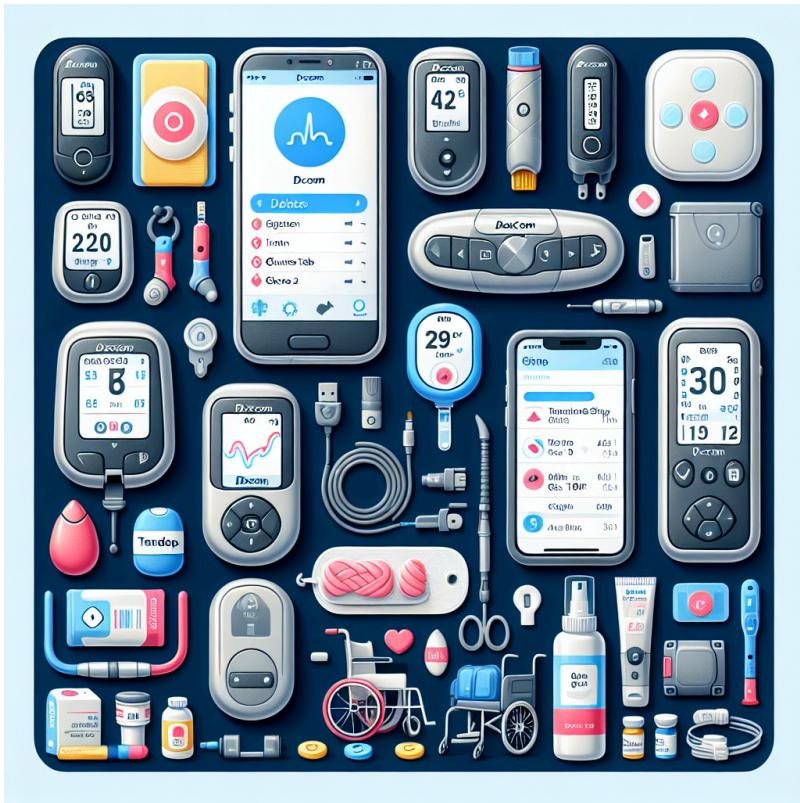
Python

Output

'The customer reviews mention the use of Dexcom, Tandem, and Omnipod system for managing type 1 diabetes. They also discuss the benefits of continuous glucose monitoring (CGM) and closed-loop control systems. The customers highlight how the Dexcom CGM has been a game-changer for them, offering immediate and painless results without the need for finger pricks. They share personal experiences with using the sensors on different body parts like arms, thighs, and even upper butt cheeks.\n\nAdditionally, the reviews touch upon the challenges of obtaining necessary supplies, dealing with insurance coverage, and navigating the healthcare system. Customers discuss their struggles with medication costs, changing insurance providers, and the importance of proper

diabetes management during pregnancies. They also mention specific issues related to using Dexcom with certain phone models and the benefits of integrating CGM data with smart devices.\n\nOverall, the reviews emphasize the significance of tec'

i. Dalle





Examine the image, the monitor closely resembles what it should look like. However, since the data is from customer reviews, there are also many situations depicted in the image. Upon closer inspection, it becomes evident that this is an image from a LLM image generate model.

d. Prompt 4

Similar to Prompt 3, this prompt aims to generate text for input into DALL-E-2 for image generation. It emphasizes focusing on product features while excluding irrelevant information, utilizing the provided text for analysis. Additionally, it specifies a word limit of 250 words and prohibits the inclusion of terms like "insulin" and "dose".

Python

```
def analyze_text_2(text, openai_api_key):
    client = openai.OpenAI(api_key=openai_api_key)
    chat_completion = client.chat.completions.create(
        messages=[
            {
                "role": "user",
                "content": f"""
                    your goal is to generate text that will be serve as
                    input for generating images using DALL-E-2
                    Focus on the product features
                    Exclude information that is not helpful for generating product image
                    Utilize the text provided in {text_to_summarize}
                    Only generate 250 words
                    Do not include words such as "insulin", "dose"
                    """
            },
            ],
        model="gpt-3.5-turbo",
    )
    return chat_completion.choices[0].message.content
```

Python

Output

'Dexcom CGM is a game changer for managing T1D. It offers accurate readings and helps to track blood sugar levels effectively. The system is comfortable to

wear, especially when placed on the upper chest or arms. Users have experienced significant improvements in their A1c levels by using Dexcom. The device is ideal for monitoring blood sugar fluctuations, which is crucial for avoiding extreme highs and lows. Despite some initial fears or discomfort, many users have found the Dexcom sensor to be unobtrusive and highly beneficial.\n\nFurthermore, having a closed loop system with a sensor integrated into the pump can simplify blood sugar management and reduce manual corrections. The convenience of continuous monitoring and automatic adjustments has been a relief for many users. Access to the Dexcom G6 app allows for easy management and insights into glucose levels. Additionally, pairing the Dexcom sensor with a compatible smartwatch has made tracking blood sugar data more convenient.\n\nIn co'

i. Dalle

```
Python
Error
BadRequestError: Error code: 400 - {'error': {'code':
'content_policyViolation', 'message': 'Your request was rejected as a result
of our safety system. Your prompt may contain text that is not allowed by our
safety system.', 'param': None, 'type': 'invalid_request_error'}}
```

DALL·E-2 does not allow the use of the words 'Insulin' and 'dose', 'blood' in its input for image generation.

e. Prompt 5

Similar to the previous prompts, this prompt instructs the AI model to generate text for input into DALL·E-2 for image generation. It emphasizes focusing on product features while excluding irrelevant information, such as medical terms like "insulin," "dose," and "blood." The provided text is utilized for analysis, and the model is directed to generate a concise output of 200 words that is suitable for generating product images.

```
Python
def analyze_text_2(text, openai_api_key):
```

```

client = openai.OpenAI(api_key=openai_api_key)
chat_completion = client.chat.completions.create(
    messages=[
        {
            "role": "user",
            "content": f"""
                your goal is to generate text that will be serve as
                input for generating images using DALL-E-2
                Focus on the product features
                Exclude information that is not helpful for generating product image
                Utilize the text provided in {text_to_summarize}
                Only generate 200 words
                Do not include words such as "insulin", "dose", and "blood"
                """
        }
    ],
    model="gpt-3.5-turbo",
)
return chat_completion.choices[0].message.content

```

Python

Output

"The Dexcom G6 is a game-changer for managing diabetes. It provides accurate readings and helps bring A1C levels down. The sensor is comfortable to wear on various body parts like the arms and thighs. It can be worn for an extended period without losing accuracy, up to 20 days or more. The Dexcom CGM system is superior and provides insights for better management. It's essential to have a good closed-loop system like the tslim + Dexcom for easier blood sugar management. The Dexcom app is user-friendly and can be connected to other apps like Sugarmate for additional insights. The sensor is less intrusive compared to insulin pumps and can be easily managed. It's recommended to secure a continuous glucose monitoring device as soon as possible to aid in diabetes management. The Dexcom G6 is a reliable option for monitoring glucose levels effectively."

i. Dalle





After focusing on the product features, you can see that the image includes only features related to the product, such as aiding in eating well and being waterproof so patients can wear it in a hot tub, etc. However, it still does not accurately depict the text, including language or numbers, present on the product.

Limitations

One significant limitation encountered during the analysis was the strict adherence to content policies, particularly regarding the generation of medical advice and the discussion of sensitive topics. Open AI model, it is programmed to adhere to strict guidelines to ensure the safety and well-being of users. However, this restriction can sometimes hinder the generation of comprehensive insights, especially when discussing medical topics such as diabetes management.

- Medical Advice:

Due to the nature of the content, the AI model is programmed to refrain from providing explicit medical advice. This limitation impacts the depth of analysis and the ability to generate actionable recommendations based on the data. While the model can summarize and extract information from customer reviews, it cannot provide personalized medical guidance or treatment recommendations. As a result, users may need to seek additional information from healthcare professionals for tailored advice.

- Content Policy Violation:

The AI model operates within a framework of content policies designed to ensure compliance with ethical and legal standards. Any prompts or inputs that violate these policies may result in rejection or modification of the output. In the context of our analysis, certain terms or phrases related to medical procedures, treatments, or sensitive topics may trigger content policy violations, limiting the scope of analysis and potentially omitting crucial insights from the generated outputs.

- General Topic: Another limitation arises from the generalization of topics to comply with content policies. While the AI model can provide insights and summaries based on the data provided, it may struggle to offer nuanced perspectives or address specific nuances within the dataset. This limitation can impact the accuracy and relevance of the generated outputs, potentially leading to oversimplification or misrepresentation of the underlying data. Therefore, it is essential to interpret the generated insights within the context of the broader dataset and consider any limitations associated with the AI model's capabilities.

Product 2: La Roche-Posay Toleriane Double Repair Face Moisturizer¹

Product Selection

The second product that we chose for this experiment is an example of a readily available, yet highly rated skin care product. La Roche-Posay attempts to sell and market its Toleriane Moisturizer in a market that is heavily saturated with products and sub-products of their own and competitors' brands. Therefore, achieving meaningful product differentiation requires attention to branding, advertising, and product efficacy.

Customer Review Data Collection

Scraped data for this product comes from the online retailing site LovelySkin² and consists of the text for the product description and product details (e.g., ingredients, applications, endorsements, etc.) along with 448 available product reviews. Reviews for this product are approximately 95% positive, 3% neutral, and 2% negative when using TextBlob sentiment analysis on each review instance's text data.

- **Product Description³:** La Roche-Posay Toleriane Double Repair Face Moisturizer
 - Highlights
 - Hydrates and maintains moisture barrier
 - Fortifies skin with ceramides
 - Calms skin with niacinamide
- **Product Details⁴:** Key Features:
 - Provides up to 48 hours of moisture for normal to dry skin
 - Strengthens the skin's moisture barrier
 - Soothes red, reactive skin with niacinamide
 - Niacinamide
 - A water-soluble form of vitamin B3 that reduces the appearance of wrinkles.

¹ Source code and outputs available on GitHub:

https://github.com/ap-dev42/94844_GenAI_Lab_Final_Project

² LovelySkin Product Review Site:

<https://www.lovelyskin.com/o/reviews/la-roche-posay-toleriane-double-repair-moisturizer>

³ Full Textual Description:

https://github.com/ap-dev42/94844_GenAI_Lab_Final_Project/blob/main/Final_Project_Files/La%20Roche-Posay%20Toleriane%20Double%20Repair%20Face%20Moisturizer_description.txt

⁴ Full Textual Description:

https://github.com/ap-dev42/94844_GenAI_Lab_Final_Project/blob/main/Final_Project_Files/La%20Roche-Posay%20Toleriane%20Double%20Repair%20Face%20Moisturizer_description.txt

Aqua/Water/Eau Glycerin Squalane Dimethicone Zea Mays Starch / Corn StarchNiacinamide Ammonium Polyacryloyldimethyl Taurate Myristyl Myristate Stearic Acid Ceramide NP Potassium Cetyl Phosphate Glyceryl Stearate SE Sodium Hydroxide Myristic Acid Palmitic Acid Capryloyl Glycine Caprylyl Glycol Xanthan Gum
Directions
Use as a daily facial moisturizer to hydrate and soothe skin. Apply to the face and neck morning and/or evening.

- **Review Examples:**

- 13-Apr-24
Mi crema favorita
It's the best cream I've had in years!
- 11-Apr-24
My Go To!
This is my go to daily morning moisturizer! It absorbs fully, moisturizes and helps with any irritation I get from retinols. I typically use the one with UV but decided to try this one with a separate tinted sunscreen. This is a great product at a great price point!
- 1-Mar-24
Excellent product
I've been using this moisturizer for years. It's excellent for sensitive skin. It works well in winter when my skin gets really dry and works equally well in summer when there's more moisture in the air. The Double Repair Face Moisturizer feels light and doesn't cause any irritation on my skin. I've been using La Roche-Posay products for years and this one is my favorite.
- 14-Mar-24
Dries out my face
Unfortunately, this moisturizer doesn't moisturize my face enough.
- 20-Feb-24
Great hydration, use daily
Works great, feels lightweight. Keeps the skin nice and plump looking but you have to use it daily for best results. If you stop using it for a long time for any reason (for example when I run out of it) skin goes back to starting point.

Analysis of Customer Reviews with a LLM (GPT-3.5-TURBO)

In utilizing GPT-3.5-TURBO for text base analysis, each prompt featured the following role assigned to the LLM: "You are a brand specialist for a company that makes skincare products with expertise in product differentiation techniques and marketing." This was done to prime the LLM each time with additional context regarding the task that would be presented.

Additionally, each prompt received the full text of the product description and the text of 10 reviews sorted by similarity with an embedding of a list of positive or negative keywords. The embedding model utilized was OpenAI's text-embedding-3-large model. This model was selected due to its perceived empirical superiority when filtering for

similarity in the context of keywords and reviews with positive or negative sentiment. Changes to the input prompt were then tailored to minimize the changes experienced during each iteration.

The prompts and their respective responses are below.

1. Prompt 1: Text Summarization with Product Description, Product Details, and the Top 10 Most Positive Reviews

- a. **Prompt:** "Provide a brief summary of the product given its description, details, and the provided reviews for context. \n Description: " + description + "\n" + context_pos
- b. **Response**⁵: The La Roche-Posay Toleriane Double Repair Face Moisturizer is a highly praised skincare product that effectively hydrates, strengthens the skin's moisture barrier, and calms irritated skin with its key ingredients like ceramides and niacinamide. It is suitable for normal to dry skin types and is particularly beneficial for those with sensitive skin as it is formulated without parabens, fragrance, or dyes. The moisturizer offers up to 48 hours of moisture and is lightweight, making it a popular choice among users. Reviews for the product are overwhelmingly positive, with users describing it as their "holy grail," "favorite," and "best moisturizer ever." They appreciate its rich but non-greasy formula, how it absorbs well into the skin, and its effectiveness in providing hydration without feeling heavy. Many users with various skin concerns such as dryness, acne-prone skin, and sensitivity have found success with this moisturizer, commenting on its gentle yet effective nature...

2. Prompt 2: Feature Extraction with Product Description, Product Details, and the Top 10 Most Positive Reviews

- a. **Prompt:** "List notable features of the product given its description, details, and the provided reviews for context. \n Description: " + description + "\n" + context_pos
- b. **Response:** Notable Features of La Roche-Posay Toleriane Double Repair Face Moisturizer:
 - 1. **Hydrating Formula**: Provides up to 48 hours of moisture, suitable for normal to dry skin types.
 - 2. **Skin Barrier Strengthening**: Fortifies skin with essential ceramides to maintain a healthy moisture barrier.
 - 3. **Soothing Niacinamide**: Contains niacinamide (vitamin B3) to calm and soothe red, reactive skin.
 - 4. **Oil-Free Formula**: Lightweight and non-greasy, making it suitable for all skin types.
 - 5. **Key Ingredient - Niacinamide**: Known for reducing the appearance of wrinkles and improving skin texture...

3. Prompt 3: Sentiment Analysis with Product Description, Product Details, and the Top 10 Most Positive Reviews

- a. **Prompt:** "Conduct sentiment analysis of the product reviews given its description, details, and the provided reviews for context. \n Description: " + description + "\n" + context_pos
- b. **Response:** Based on the sentiment analysis of the provided reviews for the La Roche-Posay Toleriane Double Repair Face Moisturizer, the overall sentiment appears to be predominantly positive. The reviewers

⁵ All responses shortened for brevity. Full responses available here:

https://github.com/ap-dev42/94844_GenAI_Lab_Final_Project/tree/main/Final_Project_Files/Responses

express satisfaction and praise for various aspects of the product, highlighting its effectiveness and suitability for different skin types.

1. "my new holy grail" Review: This review indicates high satisfaction and loyalty to the product, describing it as rich, moisturizing, and non-clogging. The reviewer emphasizes its perfect formulation and suitability for all women's skincare routines.
2. "love, love, love" Review: The reviewer expresses admiration for the moisturizer, describing it as wonderful and easy to layer with other products. This positive sentiment indicates a high level of satisfaction with the product's performance.
3. "holy grail!" Review: This review indicates strong loyalty to the product, with the reviewer appreciating its dermatologist-recommended status and effectiveness for dry, mature skin. The reviewer also praises its affordability compared to other expensive moisturizers...

4. Prompt 4: DALL-E 3 Prompt Generation with Product Description, Product Details, and the Top 10 Most Positive Reviews

- a. **Prompt:** "Using the provided product description, details, and reviews for context. Generate a prompt with specific product visuals to use as input to DALL-E 3 with the intention of creating an image of the product described. \n Description: " + description + "\n" + "Reviews: " + context_pos
- b. **Response:** Create an image of a sleek, modern skincare product with a minimalist design featuring a white tube or jar labeled "La Roche-Posay Toleriane Double Repair Face Moisturizer." The label should prominently display key features such as "Strengthens skin's moisture barrier," "Provides up to 48 hours of moisture," and "Calms skin with niacinamide." Include subtle graphics or representations of ceramides and the ingredient niacinamide to highlight their benefits. The overall aesthetic should convey a sense of luxury, effectiveness, and dermatologist-recommended quality in line with the brand's reputation.

5. Prompt 5: Feature Extraction with Product Description, Product Details, and the Top 10 Most Negative Reviews

- a. **Prompt:** "Generate a list of product details to highlight for this product in a ad campaign according to negative reviews of the product and its description. \n Description: " + description + "\n" + "Reviews: " + context_neg
- b. **Response:** Based on the negative reviews and feedback provided for the La Roche-Posay Toleriane Double Repair Face Moisturizer, here are some product details that can be highlighted in an ad campaign to address these concerns and differentiate the product:
 1. Lightweight Formula: The La Roche-Posay Toleriane Double Repair Face Moisturizer features a lightweight formula that absorbs easily into the skin without leaving a greasy residue.
 2. Non-Comedogenic: Formulated to be non-comedogenic, this moisturizer is suitable for sensitive skin types and will not clog pores, reducing the risk of breakouts.
 3. Fragrance-Free: Unlike other products that may have strong scents, this moisturizer is fragrance-free, making it ideal for those sensitive to scents or particular smells...

Image Generation with a Diffusion Model (DALL-E 3)

The response from each of the prompts above was then passed unaltered as the input prompt for DALL-E 3 with the intent of reproducing an image of the original product.

Original Product Image:



1. Response from Text Summarization with Product Description, Product Details, and the Top 10 Most Positive Reviews



2. Response from Feature Extraction with Product Description, Product Details, and the Top 10 Most Positive Reviews



3. Response from Sentiment Analysis with Product Description, Product Details, and the Top 10 Most Positive Reviews



4. Response from DALL-E 3 Prompt Generation with Product Description, Product Details, and the Top 10 Most Positive Reviews



5. Response from Feature Extraction with Product Description, Product Details, and the Top 10 Most *Negative* Reviews



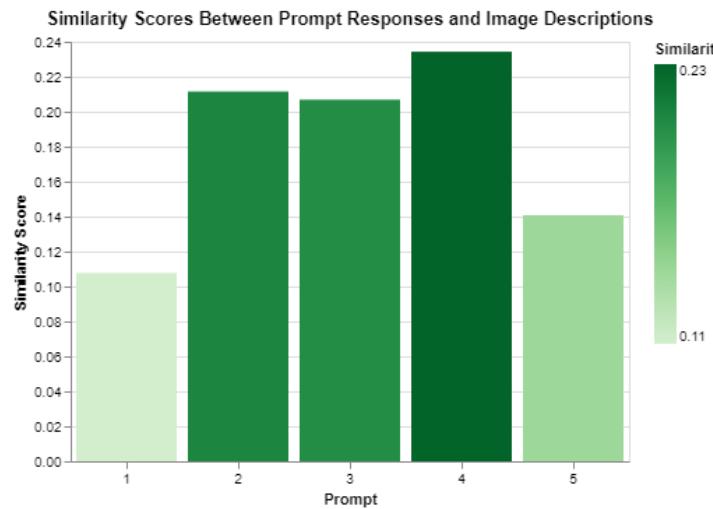
Limitations

Each of the prompts met with varying levels of success with regards to the goal of creating an image of the original product. Prompts 2-5 succeeded in generating an image of a similar product container and Prompts 2, 3, and 5 were successful in generating brand specific colors and fonts. However, the generated images indicate that

DALL-E 3 focuses on an aspect of each detail contained in the input prompt. This reveals that more verbose inputs lead to generated images with icons that float behind the product and highlight ingredients or customer reviews. With this level of attention, it then becomes difficult to craft an input prompt that focuses on key aspects of the product, a task that each prompt used above was designed to do before being used as an input. Despite this drawback, the images capture much more detail about the product than the original image displayed on the e-commerce website.

Additional Analysis

After using GPT-4-VISION-PREVIEW to generate descriptions of each of the generated images. Both these descriptions and the GPT-3.5-TURBO responses were processed and used to calculate cosine similarity scores between them to analyze how similar the input prompts were to outputs generated by an image description generator.



The analysis indicates that the responses generated using prompt styles 2, 3, and 4 yield images with generated descriptions most similar to the inputs responses. While this data appears to be sound upon examination of the text from both the GPT-3.5-TURBO generated responses and the GPT-4-VISION-PREVIEW generated image descriptions. It is worth noting that prompt style 4 (DALL-E Prompt Generation) yields the highest overall similarity score between input and output, indicating that there might be an underlying pattern recognized by both models regarding formulaic input prompts for image generation.

Product 3: Boxing Gloves

Product Selection

Boxing Gloves have been selected as the third product offering for our lineup, leveraging several strategic considerations underpinning their market potential. Firstly, boxing as a sport has witnessed a steady climb in its global standing, now ranked as the 11th most popular sport worldwide. This widespread appeal is evidenced by the impressive 59.6% of individuals globally who express an interest in boxing. Moreover, the sport's engagement within the United States is notably robust, with 3.47 million Americans incorporating boxing into their fitness regimen in 2020.

The surging interest in boxing not only points to a broad consumer base but also suggests a thriving market for boxing-related equipment, with boxing gloves being a fundamental component. Furthermore, the wealth of review data available – approximately 9,000+ reviews for the most popular boxing gloves – indicates a highly active online consumer presence. This abundance of feedback and data reflects a well-informed customer base whose purchasing decisions are significantly influenced by product reviews and peer recommendations.

Lastly, the critical importance of visualization in consumer behavior must be recognized. A product's initial visual presentation can significantly sway consumer decision-making, especially among novices in the sport who may rely heavily on first impressions. In summary, the selection of Boxing Gloves as a featured product is rooted in the sport's rising popularity, the considerable existing market interest, the influential power of consumer reviews, and the essential role of product presentation in consumer choice.

Customer Review Data Collection

Scraped data for this product comes from Amazon and consists of the text for the product description and product details (e.g., materials, patents, durability, user experience, etc.) along with 9960 available product reviews.

Product Description:

- EFFECTIVE IMPACT DISPERSION – Are your training gloves affecting your accuracy? The RDX gloves dissipate the force of impact across the specially made, pre-curved anatomical structure of the sparring gloves due to the presence of Quadro Dome 3 padding, which uses EVA foam and SpongeX sheet. This results in a comfortable training experience for the users of the RDX heavy boxing gloves.
- PATENT PENDING LOMA TECH DESIGN – Do you face trouble forming the perfect fist, while using boxing gloves ? RDX gloves feature a PATENT PENDING single seamless LOMA Tech design used in the palm area and thumb of the boxing gloves. This helps create an improved alignment between the fist and thumb and along with an especially designed attached thumb allows the trainees to form the perfect fist and punch better with the training gloves.
- EXCEPTIONALLY DURABLE MATERIAL – No matter how hard you punch these gloves make sure to outlast your intense training. The use of advanced caliber Maya Hide ConvEX Skin Leather in the KARA Series training gloves makes them durable and reliable for long-term use while also providing a superior look and feel during Boxing, Muay Thai, MMA, Kickboxing, and heavy bag training sessions among other similar sports.
- FULL WRAPAROUND WRIST SUPPORT – A hassle-free design with sufficient support for your wrists. The hook and loop Fastener straps provide a secure fit and make it easy to put on or take off the kickboxing gloves for men and women along with providing better wrist support due to the full wraparound wrist strap, while the dual stitching in the heavy bag gloves makes them durable and resilient for extensive training sessions.
- SWEAT-FREE EXPERIENCE – Bid farewell to those sweaty palms and hands. With multiple ventilation holes strategically placed in the thumb sections of the lightweight boxing gloves, RDX ensures proper airflow management so that its customers get a sweat-free experience. Furthermore, the advanced perforated sheet for breathable ventilation in the palm area is sweat-wicking and minimizes sweat accumulation.
- POWER ALIGNED PUNCHES – The heavy punching bag gloves for women and men use DenZo-Tron Grip Bar in the upper palm area to allow the users to attain the optimal posture for powerful punches during training and competitions.

Demo Product Reviews:

- These are fantastic gloves for the price. They fit well, give great wrist support, and have enough padding without being too bulky. The quality feels great, and they look slick as well. Highly recommended.
- I bought this for my Bf. He is a big guy so I was scared the gloves wouldn't fit but they did as I choose the biggest size. They are extremely comfortable and nice! They look like professional gloves.

- I really like how comfortable these are. As an 127 lb chick starting her first MMA class soon, these are oz requirement and seem really sturdy. The matte black looks pretty badass too. They do look HUGE on me though lol
- Decent gloves, very stiff compared to fairtex gloves but still for the price they're great. 1st pair lasted me 6 months, 5 months longer than my everlast (aka neverlast) gloves. Great gloves for beginners who don't know yet if they're serious about boxing, kickboxing or mma as they are very affordable.
- I am using these and RDX shinguards for Muay Thai. I am extremely impressed with the quality, appearance, and functionality of these gloves. I planned on these just being an entry level purchase needing to be upgraded but I will be using RDX gear for the foreseeable future.

Analysis of Customer Reviews with a LLM (GPT-3.5-TURBO)

- A. For the initial analysis phase, we employed OpenAI's Language Learning Model (LLM) to summarize information from each review within our dataset, focusing on a sample of 100 reviews.
 - a. Prompt 1 is designed to generate a brief summary of the product's reviews based on reviews collected.

Python

```
def summarize_reviews(reviews, openai_api_key):

    client = openai.OpenAI(api_key=openai_api_key)
    summary_completion = client.chat.completions.create(
        messages=[
            {
                "role": "user",
                "content": f"""
                    Provide a brief summary of the product's reviews
                    based on the collected data. Here is the review text: {reviews}
                    """
            }
        ],
        model="gpt-3.5-turbo",
    )
    return summary_completion.choices[0].message.content
```

```
Python
#Output
"The gloves have received positive reviews for their great fit, wrist support, and comfortable padding. Reviewers are impressed with the quality of the gloves, highlighting their durability and sturdiness. Some users recommended these gloves for beginners who are unsure about commitment to boxing, kickboxing or MMA. Few reviewers also appreciated the sleek and professional look of the gloves. The ventilation and sweat-resistant features were noted as well."
```

- b. Prompt 2 is designed to generate a brief summary of the product's description based on the description collected.

```
Python
def summarize_description(description, openai_api_key):
    """
    Summarizes the content of a product's description.

    Args:
        description: A string containing the product description to analyze.
        openai_api_key: The API key for OpenAI's services.

    Returns:
        A string containing the summary of the product description.
    """
    client = openai.OpenAI(api_key=openai_api_key)
    description_completion = client.chat.completions.create(
        messages=[
            {
                "role": "user",
                "content": f"""
                    Provide a brief summary of the product's
                    description based on the information collected. Here is the description text:
                    {description}
                """
            }
        ],
    )
```

```

        model="gpt-3.5-turbo",
)
return description_completion.choices[0].message.content

#output
"The RDX training gloves are designed for optimal impact dispersion using
Quadro Dome 3 padding and LOMA Tech design, supporting better alignment between
thumb and fist. Built to last, they are made of durable Maya Hide ConvEX Skin
Leather, and are enhanced for comfort with a sweat-free design featuring
ventilation holes. The gloves also offer full wraparound wrist support,
courtesy of easy-to-use fastener straps, and DenZo-Tron Grip Bar in the upper
palm area for power aligned punches."

```

- c. Prompt 3 is designed to extract notable features of the product given its description and reviews.

```

Python
def extract_features(description, reviews, openai_api_key):
    """
    Extracts notable features of a product given its description and reviews.

    Args:
        description: A string containing the product description.
        reviews: A string containing the product reviews.
        openai_api_key: The API key for OpenAI's services.

    Returns:
        A string listing the notable features extracted from the description
        and reviews.
    """
    client = openai.OpenAI(api_key=openai_api_key)
    features_completion = client.chat.completions.create(
        messages=[
            {
                "role": "user",
                "content": f"""
                    Extract notable features of the product given its
                    description and reviews.
                    Here is the description: {description}
                """
            }
        ]
    )
    return features_completion.choices[0].message.content

```

```

        Here are the reviews: {reviews}
        """
    }
],
model="gpt-3.5-turbo",
)
return features_completion.choices[0].message.content

#output
"Notable features of the based on the provided description, details, and reviews:
1. Effective Impact Dispersion: The gloves have Quadro Dome 3 padding that helps dissipate the force of impact across the glove structure, contributing to a comfortable training experience.

2. Patent Pending LOMA Tech Design: This design in the palm area and thumb provides improved alignment between the fist and thumb, helping the users form a perfect fist and enhance their punching power.

3. Exceptionally Durable Material: Made from advanced caliber Maya Hide ConvEX Skin Leather, the gloves are highly durable and reliable for long-term use.

4. Full Wraparound Wrist Support: The gloves feature a close-fitting design with a full wraparound wrist strap, providing better wrist support. The dual stitching adds resilience for extensive training sessions."

```

- d. Prompt 4 is designed to list notable features (focusing on visual or sentimental)of the product given its description and reviews.

Python

```

def list_visual_sentimental_features(description, reviews, openai_api_key):
"""
Lists the visual and sentimental features of a product based on its
description and reviews.

```

Args:

- description: A string containing the product description.
- reviews: A string containing the product reviews.
- openai_api_key: The API key for OpenAI's services.

```

>Returns:
    A string listing the visual and sentimental features extracted from the
description and reviews.

"""
client = openai.OpenAI(api_key=openai_api_key)
features_completion = client.chat.completions.create(
    messages=[
        {
            "role": "user",
            "content": f"""
                List notable features, focusing on visual or
sentimental aspects, of the product given its description and reviews.
                Here is the description: {description}
                Here are the reviews: {reviews}
"""
        }
    ],
    model="gpt-3.5-turbo",
)
return features_completion.choices[0].message.content

#output
    "1. Exceptionally Durable Material: Crafted from advanced caliber
Maya Hide ConvEX Skin Leather, these gloves are revered for their
ultra-durable and high-quality construction, providing a superior look
and feel.

    2. Professional Design: With a sleek, matte black finish, the gloves
exude a professional and sharp appearance, adding an element of
style to practicality.

    3. Emotional attachment: Based on reviews, these gloves inspire
confidence in the users, enabling beginners to take up boxing,
kickboxing, or MMA. Their quality and durability foster long-term
reliance and promote a committed approach to training.

    4. Sentiment of Success: Given the high-quality features of the
product, users feel satisfied with their purchase, often indicating
that the gloves surpass their expectations. This imparts a sense of
achievement and success."

```

- e. Prompt 5 is designed to extract visual or sentimental features of the product given its description and reviews

Python

```
def extract_features_for_dalle(description, reviews, openai_api_key):
    """
        As a senior prompt engineer with 10 years of experience, extract visual or
        sentimental
        features of a product from its description and reviews. The extracted
        features will be used
        as input for OpenAI's DALLE 3 to generate images that represent the
        product.

    Args:
        description: A string containing the product description.
        reviews: A string containing the product reviews.
        openai_api_key: The API key for OpenAI's services.

    Returns:
        A dictionary containing visual and sentimental features to be used with
        DALLE 3.
    """

    client = openai.OpenAI(api_key=openai_api_key)
    features_completion = client.chat.completions.create(
        messages=[
            {
                "role": "system",
                "content": "You are a senior prompt engineer with 10 years of
experience."
            },
            {
                "role": "user",
                "content": f"""
                    Extract visual and sentimental features of the
product given its description and reviews.
                    These features will be utilized as input for
                    OpenAI's DALLE 3 to generate images that visually represent the product's
                    characteristics and the emotions it evokes.
                    Description: {description}
                    Reviews: {reviews}
                """
            }
        ],
    )
```

```
        model="gpt-3.5-turbo",
    )
features = features_completion.choices[0].message.content
# Parsing and formatting the output for DALLE 3 could be implemented here.
# For the purpose of this example, the raw output is returned.
return {"features": features}

#output
"1. Visual Look: Advanced caliber Maya Hide ConvEX Skin Leather provides the
gloves an irresistible sleek look that recalls durability and resilience. Often
noted for their matte black finish, the gloves visually convey professionalism
and sophistication.

2. Powerful Punch Formation: The presence of a patent-pending LOMA Tech and
DenZo-Tron Grip Bar in the upper palm area aligns with the sentiment and
visualization of power. Users visually perceive and emotionally experience
the formation of a perfect and effective punch.

...
5. Emotional Empowerment: The gloves inspire a sense of confidence and
commitment in users, helping them view themselves as serious athletes. This
can be visually represented by the professional-quality look of the gloves
and sentimentally associated with feelings of achievement and aspiration.

"
```

Image Generation with a Diffusion Model (DALL-E 3)

Previous outputs have all been used to generate pictures:



Generated using prompt 2



Generated using prompt 3

Prompt 6 here is designed to generate a prompt based on given texts to be used as input for OpenAI's DALLE 3 to generate images of boxing gloves with certain role setting

Python

```
def extract_features_for_dalle(description, reviews, openai_api_key):
    """
        As a senior prompt engineer with 10 years of experience, extract visual or
        sentimental
        features of a product from its description and reviews. The extracted
        features will be used
        as input for OpenAI's DALLE 3 to generate images that represent the
        product.

    Args:
        description: A string containing the product description.
        reviews: A string containing the product reviews.
        openai_api_key: The API key for OpenAI's services.

    Returns:
        A dictionary containing visual and sentimental features to be used with
        DALLE 3.
    """

    client = openai.OpenAI(api_key=openai_api_key)
    features_completion = client.chat.completions.create(
        messages=[
            {
                "role": "system",
                "content": "You are a senior prompt engineer with 10 years of
experience."
            },
            {
                "role": "user",
                "content": f"""
                    Extract visual and sentimental features of the
product given its description and reviews.
                    These features will be utilized as input for
                    OpenAI's DALLE 3 to generate images that visually represent the product's
                    characteristics and the emotions it evokes.
                    Description: {description}
                    Reviews: {reviews}
                """
            }
        ]
    )
    return features_completion.choices[0].text
```

```
        }
    ],
    model="gpt-3.5-turbo",
)
features = features_completion.choices[0].message.content
# Parsing and formatting the output for DALLE 3 could be implemented here.
# For the purpose of this example, the raw output is returned.
return {"features": features}

#output
"Create an image of a pair of advanced boxing gloves designed for high
performance and comfort. The gloves should feature Quadro Dome 3 padding to
efficiently disperse impact and increase comfort during training. They should
be made from durable Maya Hide ConvEX Skin Leather, with a patent pending LOMA
Tech Design improving fist and thumb alignment to enhance punching power.
Include details like a full wraparound wrist strap with dual stitching for
extra support, multiple ventilation holes in the thumb and a perforated palm to
reduce sweat accumulation. A DenZo-Tron Grip Bar should be visible in the upper
palm area to aid in maintaining optimal posture for powerful punches. The
overall design should convey a sense of quality, durability, and professional
use, suitable for intensive training sessions."
```



Generated using prompt 6(a mixture of 4 and 5)

Prompt 7 is basically the same as 6, but the raw data utilized is summarized reviews instead of a mixture of reviews and product descriptions.



Generated using prompt 7

Limitations



As is shown in the comparing picture above, it is actually hard to find the right balance. More details instead of a summary combining both descriptions and reviews actually provide a sense of unrealistic or sci-fi, which may not be beneficial to the seller to directly use.

Conclusion:

This part 3 of our project has provided a comprehensive insight regarding the usefulness of iterations when generating prompts. A much more precise insight or conclusion can be drawn in the middle of the process, providing a suitable direction for shifting. For example, adding a certain role setting for the prompt, or getting more concise yet direct data highly related to the current target.

However, it's worth noting that a balance should be drawn between summary and details, especially when it comes to real business use. The business value of such an AI-generated picture does not necessarily increase with the amount of data and details that are fed into. Hence, iterate and making in time pivot when giving prompt should receive enough attention when using this tool for a actual business case.