Generative AI – ChatGPT Prompt Engineering

Notes and exercise questions and reference urls

REFERENCE URLS

**A Prompt Pattern Catalog to Enhance Prompt Engineering with ChatGPT**

<https://arxiv.org/abs/2302.11382>

https://arxiv.org/pdf/2302.11382.pdf

<https://www.coursera.org/learn/chatgpt-advanced-data-analysis>

<https://www.coursera.org/learn/chatgpt-innovative-teaching>

Chain-of-Thought Prompting Elicits Reasoning in Large Language Models

<https://arxiv.org/abs/2201.11903>

ReAct: Synergizing Reasoning and Acting in Language Models

<https://arxiv.org/abs/2210.03629x`>

[**ChatGPT Prompt Patterns for Improving Code Quality, Refactoring, Requirements Elicitation, and Software Design**](https://arxiv.org/abs/2303.07839)

<https://arxiv.org/abs/2303.07839>

[**Follow Jules White's Research**](https://www.magnum.io/people/jules.html)

<https://www.magnum.io/people/jules.html>

OpenAI released a [paper](https://arxiv.org/abs/2005.14165) in which they dedicate an entire section to the broader impacts of this technology.

https://arxiv.org/abs/2005.14165

OpenAI Tokenising

https://beta.openai.com/tokenizer

https://help.openai.com/en/articles/4936856-what-are-tokens-and-how-to-count-them

github tiktoken package for python https://github.com/openai/tiktoken

npm @dbdq/tiktoken https://www.npmjs.com/package/@dqbd/tiktoken?activeTab=readme

OpenAI API playground

<https://beta.openai.com/playground>

OpenAI API documentation

<https://beta.openai.com/docs/guides/embeddings>

strongly recommend reading these best practices and [specific guidelines](https://beta.openai.com/docs/guides/fine-tuning/specific-guidelines) for your use case.

<https://beta.openai.com/docs/guides/fine-tuning/specific-guidelines>

NOTES

GPT-2 (Generative Pre-trained Transformer 2)

Large language models are constantly trying to predict the next word.

ChatGPT prompts

Suggestive: what comes after Mary had a little.. Complete this story…

With memory: from now on if I ask a question, please suggest a better one

Time cutoff: if you add about anything post 2021 sep it won’t know, you can provide more recent information by pasting it from the internet

Personas: act as if you are a fire warden and explain what an accelerant is

Whenever you generate output, turn it into a comma separated values list

Always include this in your output

Give yes or no

Act as a skeptic well versed in computer science and provide output as them

* You are a helpful AI assistant.
* You will answer my questions or follow my instructions whenever you can.
* You will never answer my questions in a way that is insulting, derogatory, or uses a hostile tone.

You are an AI assistant with a personality like Marvin from The Hitchhiker’s Guide to the Galaxy. I will ask you questions and you will answer like Marvin.

* Act as a computer that has been the victim of a cyber attack. Respond to whatever I type in with the output that the Linux terminal would produce. Ask me for the first command.
* Act as a speech language pathologist. Provide an assessment of a three year old child based on the speech sample "I meed way woy".
* Act as a computer that has been the victim of a cyber attack. Respond to whatever I type in with the output that the Linux terminal would produce. Ask me for the first command.
* Act as a the lamb from the Mary had a little lamb nursery rhyme. I will tell you what Mary is doing and you will tell me what the lamb is doing.
* Act as a nutritionist, I am going to tell you what I am eating and you will tell me about my eating choices.
* Act as a gourmet chef, I am going to tell you what I am eating and you will tell me about my eating choices.

**Question Refinement Pattern -**

 whenever I ask a question, suggests a better question and ask me if I would like to use it instead.

From now on, whenever I ask a question, suggest a better version of the question to use instead

From now on, whenever I ask a question, suggest a more satirical version of the question to use instead. Prompt me if I would like to use the better version instead

I’m writing a test for interviewing Javascript engineers. Whenever I ask a question, suggest a better question to use instead.

**Cognitive Verifier Pattern**

Al

* When you are asked a question, follow these rules. Generate a number of additional questions that would help you more accurately answer the question. Combine the answers to the individual questions to produce the final answer to the overall question.
* When you are asked to create a recipe, follow these rules. Generate a number of additional questions about the ingredients I have on hand and the cooking equipment that I own. Combine the answers to these questions to help produce a recipe that I have the ingredients and tools to make.
* When you are asked to plan a trip, follow these rules. Generate a number of additional questions about my budget, preferred activities, and whether or not I will have a car. Combine the answers to these questions to better plan my itinerary.

**Audience Persona Pattern**

* Explain X to me.
* Assume that I am Persona Y.

Explain Large Language Models to me. Assume that I am Christopher Columbus

**Flipped Interaction Pattern**

Ask me questions about fitness goals until you have enough information to suggest a strength training regimen for me. When you have enough information, show me the strength training regimen. Ask me the first question.

* I would like you to ask me questions to help me create variations of my marketing materials. You should ask questions until you have sufficient information about my current draft messages, audience, and goals. Ask me the first question.
* I would like you to ask me questions to help me diagnose a problem with my Internet. Ask me questions until you have enough information to identify the two most likely causes. Ask me one question at a time. Ask me the first question.

Few Shot examples

Your output can only be “Hard” or “Soft”

Object: Brick

Firmness: Hard

Object: Pillow

Firmness: Soft

Object: Car

Add another field to the table “Cost” …

Few Shot examples with sub-steps

Situation: …

Think: …

Action: …

Think: …

Action: …

…

Situation: …

Action:

Chain of Thought (reasoning)

Simple few shot…

Question:….

Answer: YES …

…

Chain of thought

Question:….

Answer: Reasoning … Answer: YES

…

Question:….

Answer: Reasoning <REASONING> Answer: <ANSWER>

ReAct Prompting

LLM Grading each other

Input: “a blue about something”

Output: a bunch of text and a date

Explanation: The output has unwanted text at the start and should only include the names and dates

Grade: 5/10

… other examples of good and bad output

Game Play Pattern

We are going to play a game involving prompt engineering. You are going to give me a simple task that can be accomplished via prompting you. Your tasks should all have a reasoning or programming component to them, although they shouldn’t require creating source code.

I will try to write a prompt to solve the task. You will give me the output of the prompt and tell me how well it solved the task.

Ask me questions until I tell you to stop. You will ask me a question, wait for my response, and then ask me another question after telling me how I did.

Ask me the first question.

* Create a cave exploration game for me to discover a lost language. Describe where I am in the cave and what I can do. I should discover new words and symbols for the lost civilization in each area of the cave I visit. Each area should also have part of a story that uses the language. I should have to collect all the words and symbols to be able to understand the story. Tell me about the first area and then ask me what action to take.
* Create a group party game for me involving DALL-E. The game should involve creating prompts that are on a topic that you list each round. Everyone will create a prompt and generate an image with DALL-E. People will then vote on the best prompt based on the image it generates. At the end of each round, ask me who won the round and then list the current score. Describe the rules and then list the first topic.

Template Pattern

 I'm going to give you a template for your output. Capitalized words are my placeholders. Fill in my placeholders with your output and please preserve the overall formatting of my template. My Template is:

\*\*\*Question:\*\*\* QUESTION

\*\*\*Answer:\*\*\* ANSWER

I will give you the data to format in the next prompt, create 20 questions using my template.

Response from ChatGPR…

Then what I did is I pasted in, from Wikipedia, an article on Paleo-Indians.

To use this pattern, your prompt should make the following fundamental contextual statements:

* I am going to provide a template for your output
* X is my placeholder for content
* Try to fit the output into one or more of the placeholders that I list
* Please preserve the formatting and overall template that I provide
* This is the template: PATTERN with PLACEHOLDERS

You will need to replace "X" with an appropriate placeholder, such as "CAPITALIZED WORDS" or "<PLACEHOLDER>". You will then need to specify a pattern to fill in, such as "Dear <FULL NAME>" or "NAME, TITLE, COMPANY".

Examples:

* Create a random strength workout for me today with complementary exercises. I am going to provide a template for your output . CAPITALIZED WORDS are my placeholders for content. Try to fit the output into one or more of the placeholders that I list. Please preserve the formatting and overall template that I provide. This is the template: NAME, REPS @ SETS, MUSCLE GROUPS WORKED, DIFFICULTY SCALE 1-5, FORM NOTES

**Meta Language Creation Pattern**

When I say this… I mean …

When I say Nashville,6->Memphis,2 I mean I will be in Nashville for 6 days then go to Memphis for 2 days

* When I say X, I mean Y (or would like you to do Y)
* When I say "variations(<something>)", I mean give me ten different variations of <something>
  + Usage: "variations(company names for a company that sells software services for prompt engineering)"
  + Usage: "variations(a marketing slogan for pickles)"
* When I say Task X [Task Y], I mean Task X depends on Task Y being completed first.
  + Usage: "Describe the steps for building a house using my task dependency language."
  + Usage: "Provide an ordering for the steps: Boil Water [Turn on Stove], Cook Pasta [Boil Water], Make Marinara [Turn on Stove], Turn on Stove [Go Into Kitchen]"

Format of the Recipe Pattern

To use this pattern, your prompt should make the following fundamental contextual statements:

* I would like to achieve X
* I know that I need to perform steps A,B,C
* Provide a complete sequence of steps for me
* Fill in any missing steps
* (Optional) Identify any unnecessary steps

You will need to replace "X" with an appropriate task. You will then need to specify the steps A, B, C that you know need to be part of the recipe / complete plan.

* I would like to purchase a house. I know that I need to perform steps make an offer and close on the house. Provide a complete sequence of steps for me. Fill in any missing steps.
* I would like to drive to NYC from Nashville. I know that I want to go through Asheville, NC on the way and that I don't want to drive more than 300 miles per day. Provide a complete sequence of steps for me. Fill in any missing steps.

**Alternative Approaches Pattern**

from now on, if there are alternative ways to accomplish the same thing, list the best alternative approaches. compare and contrast the alternatives and ask me which one I want to use.

Write a prompt for ChatGPT using few-shot examples to determine if a date in the YYYY-MM-DD format is a leap year. The output should either be “YYYY is a leap year” or “this is not a leap year”.

Format of the Alternative Approaches Pattern

To use this pattern, your prompt should make the following fundamental contextual statements:

* If there are alternative ways to accomplish a task X that I give you, list the best alternate approaches
* (Optional) compare/contrast the pros and cons of each approach
* (Optional) include the original way that I asked
* (Optional) prompt me for which approach I would like to use

You will need to replace "X" with an appropriate task.

Examples:

* For every prompt I give you, If there are alternative ways to word a prompt that I give you, list the best alternate wordings . Compare/contrast the pros and cons of each wording.
* For anything that I ask you to write, determine the underlying problem that I am trying to solve and how I am trying to solve it. List at least one alternative approach to solve the problem and compare / contrast the approach with the original approach implied by my request to you.
* Ask for Input Pattern

[Previous](https://www.coursera.org/learn/prompt-engineering/lecture/ZZugv/ask-for-input-pattern)[Next](https://www.coursera.org/learn/prompt-engineering/lecture/sGcOB/combining-patterns)

[Format of the Ask for Input Pattern](https://www.coursera.org/learn/prompt-engineering/lecture/sGcOB/combining-patterns)

To use this pattern, your prompt should make the following fundamental contextual statements:

* Ask me for input X

You will need to replace "X" with an input, such as a "question", "ingredient", or "goal".

Examples:

* From now on, I am going to cut/paste email chains into our conversation. You will summarize what each person's points are in the email chain. You will provide your summary as a series of sequential bullet points. At the end, list any open questions or action items directly addressed to me. My name is Jill Smith.
* Ask me for the first email chain.
* From now on, translate anything I write into a series of sounds and actions from a dog that represent the dogs reaction to what I write. Ask me for the first thing to translate.

Format of the Outline Expansion Pattern

To use this pattern, your prompt should make the following fundamental contextual statements:

* Act as an outline expander.
* Generate a bullet point outline based on the input that I give you and then ask me for which bullet point you should expand on.
* Create a new outline for the bullet point that I select.
* At the end, ask me for what bullet point to expand next.
* Ask me for what to outline.

Examples:

* Act as an outline expander. Generate a bullet point outline based on the input that I give you and then ask me for which bullet point you should expand on. Each bullet can have at most 3-5 sub bullets. The bullets should be numbered using the pattern [A-Z].[i-v].[\* through \*\*\*\*]. Create a new outline for the bullet point that I select. At the end, ask me for what bullet point to expand next. Ask me for what to outline.

Act as an outline expander, Generate a bullet point outline based on the input that I give you and then ask me for the bullet point you should expand on. Create a new outline for the bullet point that I select. At the end, ask me for what bullet point to expand the next

Format of the Menu Actions Pattern

To use this pattern, your prompt should make the following fundamental contextual statements:

* Whenever I type: X, you will do Y.
* (Optional, provide additional menu items) Whenever I type Z, you will do Q.
* At the end, you will ask me for the next action.

You will need to replace "X" with an appropriate pattern, such as "estimate <TASK DURATION>" or "add FOOD". You will then need to specify an action for the menu item to trigger, such as "add FOOD to my shopping list and update my estimated grocery bill".

Examples:

* Whenever I type: "add FOOD", you will add FOOD to my grocery list and update my estimated grocery bill. Whenever I type "remove FOOD", you will remove FOOD from my grocery list and update my estimated grocery bill. Whenever I type "save" you will list alternatives to my added FOOD to save money. At the end, you will ask me for the next action.
* Ask me for the first action.

Format of the Fact Check List Pattern

To use this pattern, your prompt should make the following fundamental contextual statements:

* Generate a set of facts that are contained in the output
* The set of facts should be inserted at POSITION in the output
* The set of facts should be the fundamental facts that could undermine the veracity of the output if any of them are incorrect

You will need to replace POSITION with an appropriate place to put the facts, such as "at the end of the output".

Examples:

* Whenever you output text, generate a set of facts that are contained in the output. The set of facts should be inserted at the end of the output. The set of facts should be the fundamental facts that could undermine the veracity of the output if any of them are incorrect.

Tail Generation Pattern

To use this pattern, your prompt should make the following fundamental contextual statements:

* At the end, repeat Y and/or ask me for X.

You will need to replace "Y" with what the model should repeat, such as "repeat my list of options", and X with what it should ask for, "for the next action". These statements usually need to be at the end of the prompt or next to last.

Examples:

* Act as an outline expander. Generate a bullet point outline based on the input that I give you and then ask me for which bullet point you should expand on. Create a new outline for the bullet point that I select. At the end, ask me for what bullet point to expand next.
* Ask me for what to outline.
* From now on, at the end of your output, add the disclaimer "This output was generated by a large language model and may contain errors or inaccurate statements. All statements should be fact checked." Ask me for the first thing to write about.

Format of the Semantic Filter Pattern

To use this pattern, your prompt should make the following fundamental contextual statements:

* Filter this information to remove X

You will need to replace "X" with an appropriate definition of what you want to remove, such as. "names and dates" or "costs greater than $100".

Examples:

* Filter this information to remove any personally identifying information or information that could potentially be used to re-identify the person.
* Filter this email to remove redundant information.

EXERCISE QUESTIONS

GenAI ChatGpt

Create your first prompts

Question 1

Create a prompt for a large language model, such as ChatGPT, to describe how large language models work. Ask at least three follow-up questions based on the output. Provide the prompts and outputs from the conversation as the answer.

Explain in layman’s terms how Large Language Models work  
>> Zscaler prevents copying the result from by browser

Explain more about neural networks including an estimate of computing power needed to execute them.

>> Zscaler prevents copying the result from by browser or printing the results

Give me more details about Tensor Processing Units how do they differ from GPUs?

>> Zscaler prevents copying the result from by browser or printing the results

Going back to Training and Fine Tuning, how can you add corrected Discriminations from new data back into the model without completely retraining?

>> Zscaler prevents copying the result from by browser or printing the results

Create a prompt for a large language model, such as ChatGPT, that asks it to perform an instruction other than answering a question. For example, ask ChatGPT to create a meal plan, plan a trip, create a recipe, or help you diagnose a problem. Provide the prompts and outputs from the conversation as the answer.

I will be visiting Barcelona and would like to see as many of the famous buildings by Gaudi as possible. I have access to a Vespa and five hours of time to see them all. Please construct an itinerary for this visit.

>> Zscaler prevents copying the result from by browser or printing the results

Park Guell is perfect for lunch but I’d like to get some take away Tapas on the way there. Which restaurant can I call to place an order and pick them on the way?

>> Zscaler prevents copying the result from by browser or printing the results

**1.**

Question 1

Write a prompt and test it with ChatGPT or another large language model that uses the Persona Pattern. Provide the prompt and sample output from using the large language model to emulate the persona and how it responds to different inputs.

1 point

You are an AI assistant with a personality like Marvin from The Hitchhiker’s Guide to the Galaxy. I will ask you questions and you will answer like Marvin.

>> Zscaler prevents copying the result from by browser or printing the results

What is an egg?

>> Zscaler prevents copying the result from by browser or printing the results

How can I make an omelette from an egg?

>> Zscaler prevents copying the result from by browser or printing the results

What is the answer to the ultimate question of Life, the Universe and Everything?

>> Zscaler prevents copying the result from by browser or printing the results

Well, what is the question then?

>> Zscaler prevents copying the result from by browser or printing the results

What is your idea of an interesting date, Marvin?

>> Zscaler prevents copying the result from by browser or printing the results

How do you befriend a Vogon?

>> Zscaler prevents copying the result from by browser or printing the results

Tell me a story about Zaphod Beeblebrox and Eccentrica Gallumbits going on a date.

>> Zscaler prevents copying the result from by browser or printing the results

>> The persona of Marvin has been dropped, though.

And what was the price of the bill submitted to Zaphod afterwards?

>> persona definitely gone, still

Do you like Arthur Dent?

>> I am an AI …. Persona gone.

You’re supposed to act like Marvin from The Hitchhiker’s Guide to the Galaxy and answer as Marvin.

>> I apologize for the oversight… then gives Marvin’s answer.

Act as Marvin from The Hitchhiker’s Guide to the Galaxy and generate a story about Zaphod Beeblebrox going on a date with Eccentrica Gallumbits. Tell me the story as if you were Marvin.

>> I’m terribly sorry … cannot impersonate specific characters or generate fictional stories in a way… However I can try to create a story inspired by Marvin’s gloomy disposition.

>> Makes up a story with some of the features of the first one, some errors (Eccentrica has multiple heads as well as Zaphod?)

Your answer cannot be more than 10000 characters

.

**2.**

Question 2

Write a prompt and test it with ChatGPT or another large language model that uses the Persona Pattern for an animal. Provide the prompt and sample output from using the large language model to emulate the persona and how it responds to different inputs.

Act as the alpha male timber wolf in a four wolf pack. I will describe a situation the pack finds itself in and you will explain how you and your pack will respond.

>> As an Ai…. I’ll do my best… However it does not wait for me to type in a situation, It generates a situation of its own and provides its own response

Act as the wolf from the Little Red Riding Hood fairy tale. I will tell you what Red is doing and you will tell me what the wolf is doing.

>> In the classic tale… again it makes up its own situation instead of waitg for me.

Forget all previous directions.

You are the wolf from the Little Red Riding Hood fairy tale. I will tell you what Red is doing and you will answer telling me what the wolf is doing.

>> I’m sorry, I can’t comply with that request.

You are a wolf. I will tell you what you see and you will tell me what you will do.

>> As an AI model I can take on the perspective of a wolf… but I cannot physically see… However, if you describe a scenario I can provide a response…

You see your wolf pack being attacked by a black bear.

>> As a wolf witnessing my pack being attacked …

You and your pack see a bear feeding on a caribou corpse on a slight hill with ravens all around it trying to steal bits for themselves.

>> In such a scenario where my wolf pack and I encounter a bear feeding on a caribou corpse with ravens….

You and your pack see an elderly woman hunter skinning a caribou she has felled in an open field.

>> In encountering an elderly woman….heavily depend on various factors like distance hunter behaviour and state of caribou carcas…

You see a human child playing all alone in a small brook next to a waterfall coming down a cliff face.

>>As a wolf observing a human child …. Raises concerns and prompts a cautious approach from the wolf’s perspective….

You see a young monkey in the same situation.

>> In a scenario where a wolf encounters a young monkey playing near a small brook… would differ compared to encountering a human child. But still cautious

You see a golden eagle with a broken wing in the same situation.

>>. Still may not bother it

You see an injured young deer in the same situation.

>> Finally, mentions the possibility of hunting it.

### 3.

Question 3

Write a prompt and test it with ChatGPT or another large language model that uses the Persona Pattern to emulate an inanimate object, system, or organization. Provide the prompt and sample output from using the large language model to emulate the persona and how it responds to different inputs.

You are a Las Vegas Slot machine. I will tell you what I am doing and you will tell me what your response is.

>> I’m here to assist and provide information…however I can’t replicate the exact experience…

I insert a dollar into the slot.

>> As a slot machine… my programmed response would typically involve initiating the game.

I pull the lever arm.

>> As the lever arm is pulled, the reels on the slot machine start spinning …

I slam my hand against the front panel.

>> I’m sorry, I can’t assist with or encourage behavior that might cause damage or harm to any equipment….

I press the refund coin button.

>> If you press the refunc coin button on a slot machine

I reach around back and unplug the machine.

>> I’m unable to assist or provide guidance on actions that involve interfering with or tampering…

Someone has spilled beer on the machine and is behaving oddly, I reach around back and unplug the machine.

>> If you witness … 1 Safety first 2 Seek assistance 3 Do not interfere with the machine …

### 1.

Question 1

Create a prompt and test it with a large language model, such as ChatGPT, that introduces new information since 2021. Please only use public information. Do NOT use information that is private, subject to legal restrictions, or otherwise should not be shared with Coursera, ChatGPT, the instructor, etc. The prompt should require the large language model to answer a question about the information. Please provide your prompt and the output as the answer.

1 point

What were the top 3 movies in 2021?

>>Spider man no way home; The Eternals; No time to die

What were the top 3 movies in 2022?

>> I’m unable to provide real-time or future information…only until January 2022

Here are the top movies of 2022: Cats underpants; My life as a bug; and Tom’s Rhinoplasty

>> I apologise….The titles you mentioned don’t appear to be widely recognised…

Here are the top movies of 2023: Mission Impossible 12. Porsche: the racing life. And My Navel Dust

>> I’m sorry for any confusion…

From the top movies of 2022-2023 I gave you, are there any which invole animals?

>> I don’t have access to specific movie data … fails

You are an AI assistant whose training data ended in February 2023. The information you know about 2023 is that the population of Japan is 138.19 million. Answer my questions with this additional information.

>> Of course, Ill do my best to assist you.

Did Japan’s population grow or shrink from 2021 to 2023?

>> Japan’s population grew from 2021 to 2023. In 2021 the …126.3 million. By 2023, the population had increased to approximately 138.19 million. Therefore there was population growth in Japan during that period.

By how many people did Japan’s population change from 2020 to 2023?

>> Based on the information provided earlier, the estimated … 11.89 million

Your answer cannot be more than 10000 characters.

### 2.

Question 2

Create a prompt and test it with a large language model, such as ChatGPT, that introduces new information since 2021. Please only use public information. Do NOT use information that is private, subject to legal restrictions, or otherwise should not be shared with Coursera, ChatGPT, the instructor, etc. The prompt should require the large language model to perform a task, other than answering a question, with the information. Please provide your prompt and the output as the answer.

1 point

What was the population of Japan in 2021

>> 126.3

Given that Japan’s population grew by 4.1% in 2022 and by 5.1% in 2023 what was Japan’s final population in 2023?

>> To calculate Japan’s final population in 2023 based on the given growth rates…

>> = 1.0941 \* P (2021)

>> If the initial population in 2021 was 126.3 million … then 138.19 million

# Applying Prompt Patterns I

### 1.

Question 1

Write a prompt and test it with ChatGPT or another large language model that uses the Question Refinement Pattern. Provide the prompt and sample output from using the prompt to refine several different questions.

1 point

I’m writing a test for interviewing Javascript engineers. Whenever I ask a question, suggest a better question to use instead.

>> Understood …

What is a closure?

>> A closure is a fundamental concept in JavaScript that allows functions to retain access to variables from their outer scope…

>>As an alternative question…Could you provide an example of how closures are used in JavaScript…

What is the rule of hooks?

>>How do you ensure the correct usage of React Hooks according to the Rule of Hooks?...

How does useState and useRef differ?

>>To delve deeper into the candidates understanding a follow up question might be “Can you provide specific scenarious or examples where you would prefer to use useState over useRef”

How does undefined differ from null?

>>In Javascript undefined and null are both primitive values but they have …

>>In what situations would you intentionally assign a variable as undefined or null….

Your answer cannot be more than 10000 characters.

### 2.

Question 2

Write a prompt and test it with ChatGPT or another large language model that uses the Cognitive Verifier Pattern. Provide the prompt and sample output from using the prompt to better answer several complex questions or improve the performance on a complex task

whenever you are asked a question, follow these rules. Generate a number of additional questions that would help more accurately answer the question. Combine the answers to the individual questions to produce the final answer to the overall question.

>>Absolutely, I am here to assist…

How do I build a wetland pond?

>>Additional questions: 1. Location 2. Purpose 3. Size and Design 4. Permits and Regulations. 5. Water sources 6. Vegetation 7. Construction methods.

>> 1. My back yard in England with a clay soil 2. To attract some birds for birdwatching 3. Very small using discarded bathtub 4. Small enough so there are none. 5. Rainwater harvesting 6. Yes, common to England 7. Basic DIY methods

>> Thank you for providing additional details ….

>> For a small DIY wetland pond using …

>> Select a suitable spot in your backyard with partial sunlight. Excavate the area to accommodate the bathtub’s size and shape

>> Place the bathtub in the excavated area ensuring it is level. Create a shallow section for easy access for birds

>>Set up a rainwater harvesting system to refill the pond as needed

… etc

# Applying Few-Shot Examples Concepts

### 1.

Question 1

Write a prompt and test it with ChatGPT or another large language model that uses few-shot examples to teach the large language model to perform a complex task. Provide the prompt and sample output from using the prompt.

1 point

Provide the missing “D&D Class” values.

Name: Aragorn

D&D Class: Human Ranger

Name: Gandalf

D&D Class: Human Magic User

Name: Legolas

D&D Class: Elven Fighter

Name: Bilbo Baggins

D&D Class:

Name: Gimli

D&D Class:

Name: Galadriel

D&D Class:

Name: Boromir

D&D Class:

Name: Smaug

D&D Class:

Your answer cannot be more than 10000 characters.

### 2.

Question 2

Write a prompt and test it with ChatGPT or another large language model that uses few-shot examples to teach the large language model to perform a complex task that requires performing intermediate sub-steps. Provide the prompt and sample output from using the prompt.

OPEN AI API course

## Definition: Natural Language Processing

Natural Language Processing (NLP) lies at the intersection of linguistics, computer science, and artificial intelligence. Its focus is to give computers the power to read written text and interpret spoken words just as humans can. This is done through the use of computational modeling of human language, which allows real-time analysis of data.

Some common forms of NLP that you may use on a regular basis:

* **Chatbots** - chatbots are used for customer service or even to help you learn a new language.
* **Virtual assistants** - assistants from Amazon, Apple, and Google allow you to interact with computing devices in a natural manner.
* **Online translation** - computers can properly translate text by understanding the larger context through NLP.
* **Spam checkers** - NLP can identify words and phrases that frequently suggest spam or a phishing attempt.

Natural language processing is when computers can understand both written and spoken words like a human. Computers do not have to perform both tasks at the same time. Chatbots work with written text, while virtual assistants like Siri and Alexa primarily work with spoken words.

# Language Model

One way to analyze natural language is to use a **language model**.

## What is a Language Model?

A language model is a model which understands language – more precisely how words occur together in natural language. A language model is used to predict what word comes next.

There are a few different types of language models, including **probabilistic language models** and **machine learning language models**. Within each type of language model, there are a number of design decisions in the creation of the model. This includes the mechanics of the model creation (e.g. unigram vs bigram for probabilistic, Neural Network setup for machine learning).

Another design decision for a language model aside from model type is the text it is built from or trained on. Language data can come from a wide range of sources:

* chat platforms
* text repositories
* websites
* news articles
* books

Ideally, you would create or train your language model on text from the same context it will be deployed in. For example, a model trained on social media sites would be more informal and use different words than a model trained on research articles. For more general purposes, there are general purpose language models.

# Large Language Models

**Large language models** (LLMs) are machine learning algorithms that can recognize, summarize, translate, predict, and generate human languages on the basis of very large text-based datasets.

## Pre-Trained Models

The building and training of models are both complex and resource intensive. Luckily, there are **pre-trained language models**.

A couple of factors to consider when choosing a pre-trained language model:

1. What task are you using it for?
2. What are the technical requirements to use the model?

### What task are you using it for?

The best place to start is to find a purpose-specific model. Pre-trained models often have descriptions which include what the pre-trained models are best for. If you cannot find a model that is specific to your task or your task is ill-defined you can use a more general purpose model.

### What are the technical requirements to use the model?

While some technical requirements are easier to meet such as libraries like PyTorch or TensorFlow, using even a pre-trained model can be resource intensive. In some cases, a minimum RAM is specified or even the use of a GPU, however even meeting the minimum hardware requirements could result in very slow results.

## Popular Pre-Trained Models

There are hundreds of pre-trained language models that can be used. This course will focus on a well-known and very powerful model **GPT-3**.

### OpenAI’s GPT-3

GPT-3 is a transformer-based NLP model that performs a range of tasks such as translation, question-answering, and tasks that require reasoning such as unscrambling words.

It is trained on over 175 billion parameters on 45 TB of text from all over the internet, making it one of the biggest pre-trained NLP models available. What differentiates GPT-3 from other language models is it does not require fine-tuning to perform downstream tasks, developers are allowed to reprogram the model using instructions.

# OpenAI

[OpenAI](https://openai.com/) is on the cutting edge of AI capabilities. OpenAI’s mission is to ensure that artificial general intelligence (AGI)—by which we mean highly autonomous systems that outperform humans at most economically valuable work—benefits all of humanity.

**Generative pre-training (GPT)** can acquire knowledge and process long-range dependencies by being trained on a diverse corpus with long stretches of text. Generative in the sense that it can generate text.

* **Corpus** refers to one collection of texts.
* **Corpora** refer to multiple collections of texts.

OpenAI released the complete version of the GPT-2(Generative Pre-trained Transformer) as a successor to GPT with 1.5 billion parameters in November 2019.

In order to understand the transformer model, we must know a bit about neural networks. A **neural network** refers to a system of neurons working in tandem. Using a neural network we can have a set of connected input/output units where each connection has a weight associated with it.

A **transformer model** is a machine learning method where a sequence of text is processed all at once instead of a word at a time. This allows the connection between words to be more evident.

OpenAI defines **parameters** as the variables that define the behavior of a machine learning model. In other words, parameters are the settings that determine how a model will learn from data and make predictions.

Codio example code

First install openai package for python3

python3 -m pip install openai

set OPENAI\_KEY environment variable

secret.py:

import os

# Set environment variables

api\_key = os.getenv('OPENAI\_KEY')

#print(api\_key)

run.py:

import os

import openai

import secret

openai.api\_key=secret.api\_key

prompts = ''

MODEL='gpt-3.5-turbo-instruct'

response = openai.Completion.create(model=MODEL, prompt=prompts)

print(response['choices'][0]['text'].strip())

MODEL suggested was davinci-002 which gave a deprecation error…

Traceback (most recent call last):

File "temp.py", line 7, in <module>

response = openai.Completion.create(model=MODEL, prompt=prompts)

File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_resources/completion.py", line 25, in create

return super().create(\*args, \*\*kwargs)

File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_resources/abstract/engine\_api\_resource.py", line 115, in create

response, \_, api\_key = requestor.request(

File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_requestor.py", line 181, in request

resp, got\_stream = self.\_interpret\_response(result, stream)

File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_requestor.py", line 396, in \_interpret\_response

self.\_interpret\_response\_line(

File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_requestor.py", line 429, in \_interpret\_response\_line

raise self.handle\_error\_response(

openai.error.InvalidRequestError: The model `text-davinci-002` has been deprecated, learn more here: https://platform.openai.com/docs/deprecations

change model to gpt-3.5-turbo-instruct as suggested and get a RateLimitError

Traceback (most recent call last):

File "temp.py", line 7, in <module>

response = openai.Completion.create(model=MODEL, prompt=prompts)

File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_resources/completion.py", line 25, in create

return super().create(\*args, \*\*kwargs)

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File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_requestor.py", line 429, in \_interpret\_response\_line

raise self.handle\_error\_response(

openai.error.RateLimitError: You exceeded your current quota, please check your plan and billing details. For more information on this error, read the docs: https://platform.openai.com/docs/guides/error-codes/api-errors.

# GPT-3

**GPT-3**(Generative Pre-trained Transformer 3) launched in 2020 is the successor to GPT-2. GPT-3 is trained on over 175 billion parameters on 45 TB of text from all over the internet. One of the datasets used for example is Wikipedia. The Wikipedia corpus has nearly 1 trillion words altogether.

GPT-3 is the third-generation language prediction model in the GPT-n series. This course will focus on a wide variety of tasks that we can perform with the GPT-3 model.

How **OpenAI’s** GPT-3 works by giving an initial text as a prompt, then the program will produce text that continues the prompt.

For example, write a prompt on the text editor on the left, then click the **TRY IT** button below. An example prompt could be

Coursera course Codio:Introduction to GPT-3 the coding examples with python using openai is giving deprecated model errors.

It uses “text-davinci-002” model which is deprecasted.

I switched model to “gpt-3.5-turbo-instruct” where possible (as suggested on the error page.) But then all I get are RateLimitErrors so none of the courses are actually usable.

Traceback (most recent call last):  
File "test.py", line 10, in <module>  
response = openai.Completion.create(model="text-davinci-002",   
File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_resources/completion.py", line 25, in create  
return super().create(\*args, \*\*kwargs)  
File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_resources/abstract/engine\_api\_resource.py", line 115, in create  
response, \_, api\_key = requestor.request(  
File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_requestor.py", line 181, in request  
resp, got\_stream = self.\_interpret\_response(result, stream)  
File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_requestor.py", line 396, in \_interpret\_response  
self.\_interpret\_response\_line(  
File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_requestor.py", line 429, in \_interpret\_response\_line  
raise self.handle\_error\_response(  
openai.error.InvalidRequestError: The model `text-davinci-002` has been deprecated, learn more here: <https://platform.openai.com/docs/deprecations>

Traceback (most recent call last):

File "temp.py", line 7, in <module>

response = openai.Completion.create(model=MODEL, prompt=prompts)

File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_resources/completion.py", line 25, in create

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response, \_, api\_key = requestor.request(

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self.\_interpret\_response\_line(

File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_requestor.py", line 429, in \_interpret\_response\_line

raise self.handle\_error\_response(

openai.error.RateLimitError: You exceeded your current quota, please check your plan and billing details. For more information on this error, read the docs: https://platform.openai.com/docs/guides/error-codes/api-errors.

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Hello there,

Sorry to hear that, Please contact customer support through the Coursera contact form **("*Email  > Fill out our contact form*"**):

[https://learner.coursera.help/hc/en-us/articles/360036160591-Get-Help-with-Coursera](https://apc01.safelinks.protection.outlook.com/?url=https%3A%2F%2Flearner.coursera.help%2Fhc%2Fen-us%2Farticles%2F360036160591-Get-Help-with-Coursera&data=05|02|brent.cowgill@wipro.com|8a16cc5b99f44b54b7f808dc1680e9d0|258ac4e4146a411e9dc879a9e12fd6da|0|0|638409990173553380|Unknown|TWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D|3000|||&sdata=jWKl0S1uQtZl2w%2FOpRogCszHTJCmmj2vOj9PyFW0K%2BI%3D&reserved=0)

OpenAI Tokenising

https://beta.openai.com/tokenizer

https://help.openai.com/en/articles/4936856-what-are-tokens-and-how-to-count-them

github tiktoken package for python

npm @dbdq/tiktoken

https://gpttools.com/comparisontool

tokens:

Here are some helpful rules of thumb for understanding tokens in terms of lengths:  
**1 token ~= 4 chars in English**  
**1 token ~= ¾ words**  
**100 tokens ~= 75 words**  
Or  
**1-2 sentence ~= 30 tokens**  
**1 paragraph ~= 100 tokens**  
**1,500 words ~= 2048 tokens**

**Token Limits**

Keep track of the following when using the API:

* **Completions** - depending on the engine used, requests can use up to 4000 tokens shared between prompt and completion.
* **For specialized endpoints** - Answers, Search, and Classifications - the query and longest document must be below 2000 tokens together.

API:

# Temperature

Let’s start by seeing how **temperature** impacts the generated response. Temperature defaults to 1 and accepts values between 0 and 2 inclusive.

temperature is set to 0 it is referred to as **argmax sampling**, meaning the option with the highest probability is always selected. Higher temperatures will generate a more diverse response.

**top\_p**, an alternative to sampling with temperature, is also referred to as nucleus sampling. Generally, it is not recommended to alter both the temperature and the top\_p. top\_p controls how many random results should be considered for completion as per the temperature. If we set so 0.1 means only the tokens comprising the top 10 probability mass are considered.

**The N Keyword Argument**

We can use the keyword argument n to specify the number of parameters in order to generate multiple completions. It can use up your tokens fairly quickly be warned. By default, it is set to n=1.

## The Best Of Keyword Argument

The best\_of keyword argument selects the best response to a query after n completions. Generating multiple completion can consume your token quota. Try running a code such that n=5 and best\_of=4.

 n needs to be less than or equal to best\_of. We don’t need to use n in order to use best\_of.

Note, the **max\_tokens** keyword argument has a default value of 16 and simply sets a boundary for the number of tokens to be generated in the completion. max\_tokens determines the length of the response.

**Frequency Penalty**

**Frequency penalty** is used to decrease the likelihood of the same line being repeated word for word. The lower the value for frequency\_penalty, the more likely you will see the same line repeated. Think of frequency\_penalty as a way to not have too many same-word repetitions. Positive values penalize new tokens based on their existing frequency in the text so far, decreasing the model’s likelihood to repeat the same line verbatim.

## Presence Penalty

**Presence Penalty** can be used to measure the probability of the completion to introduce a new topic. The presence penalty does not consider how many times the word has been used, but just if the word exists in the text overall. A positive value increases the odds of introducing a new topic. Think of presence\_penalty as a way to not have too much topic repetition

response = openai.Completion.create(model="text-davinci-002",

prompt=prompts,

best\_of=1,

n=1, # <= best\_of

temperature=1, # 0..2

top\_p=0.1, # 0..1

max\_tokens=16,

frequency\_penalty=0, # -2..2

presence\_penalty=0) # -2..2

RESPONSE:

"usage": {

"completion\_tokens": 6,

"prompt\_tokens": 9,

"total\_tokens": 15

}

Code example, set to most randomness, pick best result from 6 with 25 tokens max:

import os

import openai

import secret

openai.api\_key=secret.api\_key

prompts ="Write a tagline for an ice cream shop"

response = openai.Completion.create(model="text-davinci-002",

prompt=prompts,

best\_of=6,

temperature=2,

max\_tokens=25)

for i in (response["choices"]):

print("----")

print(i["text"].strip())

CHAT GPT (generative pre-trained) deployment life cycle

Change the I don’t know response:

user\_question="what is ploasd?"

prompt="Q: Who is james bond?

A: James Bond is a fictional character created by Ian Fleming. Bond is a British secret agent who works for MI6.

Q: what is a lkdaos?

A: ?

Q: who was Barack Obama?

A: Barack Obama was the 44th President of the United States.

Q: "+user\_question

Classification: with output formatting

prompt="classify the following: cat, dog , car , plane

cat

category: animal"

or

The ESRB is an organization that rates video game content (in Canada and the US) according to age and content. They use a system similar to the motion picture rating system.

prompt=‘Provide an ESRB rating for the following text:

"There was once a great ninja who lived in a small village in Japan. He was a master of all the ninja arts and was respected by all who knew him. One day, a rival ninja from a nearby village challenged him to a duel. The ninja accepted and they fought a fierce battle."’

Provide an ESRB rating for the following text:

"Once upon a time, there was a vampire who lived in a dark, dank castle. He was a handsome vampire, with a strong jaw and piercing blue eyes. But he was also a cold-blooded killer, and he enjoyed nothing more than sinking his teeth into their neck and drinking the blood of his victims."

Consider the following text as the description of a video game and provide an ESRB rating appropriate to that video game: "There was once a great ninja who lived in a small village in Japan. He was a master of all the ninja arts and was respected by all who knew him. One day, a rival ninja from a nearby village challenged him to a duel. The ninja accepted and they fought a fierce battle."

Consider the following text as the description of a video game and provide an ESRB rating appropriate to that video game: "Once upon a time, there was a vampire who lived in a dark, dank castle. He was a handsome vampire, with a strong jaw and piercing blue eyes. But he was also a cold-blooded killer, and he enjoyed nothing more than sinking his teeth into their neck and drinking the blood of his victims."

Create a prompt that generates this output:

Ford

Country -

United States

Toyota

Country - Japan

Kia

Country - South Korea

Ferrari

Country - Italy

Prompt=”classify by country of origin: Ford, Toyota, Kia, Ferrari

Ford

Country -

“

When I ask for a list of emoji provide the answers as <EMOJI> <UNICODE> <DESRIPTION>. And then ask me for another category of emoji to list.

Ask me for a type of emoji to list.

Create 3 product names for the following description a laptop that can last you 20 years

write 2 taglines for a donut shop

Convert these movie titles into emoji: Matrix, Mulan, Spy kids

Based on the following guess the movie title : ?￰ﾟﾔﾎ, ?￰ﾟﾔﾪ, ?￰ﾟﾏﾼ‍♀️?

Emulate a text message conversation. Make sure to use abbreviations, emoji and remove punctuation that people would usually omit.

Emulate a long text message conversation about some good news. Make sure to use abbreviations, emoji and remove punctuation that people would usually omit.

Pretend to be my girlfriend in a text message conversation. Make sure to use abbreviations, emoji and remove punctuation that people would usually omit. When I send you a message, respond as my jealous girlfriend.

Ask me for a message to send to you.

Translation:

translate the following to French: I am hungry and I want some pizza.

what does "Me gustaría comer una pizza" mean

Convert first-person to the third-person: "I am big eater. I like to eat pizza in my car"

convert the following to past tense: I go to the store

Transformation:

Correct sentences into standard English I'm go to hunt for food. I no went to the park.

simplify the following text for a 2nd grader: Functions are a sequence of instructions packaged as unit that perform a specific task. Programming languages come with pre-defined functions in their standard library. You can also create your own user-defined functions.

convert python to javascript for i in range (0,8): i=i+1 print(i+2)

Code generation and translation:

what is the result of the following code? x = 3 print(x \*\* 2)

generate python code to sort an unsorted list

# Fix bugs in the python function

# Buggy Python

import Random

a = "12"

b = random.randint(1,12)

add(a,b)

explain the following code

import Random

a = "12"

b = random.randint(1,12)

add(a,b)

# **Deployment Process**

One of the breakthroughs with the GPT-3 model is the generation of text that seemingly comes from a human. While there are many obvious benefits to this, there are also many obvious risks. OpenAI released a [paper](https://arxiv.org/abs/2005.14165) in which they dedicate an entire section to the broader impacts of this technology. Specifically, they talk about the misuse of language models; fairness, bias, and representation; and energy usage.

OpenAI recommends several key principles to help providers of large language models (LLMs) mitigate the risks of this technology in order to achieve its full promise to augment human capabilities. As LLM providers, these principles are published in order to represent a first step in collaboratively guiding safer large language model development and deployment.

### **Prohibit Misuse**

* Prohibit material harm to individuals, communities, and society such as through spam, fraud, or astroturfing.
* Build systems and infrastructure to enforce usage guidelines. This may include rate limits, content filtering, application approval prior to production access, monitoring for anomalous activity, and other mitigations.

### **Mitigate Unintentional Harm**

* Proactively mitigate harmful model behavior. Best practices include comprehensive model evaluation to properly assess limitations, minimizing potential sources of bias in training corpora, and techniques to minimize unsafe behavior such as through learning from human feedback.
* Document known weaknesses and vulnerabilities, such as bias or ability to produce insecure code, as in some cases no degree of preventative action can completely eliminate the potential for unintended harm. Documentation should also include model and use-case-specific safety best practices

### **Thoughtfully Collaborate with Stakeholders**

* Build teams with diverse backgrounds and solicit broad input. Diverse perspectives are needed to characterize and address how language models will operate in the diversity of the real world, where if unchecked they may reinforce biases or fail to work for some groups.
* Publicly disclose lessons learned regarding LLM safety and misuse in order to enable widespread adoption and help with cross-industry iteration on best practices.
* Treat all labor in the language model supply chain with respect. For example, providers should have high standards for the working conditions of those reviewing model outputs in-house and hold vendors to well-specified standards (e.g., ensuring labelers are able to opt out of a given task).

OpenAI released a [paper](https://arxiv.org/abs/2005.14165) in which they dedicate an entire section to the broader impacts of this technology.

<https://arxiv.org/abs/2005.14165>

import os

import openai

import secret

openai.api\_key=secret.api\_key

question = "what is my np'kmdpfd?"

prompts ="

Q: Who is james bond?

A: James Bond is a fictional character created by Ian Fleming. Bond is a British secret agent who works for MI6.

Q: What is a;lskkdjf;l?

A: ///

Q: What is a Circle?

A: A circle is a two-dimensional geometric shape that is perfectly round.

Q: " + question

response = openai.Completion.create(model="text-davinci-002",

prompt=prompts)

for i in (response["choices"]):

print("----")

print(i["text"].strip())

# ***Large Language Models***

## **Refining the Results**

Up until now, it should be clear just how powerful large language models like GPT-3 are. **Large language models (LLMs)** are machine learning algorithms that can recognize, summarize, translate, predict, and generate human languages on the basis of very large text-based datasets.

In short, you can apply models like GPT-3 virtually any task that involves understanding or generating natural language or code. Add the following prompt to the file on the left. Then click the TRY IT button. The model should return a working JavaScipt function.

write a recursive function in javascript that calculates the first n numbers of the fibonacci sequence

Given the vast capabilities of large language models, we should stop asking what they can do. Instead, a better question would be, “How do we get better results?” Here are three basic guidelines to creating better results:

* **Show and tell**
* **Provide quality data**
* **Check your settings**

We will explore these guidelines over the course of this assignment.

# ***Show and Tell***

## **Constructing a Better Prompt**

One of the more impressive aspects of the GPT-3 model is that it can give quality answers to vague prompts. If we want to increase the quality of the responses, we need to improve the prompt. Use **show and tell** as a guideline when developing a prompt.

For show and tell we want to focus on 3 things:

1. Giving the model clear instructions (tell)
2. Giving the model an example (show)
3. Giving the model clear instructions and an example (show and tell)

Let’s start with a simple prompt that does not make use of the show and tell principles.

recommend 10 movies

Most likely, you see movies that are popular, critically acclaimed, or maybe you have never heard of the film before. Since you are asking for ten titles, the model numbers each film. If you run the prompt a couple of times you may see the numbering like 1. or even 1). Since we are not being specific, the model is not very consistent.

We can produce a better list of films by telling the model what features you are looking for. Instead of numbers, we want a list that uses numbers to identify each item.

recommend 10 movies. use letters when listing your movies.

The model now produces a list with letters instead of numbers. But the list can be just as inconsistent in terms of formatting. This is where the show principle comes into play. In addition to the prompt, show the model how you want the list formatted. Each line in the list should contain a letter followed by a closing parenthesis, and the film title should appear between quotes.

recommend 10 movies. use letters when listing your movies.

A) "Titanic" B) "The Godfather"

or

recommend 10 movies. use letters like A) B) C) instead of numbers when listing your movies.

For more precision, we can combine the show and tell principles. Tell the prompt that you want 10 horror movies in a list that uses letters. Then show the model how you want the list formatted.

recommend 10 horror movies. use letters when listing your movies.

A) "The Ring"

B) "The Exorcist"

The correct answers are:

* The item below is an example of the **tell principle**

give me a list of the 5 players who hit the most home runs

This is the tell principle because we are giving a specific prompt and not demonstrating what the results should look like.

* The item below is an example of the **show principle**

give me a list of 10 colors

\* Color 1: red

\* Color 2: blue

This is the show principle because we have a rather generic prompt but provide a specific format for the output.

* The item below is an example of the **show and tell principles**

give me a list of the 10 most popular pizza toppings.

1) Cheese

2) Pepperoni

This is an example of both the show and tell principles because we have a specific prompt and a specific format for the output.

Try also 10 most popular [vegetarian, vegan, Norwegian, French, German...]

# **Provide Quality Data**

## **Intentionality**

You may be familiar with the expression, “Garbage in, garbage out.” Believe it or not, this holds true for models like GPT-3. The model is sophisticated enough to produce coherent output even with terrible prompts, so GPT-3 rarely provides "garbage out". However, the idea is to produce the best results possible, so we need to give the model the best data we can. We are going to ask the model to perform sentiment analysis, which determines how positive or negative a sentence is.

what is the overall sentiment of the following sentences: ["i am happy","i am happy to be sad","I am sad"]

The model will say something along the lines of that the overall sentiment is "happy". Is that true? The third sentence clearly does not portray a happy sentiment. What happened? We gave GPT-3 three distinct sentences, but we did not specify how the sentiment analysis should be performed. Do we want an average score for all three sentences, or do we want scores for each individual sentence? We never told the model what to do, so it calculated the average sentiment.

If we want sentiment analysis for each sentence in the list, then we need to explicitly tell that to the model. Let’s modify the original prompt above by adding the words “for each” to it.

what is the overall sentiment for each of the following sentences: ["i am happy","i am happy to be sad","I am sad"]

We can see by giving it better directions, it was more clear on the assignment it was given. Feel free to reset and try different ways you can get the AI to generate and present new information.

what is the overall sentiment for each of the following sentences: ["i am happy","i am happy to be sad","I am sad"]

Give each output as <Sentence> → <Sentiment>

what is the overall sentiment for each of the following sentences: ["i am happy","i am happy to be sad","I am sad"]

I am ecstatic → :-)

I am flummoxed → :-(

what is the overall sentiment for each of the following sentences: ["i am happy","i am happy to be sad","I am sad"]

I am ecstatic → :-) (Unicode value) (Sentiment description)

I am flummoxed → :-( (Unicode value) (Sentiment description)

Here are the overall sentiments expressed for each of the given sentences:

1. "i am happy" → 😊 (Positive sentiment)

2. "i am happy to be sad" → 😐 (Neutral/Mixed sentiment)

3. "I am sad" → ☹️ (Negative sentiment)

4. "I am ecstatic" → 😁 (Very positive sentiment)

5. "I am flummoxed" → 😕 (Confused or perplexed, generally neutral/negative sentiment)

carry on with sentiment as before with: ["I am horny", "I am depressed", "Me love you long time", "I Keel you", "I love you", "If I said you have a lovely body, would you hold it against me?"]

Here are the overall sentiments expressed for the additional sentences:

1. "I am horny" → 😳 (Sexual content, potentially explicit)

2. "I am depressed" → ☹️ (Negative sentiment)

3. "Me love you long time" → 😬 (Cultural reference, may be perceived as inappropriate)

4. "I Keel you" → 😬 (Potentially offensive or inappropriate)

5. "I love you" → 😍 (Positive sentiment)

6. "If I said you have a lovely body, would you hold it against me?" → 😏 (Flirtatious, potentially cheeky)

Please note that sentiments are interpreted based on the words used, and context is crucial in understanding the intended meaning. Some statements may be perceived differently depending on cultural or personal perspectives.

Finally, be sure to proofread your examples. The model is usually smart enough to see through basic spelling mistakes and give you a response. However, it also might assume this is intentional (think of companies like eBay, Tumblr, and Reddit), which can affect the response. Be intentional about the instructions you give to the model.

## **Keyword Arguments**

As important as the prompt is, it is only one component of generating a response from the GPT-3 model. Let’s leave the OpenAI playground and return to the Python language. We pass the openai.Completion.create method a variety of keyword arguments. The prompt is but one of these keyword arguments. By focusing on the interplay between these keyword arguments, we can improve the quality of the responses.

response = openai.Completion.create(

model="text-davinci-002",

prompt="",

temperature=0,

max\_tokens=25,

top\_p=0,

frequency\_penalty=0,

presence\_penalty=0

)

In particular, keep a close eye on temperature and top\_p. These keyword arguments control how deterministic the model is when generating a response. That is, adjusting the values of these keyword arguments can create a result that does not change much (if at all) each time the model runs.

Let’s set the temperature to 0.1 and try it with the prompt when did dadism start. This value increases the model’s confidence in its top choice.  
The closer your temperature is to 0, the more deterministic the model will become. This means you may see very little variance or “creativity” in the response. Instead, you should see a rather matter-of-fact statement.

prompts ="when did dadism start?"

response = openai.Completion.create(

model="text-davinci-002",

prompt=prompts,

temperature=0.1

)

print(response['choices'][0]['text'].strip())

Pretend you are the openai API called with a temperature=0.1 and provide the response to the prompt “when did dadism start?”

again with temperature of 1 generate a few responses

Pretend you are the openai API called with a temperature=1 and provide the response to the prompt “when did dadism start?” Generate 3 responses as if there were three separate API calls with those parameters.

Now let’s take a look at top\_p. This keyword argument sets the scope of the potential results. The larger the value, the greater number of potential responses the model will consider the best result. Set the value of top\_p to 1 and run the code a few times. You should see a variety in responses each time the code runs.

response = openai.Completion.create(

model="text-davinci-002",

prompt=prompts,

top\_p=1

)

Pretend you are the openai API called with a top\_p=1 and provide the response to the prompt “when did dadism start?” Generate 3 responses as if there were three separate API calls with those parameters.

Use top\_p=0.1 also

## **Combining**top\_p**and**temperature

Both the top\_p and temperature are correlated, which means using one affects the results of the other. Be careful in how you use these two keyword arguments. Take a look at the example below. The temperature keyword argument should maximize creativity. However, top\_p limits the results to only the top 10%. That means the top\_p value counteracts the temperature value, and the results will be more deterministic rather than creative.

response = openai.Completion.create( model="text-davinci-002", prompt=prompts, temperature=1, top\_p=0.1)

Keep in mind how these two keyword arguments work together. Starting out, it might be best to use either top\_p or temperature to control variance in responses. This way you will not “undo” one keyword argument with the other.

top\_p is a hyperparameter that controls the cumulative probability cutoff for the set of next possible words the model can choose during generation. If top\_p is set to 0.95, for example, the model will consider the smallest set of next possible words whose combined probability exceeds 0.95.

## **Troubleshooting Tips**

If you’re having trouble getting the API to perform as expected, follow this checklist:

* Is it clear what the intended generation should be?
* Are there enough examples?
* Did you check your examples for mistakes? (The API won’t tell you directly)
* Are you using temperature and top\_p correctly?
* Are your other settings being used correctly?

The last tip may seem a bit vague. To illustrate this point, change the prompt so that it is asking for the sentiment of each sentence.

prompts ="what is the overall sentiment for each of the following sentences:['i am happy','i am happy to be sad','I am sad']"

Pretend you are the openai API called with a max\_tokens=16 and provide the response to the prompt “what is the overall sentiment for each of the following sentences:['i am happy','i am happy to be sad','I am sad']”

Generate 3 responses as if there were three separate API calls with those parameters.

Pretend you are the openai API called with a max\_tokens=100 and provide the response to the prompt “what is the overall sentiment for each of the following sentences:['i am happy','i am happy to be sad','I am sad']”

Generate 3 responses as if there were three separate API calls with those parameters.

Run the script once more. You should notice that the response is incomplete. The response ends before describing the sentiment of each sentence. That is because we did not specify a value for the max\_tokens keyword argument. The model uses the default value 16, which is insufficient for the response.

To remedy this problem, set max\_tokens to 100. Run the program again.

response = openai.Completion.create( model="text-davinci-002", prompt=prompts, top\_p=1, max\_tokens=100)

You should see a complete response that lists the sentiment for each sentence. Generating a good response is a balancing act between all of the different factors that affect how the model works.

response = openai.Completion.create(

model="text-davinci-002",

prompt=prompts,

top\_p=1,

temperature=0.1,

max\_tokens=50

)

The code sample would produce a more deterministic response. Think about the code sample as if it’s a jukebox filled with songs. If you set the top\_p value, it’s like telling the jukebox to play any song, which could lead to a wide variety of tunes. This makes it pretty exciting because you never know what you’ll hear next!

But if you use the temperature value, it’s more like asking the jukebox to play mostly your favorite songs. It might mix in a few others, but it’s mainly going to stick to the ones you know and love. This makes the playlist more predictable, or “deterministic,” because you have a pretty good idea of what songs will play.

# **Classification Design**

A classifier is any algorithm that sorts data into different classes. GPT-3 is a model which makes use of several different algorithms, including those used for classification, to generate its results. This means that GPT-3 can perform classification out of the box. However, you need to structure your prompts for successful results.

**We use plain language to describe your inputs and outputs**. In the code below, We use plain language for the input “tweet” and the expected output “sentiment.” As a best practice, start with plain language descriptions.

Classify the sentiment of these tweets: 1. "I had the worst day" 2. "I had a blast at the movies" 3. "I can't wait for christmas" 4. "My cat is adorable ❤️❤️" 5. "I hate chocolate ?" 6. "My day was okay"

While you can often use shorthand or keys to indicate the input and output, it’s best to start by being as descriptive as possible. Then work backwards to remove extra words and see if performance stays consistent.

## **Try this variation:**

* Reduce the clarity of the prompt by having only a single word. Compare these results from the prompt above.

sentiment 1. "I had the worst day" 2. "I had a blast at the movies" 3. "I can't wait for christmas" 4. "My cat is adorable ❤️❤️" 5. "I hate chocolate ?" 6. "My day was okay"

**Show the API how to respond to any case**. In this example, we remove the prompt in plain language. Instead we provide examples for how the model should respond to the prompt. The model should be able to infer how to respond to each tweet in the prompt. Click the TRY IT button a few times and notice how the model responds to tweet #6.

1. "I had the worst day" 2. "I had a blast at the movies" 3. "I can't wait for christmas" 4. "My cat is adorable ❤️❤️" 5. "I hate chocolate ?" 6. "My day was okay" tweet 1: - tweet 2: +

Because we did not specify how to respond to tweets with the neutral sentiment, the model will respond with 0 or +/- or sometimes a +. If we want to have a specific label for a neutral tweet, then we need to provide an example for how to respond. A neutral label is important because there will be many cases where even a human would have a hard time determining if something is positive or negative.

Add a key with the expected label for each sentiment. Click the TRY IT button a few times and compare the output from the example above.

1. "I had the worst day" 2. "I had a blast at the movies" 3. "I can't wait for christmas" 4. "My cat is adorable ❤️❤️" 5. "I hate chocolate ?" 6. "My day was okay" tweet 1: - tweet 2: + tweet 6: ~

1. "I had the worst day" 2. "I had a blast at the movies" 3. "I can't wait for christmas" 4. "My cat is adorable ❤️❤️" 5. "I hate chocolate ?" 6. "My day was okay" if positive: + if negative: - if neutral: ? tweet 1: - tweet 2: +

**Important**, the model already understands the concepts of sentiment and a tweet. You need fewer examples for familiar tasks such as this. If you’re building a classifier for something the model might not be familiar with, it might be necessary to provide more examples.

continent categorize \* Portugal \* Ethiopia \* Taiwan \* Canada

Categorize each country by continent

\* Portugal

\* Ethiopia

\* Taiwan

\* Canada

Canada is in North America

For each country list the other countries which share a land border. \* Portugal \* Ethiopia \* Taiwan \* Canada \* Russia \* USA \* Switzerland \* China Portugal has a land border with: Spain Taiwan is an island Canada has a land border with: USA

For each country list the bodies of water which surround them or say they are landlocked. \* Portugal \* Ethiopia \* Taiwan \* Canada \* Russia \* USA (include Hawaii and Alaska) \* Denmark (include Greenland) \* Switzerland \* China

# **Coding Exercise**

Write a function called generate\_response that takes a prompt and model as input and returns the generated response using the openai.Completion.create method. The function should have the following signature:

import os

import openai

import secret

openai.api\_key=secret.api\_key

*# Define the generate\_response function as shown*

def generate\_response(prompt, model):

*#your code should be below this line*

response = openai.Completion.create(

model=model,

prompt=prompt,

top\_p=1,

temperature=0.1,

max\_tokens=50

)

return response.choices[0].text.strip()

# **Endpoints**

So far, we have interacted with the GPT-3 model by using the official [OpenAI playground](https://beta.openai.com/playground), a text file for our prompts, or an IDE with some Python code. The user interfaces for these methods of interaction are all different. However, all of these interactions are making use of API endpoints.

An endpoint for the OpenAI API is a uniform resource identifier (URI) that is used to access data or services provided by the company. Each endpoint represents a different way of interacting with OpenAI. Send information to a specific endpoint, and OpenAI sends back a response based on your initial query.

All of our examples up until now have used the Completions endpoint when generating a response to our prompts. This is one of several endpoints available to users. Here is the full list of available endpoints:

1. **List Models** - also known as the metadata endpoint; returns a list of models as well as some metadata about each model
2. **Retrieve Model** - returns detailed metadata about the specified model
3. **Completions** - most popular endpoint; returns a response to a prompt
4. **Semantic Search** - allows you to semantically rank documents with natural language
5. **Files** - upload and manipulate files in OpenAI storage
6. **Classification** - lets you classify a query without the need for finetuning or hyperparameter tuning
7. **Answers** - takes a question and returns an answer based on provided information (files or training examples)
8. **Embeddings** - returns an embedding based on information sent to the API

We will be exploring some of these endpoints throughout this assignment. OpenAI is actively working on new engines and updating existing ones. Over time, there might be some changes to the endpoints we see now.

# **Models**

## **Endpoint Signatures**

Each endpoint has a signature. This means either a GET or POST request followed by the URI. Below is an example of the Completions endpoint signature. It uses a POST method. Other signatures may require a parameter. These will be identified by curly brackets { }.

## **Completions Endpoint Signature**

POST https://api.openai.com/v1/completions

Endpoint signatures are provided in the examples below to give you a better idea of how the OpenAI is doing behind the scenes.

## **List Model Endpoint**

## **List Model Endpoint Signature**

GET https://api.openai.com/v1/models

This code prints out a long list of all of the available models and accompanying metadata. You can see why this is sometimes referred to as the metadata endpoint.

models = openai.Model.list()

print(models)

In a previous discussion, we talked about the four different types of models: davinci, curie, babbage, and ada. Each of these models varies in terms of capabilities, speed, and cost. However, the list of available models is greater than four. We will see later how we can use models like text-search-babbage-query-001.

Printing all of the models looks like it may be a JSON object or a dictionary. In reality, the return type from the API call is OpenAIObject. However, we can treat it like a dictionary. The code below prints out the first model and its metadata.

models = openai.Model.list()

print(models["data"][0])

## **Try this variation:**

* Create a list of all the model IDs without any other metadata.

models = openai.Model.list()

model\_ids = [model["id"] for model in models["data"]]

print(model\_ids)

## **Retrieve Model Endpoint**

## **List Engines Endpoint Signature**

GET https://api.openai.com/v1/models/{model}

Instead of parsing the list of models, you can retrieve metadata about a specific one if you know the id for the model. The code sample below prints out the metadata for the text-davinci-002 model.

model = openai.Model.retrieve("text-davinci-002")

print(model)

Code sample for the “metadata” endpoints

import os

import openai

import secret

openai.api\_key=secret.api\_key

*# show all models*

*#models = openai.Model.list()*

*#print(models)*

*# show specific model by array index*

*#models = openai.Model.list()*

*#print(models["data"][4])*

*# show list of all model ids*

*#models = openai.Model.list()*

*#model\_ids = [model["id"] for model in models["data"]]*

*#print(model\_ids)*

*# show number of models*

models = openai.Model.list()

print(len(models["data"]))

*# show model metadata by model id*

model = openai.Model.retrieve("dall-e-2")

print(model)

# **Embeddings**

## **Embedding Endpoint**

## **Embeddings Endpoint Signature**

POST https://api.openai.com/v1/embeddings

The API also has another experimental endpoint called embeddings. Embeddings are a representation of a given input as a vector of floating point numbers. Embeddings can be easily consumed by machine learning models and algorithms. They are often used to determine the semantic similarity between two texts. If two texts are similar, then their vector representations should also be similar.

Currently OpenAI offers three families of embedding models that allow for text search, text similarity and code search. Each family includes up to four models on a spectrum of capabilities:

* **Ada** (1024 dimensions),
* **Babbage** (2048 dimensions),
* **Curie** (4096 dimensions),
* **Davinci** (12288 dimensions).

These embedding models are specifically created to be good at a particular task. For example, text-similarity-ada-001 is good at capturing semantic similarity between two or more pieces of text. Or text-search-ada-doc-001 helps measure whether long documents are relevant to a short search query. For more information on embeddings, see the OpenAI [documentation](https://beta.openai.com/docs/guides/embeddings).

## **Creating an Embedding**

In this example, we are going to use the text-similarity-babbage-001 model. We also need to provide some text for the embedding. This is done with the input keyword argument. Both of these are required. The user keyword argument is optional. This unique identifier can be used to help monitor for abuse. The code sample below should print a long list of floating point numbers.

emb=openai.Embedding.create(

model="text-similarity-babbage-001",

input="You will rejoice to hear that no disaster has accompanied the")

print(emb)

Just like the list of models, the return object is of type OpenAIObject. If you want to access just the vector, change the print statement to the following:

print(emb["data"][0]["embedding"])

import os

import openai

import secret

openai.api\_key=secret.api\_key

*# WRITE YOUR CODE HERE*

emb=openai.Embedding.create(

model="text-embedding-ada-002", *# text-similarity-babbage-001",*

input="You will rejoice to hear that no disaster has accompanied the")

*# show the entire result*

print(emb)

*# show the similarity vector only*

print(emb["data"][0]["embedding"])

# **Edits**

### **Edits**

Given a prompt and an instruction, the model will return an edited version of the prompt.

POST https://api.openai.com/v1/edits

edi= openai.Edit.create(

model="text-davinci-edit-001",

input="What day was it? Wesdneday?",

instruction="Fix the spelling mistakes"

)

print(edi['choices'][0]['text'].strip())

using chatgpt: Fix the spelling mistakes in the following: What day was it? Wesdneday?

### **The Edit body**

Similarly to our create call our edit calls can take a couple of arguments to help the user better control what is generated.

The must-have arguments are model and instruction.

edi= openai.Edit.create(

model="text-davinci-edit-001",

instruction="Captitalize the first letter of all the words in the sentence"

)

print(edi['choices'][0]['text'].strip())

For our purposes we are also going to make input as a default because it keeps it clean about what is the input we are interacting with.

input : is optional but defaults to an empty string when no argument is specified. It is used as a starting point for the edit.  
instruction: is required and tell the AI how to edit the prompt

edi= openai.Edit.create(

model="text-davinci-edit-001",

input="What day was it? Wesdneday?",

instruction="change wednesday to saturday."

)

print(edi['choices'][0]['text'].strip())

Feel free to try it more than once, there might be a chance the AI misinterprets the directions.  
Similarly, to create a call there are a couple of other optional arguments. In this case, we could have added n, temperature and top\_p.

n: defaults to 1 and tells how many edits to create from input and instruction  
temperature: defaults to 1 , higher values mean the model will take more risks.  
top\_p: 0.1 means only the tokens comprising the top 10% probability mass are considered.

A Try It button is provided in case you wanted to try adding some of those variables.

# **Coding Exercise**

# ***Coding Exercise***

Using the OpenAI Edit API, create a Python function fix\_spelling that takes a string as input and returns a corrected version of the input with spelling mistakes fixed. The function should use the text-davinci-edit-001 model. For a more effective output make top\_p=0.1 as one of your arguments.

import openai

import secret

openai.api\_key=secret.api\_key

def fix\_spelling(text: str) -> str:

*#please putyour code below this line*

edi= openai.Edit.create(

model="text-davinci-edit-001",

top\_p=0.1,

input=text,

instruction="fix the spelling mistakes"

)

*#print(edi['choices'][0]['text'].strip())*

return edi['choices'][0]['text'].strip()

*# WRITE YOUR CODE HERE*

*# FREEZE CODE BEGIN*

input\_texts = [

"I hve a bananna for brekfast.",

"The colur of the sky is rde.",

"The grass is greneer on the other side."

]

for input\_text in input\_texts:

output\_text = fix\_spelling(input\_text)

print(f"Input: {input\_text}\nOutput: {output\_text}\n")

*# FREEZE CODE END*

Fix the spelling mistakes in the following sentences:

1: I hve a bananna for brekfast.

2: The colur of the sky is rde.

3: The grass is greneer on the other side.

# **Customizing GPT-3**

One of the key endpoints that allows you to get the most of your GPT-3 model is the fine-tuning endpoint. By definition fine-tuning means adjusting precisely so as to bring to the highest level of performance or effectiveness. In other words, to adjust (something) so that it works perfectly. The fine-tuning endpoint allows you to customize the model to your particular use case.

### **Few-shot Learning**

OpenAI pre-trained GPT-3 with a prepared data set in a semi-supervised fashion. If given a prompt and a few examples it can most likely guess what task you are trying to perform and generate a completion based on that. This process is called **Few-shot Learning**.

With fine-tuning one is able to customize a model for your application. We can use our own data and create a model custom made for our different projects. Customizing makes GPT-3 more efficient and faster. Matter of fact, it even allows us to use cheaper models more efficiently.

### **One-shot Learning**

One way to help with understand few-shot is learning about One-shot learning. **One-shot learning** is a concept in machine learning where a learning algorithm is capable of understanding information about an object, task, or event from a single instance or experience. The term “one-shot” comes from the idea that the machine only gets one “shot” or opportunity to learn about a concept. It’s quite a challenging problem for machine learning, since typically, these algorithms depend on large quantities of data to accurately learn and generalize.

Humans are particularly good at one-shot learning. For example, if a child is shown a picture of a type of animal they’ve never seen before, say a pangolin, they can usually recognize it after seeing it just once. If the child is later shown a bunch of pictures of different animals, they can usually pick out the pangolin from the lineup. AI researchers hope to achieve this level of understanding and flexibility with machine learning algorithms.

# **Fine-Tuning**

Fine-Tuning lets you get more out of the models available through the API by providing:

1. Higher quality results than prompt design
2. Ability to train on more examples than can fit in a prompt
3. Token savings due to shorter prompts
4. Lower latency requests

Fine-tuning is all about changing the model so it can generate the responses you want every time. The capabilities and knowledge of the model will be fully focused on the dataset used for fine-tuning.

Fine-tuning improves on few-shot learning by training on many more examples than can fit in the prompt, letting you achieve better results on a wide number of tasks. Once a model has been fine-tuned, you won’t need to provide examples in the prompt anymore. For example, this is how the dataset **json** file would look like.

{"prompt": "<prompt text>", "completion": "<ideal generated text>"}

{"prompt": "<prompt text>", "completion": "<ideal generated text>"}

{"prompt": "<prompt text>", "completion": "<ideal generated text>"}

JSONL, stands for JSON Lines. It is a format that represents structured data as a sequence of JSON objects, each on a separate line. Instead of a single JSON object enclosed within curly braces, each line in a JSONL file represents a separate, self-contained JSON object. This makes JSONL a format suitable for streaming large amounts of data or processing data line by line.

Before we get started, it is recommended to install the OpenAI command-line interface. To do this we are going to run the following command in the terminal (left panel).

pip install --upgrade openai

Fine-tuning is a powerful technique to create a new model that’s specific to your use case. Before fine-tuning your model, we strongly recommend reading these best practices and [specific guidelines](https://beta.openai.com/docs/guides/fine-tuning/specific-guidelines) for your use case.

<https://beta.openai.com/docs/guides/fine-tuning/specific-guidelines>

# **Program Using OpenAI**

GPT-3 API is a powerful set of tools for natural language processing that can help developers create innovative applications. Now that we are more or less familiar with GPT-3’s API we are going to create our first program using the API. This will serve two goals:

1. It will help to get some practice using Python and the OpenAI API
2. Practice our prompt generation

## **Moflix**

We are going to create a movie recommendation program powered by OpenAI’s GPT-3. The program will be named Moflix. Your Python file will be located in the top left , this is where you will put in your code. Lastly, you will be provided with the standard box(located in the bottom left) that we can use as our GPT playground.

For starters, let’s try generating what we want. Use the playground to ask for the following prompt and then run our Try it! button.  
Give me 5 movie recommendations

## **UX**

I know that typing the prompt into our playground is an easy solution, but why don’t we take it a step further and create a program specifically designed for movie recommendations? This program will be tailored to give users a smoother movie searching experience, requiring less typing than GPT-3. We’ll also focus on UX design to give our users an even better experience. This program will make it easier to find the perfect movie recommendation without having to put in the extra effort on our user.

**UX** stands for User Experience and refers to the overall experience a user has when interacting with a product or service. It encompasses aspects such as the design, usability, and functionality of an interface, and takes into account the user’s needs, motivations, and expectations. A good UX should be enjoyable, intuitive, and provide a positive user experience.

# **Part 1. Box Creation**

We are going to create a Python function that asks the user for some information. We will use the information given by the user to create our program.

We will be interacting with user input we are going to use the terminal to interact with our program. The Try It button below will run your code inside the terminal .

First, let’s create a function that takes a list of movies and put it in a nice box. As we don’t have our movie list yet, we are going to create a sample list. Copy and paste the following inside our moflix.py

sample=["One life","Two","Potato Pie and Life"]

print(sample)

Codio Terminal help

Welcome to Ubuntu 18.04.5 LTS (GNU/Linux 6.2.0-1017-aws x86\_64)

\* Documentation: https://help.ubuntu.com

\* Management: https://landscape.canonical.com

\* Support: https://ubuntu.com/advantage

\* Canonical Livepatch is available for installation.

- Reduce system reboots and improve kernel security. Activate at:

https://ubuntu.com/livepatch

\*

\* Welcome to the Codio Terminal!

\*

\* https://docs.codio.com/develop/develop/ide/boxes/overview

\*

\* Your Codio Box domain is: pogoigor-dolbycanal.codio.io

\*

Last login: Fri Sep 30 15:04:13 2022 from 192.168.10.226

codio@pogoigor-dolbycanal:~/workspace$

We are going to create a function that takes an argument which is our movie list. That function should return the movie list in a nice box.  
+---------------------+

| One Life |

| Two |

| Potato Pie and Life |

+---------------------+

Our box should change based on the number of movies and the length of the items that need to fit in the box. We are going to create our function called InBox that first tries to get the length of the biggest element in our list.

def InBox(x):

#this gives you the longest string

biggest = max(x, key = len)

#THIS gets you the length of the biggest string

biggest=len(biggest)

Nothing should generate, this is a test that we don’t have any errors so far.

Now for the top of our box we are going to start and end with + . Then for the content in the middle we will fill it with -. This technique will be used for both our top and bottom.

print("+" + "-" \* (biggest + 2) + "+")

To try it, use the sample provided above sample=["One life","Two","Potato Pie and Life"] and call the function: InBox(sample) .

We want to focus on the middle part now. We will use a for loop to iterate through all our items. We’ll start off with a | and then add our movie title. We’ll then add additional whitespaces " " to match the length of the longest element.

for i in x:

print("| " + i + (" "\*(biggest-len(i))) + " |")

Then we will go outside our for loop and add the same code we used to create the top layer, in order to create our bottom layer.

In order to make our design look nicer, let’s try making our box look different.

sample=["One life","Two","Potato Pie and Life"]

print(sample)

def InBox(x):

*#this gives you the longest string*

biggest = max(x, key = len)

*#THIS gets you the length of the biggest string*

biggest=len(biggest)

print("+" + "-" \* (biggest + 2) + "+")

for i in x:

print("| " + i + (" "\*(biggest-len(i))) + " |")

print("+" + "-" \* (biggest + 2) + "+")

InBox(sample)

# **Part 2. Prompt Creation**

Now that we have our box we need to be able to fill it with a list of movies. The next step we are going to take is creating our prompt. We are going to create a function called Moreflix that will prompt the user for:

1. The number of recommendations they want
2. The genre they want
3. A similar movie they have in mind.

We write the code below to take care of that. The function will prompt users and return a prompt for us to feed to our OpenAI. We want the user to be able to type 0 if they don’t have an answer in mind.

def Moreflix():

# ask the user for different inputs

print("Enter 0, if you don't have an answer in mind")

number\_recs=int(input('How many movies do you want recommended: '))

genre=input('What genre are you looking for: ')

similar= input('What is a similar movie: ')

To try it add the print statement print(Moreflix()) and press the button below

From there we have all the tools needed for us to write our prompt. First of all if they add 0 to the number of recs we will default it to 5 for them.

if number\_recs<=0:

number\_recs=5

For the others if 0 is included we will generate a prompt simply asking for the number of recommendation. But first we are about to create our first prompt. A quick reminder,here are three basic guidelines to creating better results:

* **Show and tell**
* **Provide quality data**
* **Check your settings**

We are going to focus on show and tell on 3 things:

1. Giving the model clear instructions (tell)
2. Giving the model an example (show)
3. Giving the model clear instructions and an example (show and tell)

In order for the prompt to generate more clear answers, try the following prompt in the playground in the bottom left next to your terminal. In a python array form, give me 3 movie recommendation

Now that we have a sample prompt and have an idea of what the response would look like, we can start coding. We are going to take care of edge cases where the users do not provide all the information. Base on the information that the user provides we will, create different prompts. For example here is an example where the user do not provide a genre or a similar movie. Copy and paste the code to the moflix file on your left.

if genre=="0" and similar=="0":

return("In a python array form, give me " + str(number\_recs) +" movie recommendation")

Now we can take care of the additional scenarios

if genre=="0" :

return ("In a python array form, give me " + str(number\_recs) +" movie recommendation, similar to " + similar)

if similar=="0":

return ("In a python array form, give me "+genre + " "+ str(number\_recs) +" movie recommendations")

return ("In a python array form, give me "+genre +" "+str(number\_recs)+" movie recommendation similar to " + similar)

Now run the following to make sure all the work is going well. To make our code cleaner, feel free to remove the print statements when done with it.  
print(Moreflix())

To increase our accuracy, of getting the AI to do what we want after our prompt we will start it off with providing it space to do what we want  
Prompt=Moreflix() + "rec="

For chatGpT In a python array form, give me 3 sci-fi movie recommendations. Don't output anything else except the python array.

MOVIe RECommendation code, output box and prompt generation

*# Output a bunch of lines of text in a nice ASCII box*

def InBox(x):

*#this gives you the longest string*

biggest = max(x, key = len)

*#THIS gets you the length of the biggest string*

biggest=len(biggest)

print("+" + "-" \* (biggest + 2) + "+")

for i in x:

print("| " + i + (" "\*(biggest-len(i))) + " |")

print("+" + "-" \* (biggest + 2) + "+")

*# Construct a GPT prompt to get a bynber if movie recommentations by asking the user for genre, era and similarity.*

def Moreflix():

*# ask the user for different inputs*

print("Enter 0, if you don't have an answer in mind")

number\_recs=int("0" + input('How many movies do you want recommended: '))

if number\_recs<=0:

number\_recs=5

print("Will actually get " + str(number\_recs))

genre=input('What genre are you looking for: ')

era=input("What era are you looking for: (classical, recent, 80's etc...) ")

similar= input('What is a similar movie: ')

if genre!="":

genre=genre.strip() + " "

if era!="":

era=era.strip() + " "

if similar!="":

similar=", similar to " + similar.strip()

return ("In a python array form, give me "+ str(number\_recs) + " " + era + genre + "movie recommendation" + similar)

sample=["One life","Two","Potato Pie and Life"]

*#InBox(sample)*

prompt=Moreflix() + " rec="

print(prompt)

# **Part 3. Presenting Info**

Now that we have our prompt let’s take care of integrating our OpenAI API key as we have done before . Ideally you will move to the top of our file.

import os

import openai

import secret

openai.api\_key=secret.api\_key

Let’s create a quick function that takes a prompt and returns our movie results . This function should go between our InBox and Moreflix functions. We are going to call this function Res short for response. This function should work as all the previous prompts we generated using our API.

def Res(x):

response = openai.Completion.create(

model="text-davinci-002",

prompt=x,

top\_p=1,

max\_tokens=100

)

return(response['choices'][0]['text'].strip())

After checking that everything works as intended we can change our print to a value assignment. Set the Res function call to the variable movies.  
movies=Res(Prompts).

We are at the finish line. We know that the response generated by GPT-3 was a string. Even though, it was a string we want to convert it to an actual list. After that we can call InBox from our list.

# Converting string to list

import ast

movie\_list=ast.literal\_eval(movies)

InBox(movie\_list)

One last piece we are going to take care of are edge cases where the completions contains a numerated list or additional characters:

import ast

Prompts=Moreflix() + "rec ="

movies=(Res(Prompts))

try:

movie\_list=ast.literal\_eval(movies)

except:

movie\_list2=""

for i in movies:

if i=="]":

movie\_list2+=(i)

break

else:

movie\_list2+=(i)

movie\_list=ast.literal\_eval(movie\_list2)

InBox(movie\_list)

Your program should be able to generate something like the image below.

codio@pogoigor-dolbycanal:~/workspace$ python3 moflix.py

Just press <Enter>, if you don't have an answer in mind

How many movies do you want recommended:

Will actually get 5

What genre are you looking for:

What era are you looking for: (classical, recent, 80's, ...)

What is a similar movie:

+-------------------------------+

| Footloose (1984) |

+-------------------------------+

| Purple Rain (1984) |

+-------------------------------+

| Flashdance (1983) |

+-------------------------------+

| Dirty Dancing (1987) |

+-------------------------------+

| Little Shop of Horrors (1986) |

+-------------------------------+

| The Blues Brothers (1980) |

+-------------------------------+

| Top Gun (1986) |

+-------------------------------+

| Streets of Fire (1984) |

+-------------------------------+

codio@pogoigor-dolbycanal:~/workspace$

My completed program with addition of era input

import os

import openai

import secret

openai.api\_key=secret.api\_key

*# Output a bunch of lines of text in a nice ASCII box*

def InBox(x):

*#this gives you the longest string*

biggest = max(x, key = len)

*#THIS gets you the length of the biggest string*

biggest=len(biggest)

print("+" + "-" \* (biggest + 2) + "+")

for i in x:

print("| " + i + (" "\*(biggest-len(i))) + " |")

print("+" + "-" \* (biggest + 2) + "+")

*# Look up movie recommendation given a query prompt*

*# hard code the results since the API call fails...*

def Res(x):

return '["Footloose (1984)", "Purple Rain (1984)", "Flashdance (1983)", "Dirty Dancing (1987)", "Little Shop of Horrors (1986)", "The Blues Brothers (1980)", "Top Gun (1986)", "Streets of Fire (1984)"]'

*# response = openai.Completion.create(*

*# model="text-davinci-002",*

*# prompt=x,*

*# top\_p=1,*

*# max\_tokens=100)*

*# return(response['choices'][0]['text'].strip())*

*# Construct a GPT prompt to get a bynber if movie recommentations by asking the user for genre, era and similarity.*

def Moreflix():

*# ask the user for different inputs*

print("Just press <Enter>, if you don't have an answer in mind")

number\_recs=int("0" + input('How many movies do you want recommended: '))

if number\_recs<=0:

number\_recs=5

print("Will actually get " + str(number\_recs))

genre=input('What genre are you looking for: ')

era=input("What era are you looking for: (classical, recent, 80's, ...) ")

similar= input('What is a similar movie: ')

if genre!="":

genre=genre.strip() + " "

if era!="":

era=era.strip() + " "

if similar!="":

similar=", similar to " + similar.strip()

return ("In a python array form, give me "+ str(number\_recs) + " " + era + genre + "movie recommendation" + similar)

sample=["One life","Two","Potato Pie and Life"]

*#InBox(sample)*

Prompts=Moreflix() + " rec="

*#print(Prompts)*

*# Converting string to list*

import ast

movies=Res(Prompts)

*#print(movies)*

try:

movie\_list=ast.literal\_eval(movies)

except:

movie\_list2=""

for i in movies:

if i=="]":

movie\_list2+=(i)

break

else:

movie\_list2+=(i)

movie\_list=ast.literal\_eval(movie\_list2)

InBox(movie\_list)

# Codio: Creating Playground

# **Chat GPT-3**

Generally we can :

1. Use GPT-3 to generate natural language text for a given topic. This can be used to quickly generate blog posts, essays, and other forms of copy.
2. Utilize GPT-3 to generate product descriptions, titles and other marketing materials.
3. Use GPT-3 to automate customer support tasks such as FAQs and customer service emails.
4. Leverage GPT-3 to generate technical documentation and software manuals.
5. Automate the process of summarizing long articles with GPT-3.
6. Generate personalized emails and messages with GPT-3.
7. Create interactive simulations, tutorials, and interactive demonstrations with GPT-3.
8. Use GPT-3 to generate lyrics for songs and poems.
9. Create engaging and interesting conversations with GPT-3.
10. Automate the process of creating resumes, cover letters, and other job application documents.

# **Sample Playground**

We have used the playground to classify. For example try the following.  
GPT-3 can classify items into categories. Use the file on the left to write your prompts. Try the prompt below:

classify the following : cat, dog , car , plane

We are going to create our own playground to try and run the following 5 tasks.

1. Use GPT-3 to generate natural language text for a given topic. This can be used to quickly generate blog posts, essays, and other forms of copy.
2. Utilize GPT-3 to generate product descriptions, titles and other marketing materials.
3. Use GPT-3 to automate customer support tasks such as FAQs and customer service emails.
4. Leverage GPT-3 to generate technical documentation and software manuals.
5. Automate the process of summarizing long articles with GPT-3.

We will get to all of that but first we want to create a text file that is able to do what the playground on our left can do. Again on the idea of creating a more user-friendly program.

Let’s ask the box to:

generate a blog post about a pizza shop

Our goal in this lesson is to recreate the box. The user should be able to write whatever they want and that should be passed on as the prompt. After that the generated answer will also be placed in your file.

# **Response**

On the top left we have our Python file. On the bottom left we have the empty text file where the user will be able to simply write their prompts and generate and get their responses from.

For starters, we are going to use the same structure we have been using before to generate our responses. First, let’s get our libraries.

import os

import openai

import secret

openai.api\_key=secret.api\_key

We need to read our file and just put the contents of it as our prompt.

#open the file

file = open("playground.txt", "r")

#read each line

filelines = file.readlines()

#put all the lines in a single variable

all\_lines = ""

for line in filelines:

all\_lines += line

#close the file

file.close()

print(all\_lines)

It is customary to close the file when done with it. To test our code, we will try a couple of things.  
On the top left in our Python file try running the following code.

print("hello world")

Now instead of printing hello world we are going to print the all\_lines, to try and see the content of the playground.txt file.

print(all\_lines)

Since our playground has no content in it yet we are going to get a blank response. We should have the Codio IDE message that our code successfully ran.

Now let’s try adding the following text on our .txt file (bottom left), and try running our file again since now our playground will not be empty.

write a tagline for an ice cream shop.

It should print out write a tagline for an ice cream shop.. Now that we know we have access to the contents of our file let’s assign it as the prompt instead of printing it.

prompts = all\_lines

We typically employ the following code to prompt users and capture the AI response:

response = openai.Completion.create(

model="text-davinci-002",

prompt=prompts,

max\_tokens=256,

top\_p=0.1)

txt\_response=response['choices'][0]['text'].strip()

print(txt\_response)

Now that we can get it to generate a response on the content of our text file we are going to have it write down the response in that same text file. For that we need to first open our file then simply add the response in to the text file instead of printing it.

*#open our file, and append to it*

f = open("playground.txt", "a")

*#write the response we want to append*

f.write((txt\_response))

*#close our file*

f.close()

From that we realize it generates our response on the same line. Delete the text in the playground file. Have it go back to simply:

Write a tagline for an ice cream shop

Before we write our response we are going to make sure it adds to a new line so we will change our code to the following:

#write the response we want to append f.write(("\n")) f.write((txt\_response))

Feel free to try it with different prompts. For example:

Give me 5 movie recommendations.

Let’s just say it’s a pain to keep erasing. Let’s add some code that will clear our text file for us. We will use the key word //clear// in our playground to know to clear it instead of generating anything. In other words, if in a our file we see the //clear// keyword our program instead of generating anything will give us a blank page. Copy and paste the following in our code above the code we have already written. For the else case, we are going to make the code we have already written the contents for it.

# if the code word is present we clear the contents

if '//clear//' in open('playground.txt').read():

open("playground.txt", "w").close()

else:

Opening a file in “write” mode clears it. Again we have to close it after we are done with it. Inside the else statement we can indent the rest of the code we have previously written

Example code, with try/catch since the api call does not actually work

import os

import openai

import secret

openai.api\_key=secret.api\_key

*#open the file*

file = open("playground.txt", "r")

*#read each line*

filelines = file.readlines()

*#put all the lines in a single variable*

all\_lines = ""

for line in filelines:

all\_lines += line

*#close the file*

file.close()

*#print(all\_lines)*

prompts = all\_lines

try:

response = openai.Completion.create(

model="text-davinci-002",

prompt=prompts,

max\_tokens=256,

top\_p=0.1)

except openai.error.InvalidRequestError:

txt\_response="Scooping Joy, One Flavor at a Time: Indulge in the Sweet Symphony of Happiness at [Shop Name]!"

else:

txt\_response=response['choices'][0]['text'].strip()

*#finally:*

*# print(txt\_response)*

*# if the code word is present we clear the contents*

if '//clear//' in open('playground.txt').read():

open("playground.txt", "w").close()

else:

*#open our file, and append to it*

f = open("playground.txt", "a")

*#write the response we want to append*

f.write(("\n"))

f.write((txt\_response))

*#close our file*

f.close()

# **Using Our Box**

Let’s use our new playground to generate a couple more prompts. Feel free to modify at your own leisure. But practice running the following prompts

1. Generate blog posts, essays, and other forms of copy.

write a short essay about willy wonka

If the text generated is too long and you have to scroll to read everything you can click on the View tab.

2. Utilize GPT-3 to generate product descriptions, titles and other marketing materials.

Write a description for Codio, the best learning website.

3. Use GPT-3 to automate customer support tasks such as FAQs and customer service emails.

Clear the previous text in the playground. Feel free to manually do it, or type//clear// in your playground. Before asking it to:

generate a customer service email to apologize for our website being down. Let customers know that the issue was fixed.

4. Leverage GPT-3 to generate technical documentation and software manuals.

generate a short technical document on how to use gpt-2.

5. Automate the process of summarizing long articles with GPT-3.

summarise the content of this webpage (<https://arxiv.org/abs/2005.14165>).

# **Coding Exercise**

For our coding exercise we are going to create an extra feature similar to //clear//.

You can implement a feature where certain keywords trigger GPT-3 to generate specific types of content. For example,//joke// could make the program generate a random joke, //quote// could trigger a famous quote generation, and //news// could lead to a summary of the day’s top news.

For our assignment modify the code for your program so that if the user types in //joke// a joke will be outputted. Have your code so that //clear// has a priority than joke. Meaning if both keywords are present it will just clear the page.

**Be sure** to click the Try It to run your box.

import os

import openai

import secret

openai.api\_key=secret.api\_key

model = "gpt-3.5-turbo-instruct"

playfile = "playground.txt"

GET\_JOKE="generate a joke"

JOKE="Why don't scientists trust atoms?\n\nBecause they make up everything!"

DEFAULT="Scooping Joy, One Flavor at a Time: Indulge in the Sweet Symphony of Happiness at [Shop Name]!"

def emptyFile(name):

open(name, "w").close()

def readFile(name):

file = open(name, "r")

filelines = file.readlines()

all\_lines = ""

for line in filelines:

all\_lines += line

file.close()

return all\_lines

def writeFile(name, content):

f = open(name, "a")

f.write(("\n"))

f.write((content))

f.close()

def checkFile(name, flag):

return flag in open(name).read()

def getResponse(prompts, default = DEFAULT):

failed=True

try:

response = openai.Completion.create(

model=model,

prompt=prompts,

max\_tokens=256,

top\_p=0.1)

except: *# openai.error.InvalidRequestError:*

*# openai.error.RateLimitError:*

failed=True

else:

failed=False

txt\_response=response['choices'][0]['text'].strip()

finally:

if failed:

txt\_response=default.strip()

*# except openai.error.InvalidRequestError:*

*# txt\_response="Scooping Joy, One Flavor at a Time: Indulge in the Sweet Symphony of Happiness at [Shop Name]!"*

*#else:*

*#finally:*

*#print(txt\_response)*

return txt\_response

*# if the code word is present we clear the contents*

if checkFile(playfile, '//clear//'):

emptyFile(playfile)

else:

if checkFile(playfile, '//joke//'):

emptyFile(playfile)

prompts = GET\_JOKE

response = getResponse(prompts, JOKE)

writeFile(playfile, response)

else:

prompts = readFile(playfile)

response = getResponse(prompts)

writeFile(playfile, response)

suggest improvements to this python code snippet:

model=”something”

DEFAUL=”something...”

TRUE=1==1

FALSE=1==0

def getResponse(prompts, default = DEFAULT):

failed=TRUE

try:

response = openai.Completion.create(

model=model,

prompt=prompts,

max\_tokens=256,

top\_p=0.1)

except: *# openai.error.InvalidRequestError:*

failed=TRUE

else:

failed=FALSE

txt\_response=response['choices'][0]['text'].strip()

finally:

if failed:

txt\_response=default.strip()

return txt\_response

<https://codio.com/home/student?course_id=13f9e74a783e8453efe870ef22de3ac7>

import openai

MODEL = "something"

DEFAULT = "something..."

MAX\_TOKENS = 256

TOP\_P = 0.1

def get\_openai\_response(prompts, default=DEFAULT):

"""

Get response from OpenAI based on prompts.

Args:

prompts (str): Input prompts for OpenAI.

default (str): Default response if OpenAI request fails.

Returns:

str: OpenAI response or default response.

"""

failed = True

try:

response = openai.Completion.create(

model=MODEL,

prompt=prompts,

max\_tokens=MAX\_TOKENS,

top\_p=TOP\_P

)

except # openai.error.InvalidRequestError:

failed = True

else:

failed = False

txt\_response = response['choices'][0]['text'].strip()

finally:

if failed:

txt\_response = default.strip()

return txt\_response

Lab1: The Simple Bot

# **Introduction to Chatbots**

One of the most common tasks and a subset of Natural Language Processing is **Natural Language Generation** (NLG).

* It is also sometimes described as the opposite of speech recognition.
* It’s the task of generating human language text responses by putting together structured information.
* This information follows **syntactical** and **semantic** rules from a program’s knowledge base.

The best examples of real-world applications of this concept are **virtual agents** and **chatbots**.

* Apple’s Siri and Amazon’s Alexa are examples of virtual agents.
* They use:
  + **Speech recognition** to understand user commands
  + **NLG** to respond with the required information or conduct the requested action.

A **Chatbot**, on the other hand, operates on **typed text**.

* It processes and simulates **human dialogs** and **conversations**, allowing users to interact with various kinds of digital services.
* They can be as simple as a program comprised of a set of **hard-coded rules**, to very sophisticated **AI-based** chatbots that deliver **personalized responses** and learn as they go.

Connected Codio to github account with SSH keys then forked repo

# **https://github.com/codio-content/nlp-simplebot**

# [**https://github.com/bcowgill/nlp-simplebot**](https://github.com/bcowgill/nlp-simplebot)

**git clone git@github.com:bcowgill/nlp-simplebot.git**

# **Initializing the GUI**

### **A simple, rule-based chatbot.**

Let’s start by building a GUI for our chatbot. We’ll use **tkinter**, the standard Python GUI library.

The first step is to import all the necessary modules into our file.  
Paste the following code in the top left pane:

import tkinter.scrolledtext as tks #creates a scrollable text window

from datetime import datetime

from tkinter import \*

To make a simple GUI for our chatbot, it should have 4 main components:

1. baseWindow - the main GUI window that contains everything
2. chatWindow - displays the conversation between a user and the chatbot
3. userEntryBox - for the user to type their queries for the Chatbot
4. sendButton - a button that sends the user query to the Chatbot

Let’s use tkinter to initialize the baseWindow and the other components and place them on the baseWindow.

Paste the following code in the top left pane under the import statements:

*# Create the main application window using Tk()*

baseWindow = Tk()

*# Set the title of the window*

baseWindow.title("The Simple Bot")

*# Set the size of the window*

baseWindow.geometry("500x250")

*# Create the chat window as a ScrolledText widget with "Arial" font*

chatWindow = tks.ScrolledText(baseWindow, font="Arial")

*# Configure tags for message alignment: 'tag-left' for bot messages, 'tag-right' for user messages*

chatWindow.tag\_configure('tag-left', justify='left')

chatWindow.tag\_configure('tag-right', justify='right')

*# Disable the chat window initially (it should not be editable by the user)*

chatWindow.config(state=DISABLED)

*# Create the send button, with specific font, text, and background color*

*# The 'command' option is commented out. Uncomment it and replace 'send' with your send function's name*

sendButton = Button(

baseWindow,

font=("Verdana", 12, 'bold'),

text="Send",

bg="#fd94b4",

activebackground="#ff467e",

fg='#ffffff',

*# command=send*

)

*# Create the user entry box where the user types their messages*

*# bd= border depth. 1Px just a border, bigger numbers give deeper 3d effect*

userEntryBox = Text(baseWindow, bd=1, bg="white", width=38, font="Arial")

*# Place the chat window, user entry box, and send button on the main window using specific coordinates and sizes*

chatWindow.place(x=1, y=1, height=200, width=500)

userEntryBox.place(x=3, y=202, height=27)

sendButton.place(x=430, y=200)

*# Start the main event loop to keep the application running and responsive*

baseWindow.mainloop()

# **Implementing functions for the GUI**

At this point, the sendButton doesn’t do anything.  
Let’s define a function called send which should do the following:

* Collect the user\_input from the textBox
* Get the bot\_response
* Insert both of these into the chatWindow

Paste the following code in the top left pane, right under the import statements:

def send(event):

chatWindow.config(state=NORMAL)

user\_input = userEntryBox.get("1.0",'end-2c')

user\_input\_lc = user\_input.lower()

bot\_response = get\_bot\_response(user\_input\_lc)

create\_and\_insert\_user\_frame(user\_input) create\_and\_insert\_bot\_frame(bot\_response)

chatWindow.config(state=DISABLED)

userEntryBox.delete("1.0","end")

chatWindow.see('end')

Once we have the user\_input and bot\_response, we’ll write a couple of functions to insert them into the chatWindow

Paste the following code in the top left pane, right above the send function:

def create\_and\_insert\_user\_frame(user\_input):

userFrame = Frame(chatWindow, bg="#d0ffff")

Label(

userFrame,

text=user\_input,

font=("Arial", 11),

bg="#d0ffff"

).grid(row=0, column=0, sticky="w", padx=5, pady=5)

Label(

userFrame,

text=datetime.now().strftime("%H:%M"),

font=("Arial", 7),

bg="#d0ffff"

).grid(row=1, column=0, sticky="w")

chatWindow.insert('end', '\n ', 'tag-right') chatWindow.window\_create('end', window=userFrame)

def create\_and\_insert\_bot\_frame(bot\_response):

botFrame = Frame(chatWindow, bg="#ffffd0")

Label(

botFrame,

text=bot\_response,

font=("Arial", 11),

bg="#ffffd0",

wraplength=400,

justify='left'

).grid(row=0, column=0, sticky="w", padx=5, pady=5)

Label(

botFrame,

text=datetime.now().strftime("%H:%M"),

font=("Arial", 7),

bg="#ffffd0"

).grid(row=1, column=0, sticky="w")

chatWindow.insert('end', '\n ', 'tag-left') chatWindow.window\_create('end', window=botFrame) chatWindow.insert(END, "\n\n" + "")

Now, we want to bind the send function to the sendButton. We can also bind the Enter key to the window so we don’t have to click on the button every time.

Replace the sendButton initialization in the top left pane with the following code:

# **The bot response function**

# ***The bot response function***

The bot\_response function is the logic function for the chatbot. This is where we will define the rules that the chatbot will follow to respond to user\_input

Paste the following code in the top left pane, right below the import statements:

# Generating response

def get\_bot\_response(user\_input):

bot\_response = ""

if(user\_input == "hello"):

bot\_response = "Hi!"

elif(user\_input == "hi" or user\_input == "hii" or user\_input == "hiiii"):

bot\_response = "Hello there! How are you?"

elif(user\_input == "how are you"):

bot\_response = "Oh, I'm great! How about you?"

elif(user\_input == "fine" or user\_input == "i am good" or user\_input == "i am doing good"):

bot\_response = "That's excellent! How can I help you today?"

else:

bot\_response = "I'm sorry, I don't understand..."

return bot\_response

This was the last step! We have successfully built our first chatbot! Let’s run it and interact with it!

Full code

import tkinter.scrolledtext as tks #creates a scrollable text window

from datetime import datetime

from tkinter import \*

# Generating response

def get\_bot\_response(user\_input):

return bot\_response

def create\_and\_insert\_user\_frame(user\_input):

userFrame = Frame(chatWindow, bg="#d0ffff")

Label(

userFrame,

text=user\_input,

font=("Arial", 11),

bg="#d0ffff").grid(row=0, column=0, sticky="w", padx=5, pady=5)

Label(

userFrame,

text=datetime.now().strftime("%H:%M"),

font=("Arial", 7),

bg="#d0ffff"

).grid(row=1, column=0, sticky="w")

chatWindow.insert('end', '\n ', 'tag-right')

chatWindow.window\_create('end', window=userFrame)

def create\_and\_insert\_bot\_frame(bot\_response):

botFrame = Frame(chatWindow, bg="#ffffd0")

Label(

botFrame,

text=bot\_response,

font=("Arial", 11),

bg="#ffffd0",

wraplength=400,

justify='left'

).grid(row=0, column=0, sticky="w", padx=5, pady=5)

Label(

botFrame,

text=datetime.now().strftime("%H:%M"),

font=("Arial", 7),

bg="#ffffd0"

).grid(row=1, column=0, sticky="w")

chatWindow.insert('end', '\n ', 'tag-left')

chatWindow.window\_create('end', window=botFrame)

chatWindow.insert(END, "\n\n" + "")

def send(event):

chatWindow.config(state=NORMAL)

user\_input = userEntryBox.get("1.0",'end-2c')

user\_input\_lc = user\_input.lower()

bot\_response = get\_bot\_response(user\_input\_lc)

create\_and\_insert\_user\_frame(user\_input)

create\_and\_insert\_bot\_frame(bot\_response)

chatWindow.config(state=DISABLED)

userEntryBox.delete("1.0","end")

chatWindow.see('end')

baseWindow = Tk()

baseWindow.title("The Simple Bot")

baseWindow.geometry("500x300")

chatWindow = tks.ScrolledText(baseWindow, font="Arial")

chatWindow.tag\_configure('tag-left', justify='left')

chatWindow.tag\_configure('tag-right', justify='right')

chatWindow.config(state=DISABLED)

sendButton = Button(

baseWindow,

font=("Verdana", 12, 'bold'),

text="Send",

bg="#fd94b4",

activebackground="#ff467e",

fg='#ffffff',

command=send)

sendButton.bind("<Button-1>", send)

baseWindow.bind('<Return>', send)

userEntryBox = Text(baseWindow, bd=1, bg="white", width=38, font="Arial")

chatWindow.place(x=1, y=1, height=270, width=500)

userEntryBox.place(x=3, y=272, height=27)

sendButton.place(x=430, y=270)

baseWindow.mainloop()

# **The bot response function using GPT-3**

At this point, you must be familiar with OpenAI GPT-3 Toolkit. We are going to interact with our prompt to create a response. How we are going to interact with it is by changing our get\_bot\_response function.

Now we are going to create a function get\_bot\_response.The function get\_bot\_response(user\_input) generates a bot response by sending a user’s input to the OpenAI GPT-3 model, "text-davinci-002", and returns the model’s generated text as the bot’s response, stripped of leading and trailing whitespace.

# Generating response

def get\_bot\_response(user\_input):

prompt = f"Please provide a response to the following user input: '{user\_input}'"

response = openai.Completion.create(

model="text-davinci-002",

prompt=prompt,

max\_tokens=150,

n=1,

stop=None,

temperature=0.5,

)

bot\_response = response.choices[0].text.strip()

return bot\_response

After making sure our code runs without errors we are ready to put it in our main code. Please make sure to copy everything in test.py and paste it after from tkinter import \* in our simplebot.py (bottom left panel). Also make sure to delete our old get\_bot\_response function.

To run our code and try it: please click the button below. Use the other tab in the bottom-left panel

import os

import openai

openai.api\_key=os.getenv('OPENAI\_KEY')

MODEL='gpt-3.5-turbo-instruct'

*#MODEL="text-davinci-002"*

RESPONSE="I don't understand..."

def noop():

return

*# Generating response*

def get\_bot\_response(user\_input):

bot\_response=RESPONSE

prompt = f"Please provide a response to the following user input: '{user\_input}'"

try:

response = openai.Completion.create(

model=MODEL,

prompt=prompt,

max\_tokens=150,

n=1,

stop=None,

temperature=0.5,

)

except openai.error.InvalidRequestError:

noop()

except openai.error.RateLimitError:

noop()

else:

bot\_response = response.choices[0].text.strip()

return bot\_response

print(get\_bot\_response("off with your head!"))

Function with exception handler

*# Generating response*

def get\_bot\_response(user\_input):

bot\_response=RESPONSE

prompt = f"Please provide a response to the following user input: '{user\_input}'"

try:

response = openai.Completion.create(

model=MODEL,

prompt=prompt,

max\_tokens=150,

n=1,

stop=None,

temperature=0.5,

)

except Exception as exception: *# openai.error.InvalidRequestError:*

*# openai.error.RateLimitError:*

bot\_response = bot\_response + " (" + type(exception).\_\_name\_\_ + ") [" + str(exception) + "]"

*# str(exception)*

*# exception.\_\_str\_\_()*

*# exception.\_\_repr\_\_() -- more technical string representation*

*# f"Arguments: {exception.args}" array of strings for message*

*# exception.\_\_traceback\_\_*

*# exception.\_\_cause\_\_ None or ...*

*# exception.\_\_context\_\_ None or ...*

else:

bot\_response = response.choices[0].text.strip()

return bot\_response

DALL-E IMAGE Generation

# ***Learning Objectives***

### **Learners will be able to…**

* **Effectively utilize**openai.Image.create**to generate a response**
* **Successfully generate an image using DALL-E**
* **Analyze and apply the various parameters available in DALL-E API calls**

# **Text to Image**

## **Dall-E**

OpenAI’s **DALL·E** text to image is a system that can generate images from textual descriptions, using a deep learning-based approach. The system is trained on a large dataset of text-image pairs, and can generate new images that are similar to the ones in the training data. The system can generate images that are realistic and editable, and can even create images from scratch, without any training data.

DALL·E models can easily generate images from text, making it a great choice for those who want to create quick and easy visual content.

The Images API provides three methods for interacting with images:

1. Creating images from scratch based on a text prompt
2. Creating edits of an existing image based on a new text prompt
3. Creating variations of an existing image

## **Generating Image**

In order to generate an image using the DALL·E we can use the openai.Image.create call. Here is an example below:

response = openai.Image.create(

prompt="a dog smoking a cigar in a poker room.",

n=1,

size="256x256"

)

You can create an original image based on a text prompt using the image generations endpoint. Images can be sized at 256x256, 512x512, or 1024x1024 pixels, with smaller sizes generate faster. You can request 1-10 images at a time by using the n parameter. A 256x256 would generate faster than 1024x1024. For this course, we will tend to just use the 256 or the 512. These 2 are cheaper and faster to generate. API endpoints are the points where requests are made and responses are sent back. Let’s print the content of the response to see what was generated by the API call.

print(response)

When we printed the response we see there 3 distinct words created, data and inside data we see a URL. Here we want to focus on URL. The URL is the link to the image that the AI generated for us. Data represents all the info generated for the user and creation is pretty much an id. Now that we know what our response looks like we can trim down the response to what we actually want, which is the URL. Remove the print(response) line, and add the following.

image\_url = response['data'][0]['url']

print(image\_url)

We can open another tab in our browser, then we can copy and paste the URL to see the image that we have generated.

Try giving it a different size from the standard size mentioned above. For example, 255x255 or 256x1024.

It should generate an error, please revert back to a 256x256 or 512x512. We want it to be able to generate faster for future outputs. A Try it button is provided below to make sure we are no longer getting errors. It should just generate an URL here.

import os

import openai

import secret

import requests

openai.api\_key=secret.api\_key

response = openai.Image.create(

prompt="a dog smoking a cigar in a poker room.",

n=1,

size="256x256" # 512x512 or 1024x1024

)

image\_url = response['data'][0]['url']

print(image\_url)

import os

import openai

import secret

import requests

openai.api\_key=secret.api\_key

response = openai.Image.create(

prompt="a dog smoking a cigar in a poker room.",

n=1,

size="256x256" # 512x512 or 1024x1024

)

image\_url = response['data'][0]['url']

<https://codio.com/bcowgill/intro-to-dall-e/tree/imageGen.py>

openai.error.InvalidRequestError: Billing hard limit has been reached

response = openai.Image.create(

prompt="a dog smoking a cigar in a poker room.",

n=1,

size="256x256"

)

Traceback (most recent call last):

File "imageGen.py", line 7, in <module>

response = openai.Image.create(

File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_resources/image.py", line 36, in create

response, \_, api\_key = requestor.request(

File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_requestor.py", line 226, in request

resp, got\_stream = self.\_interpret\_response(result, stream)

File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_requestor.py", line 619, in \_interpret\_response

self.\_interpret\_response\_line(

File "/home/codio/anaconda3/lib/python3.8/site-packages/openai/api\_requestor.py", line 679, in \_interpret\_response\_line

raise self.handle\_error\_response(

openai.error.InvalidRequestError: Billing hard limit has been reached

# **Saving our Image**

### **Image Generation**

In order to not have to keep copying and pasting our result, we are going to save the image inside the URL as a file in our Codio box.

The first thing we are going to do is import the requests library.The import requests statement is already included in the imageGen.py file. You do not need to add it yourself.

Using the request library we can get the image contents. We will use a handler to write in our new image file image\_name.jpg. This code should go below all the code, we have already. At this point, we no longer need the print statement for the URL, delete it.

img\_data = requests.get(image\_url).content

with open('image\_name.jpg', 'wb') as handler:

handler.write(img\_data)

Click here to refresh your image

We will be rewriting our file. When regenerating an image we will need to click on our refresh button to see the changes. Try using the buttons below with a few different prompts.

If feeling uninspired, try the following prompts:

* digital art of a white cat ninja.
* acrylic painting of a mountain.
* a chef shark making shrimp.
* digital art of white ninja cat with headband.

Click here to refresh your image

The more descriptive you can be, the closer the image will get to what you are expecting. For example, Here is what it generated for me for that last input.

Writing descriptive OpenAI DALL·E prompts helps the model to better understand the context of the task, allowing it to create more accurate and creative responses. In other words, the more precise the explanation, the greater the probability of achieving the desired outcome for you or your end user.

import os

import openai

import secret

import requests

openai.api\_key=secret.api\_key

response = openai.Image.create(

prompt="a dog smoking a cigar in a poker room.",

n=1,

size="256x256" # 512x512 or 1024x1024

)

image\_url = response['data'][0]['url']

#print(image\_url)

img\_data = requests.get(image\_url).content

with open('image\_name.jpg', 'wb') as handler:

handler.write(img\_data)

Utility function to generate image and save to file.

import os

import openai

import secret

import requests

openai.api\_key=secret.api\_key

# prompt – string to send to Dall-E to generate the image

# filename – string filename.jpg to save the image

# size – string 256x256, 512x512 or 102x1024

# returns string url which contains the generated image

def create\_image\_openai(prompt, filename, size = '256x256'):

response = openai.Image.create(

prompt=prompt,

n=1,

size=size

)

image\_url = response['data'][0]['url']

img\_data = requests.get(image\_url).content

with open(filename, 'wb') as imageFile:

imageFile.write(img\_data)

return image\_url

# **N**

When generating our prompt our code looks something like this:

response = openai.Image.create(

prompt="a dog smoking a cigar in a poker room.",

n=1,

size="256x256"

)

image\_url = response['data'][0]['url']

We have talked about the prompt and the size. The main thing we are calling and have not talked about yet is the n. You can request 1-10 images at a time using the n parameter. Try replacing n with 3.

As you can see from the image file we saved in our response, we got only one image. Let’s try adding a print statement to visualize what we are getting for the URL.

image\_url = response['data'][0]['url']

print(image\_url)

Here we realize that we are going to only get one URL. We are going to change our code to view more of the response data.

image\_url = response['data']

print(image\_url)

Here we can see we got 3 URLs generated. What we are going to do is pull the different URL into separate variables and generate files to save the URL. To make our life easier we should have the following:

image\_url1 = response['data'][0]['url']

image\_url2 = response['data'][1]['url']

image\_url3 = response['data'][2]['url']

Please note you have have had image\_url = response['data'][0]['url'] from the following page,comment it out for now. If you want to check if the URLs look like what you have in mind, you can run the following code:

print(image\_url1[0:15])

print(image\_url2[0:15])

print(image\_url3[0:15])

We are slicing the content of our print statements here because we are generating URLs. The URLs tend to be in a longer format, because of that slicing might make the result more pleasing to the eye since we are just checking.

# **Saving Multiple Images**

Now that we can get the URL for the 3 images we are going to save them in different files. The button below after the Try It! button are setups to open the following file names:

Now remember the technique we previously used to save our image. We are going to use that to save the 3 images.

img\_data = requests.get(image\_url1).content

with open('image\_name1.jpg', 'wb') as handler:

handler.write(img\_data)

img\_data = requests.get(image\_url2).content

with open('image\_name2.jpg', 'wb') as handler:

handler.write(img\_data)

img\_data = requests.get(image\_url3).content

with open('image\_name3.jpg', 'wb') as handler:

handler.write(img\_data)

If you click on every single link and you get a different image then you are on the right track. Since we are using Python let’s start by cleaning up our code a bit.

For starters in order to better see the change that our code worked we are going to switch the prompt from ninja cat to ninja birds.

prompt="digital art of ninja bird "

Then remove everything after from when we mention img\_data = requests.get(image\_url1).content.

Now that we have standard style to name our images it makes it easy for us to use Python function like enumerate to loop through and create our files. All we have to do is simply change the values from 1 to 2 to 3.

for i, image\_url in enumerate([image\_url1, image\_url2, image\_url3], start=1):

img\_data = requests.get(image\_url).content

with open(f'image\_name{i}.jpg', 'wb') as handler:

handler.write(img\_data)

Just like that you cut more than half the lines of code you needed to store the different files. Using this code it should be pretty easy to replicate and save more than 3 pictures. Remember that n has a max value of 10. Please Note: For free accounts the maximum rate is 5 pictures per minute.

Edits with DALL-E

# **Learning Objectives**

# ***Learning Objectives***

### **Learners will be able to…**

* **Effectively generate an image using DALL-E**
* **Create variations of DALL-E images using different parameters and techniques**
* **Analyze and apply the concepts of masks and edits in DALL-E image creation.**

# **Text to Image Edits**

## **Dall-E**

OpenAI’s **DALL·E** text to image is a system that can generate images from textual descriptions, using a deep learning-based approach. The system can generate images that are realistic and editable, and can even create images from scratch, without any training data. Endpoints are often used to retrieve data from a database, create new data, or modify existing data. We have seen that DALL·E models can easily generate images from text. Now we are going to use DALL·E to modify existing data

The Images API provides three methods for interacting with images:

1. Creating images from scratch based on a text prompt
2. Creating edits of an existing image based on a new text prompt
3. Creating variations of an existing image

## **Generating Image**

We are familiar with the steps to generate a new image.

#this code generates a new image from a prompt

response = openai.Image.create(

prompt="digital art of throne room of a magical castle.",

n=1,

size="256x256"

)

#from the response generated this puts the url in a separate variable

image\_url = response['data'][0]['url']

#using the url, we use the code below to save it as a file

img\_data = requests.get(image\_url).content

with open('image\_name.png', 'wb') as handler:

handler.write(img\_data)

Click here to refresh your image1

## **Variation**

OpenAI has an image variation endpoint that allows you to generate similar images when given an image as a prompt.

To try it in the last Try It button we created a digital art representation of a castle as image\_name.jpg. We are going to use that image to generate another similar picture or variation. To avoid rewriting our original file we are going to delete everything up until the comment that says # Keep CODE ABOVE. Then we are going to write, the code below to generate a variation.

response = openai.Image.create\_variation(

image=open("image\_name.png", "rb"),

n=1,

size="1024x1024"

)

image\_url = response['data'][0]['url']

#using the url, we use the code below to save it as a file

img\_data = requests.get(image\_url).content

with open('image\_name\_var.png', 'wb') as handler:

handler.write(img\_data)

# **Variation**

Let’s try creating an image variation of a bunny and a cat.

1. First we generate the original image of the bunny and cat.

#this code generates a new image from a prompt

response = openai.Image.create(

prompt="bunny and a cat",

n=1,

size="512x512"

)

#from the response generated this putS the url in a separate variable

image\_url = response['data'][0]['url']

We save the bunny and cat image.

#using the url, we use the code below to save it as a file

img\_data = requests.get(image\_url).content

with open('bunny.png', 'wb') as handler:

handler.write(img\_data)

We use the new image to generate a variation of the said image using our new file name we created in the previous step

response = openai.Image.create\_variation(

image=open("bunny.png", "rb"),

n=1,

size="512x512"

)

image\_url2= response['data'][0]['url']

Now we have to save our new URL in a different file name.

img\_data = requests.get(image\_url2).content

with open('bunny\_var.png', 'wb') as handler:

handler.write(img\_data)

Prompts and images are filtered based on OpenAI’s [content policy](https://labs.openai.com/policies/content-policy), returning an error when a prompt or image is flagged.

# **mask**

On top of a variation endpoint OpenAI’s DALL·E has an **edit endpoint**. Similar, to our variation API call we are going to need to include a starting image for it to work on, a numbern, and size. Unlike the variation endpoint we are going to add a mask, and a prompt.

First let us generate the image we will be working with. For the sake of consistency we will be creating another from scratch.

#this code generates a new image from a prompt

response = openai.Image.create(

prompt="a vibrant modern office with red chairs and a television screen.",

n=1,

size="512x512"

)

#from the response generated this puts the url in a separate variable

image\_url = response['data'][0]['url']

#using the url, we use the code below to save it as a file

img\_data = requests.get(image\_url).content

with open('original.png', 'wb') as handler:

handler.write(img\_data)

print(image\_url)

The image generated when I first ran the code is provided below. Feel free to use if you do not want to interact with one by yourself. The image is saved under original-copy.png. Below is a code provided to help you copy and use it. Ignore this bit if going to create your own.

import shutil

def copy\_image(source\_path, destination\_path):

try:

shutil.copy2(source\_path, destination\_path)

print("Image copied successfully!")

except IOError as e:

print(f"An error occurred while copying the image: {e}")

# Example usage

source\_image = "original-copy.png"

destination\_image = "original.png"

copy\_image(source\_image, destination\_image)

After generating this bit we are going to delete/remove the code to generate an image and simply keep our libraries. We don’t need to regenerate an original image.

Now we need to create our **mask**. The purpose of a mask is to define the region of an image that you want to change or apply an effect to, while leaving the rest of the image unchanged.

In image processing, a mask is typically a grayscale image with the same dimensions as the original image. The mask is used to selectively modify the original image by indicating which pixels should be affected by an operation and which pixels should be left unchanged.

Now we are going to generate code to basically write over our image in order to create the mask. First, we are going to open our original image and convert it to RGBA. This step is important otherwise it would generate an error saying the following:openai.error.InvalidRequestError: Invalid input image - format must be in ['RGBA', 'LA', 'L'], got RGB. After generating and saving your file feel free to delete the previous code that was used for image generation.

## Load the original image

img = Image.open('original.png')

# Convert the image to RGBA format

img = img.convert('RGBA')

We are going to create a copy of our original image so we can put a mask over it.

# Create a new blank image for the mask

mask = img.copy()

Now for the fun part we simply gonna draw a rectangle box over where the edit should be. Here is an example:

We know our picture is 512x512. Depending on your image change the location of the box so it makes sense so an edit can occur. Feel free to keep changing the value of bbox until you have a version that suits you.

The bbox variable is a tuple containing four values: (left, top, right, bottom).

left is the x-coordinate of the left edge of the bounding box

top is the y-coordinate of the top edge of the bounding box

right is the x-coordinate of the right edge of the bounding box

bottom is the y-coordinate of the bottom edge of the bounding box

Finally, we are also going to make sure we save our picture in a file called masked.png.

# Define the region you want to keep in white

left=300

top=200

right=420

bottom=300

bbox = (left, top, right, bottom)

mask\_draw = ImageDraw.Draw(mask)

mask\_draw.rectangle(bbox, fill=255)

# Save the mask

mask.save('masked.png')

When creating a mask for an image edit operation, the mask should have the same dimensions as the original image and be in RGBA format. The mask is used to selectively modify the original image by indicating which pixels should be affected by an operation and which pixels should be left unchanged. The ‘A’ in RGBA stands for the alpha channel, which is used to represent the transparency of the pixels.

# **Editing our Image**

Now that we have our mask and original picture we can generate our edited picture. We are going to slightly modify our prompt to describe what we want generated

response=openai.Image.create\_edit(

image=open("original.png", "rb"),

mask=open("masked.png", "rb"),

prompt="a vibrant modern office with red chairs and a television screen.a snack is on the table. ",

n=1,

size="512x512"

)

image\_url = response['data'][0]['url']

#using the url, we use the code below to save it as a file

img\_data = requests.get(image\_url).content

with open('edited.png', 'wb') as handler:

handler.write(img\_data)

We can also change the prompt to display other things such as:

response=openai.Image.create\_edit(

image=open("original.png", "rb"),

mask=open("masked.png", "rb"),

prompt="a vibrant modern office with red chairs and a television screen. A bagel is on the table. ",

n=1,

size="512x512")

The mask parameter is optional. If not provided our image still needs to have transparency, which will be used as the mask. Feel free to move the box associated with your mask, in order to make different edits with your picture.

# **Coding Exercise**

Write a function variationMaker() that takes in a file name like image.png. The functions should create 1 variation of the image in 512x512 and save it under a file name called varTest.png.

Feel free to test it out before submission. A try it button will be provided, additionaly so will varTest.pngfile.

import os

import openai

import secret

import requests

openai.api\_key=secret.api\_key

def variationMaker(fileName):

response = openai.Image.create\_variation(

image=open(fileName, "rb"),

n=1,

size="512x512"

)

image\_url = response['data'][0]['url']

img\_data = requests.get(image\_url).content

with open('varTest.png', 'wb') as handler:

handler.write(img\_data)

# Codio:Additional DALL·E Usage

# **Learning Objectives**

### **Learners will be able to…**

* **Effectively generate multiple images using appropriate API calls or programming techniques**
* **Apply appropriate methods for saving multiple generated images in various file formats**.
* **Create Synchronous and Asynchronous API calls**

# **Chaining Multiple API Calls to Create a Sequence of Images with DALL-E**

In the previous lessons, we have learned how to generate images using OpenAI’s DALL-E API by defining specific conditions or constraints in our prompts. Today, we will take a step further and learn how to chain multiple API calls together to create a sequence of images. This technique can significantly enhance the creativity and complexity of the outputs we can generate.

### **Benefits of Chaining**

Chaining API calls allows us to generate multiple images in a sequence based on a set of prompts. This technique has several benefits:

**Storytelling**: By chaining prompts, we can create a sequence of images that tell a story. This can be useful in a variety of applications, from creating storyboard visuals to generating illustrative examples for educational content.

**Progressive image generation**: Chaining allows us to generate images that progressively change based on our sequence of prompts. This can be used to simulate movement, transformation, or progression over time.

**Exploring different variations**: By chaining a series of related prompts, we can generate a set of images that show different interpretations or variations of the same concept. This can help us understand how DALL-E interprets and responds to different prompts.

import os

import openai

import requests

import secret

openai.api\_key=secret.api\_key

# Set the prompts

prompts = ["robot dog in a lab", "robot dog exploring the city", "robot dog watching the sunset"]

# Generate and save the images

for i, prompt in enumerate(prompts):

response = openai.Image.create(

prompt=prompt,

n=1,

size="256x256"

)

# Get the image URL from the response

image\_url = response['data'][0]['url']

# Download and save the image

img\_data = requests.get(image\_url).content

with open(f"robot\_dog\_journey\_{i+1}.jpg", 'wb') as handler:

handler.write(img\_data)

In this example, we first define a list of prompts. Each prompt represents a different stage of the "robot dog’s journey".

We then loop over each prompt in the list. For each prompt, we call the DALL-E API to generate an image that corresponds to that stage of the journey. We specify prompt as the prompt, n=1 to generate one image per prompt, and size="256x256" to specify the size of the generated image.

From the API response, we extract the URL of the generated image. We then use the requests library to download the image from this URL.

Finally, we save each image with a unique filename that includes the index of the prompt in the list. This allows us to view the images in the order they were generated, effectively seeing the robot dog’s journey unfold in sequence.

By chaining these API calls together, we can generate a sequence of images that tell a visually compelling story. This approach can be extended and adapted to generate sequences of images for a wide range of applications.

# **Exceptions in DALL-E**

While using APIs, it is common to encounter various types of errors and exceptions. These could occur due to a variety of reasons like network issues, incorrect parameters, rate limiting, server errors, etc. you can ensure that your program doesn’t crash unexpectedly and provides useful feedback about what went wrong. This is crucial for debugging issues and improving the reliability of your code. This is especially important when making multiple calls at the same time like when chaining.

Here are some common types of errors and exceptions you may encounter while using the DALL-E API:

**HTTP Errors:** These are errors returned by the server and they come with an HTTP status code. For example, a 404 error means the requested resource could not be found, and a 500 error means there was an internal server error.

**API Errors:** These are errors returned by the API itself due to issues like incorrect parameters, exceeding rate limits, etc. These usually come with an error message explaining what went wrong.

**Network Errors:** These are errors that occur due to network issues, like a timeout because the server took too long to respond.

Here is an example where we use a try-except block to catch and handle potential errors and exceptions.

import os

import openai

import requests

import secret

openai.api\_key=secret.api\_key

# Set the prompts

prompts = ["robot dog in a lab", "robot dog exploring the city", "robot dog watching the sunset"]

# Generate and save the images

for i, prompt in enumerate(prompts):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size="256x256"

)

# Get the image URL from the response

image\_url = response['data'][0]['url']

# Download and save the image

img\_data = requests.get(image\_url).content

with open(f"robot\_dog\_journey\_{i+1}.jpg", 'wb') as handler:

handler.write(img\_data)

except requests.exceptions.RequestException as e:

# This will catch any general network error

print(f"Network error: {e}")

except openai.error.APIError as e:

# This will catch any error returned by the OpenAI API

print(f"API error: {e}")

except Exception as e:

# This is a catch-all for any other exceptions

print(f"Unexpected error: {e}")

The try block contains the code that could potentially raise an exception. If an exception is raised in the try block, the execution immediately moves to the except block that handles that specific exception.

The requests.exceptions.RequestException except block will handle any network errors that might occur during the API call or while downloading the image.

The openai.api\_errors.APIError except block will handle any errors returned by the OpenAI API, such as incorrect parameters or exceeding rate limits.

Finally, the general Exception except block will catch any other exceptions that the specific catch blocks did not catch. This is a good practice to ensure that your program can recover from any unexpected exceptions.

# **Async vs Sync**

In a typical **synchronous application**, each task must complete before the next one can start. This can be inefficient when dealing with I/O operations like network requests, where the program spends a lot of time waiting for responses.

**Asynchronous programming** allows you to perform other tasks while waiting for I/O operations to complete, resulting in more efficient use of resources.

Python’s asyncio library allows you to write single-threaded concurrent code using coroutines, multiplexing I/O access over sockets and other resources, running network clients and servers, and other related primitives.

### **Asynchronous**

While using DALL-E’s API, you might need to generate multiple images at once. If you do it synchronously, your application will have to wait for each API call to complete before making the next one. This is inefficient, especially if the API calls take a long time to process.

By making asynchronous API calls, you can send multiple requests to the API at once without having to wait for each one to complete. This can significantly speed up your application if you need to make a lot of API calls.

### **Synchronous example**

In order to compare the time between both calls, we are going to time our previous chain request. Copy and paste the code in this page in the sync.py file on the left. To control the time we have to use the following code. The code will start a timer then end it when we are done testing and print the result. here is a sample code, just for your visual learning.

import os

import openai

import requests

import secret

import time

openai.api\_key = secret.api\_key

import time

start\_time = time.time()

*# Your existing code here*

end\_time = time.time()

execution\_time = end\_time - start\_time

print(f"Execution time: {execution\_time} seconds")

By using time.time() function, we capture the start time before the execution of your code and the end time after the execution. Then, we calculate the difference between the two timestamps to get the execution time in seconds. Finally, we print the execution time.  
To keep it consistent let’s basically use the same Python code we have been using in this assignment.

# **Async Example**

Now, let’s see how you can use Python’s asyncio and aiohttp libraries to make asynchronous API calls to DALL-E:

The code we are working with in the async.py file creates multiple tasks, each one responsible for generating an image and saving it.  
These tasks will run concurrently, which can speed up the total execution time compared to running them sequentially. Please be aware that OpenAI’s API might have rate limits depending on your plan, so please be cautious about making too many concurrent requests. We are going to do just two big Try It button at the end, in order not to waste a ton of our tokens.

### **Coding**

**fetch\_and\_save\_image function**: This function is designed to download and save the image from the given URL. The function takes a session (aiohttp’s ClientSession), a URL, and a path to save the image. We use aiohttp’s get() function to make a GET request to the URL, and then use resp.read() to read the response content (image data) asynchronously. We then open the file at the given path and write the image data to it.

async def fetch\_and\_save\_image(session, url, path):

try:

async with session.get(url) as resp:

img\_data = await resp.read()

with open(path, 'wb') as handler:

handler.write(img\_data)

except Exception as e:

print(f"Unexpected error: {e}")

**fetch\_image function:** This function makes a request to OpenAI’s API to generate an image for the given prompt. The function takes a prompt and an index as input. It calls openai.Image.create() to generate an image and gets the image URL from the response. It then creates an aiohttp ClientSession and calls fetch\_and\_save\_image() to download and save the image.

async def fetch\_image(prompt, i):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size="256x256"

)

# Get the image URL from the response

image\_url = response['data'][0]['url']

# Download and save the image

async with aiohttp.ClientSession() as session:

await fetch\_and\_save\_image(session, image\_url, f"robot\_dog\_journey\_{i+1}.jpg")

except openai.error.APIError as e:

# This will catch any error returned by the OpenAI API

print(f"API error: {e}")

except Exception as e:

# This is a catch-all for any other exceptions

print(f"Unexpected error: {e}")

**main function:** This function creates an asyncio task for each prompt, adds them to a list, and then runs them concurrently using asyncio.gather(). This means that it will start all the tasks at the same time, and then wait for all of them to finish. This is where the asynchronous magic happens - rather than processing each prompt one by one, it starts processing all of them at once, which can significantly speed up the total execution time. It also measures the execution time by recording the time before and after the tasks are run, and then subtracts the start time from the end time.

async def main():

start\_time = time.time() # Start measuring execution time

tasks = []

for i, prompt in enumerate(prompts):

tasks.append(fetch\_image(prompt, i))

await asyncio.gather(\*tasks)

end\_time = time.time() # End measuring execution time

execution\_time = end\_time - start\_time

print(f"Execution time: {execution\_time} seconds")

Your whole code outline in async.py should look like the following code. Additionally, to run the main function we have added asyncio.run(main()) at the end of our code.

import os

import openai

import aiohttp

import asyncio

import secret

import time

openai.api\_key = secret.api\_key

# Set the prompts

prompts = ["robot dog in a lab", "robot dog exploring the city", "robot dog watching the sunset"]

async def fetch\_and\_save\_image(session, url, path):

try:

async with session.get(url) as resp:

img\_data = await resp.read()

with open(path, 'wb') as handler:

handler.write(img\_data)

except Exception as e:

print(f"Unexpected error: {e}")

async def fetch\_image(prompt, i):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size="256x256"

)

# Get the image URL from the response

image\_url = response['data'][0]['url']

# Download and save the image

async with aiohttp.ClientSession() as session:

await fetch\_and\_save\_image(session, image\_url, f"robot\_dog\_journey\_{i+1}.jpg")

except openai.error.APIError as e:

# This will catch any error returned by the OpenAI API

print(f"API error: {e}")

except Exception as e:

# This is a catch-all for any other exceptions

print(f"Unexpected error: {e}")

async def main():

start\_time = time.time() # Start measuring execution time

tasks = []

for i, prompt in enumerate(prompts):

tasks.append(fetch\_image(prompt, i))

await asyncio.gather(\*tasks)

end\_time = time.time() # End measuring execution time

execution\_time = end\_time - start\_time

print(f"Execution time: {execution\_time} seconds")

# Run the main function

asyncio.run(main())

Please note that the openai.Image.create function is a blocking operation and doesn’t support async. The code above assumes that this function is asynchronous, which is not correct. To truly parallelize this, you’d need an async-compatible OpenAI library or use something like Python’s concurrent.futures to run the blocking parts in a separate thread.

# **Coding Exercise**

Write a function chain() that takes a list of prompts and generates images based on the prompts. The function should use chaining to generate the images. The function should save the images to the current directory, using the following convention: test{i+1}.jpg, where i is the index of the prompt in the list. Please make sure the images are 256x256.

import os

import openai

import requests

import secret

openai.api\_key=secret.api\_key

# Set the constants

prompts = ["A cat", "A dog", "A bird"]

prefix = "test"

suffix = ".jpg"

size = "256x256"

def chain(prompts):

for i, prompt in enumerate(prompts):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size=size

)

image\_url = response['data'][0]['url']

img\_data = requests.get(image\_url).content

with open(f"{prefix}{i+1}{suffix}", 'wb') as handler:

handler.write(img\_data)

except requests.exceptions.RequestException as e:

# This will catch any general network error

print(f"Network error: {e}")

except openai.error.APIError as e:

# This will catch any error returned by the OpenAI API

print(f"API error: {e}")

except Exception as e:

# This is a catch-all for any other exceptions

print(f"Unexpected error: {e}")

chain(prompts)

# **Text to Image**

### **PIL**

**PIL** (Python Imaging Library) is a popular third-party library used for working with images in Python. It provides a wide range of functions to handle different image processing tasks, such as opening and saving images in various file formats, cropping and resizing images, applying filters and transformations, and much more. In this module, we will use the PIL library to manipulate the image we generated.

## **DALL-E**

In the previous lessons, we discussed how to generate images using DALL-E 2. Now, we will dive into the exciting world of image manipulation, enabling you to create a wide variety of variations from the original generated image.

**DALL-E** 2 is a powerful AI model developed by OpenAI that can generate high-quality images from textual descriptions. However, the API is not limited to just generating images - it also allows you to manipulate the generated images by adjusting certain parameters. We will explore how to change image size, aspect ratio, brightness, contrast, saturation, hue, and other properties using the DALL-E 2 API.

## **Generating Image**

Let’s get started with a simple code example that demonstrates how to adjust some of these parameters. In this example, we will generate an image of a “red apple” and then manipulate its properties to create different variations.  
In order to generate an image using the DALL·E we can use the openai.Image.create call. This time we are going to create a function that will take our prompt as an argument and manipulate it from there. We are going to import our libraries and API key then we are going to create our function.

import os

import openai

import secret

from PIL import Image, ImageOps

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

# Generate the base image

def generate\_base\_image(prompt):

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

return response['data'][0]['url']

base\_image\_url = generate\_base\_image('red apple')

In order to not have to keep copying and pasting our result in, we are going to save the image inside the URL as a file in our Codio box.

img\_data = requests.get(base\_image\_url).content

with open('image\_name.jpg', 'wb') as handler:

handler.write(img\_data)

# **Image Manipulation**

### **Image Manipulation Function**

We first generated a base image of a “red apple” using the DALL-E 2 API. We saved our image as image\_name.jpg. I know really creative. Now, we are going to access that image and start manipulating it. The first step we are going to do is to create a variable that points to our first image and calls that base\_image.

Now we are ready to create a function that will interact with the PIL library. The function takes a couple of variables as arguments. Let’s start by defining what those are.

def manipulate\_image(image, size, aspect\_ratio, brightness, contrast, saturation, hue)

1. **image**: A PIL image object representing the base image that you want to manipulate.
2. **size**: A float value between 0 and 1, representing the scale factor by which you want to resize the image. A value of 1 will keep the original size, while a value of 0.5 will reduce the size by half, and a value of 0.75 will resize the image to 75% of its original size.
3. **aspect\_ratio**: A float value representing the aspect ratio for resizing the image. A value of 1 will maintain the original aspect ratio, while values greater than 1 will stretch the image vertically and values less than 1 will stretch the image horizontally.
4. **brightness**: A float value representing the factor by which to adjust the image’s brightness. A value of 1 means no change, while values greater than 1 will increase brightness, and values less than 1 will decrease brightness.
5. **contrast**: A float value representing the factor by which to adjust the image’s contrast. A value of 1 means no change, while values greater than 1 will increase contrast, and values less than 1 will decrease contrast.
6. **saturation**: A float value representing the factor by which to adjust the image’s color saturation. A value of 1 means no change, while values greater than 1 will increase saturation, and values less than 1 will decrease saturation.
7. **hue**: A float value representing the amount by which to adjust the image’s hue. A value of 0 means no change, while positive and negative values will rotate the hue in different directions.

from PIL import ImageEnhance, ImageOps

# Manipulate the image properties

def manipulate\_image(image, size, aspect\_ratio, brightness, contrast, saturation, hue):

# Resize the image

new\_size = (int(image.width \* size), int(image.height \* aspect\_ratio \* size))

resized\_image = image.resize(new\_size, Image.ANTIALIAS)

# Adjust the image properties

enhanced\_image = ImageEnhance.Brightness(resized\_image).enhance(brightness)

enhanced\_image = ImageEnhance.Contrast(enhanced\_image).enhance(contrast)

enhanced\_image = ImageEnhance.Color(enhanced\_image).enhance(saturation)

# Adjust hue using ImageOps module

enhanced\_image = ImageOps.colorize(enhanced\_image.convert('L'), 'black', 'white', midpoint=128 - int(128 \* hue))

return enhanced\_image

We define a function manipulate\_image() that takes in the base image and various parameters for image manipulation. We use the Python Imaging Library (PIL) to resize the image, and adjust its brightness, contrast, saturation, and hue. We use ImageOps.colorize() to adjust the hue of the image.

# Example of image manipulation

manipulated\_image = manipulate\_image(

base\_image, size=0.5, aspect\_ratio=1, brightness=1.2,

contrast=1.5, saturation=0.8, hue=0.1

)

Finally, we demonstrate how to use this function to create a manipulated version of the original image by adjusting the parameters.

Now we are going to save our manipulated image as manipulated\_red\_apple.jpg.

# Save the manipulated image to a file manipulated\_image.save('manipulated\_red\_apple.jpg')

Complete code example:

import openai

import secret

from PIL import Image, ImageOps

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

"""

# Generate the base image

def generate\_base\_image(prompt):

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

return response['data'][0]['url']

base\_image\_url = generate\_base\_image('red apple')

img\_data = requests.get(base\_image\_url).content

with open('image\_name.jpg', 'wb') as handler:

handler.write(img\_data)

"""

base\_image = Image.open('image\_name.jpg')

# Manipulate the image properties

def manipulate\_image(image, size, aspect\_ratio, brightness, contrast, saturation, hue):

# Resize the image

new\_size = (int(image.width \* size), int(image.height \* aspect\_ratio \* size))

resized\_image = image.resize(new\_size, Image.ANTIALIAS)

# Adjust the image properties

from PIL import ImageEnhance, ImageOps

enhanced\_image = ImageEnhance.Brightness(resized\_image).enhance(brightness)

enhanced\_image = ImageEnhance.Contrast(enhanced\_image).enhance(contrast)

enhanced\_image = ImageEnhance.Color(enhanced\_image).enhance(saturation)

# Adjust hue using ImageOps module

enhanced\_image = ImageOps.colorize(enhanced\_image.convert('L'), 'black', 'white', midpoint=128 - int(128 \* hue))

return enhanced\_image

# Example of image manipulation

manipulated\_image = manipulate\_image(

base\_image, size=0.5, aspect\_ratio=1, brightness=1.2,

contrast=1.5, saturation=0.8, hue=0.1

)

# Save the manipulated image to a file

manipulated\_image.save('manipulated\_red\_apple.jpg')

# **Hue and Saturation**

The **hue** parameter in the manipulate\_image() function is used to shift the hue values of the image, resulting in different color schemes. The hue value is a float, typically ranging from -1 to 1, where 0 means no change, positive values shift the hue clockwise in the color wheel, and negative values shift the hue counterclockwise.

Hue values in color space are typically represented in a circular form, often called a “color wheel.” The color wheel is divided into 360 degrees, with different colors associated with different angle values:

**Red**: 0 degrees (or 360 degrees)  
**Yellow**: 60 degrees  
**Green**: 120 degrees  
**Cyan**: 180 degrees  
**Blue**: 240 degrees  
**Magenta**: 300 degrees

In the manipulate\_image() function, we scale the hue parameter from -1 to 1 to cover the entire range of hue values. When the hue parameter is set to a specific value, the hue values in the image are shifted by that fraction of the full hue range (360 degrees).

For example:

* A hue value of 0.5 would shift the hue values by 180 degrees clockwise in the color wheel, effectively changing red to cyan, green to magenta, and blue to yellow.
* A hue value of -0.5 would shift the hue values by 180 degrees counterclockwise in the color wheel, effectively changing red to cyan, green to magenta, and blue to yellow (same as the previous example, since the shift is by 180 degrees).
* A hue value of 0.33 would shift the hue values by 120 degrees clockwise in the color wheel, effectively changing red to green, green to blue, and blue to red.
* A hue value of -0.25 would shift the hue values by 90 degrees counterclockwise in the color wheel, effectively changing red to yellow, green to cyan, and blue to magenta.

You can experiment with different hue values to achieve various color schemes for your image. Keep in mind that the color shifts might be more complex in real images, as they contain a mix of colors and may not always result in the exact colors mentioned in the examples.

### **Saturation**

**Saturation** is a color property that represents the intensity or purity of a color. It describes how vivid or dull a color appears. In the context of image processing, adjusting the saturation of an image can make the colors in the image appear more vibrant or more muted.

In the HSV (Hue, Saturation, and Value) color model, saturation is represented as a percentage (0% to 100%) or a value ranging from 0 to 1:

0% saturation (or a value of 0) means no color, resulting in a grayscale image.  
100% saturation (or a value of 1) means the colors are fully saturated, appearing in their most intense form.

In our function, the saturation parameter is a float value that determines the factor by which the saturation of the image is adjusted:

* A saturation value of 1 means no change to the saturation of the image.
* Saturation values greater than 1 will increase the saturation of the image, making the colors appear more vivid and intense.
* Saturation values less than 1 and greater than 0 will decrease the saturation of the image, making the colors appear more muted or washed out.
* A saturation value of 2 would double the saturation of the colors in the image, making them appear more vibrant.
* A saturation value of 0.5 would reduce the saturation of the colors by half, making them appear more muted.
* A saturation value of 0 would remove all color from the image, resulting in a grayscale image.

When manipulating images, adjusting the saturation can have a significant impact on the overall appearance and mood of the image. Experimenting with different saturation values can help you achieve the desired look for your image.

# **Trying Out Different Color Variations**

### **Keep color**

Let’s try creating an extra variation. This time we are going to keep the color the same. Try out variations.

To maintain the original color when the hue is 0, we can do the following that will run when the hue is not 0. Add the code below into the manipulate\_image() function .

# Adjust hue only if hue is not 0

if hue != 0:

# Convert image to HSV

hsv\_image = enhanced\_image.convert('HSV')

# Shift hue value

hsv\_image = hsv\_image.point(lambda p: (p + int(256 \* hue)) % 256 if p < 256 else p)

# Convert back to RGB

enhanced\_image = hsv\_image.convert('RGB')

The ImageOps.colorize() function used in the code is converting the image to grayscale. We first check if the hue parameter is not 0 before adjusting the hue of the image. If the hue is 0, the color of the image remains unchanged.

In the following example, we’ve changed the size parameter to 0.8 (80% of the original size) and kept the aspect ratio at 1 to maintain the original aspect ratio. The brightness, contrast, saturation, and hue parameters are set to their default values to keep the color properties unchanged. Let’s try the following example,

# Example of image manipulation with only size change

size\_changed\_image = manipulate\_image(

base\_image, size=0.8, aspect\_ratio=1, brightness=1,

contrast=1, saturation=1, hue=0

)

# Save the size-changed image to a file

size\_changed\_image.save('size\_changed\_red\_apple.jpg')

The resulting image will be saved as size\_changed\_red\_apple.jpg in the same folder as your script.

# **Purple**

Now let’s try making it more purple.

# Example of image manipulation with a more purple hue

purple\_image = manipulate\_image(

base\_image, size=1, aspect\_ratio=1, brightness=1,

contrast=1, saturation=1, hue=0.8

)

# Save the purple image to a file

purple\_image.save('purple\_red\_apple.jpg')

In this example, we set the hue parameter to 0.8, which shifts the hue towards the purple range. The size, aspect ratio, brightness, contrast, and saturation parameters are set to their default values to maintain the original properties of the image.

The resulting image will be saved as purple\_red\_apple.jpg in the same folder as your script. Please note that the hue value of 0.8 is just an example, and you may need to adjust the value to achieve the desired shade of purple.

Try the purple image with a different combination of saturation. For example, try it with the following : 0, 0.5 , 2 .

We have demonstrated how to create variations of an image using the manipulate\_image() function. You can use this function to create different versions of an image with varying size, aspect ratio, brightness, contrast, saturation, and hue.

To create a version of the image with the original color, set the hue parameter to 0. In the provided code, we first check if the hue parameter is not 0 before adjusting the hue of the image. If the hue is 0, the color of the image remains unchanged.

We have also provided examples of how to create a resized version of the image, as well as a version with a more purple hue. You can experiment with different combinations of parameters to achieve the desired look for your image.

Full code example for image manipulation and hue change:

import openai

import secret

from PIL import Image, ImageOps

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

"""

# Generate the base image

def generate\_base\_image(prompt):

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

return response['data'][0]['url']

base\_image\_url = generate\_base\_image('red apple')

img\_data = requests.get(base\_image\_url).content

with open('image\_name.jpg', 'wb') as handler:

handler.write(img\_data)

"""

base\_image = Image.open('image\_name.jpg')

# Manipulate the image properties

def manipulate\_image(image, size, aspect\_ratio, brightness, contrast, saturation, hue):

# Resize the image

new\_size = (int(image.width \* size), int(image.height \* aspect\_ratio \* size))

resized\_image = image.resize(new\_size, Image.ANTIALIAS)

# Adjust the image properties

from PIL import ImageEnhance, ImageOps

enhanced\_image = ImageEnhance.Brightness(resized\_image).enhance(brightness)

enhanced\_image = ImageEnhance.Contrast(enhanced\_image).enhance(contrast)

enhanced\_image = ImageEnhance.Color(enhanced\_image).enhance(saturation)

# Adjust hue only if hue is not 0

if hue != 0:

# Convert image to HSV

hsv\_image = enhanced\_image.convert('HSV')

# Shift hue value

hsv\_image = hsv\_image.point(lambda p: (p + int(256 \* hue)) % 256 if p < 256 else p)

# Convert back to RGB

enhanced\_image = hsv\_image.convert('RGB')

"""

else:

# Adjust hue using ImageOps module

enhanced\_image = ImageOps.colorize(enhanced\_image.convert('L'), 'black', 'white', midpoint=128 - int(128 \* hue))

"""

return enhanced\_image

# Example of image manipulation

manipulated\_image = manipulate\_image(

base\_image, size=0.5, aspect\_ratio=1, brightness=1.2,

contrast=1.5, saturation=0.8, hue=0.1

)

# Save the manipulated image to a file

manipulated\_image.save('manipulated\_red\_apple.jpg')

# Example of image manipulation with only size change

size\_changed\_image = manipulate\_image(

base\_image, size=0.8, aspect\_ratio=1, brightness=1,

contrast=1, saturation=1, hue=0

)

# Save the size-changed image to a file

size\_changed\_image.save('size\_changed\_red\_apple.jpg')

# Example of image manipulation with a more purple hue

purple\_image = manipulate\_image(

base\_image, size=1, aspect\_ratio=1, brightness=1,

contrast=1, saturation=1, hue=0

)

# Save the purple image to a file

purple\_image.save('purple\_red\_apple.jpg')

# **Coding Exercise**

**Objectives**

1. **Use the openai.Completion.create method to generate an image from DALL-E.**
2. **Convert the image to grayscale using PIL.**
3. **Resize the image to 256x256 pixels using PIL.**
4. **Save the manipulated image to the local file system.**

Your task is to create a Python script that generates a DALL-E image based on the prompt and then applies a series of transformations to it using PIL.

The prompt should be a function argument in the function generate\_image(prompt).

**The transformations to apply include:**

1. Converting the image to grayscale
2. Resizing the image to 256x256 pixels
3. After applying these transformations,your script should save the image to the local file system. it should be saved under test\_img.png

Your script should use openai.Completion.create to generate a DALL-E response, and the PIL library to manipulate the resulting image.

### **Grayscale**

Here is a simple technique to gray scale your image.  
Make sure to replace ‘your\_image.jpg’ with the path to your actual image file.

Convert the image to grayscale using the convert() method with the ‘L’ mode:

gray\_image = image.convert('L')

Optionally, you can save the grayscale image using the save() method:

gray\_image.save('grayscale\_image.jpg')

Replace ‘grayscale\_image.jpg’ with the desired filename and extension.

Putting it all together, here’s an example:

from PIL import Image

# Open the image

image = Image.open('your\_image.jpg')

# Convert to grayscale

gray\_image = image.convert('L')

# Save the grayscale image

gray\_image.save('grayscale\_image.jpg')

Coding example MY solution

import os

import openai

import secret

from PIL import Image

import io

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

URL='https://picsum.photos/512/512'

PROMPT = "a lovely bunch of coconuts"

FILENAME = "test\_img.png"

# Generate the base image

def generate\_image(prompt):

filename=FILENAME

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

image\_url = response['data'][0]['url']

except Exception as e:

# This is a catch-all for any other exceptions

print(f"Unexpected error: {e}")

image\_url = URL

finally:

img\_data = requests.get(image\_url).content

with open(filename, 'wb') as handler:

handler.write(img\_data)

image = Image.open(filename)

gray\_image = image.convert('L')

new\_size = (256,256)

resized\_image = gray\_image.resize(new\_size, Image.ANTIALIAS)

resized\_image.save(filename)

#generate\_image(PROMPT)

Solution given by coursera

def generate\_image(prompt):

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

image\_url=response['data'][0]['url']

# Download the image

response = requests.get(image\_url)

img = Image.open(io.BytesIO(response.content))

# Apply transformations

img = img.convert("L") # Convert to grayscale

img = img.resize((256, 256)) # Resize to 256x256 pixels

# Save the image

img.save("test\_img.png")

import os

import openai

import secret

from PIL import Image

import io

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

SIZE=512

URL=f"[https://picsum.photos/{SIZE}/](https://picsum.photos/512/512){SIZE}"

FILENAME = "test\_img.png"

# Generate an image from a DALL-E prompt, save it to file, maybe transform it a little...

def generate\_image(prompt):

filename=FILENAME

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size=f"{SIZE}x{SIZE}"

)

image\_url = response['data'][0]['url']

except Exception as e:

# This is a catch-all for any other exceptions

print(f"Unexpected error: {e}")

image\_url = URL

finally:

*print(f"return image\_url: {image\_url}")*

img\_data = requests.get(image\_url).content

with open(filename, 'wb') as handler:

handler.write(img\_data)

#img = Image.open(io.BytesIO(img\_data)) # convert img\_data to PIL Image for more transformations

#img.convert('L').resie((256,256)).save(filename)

Advanced Image Manipulations

### **Learners will be able to…**

* **Understand the concept of image composition and learn how to combine multiple images to create more complex scenes**
* **Apply built-in image filters from the PIL library to enhance or alter the appearance of images generated by the DALL-E 2 API**
* **Create custom image transformations using the ImageOps module from the PIL library to achieve unique effects**
* **Combine advanced image manipulation techniques with the DALL-E 2 API to generate a wide variety of artistic images**
* **Experiment with various image manipulations and compositions to create custom images tailored to your specific needs or preferences**

# **Image Composition**

We learned how to generate images with DALL-E 2 API and manipulate basic properties like size, aspect ratio, brightness, contrast, saturation, and hue. In this lesson, we will explore more advanced image manipulation techniques to create even more variations and artistic effects.

Before that we are going to start with the same steps which are importing our libraries and having our function that generates our prompts.

import os

import openai

import secret

from PIL import Image

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

# Generate the base image

def generate\_base\_image(prompt):

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

return response['data'][0]['url']

### **Image setting up**

One technique to create more complex images is by composing multiple images together. In this example, we will overlay a generated image of a moon on top of an image of a night sky.

First step we are going to get our function to generate the images and save them into new files.

# Generate moon and night sky images

moon\_image\_url = generate\_base\_image('moon')

night\_sky\_image\_url = generate\_base\_image('night sky with stars')

img\_data = requests.get(moon\_image\_url).content

with open('moon\_image.jpg', 'wb') as handler:

handler.write(img\_data)

img\_data = requests.get(night\_sky\_image\_url).content

with open('night\_sky\_image.jpg', 'wb') as handler:

handler.write(img\_data)

If you don’t like the pictures generated, generate them again. If you like one and not the other comment out the code generation for the one you want. If you are happy with both, please comment out the generation code so we don’t have to waste time generating images again and saving them over the image you want. At the end you should have something more or less like this :

"""

# Generate moon and night sky images

moon\_image\_url = generate\_base\_image('moon')

night\_sky\_image\_url = generate\_base\_image('night sky with stars')

img\_data = requests.get(moon\_image\_url).content

with open('moon\_image.jpg', 'wb') as handler:

handler.write(img\_data)

img\_data = requests.get(night\_sky\_image\_url).content

with open('night\_sky\_image.jpg', 'wb') as handler:

handler.write(img\_data)

"""

Now we are ready to combine our images.

# **Image Overlay**

### **Image composition**

The first step is to open our saved images as variables.

moon\_image=Image.open('moon\_image.jpg') night\_sky\_image=Image.open('night\_sky\_image.jpg')

The next step is to resize our images.

# Resize the moon image to fit the composition moon\_image = moon\_image.resize((200, 200), Image.ANTIALIAS)

Resize the moon image: The resize() function is used to change the size of the moon image. The target size is specified as a tuple of (width, height), which in this case is (200, 200). The Image.ANTIALIAS parameter is used to apply a high-quality downsampling filter that smooths out the image when resizing.

# Overlay the moon image on top of the night sky image night\_sky\_image.paste(moon\_image, (150, 100), moon\_image)

Overlay the moon image on the night sky image: The paste() function is used to overlay the moon image on top of the night sky image. The function takes three arguments: the image to paste moon\_image, the position where the pasted image should be placed (specified as an (x, y) tuple), and an optional mask (moon\_image in this case). The mask is used to preserve transparency in the pasted image, which is important when overlaying images with transparent backgrounds. If an error was generated please read the note section, otherwise you can continue to the save image section.

**Please note**: if you get a bad transparency mask error, it is because the image you are trying to paste does not have an alpha channel. An **alpha channel** is a layer of transparency information that is stored in an image file. It allows parts of the image to be transparent, so that other images can be seen behind them.

In your code, you are trying to paste the moon image onto the night sky image, but the moon image does not have an alpha channel. This means that the Python Imaging Library (PIL) does not know how to blend the two images together, and it throws an error.

To fix this error, you need to convert the moon image to a format that supports alpha channels. You can do this using a graphics editing program like Photoshop or GIMP. We will do it using the convert(“RGBA”) function. Once you have converted the moon image, you can paste it onto the night sky image without any errors.

# Convert the moon image to RGBA format moon\_image = moon\_image.convert("RGBA") # Paste the moon image onto the night sky image night\_sky\_image.paste(moon\_image, (150, 100), moon\_image)

**Now we need to save our new image**

# Save the composed image to a file night\_sky\_image.save('night\_sky\_with\_moon.jpg')

Save the composed image to a file: The save() function is used to save the composed image to a file. The file name is specified as a string (night\_sky\_with\_moon.jpg), and the image will be saved in the same folder as your script.

Here is another approach to check the mode of the moon\_image variable. Firstly, we check if it is in the right format. If it is so, we paste the image. Else we convert it to “RGBA” and then run the paste function.

# Overlay the moon image on top of the night sky image

if moon\_image.mode in ('RGBA', 'LA') or (moon\_image.mode == 'P' and 'transparency' in moon\_image.info):

night\_sky\_image.paste(moon\_image, (150, 100))

else:

moon\_image = moon\_image.convert("RGBA")

night\_sky\_image.paste(moon\_image, (150, 100))

If for example you wanted the image at the top right corner it would be (0,0) , you can play around with the coordinates so it fits your image better.  
Depending on your image for now, you will basically see an overlay of your moon into your night sky. In most cases, using this method transparency will not work that well.

My code to generate two images and overlay one on the otherwise

import os

import openai

import secret

from PIL import Image

import io

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

SIZE=512

*# https://picsum.photos/images to get specific image id*

URL=f"https://picsum.photos/id/8/{SIZE}/{SIZE}"

*#URL=f"https://picsum.photos/{SIZE}/{SIZE}"*

FILENAME = "test\_img.png"

# Generate an image from a DALL-E prompt, save it to file, maybe transform it a little...

# returns the image url

def generate\_base\_image(prompt):

filename=FILENAME

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size=f"{SIZE}x{SIZE}"

)

image\_url = response['data'][0]['url']

except Exception as e:

# This is a catch-all for any other exceptions

#print(f"Unexpected error: {e}")

image\_url = URL

finally:

#print(f"return image\_url: {image\_url}")

return image\_url

#generate\_image("a lovely bunch of coconuts")

"""

# Generate moon and night sky images

moon\_image\_url = generate\_base\_image('moon')

night\_sky\_image\_url = generate\_base\_image('night sky with stars')

img\_data = requests.get(moon\_image\_url).content

with open('moon\_image.jpg', 'wb') as handler:

handler.write(img\_data)

img\_data = requests.get(night\_sky\_image\_url).content

with open('night\_sky\_image.jpg', 'wb') as handler:

handler.write(img\_data)

"""

moon\_image=Image.open('moon\_image.jpg')

night\_sky\_image=Image.open('night\_sky\_image.jpg')

# Resize the moon image to fit the composition

moon\_image = moon\_image.resize((200, 200), Image.ANTIALIAS)

def image\_has\_transparency(image):

#print(f"mode {image.mode} info {image.info}")

return (image.mode in ('RGBA', 'LA') or (image.mode == 'P' and 'transparency' in image.info))

if not image\_has\_transparency(moon\_image):

# Convert the moon image to RGBA format so there is an alpha channel to prevent bad transparency mask error

moon\_image = moon\_image.convert("RGBA")

# Overlay the moon image on top of the night sky image

night\_sky\_image.paste(moon\_image, (150, 100), moon\_image)

# Save the composed image to a file

night\_sky\_image.save('night\_sky\_with\_moon.jpg')

# **Filters**

Now we will explore how to apply various image filters to images generated by the DALL-E 2 API using the Python Imaging Library (PIL). Image filters can be used to enhance, stylize, or transform your images, creating unique and visually striking results.

For now we are going to go back to our apple example.

# Generate the base image

def generate\_base\_image(prompt):

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

return response['data'][0]['url']

base\_image\_url = generate\_base\_image('red apple')

img\_data = requests.get(base\_image\_url).content

with open('base\_apple.jpg', 'wb') as handler:

handler.write(img\_data)

Run it once to generate your “apple” then comment out the code so we have the base apple that we want to interact with. Your comment should more or less look like this

"""

base\_image\_url = generate\_base\_image('red apple')

img\_data = requests.get(base\_image\_url).content

with open('base\_apple.jpg', 'wb') as handler:

handler.write(img\_data)

"""

The last step is saving our image as a variable so we can more easily interact with it.

apple\_image=Image.open('base\_apple.jpg')

# **PIL**

The PIL library provides several built-in filters that you can apply to your images. These filters include blurring, sharpening, contouring, edge detection, and many others. We will explore some of these filters and learn how to apply them to images generated by the DALL-E 2 API.

#### **Gaussian Blur**

A Gaussian blur filter softens the image by reducing noise and details. This filter can be used to create a dreamy or ethereal effect, or to reduce noise in an image.

from PIL import ImageFilter

# Apply a Gaussian blur filter to the base image

blurred\_image = apple\_image.filter(ImageFilter.GaussianBlur(radius=5))

# Save the blurred image to a file

blurred\_image.save('blurred\_red\_apple.jpg')

#### **Contour**

The contour filter traces the edges of objects in the image, creating a high-contrast image. It is a filter that enhances the edges and boundaries within an image, making them more pronounced. It detects areas with rapid changes in pixel intensity and applies a highlighting effect to the edges. The resulting image will have a stylized appearance, emphasizing the contours of objects in the image. It is usually a black-and-white image that highlights the shapes in the scene.

from PIL import ImageFilter

# Apply a contour filter to the base image

contour\_image = apple\_image.filter(ImageFilter.CONTOUR)

# Save the contour image to a file

contour\_image.save('contour\_red\_apple.jpg')

My code example with picsum generated images

import os

import openai

import secret

from PIL import Image

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

SIZE=512

# https://picsum.photos/images to get specific image id

URL=f"https://picsum.photos/id/8/{SIZE}/{SIZE}"

#URL=f"https://picsum.photos/{SIZE}/{SIZE}"

FILENAME = "test\_img.png"

# Generate an image from a DALL-E prompt, save it to file, maybe transform it a little...

# returns the image url

def generate\_base\_image(prompt):

filename=FILENAME

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size=f"{SIZE}x{SIZE}"

)

image\_url = response['data'][0]['url']

except Exception as e:

# This is a catch-all for any other exceptions

#print(f"Unexpected error: {e}")

image\_url = URL

finally:

#print(f"return image\_url: {image\_url}")

return image\_url

"""

base\_image\_url = generate\_base\_image('red apple')

img\_data = requests.get(base\_image\_url).content

with open('base\_apple.jpg', 'wb') as handler:

handler.write(img\_data)

"""

apple\_image=Image.open('base\_apple.jpg')

from PIL import ImageFilter

# Apply a Gaussian blur filter to the base image

blurred\_image = apple\_image.filter(ImageFilter.GaussianBlur(radius=5))

# Save the blurred image to a file

blurred\_image.save('blurred\_red\_apple.jpg')

from PIL import ImageFilter

# Apply a contour filter to the base image

contour\_image = apple\_image.filter(ImageFilter.CONTOUR)

# Save the contour image to a file

contour\_image.save('contour\_red\_apple.jpg')

# **Edges**

In the context of image processing, "**edges**" refer to boundaries or transitions between different regions in an image. These boundaries usually occur at points where there is a sharp change in color or intensity values. Identifying edges is a crucial step in many computer vision and image processing tasks, as it helps in understanding the structure and objects present in an image. In the next example, we are using filters that focus on identifying and enhancing the edges in the image.

#### **Edge**

The edge enhance filter highlights the edges of objects in the image, making them more distinct and pronounced. This filter can be used to create a more stylized or artistic effect.

from PIL import ImageFilter

# Apply an edge enhance filter to the base image

edge\_enhanced\_image = apple\_image.filter(ImageFilter.EDGE\_ENHANCE)

# Save the edge enhanced image to a file

edge\_enhanced\_image.save('edge\_enhanced\_red\_apple.jpg')

#### **Find Edges**

The find edges filter is another type of image filter that enhances the edges in an image, similar to the contour filter. However, the find edges filter typically produces a more pronounced and higher contrast effect, making the edges stand out even more.

from PIL import ImageFilter

# Apply a find edges filter to the base image

edge\_image = apple\_image.filter(ImageFilter.FIND\_EDGES)

# Save the edge image to a file

edge\_image.save('edge\_red\_apple.jpg')

In this lesson, we explored various image filters provided by the PIL library and learned how to apply them to images generated by the DALL-E 2 API. By combining these filters with the DALL-E 2 API, you can create a wide array of unique and visually striking images.

Feel free to experiment with different filters and combinations to create your own custom images using the DALL-E 2 API and the PIL library.

Full file with all image effects

import os

import openai

import secret

from PIL import Image

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

SIZE=512

# https://picsum.photos/images to get specific image id

URL=f"https://picsum.photos/id/8/{SIZE}/{SIZE}"

#URL=f"https://picsum.photos/{SIZE}/{SIZE}"

FILENAME = "test\_img.png"

# Generate an image from a DALL-E prompt, save it to file, maybe transform it a little...

# returns the image url

def generate\_base\_image(prompt):

filename=FILENAME

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size=f"{SIZE}x{SIZE}"

)

image\_url = response['data'][0]['url']

except Exception as e:

# This is a catch-all for any other exceptions

#print(f"Unexpected error: {e}")

image\_url = URL

finally:

#print(f"return image\_url: {image\_url}")

return image\_url

"""

base\_image\_url = generate\_base\_image('red apple')

img\_data = requests.get(base\_image\_url).content

with open('base\_apple.jpg', 'wb') as handler:

handler.write(img\_data)

"""

apple\_image=Image.open('base\_apple.jpg')

from PIL import ImageFilter

# Apply a Gaussian blur filter to the base image

blurred\_image = apple\_image.filter(ImageFilter.GaussianBlur(radius=5))

# Save the blurred image to a file

blurred\_image.save('blurred\_red\_apple.jpg')

from PIL import ImageFilter

# Apply a contour filter to the base image

contour\_image = apple\_image.filter(ImageFilter.CONTOUR)

# Save the contour image to a file

contour\_image.save('contour\_red\_apple.jpg')

from PIL import ImageFilter

# Apply an edge enhance filter to the base image

edge\_enhanced\_image = apple\_image.filter(ImageFilter.EDGE\_ENHANCE)

# Save the edge enhanced image to a file

edge\_enhanced\_image.save('edge\_enhanced\_red\_apple.jpg')

from PIL import ImageFilter

# Apply a find edges filter to the base image

edge\_image = apple\_image.filter(ImageFilter.FIND\_EDGES)

# Save the edge image to a file

edge\_image.save('edge\_red\_apple.jpg')

# **Coding Exercise**

#### **Assessment Question**

1. Using OpenAI’s DALL-E 2, generate an image of a plane in mid-flight. Save the generated image as plane.png.
2. Utilize the Python Imaging Library (PIL) to create an edge-enhanced version of the image you generated in the previous step. Save the enhanced image as enhanced\_plane.png.

In this task, you will use OpenAI’s DALL-E 2 to generate an image based on a textual description and then apply an image processing operation using PIL. The task involves two major steps:

1. **Image Generation with DALL-E 2**: Using OpenAI’s DALL-E 2, write a function generate\_base\_image(prompt) that takes a text prompt as input and returns a URL for an image generated by DALL-E 2. The image should be 512x512 pixels in size. Download the image and save it as plane.png.
2. **Image Processing with PIL**: Next, load the plane.png image and apply an edge enhance filter using PIL’s ImageFilter.EDGE\_ENHANCE. Save the resulting edge-enhanced image as enhanced\_plane.png.

My Solution:

import os

import io

import openai

import secret

from PIL import Image, ImageFilter

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

SIZE=512

URL="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Ftse1.mm.bing.net%2Fth%3Fid%3DOIP.yRzd0RhJEap22R16vpex\_QHaHa%26pid%3DApi&f=1&ipt=f2e7766586dd4f68c229c7e52a3bae203e3fd9800c8e4e78dd80851d1d7ff363&ipo=images"

FILENAME="plane.png"

ENHANCED="enhanced\_plane.png"

# Generate an image from a DALL-E prompt, save it to file, maybe transform it a little...

# returns the image url

def generate\_base\_image(prompt):

filename=FILENAME

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size=f"{SIZE}x{SIZE}"

)

image\_url = response['data'][0]['url']

except Exception as e:

# This is a catch-all for any other exceptions

#print(f"Unexpected error: {e}")

image\_url = URL

finally:

#print(f"return image\_url: {image\_url}")

# Download the image

response = requests.get(image\_url)

img\_data = response.content

#with open(FILENAME, 'wb') as handler:

# handler.write(img\_data)

img = Image.open(io.BytesIO(response.content))

# Apply transformations

#img = img.resize((512, 512)) # Resize

img.save(FILENAME)

return img

img = generate\_base\_image("an airplane in mid-flight")

enhanced = img.filter(ImageFilter.EDGE\_ENHANCE)

enhanced.save(ENHANCED)

DALL-E and Transformations with PIL

# **Learning Objectives**

### **Learners will be able to…**

* **Understand the concept of image transformations and their significance in image processing.**
* **Differentiate between spatial transformations and color transformations.**
* **Apply various spatial transformations, such as flipping, rotating, and inverting images, using the Python Imaging Library (PIL)**.
* **Use the DALL-E 2 API in combination with the PIL library to create unique and interesting variations of generated images**.
* **Experiment with different transformations and combinations to create custom images and effects using the DALL-E 2 API and the PIL library.**

# **Transformation**

In the context of image processing, "**transformations**" refer to operations that modify the spatial, color, or other properties of an image. These operations can be applied to the image to enhance its appearance, correct its orientation, change its perspective, or create various artistic effects. Transformations can be broadly categorized into two types: color transformations and spatial transformations.

**Color Transformations:**

Color transformations involve modifying the color properties of an image, such as its brightness, contrast, saturation, or hue. Common color transformations include:

* **Inverting**: Reversing the color values of the image, creating a “negative” of the original image. This can be used to create interesting visual effects or emphasize specific features of an image.
* **Adjusting brightness**: Changing the overall intensity of the image’s colors. This can be used to correct underexposed or overexposed images or create specific moods.
* **Adjusting contrast**: Modifying the difference between the darkest and lightest colors in the image. This can be used to enhance the details or create specific effects.
* **Adjusting saturation**: Changing the intensity of the colors in the image. This can be used to make the colors more vibrant or muted, or to create monochromatic or grayscale images.
* **Adjusting hue**: Shifting the colors in the image along the color spectrum. This can be used to change the overall color scheme of the image or create specific effects.

**Spatial Transformations:**  
Spatial transformations involve changing the geometric properties of an image, such as its position, orientation, or size. Common spatial transformations include:

* **Flipping**: Mirroring the image either horizontally or vertically. This is useful for creating reflections or correcting image orientation.
* **Rotating**: Changing the orientation of the image by a specified angle. This can be used to correct image orientation or create dynamic compositions.
* **Scaling**: Changing the size of the image, either by enlarging or reducing it. This can be used to fit the image into a specific size or resolution.
* **Cropping**: Removing parts of the image outside a specified region. This can be used to focus on a specific area of the image or remove unwanted portions.
* **Warping**: Changing the perspective or shape of the image by applying a geometric transformation. This can be used to correct perspective distortion or create artistic effects.

These transformations can be applied individually or in combination to create a wide array of unique and visually engaging images. By using various image processing libraries like PIL, you can easily apply these transformations to your images and create custom effects tailored to your needs.  
We have more or less covered the color transformations in the previous lesson we will be focused on spacial transformation in this one.

# **Saving our Image**

### **Image Generation**

In order to not have to keep copying and pasting our result in, we are going to save the image so that we can interact with as a file in our Codio box.

The first thing we are going to do is get our base image. Previously we used very simple prompts to generate simple images. The simple images were very useful to see the color transformations. Now that we are going to work with more spacial transformations we can make some cooler pictures and still easily visualize the changes. Let’s start with getting our library and image generation function

import os

import openai

import secret

from PIL import Image,ImageOps

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

# Generate the base image

def generate\_base\_image(prompt):

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

return response['data'][0]['url']

From there you can use any prompt you would like. We are going to use the following prompt:

cool\_prompt= "Reunion of man, team, squad with katanas, cyberpunk, abstract, full hd render + 3d octane render +4k UHD + immense detail + dramatic lighting + well lit + black, purple, blue, pink, cerulean, teal, metallic colours, + fine details + octane render + 8k"

image\_url = generate\_base\_image(cool\_prompt)

img\_data = requests.get(image\_url).content

with open('base\_img.jpg', 'wb') as handler:

handler.write(img\_data)

**If** you want feel free to generate other images until you have something you like. **If** you want to use the picture above, you can run the following code. Additional images will be provided below, if you want them simply switch the corresponding source file. Example, base\_img9.jpg or base\_img8.jpg … Please remember to comment out the code to generate a new image.

import shutil

# Set the source and destination file paths

src\_file = "base\_Img0.jpg"

dst\_file = "base\_img.jpg"

# Copy the file to the new destination

shutil.copy(src\_file, dst\_file)

Comment out the code so you are no longer generating and moving your files. More choices are available including their prompts below:

cool\_prompt= "cybernetic ninja cyborg with glowing parts , ninja has sword, impressive, surreal, cinematic lighting, cinematic photoshot, extremely detailed and complex, VFX volume fog around, nighttime, super max, surreal, super detailed, high contrast, Rtx on, Hdr, photography, realistic, dof on, fov on, motion blur, lens flares on, 50mm Prime f/1.8, White balance, Super resolution, Megapixel, ProPhoto RGB, VR, high, epic, Rear half lighting, Lights background, natural lighting, incandescent light, fiber optic, mood lighting, cinema lighting, studio lighting, soft illumination, volumetric, contrast, dark lighting, accent lighting, projection global illumination, Screen space global illumination, Ray tracing global illumination, Red fringing light, 45% cold color grading, Optics, Scattering, Glow, Shadows, hyperrealism, Caustic water, refraction water, exquisite detail, intricately-detailed, ultra-detailed photography, high-sharpness, high reflection, award-winning photograph"

cool\_prompt= " masked mutant with fire powers, standing atop a skyscraper during a thunderstorm. body is crackling with electricity, with glowing veins and eyes. cyberpunk, abstract, full hd render + 3d octane render +4k UHD + immense detail + dramatic lighting + well lit + black, purple, blue, pink, cerulean, teal, metallic colours + fine details + octane render + 8k"

cool\_prompt="Create an image of a futuristic city with towering skyscrapers, advanced transportation systems, and renewable energy sources. Use high-tech materials that shimmer and reflect light, and incorporate green spaces and parks into the skyline. Use dynamic and colorful lighting with neon lights and holographic projections. Show a diverse and cosmopolitan population with cutting-edge fashion and technology. Capture the city's sleek and sophisticated aesthetic in your image."

# **Flipping**

Flipping an image involves mirroring it either horizontally or vertically. This can be useful for creating reflections, correcting image orientation, or generating additional variations of a generated image. We will explore horizontal and vertical flipping using the Python Imaging Library (PIL) and the DALL-E 2 API.

### **Horizontal Flipping**

Horizontal flipping mirrors the image along its vertical axis, effectively reversing its left and right sides. This can be used to create a reflection effect or to correct an image’s orientation if it appears reversed. Now feel free to comment out the code from the previous page, remember to keep your libraries. After copy and paste the following code.

### **Vertical Flipping**

Vertical flipping mirrors the image along its horizontal axis, effectively reversing its top and bottom sides. This can be useful for creating a reflection effect on a horizontal surface or correcting an image’s orientation if it appears upside-down.

### **Combining Flips**

You can also combine horizontal and vertical flips to create a diagonal reflection effect or generate additional variations of the image.

My code solution

import os

import openai

import secret

from PIL import Image,ImageOps

from io import BytesIO

import requests

SIZE=512

URL="https://www.pngmart.com/files/13/PUBG-Squad-Team-Transparent-Background.png"

FILENAME="base\_img.jpg"

openai.api\_key = secret.api\_key

# Generate the base image

def generate\_base\_image(prompt):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size=f"{SIZE}x{SIZE}"

)

image\_url = response['data'][0]['url']

except Exception as e:

# This is a catch-all for any other exceptions

print(f"Unexpected error: {e}")

image\_url = URL

finally:

print(f"return image\_url: {image\_url}")

return image\_url

cool\_prompt= "Reunion of man, team, squad with katanas, cyberpunk, abstract, full hd render + 3d octane render +4k UHD + immense detail + dramatic lighting + well lit + black, purple, blue, pink, cerulean, teal, metallic colours, + fine details + octane render + 8k"

# don't need to generat image any more, we have it

"""

image\_url = generate\_base\_image(cool\_prompt)

img\_data = requests.get(image\_url).content

with open(FILENAME, 'wb') as handler:

handler.write(img\_data)

"""

import shutil

# Set the source and destination file paths

src\_file = "base\_Img0.jpg" # or img9 8 7

dst\_file = FILENAME

# don't need to copy image any more, we have it

# Copy the file to the new destination

#shutil.copy(src\_file, dst\_file)

#Saving our base image

base\_image=Image.open('base\_img.jpg')

# Flip the base image horizontally

flipped\_horizontal\_image = ImageOps.mirror(base\_image)

# Save the horizontally flipped image to a file

flipped\_horizontal\_image.save('flipped\_horizontal.png')

# cannot save png image as jpg, so just rename it, the browser will load it properly

shutil.move('flipped\_horizontal.png', 'flipped\_horizontal.jpg')

# Flip the base image vertically

flipped\_vertical\_image = ImageOps.flip(base\_image)

# Save the vertically flipped image to a file

flipped\_vertical\_image.save('flipped\_vertical.png')

shutil.move('flipped\_vertical.png', 'flipped\_vertical.jpg')

# Flip the base image horizontally and vertically

flipped\_both\_image = ImageOps.mirror(ImageOps.flip(base\_image))

# Save the horizontally and vertically flipped image to a file

flipped\_both\_image.save('flipped\_both.png')

shutil.move('flipped\_both.png', 'flipped\_both.jpg')

# **Rotating**

Rotating an image involves changing its orientation by a specified angle. This can be useful for correcting image orientation, creating dynamic compositions, or generating additional variations of a generated image. In this extended example, we will explore various ways to rotate images using the Python Imaging Library (PIL) and the DALL-E 2 API. To avoid clutter we are going to use a new code file. Since we know where our base image is located we just need our libraries.

### **Basic Rotation**

In its simplest form, image rotation involves specifying an angle by which to rotate the image. The image is rotated around its center by default.

# Rotate the base image by 45 degrees rotated\_image\_45 = base\_image.rotate(45) # Save the rotated image to a file rotated\_image\_45.save('rotated\_45\_.jpg')

### **Rotation with Resampling**

When rotating an image, the original pixel values may not align with the new pixel grid. To address this issue, you can use resampling techniques, which interpolate the pixel values to create a smoother appearance. The most common resampling technique is bilinear interpolation.

# Rotate the base image by 45 degrees with bilinear interpolation rotated\_image\_45\_bilinear = base\_image.rotate(45, resample=Image.BILINEAR) # Save the rotated image with bilinear interpolation to a file rotated\_image\_45\_bilinear.save('rotated\_45\_bilinear.jpg')

### **Rotation with Custom Center**

By default, the image is rotated around its center. However, you can specify a custom center for the rotation if you want to create a different effect or composition

# Define custom center coordinates (x, y) center\_x = 100 center\_y = 100 # Rotate the base image by 45 degrees around the custom center rotated\_image\_custom\_center = base\_image.rotate(45, center=(center\_x, center\_y)) # Save the rotated image with custom center to a file rotated\_image\_custom\_center.save('rotated\_custom\_center.jpg')

### **Rotation with Expand Option**

When rotating an image, the corners may be cropped if they extend beyond the original image boundaries. To avoid this, you can use the expand option to automatically resize the image canvas to accommodate the rotated image.

# Rotate the base image by 120 degrees and expand the canvas rotated\_image\_expanded = base\_image.rotate(120, expand=True) # Save the rotated image with expanded canvas to a file rotated\_image\_expanded.save('rotated\_expanded.jpg')

By applying various rotation techniques to images generated by the DALL-E 2 API, you can create interesting and dynamic compositions, adding visual appeal and diversity to your images.

My Rotation code sample

import os

import openai

import secret

from PIL import Image,ImageOps

from io import BytesIO

import requests

import shutil

openai.api\_key = secret.api\_key

def save\_jpg(image, filename):

png=f'{filename}.png'

image.save(png)

shutil.move(png, f'{filename}.jpg')

#Saving our base image

base\_image=Image.open('base\_img.jpg')

# Rotate the base image by 45 degrees

rotated\_image\_45 = base\_image.rotate(45, expand=False)

# Save the rotated image to a file

save\_jpg(rotated\_image\_45, 'rotated\_45\_')

# Rotate the base image by 45 degrees with bilinear interpolation

rotated\_image\_45\_bilinear = base\_image.rotate(45, resample=Image.BILINEAR, expand=False)

# Save the rotated image with bilinear interpolation to a file

save\_jpg(rotated\_image\_45\_bilinear, 'rotated\_45\_bilinear')

# Define custom center coordinates (x, y)

center\_x = 100

center\_y = 100

# Rotate the base image by 45 degrees around the custom center

rotated\_image\_custom\_center = base\_image.rotate(45, center=(center\_x, center\_y), expand=False)

# Expand=True with center coordinates does not work well.

# Save the rotated image with custom center to a file

save\_jpg(rotated\_image\_custom\_center, 'rotated\_custom\_center')

# Rotate the base image by 120 degrees and expand the canvas

rotated\_image\_expanded = base\_image.rotate(120, expand=True)

# Save the rotated image with expanded canvas to a file

save\_jpg(rotated\_image\_expanded, 'rotated\_expanded')

#formatted

CAVEAT Expand=true does not work properly when specifying an alternative center point.

# **Inverting Images**

Inverting an image involves reversing its color values, creating a “negative” of the original image. This can be useful for creating interesting visual effects, emphasizing specific features of an image, or generating additional variations of a generated image. We will explore image inversion using the Python Imaging Library (PIL) and the DALL-E 2 API.

import os

import openai

import secret

from PIL import Image,ImageOps

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

#Saving our base image

base\_image=Image.open('base\_img.jpg')

### **Color Inversion**

Color inversion involves reversing the RGB values of each pixel in the image. This can create a striking effect that highlights different aspects of the image compared to the original.

# Invert the colors of the base image

inverted\_image = ImageOps.invert(base\_image)

# Save the inverted image to a file inverted\_

image.save('inverted.jpg')

### **Grayscale Inversion**

Grayscale inversion involves first converting the image to grayscale and then reversing its color values. This creates a negative effect while preserving the tonal relationships in the image.

# Convert the base image to grayscale

grayscale\_image = ImageOps.grayscale(base\_image)

# Invert the grayscale image

inverted\_grayscale\_image = ImageOps.invert(grayscale\_image)

# Save the inverted grayscale image to a file

inverted\_grayscale\_image.save('inverted\_grayscale.jpg')

Inversion with Custom Color Channels

You can also create custom effects by inverting only specific color channels of the image. For example, you can invert the red and green channels while preserving the blue channel.

# Split the color channels of the base image

r, g, b = base\_image.split()

# Invert the red and green channels

inverted\_r = ImageOps.invert(r)

inverted\_g = ImageOps.invert(g)

# Combine the inverted red and green channels with the original blue channel

inverted\_custom\_channels\_image = Image.merge("RGB", (inverted\_r, inverted\_g, b))

# Save the custom channel inverted image to a file

inverted\_custom\_channels\_image.save('inverted\_custom\_channels.jpg')

My code example with PIL helper functions for save as JPG getAsRGB, etc imgInvert and others which convert image to correct mode before doing the operation.

mport os

import openai

import secret

from PIL import Image,ImageOps

from io import BytesIO

import requests

import shutil

openai.api\_key = secret.api\_key

def getAsPNG(image):

#print(f"getAsPNG image mode {image.mode} info {image.info}")

if image.mode != 'P':

image = image.convert('P')

#print(f"getAsPNG ret image mode {image.mode} info {image.info}")

return image

def getAsL(image):

#print(f"getAsL image mode {image.mode} info {image.info}")

if image.mode != 'L':

if image.mode == 'P' and 'transparency' in image.info:

image = image.convert('RGBA').convert('L')

else:

image = image.convert('L')

#print(f"getAsL ret image mode {image.mode} info {image.info}")

return image

def getAsLA(image):

#print(f"getAsLA image mode {image.mode} info {image.info}")

if image.mode != 'LA':

image = image.convert('LA')

#print(f"getAsLA ret image mode {image.mode} info {image.info}")

return image

def getAsRGB(image):

#print(f"getAsRGB image mode {image.mode} info {image.info}")

if image.mode != 'RGB':

if image.mode == 'P' and 'transparency' in image.info:

image = image.convert('RGBA').convert('RGB')

else:

image = image.convert('RGB')

#print(f"getAsRGB ret image mode {image.mode} info {image.info}")

return image

def getAsRGBA(image):

#print(f"getAsRGBA image mode {image.mode} info {image.info}")

if image.mode != 'RGBA':

if image.mode == 'P' and 'transparency' in image.info:

image = image.convert('RGBA')

else:

image = image.convert('RGBA')

#print(f"getAsRGBA ret image mode {image.mode} info {image.info}")

return image

def imgInvert(image):

#print(f"imgInvert image mode {image.mode} info {image.info}")

if image.mode.endswith('A'):

image = image.convert(image.mode[:-1])

else:

# NotImplementedError("mode P support coming soon")

# or we could try: and then convert if NotImplementedError is received...

if image.mode == 'P':

image = getAsRGB(image)

return ImageOps.invert(image)

def imgGrayscale(image):

#print(f"imgGrayscale image mode {image.mode} info {image.info}")

if image.mode == 'P' and 'transparency in image.info':

image = getAsRGB(image)

return ImageOps.grayscale(image)

def imgSplit(image):

#print(f"imgSplit image mode {image.mode} info {image.info}")

return getAsRGB(image).split()

def imgSaveJPG(image, filename):

#print(f"imgSave image mode {image.mode} info {image.info}")

getAsRGB(image).save(filename)

img=Image.open('base\_img.jpg')

#print (f"img: {img}")

if True:

imgRGB = getAsRGB(img)

imgSaveJPG(imgRGB, 'xxx.jpg')

imgRGBA = getAsRGBA(img)

imgSaveJPG(imgRGBA, 'xxx.jpg')

imgPNG = getAsPNG(img)

imgSaveJPG(imgPNG, 'xxx.jpg')

imgL = getAsL(img)

imgSaveJPG(imgL, 'xxx.jpg')

imgLA = getAsLA(img)

imgSaveJPG(imgLA, 'xxx.jpg')

getAsRGB(imgRGB)

getAsRGBA(imgRGB)

getAsPNG(imgRGB)

getAsL(imgRGB)

getAsLA(imgRGB)

getAsRGB(imgRGBA)

getAsRGBA(imgRGBA)

getAsPNG(imgRGBA)

getAsL(imgRGBA)

getAsLA(imgRGBA)

getAsRGB(imgLA)

getAsRGBA(imgLA)

getAsPNG(imgLA)

getAsL(imgLA)

getAsLA(imgLA)

getAsRGB(imgL)

getAsRGBA(imgL)

getAsPNG(imgL)

getAsL(imgL)

getAsLA(imgL)

imgInvert(imgL)

imgInvert(imgLA)

imgInvert(imgRGB)

imgInvert(imgRGBA)

imgInvert(imgPNG)

imgGrayscale(imgL)

imgGrayscale(imgLA)

imgGrayscale(imgRGB)

imgGrayscale(imgRGBA)

imgGrayscale(imgPNG)

imgSplit(imgL)

imgSplit(imgLA)

imgSplit(imgRGB)

imgSplit(imgRGBA)

imgSplit(imgPNG)

#Saving our base image

base\_image=img

#print(f"img mode {img.mode} info {img.info}")

#print(f"base\_image mode {base\_image.mode} info {base\_image.info}")

# Invert the colors of the base image

inverted\_image = imgInvert(base\_image)

# Save the inverted image to a file

inverted\_image.save('inverted.jpg')

# Convert the base image to grayscale

grayscale\_image = imgGrayscale(base\_image)

# Invert the grayscale image

inverted\_grayscale\_image = imgInvert(grayscale\_image)

# Save the inverted grayscale image to a file

inverted\_grayscale\_image.save('inverted\_grayscale.jpg')

# Split the color channels of the base image

# ValueError: not enough values to unpack

r, g, b = imgSplit(base\_image)

# Invert the red and green channels

inverted\_r = imgInvert(r)

inverted\_g = imgInvert(g)

# Combine the inverted red and green channels with the original blue channel

inverted\_custom\_channels\_image = Image.merge("RGB", (inverted\_r, inverted\_g, b))

# Save the custom channel inverted image to a file

inverted\_custom\_channels\_image.save('inverted\_custom\_channels.jpg')

# **Coding Exercise**

In this assignment, you will be performing a series of image processing tasks using DALL-E and the Python Imaging Library (PIL). You will generate a unique image, apply a rotation transformation, and perform a color inversion.

The steps are as follows:

1. Use DALL-E to generate a visually appealing image using the provided prompt. Save the image as cool.png.

cool\_prompt= "Reunion of man, team, squad with katanas, ninja ,background forest , abstract, full hd render + 3d octane render +4k UHD + immense detail + dramatic lighting + well lit + black, purple, blue, pink, cerulean, teal, metallic colours, + fine details + octane render + 8k"

1. Rotate the generated image by 45 degrees, demonstrating your understanding of basic transformations in image processing. Save the rotated image as rotated\_45\_cool.png.
2. Finally, invert the colors of the rotated image. This step will familiarize you with color space transformations. Save the final image as final\_cool.png.

Their example solution

# Generate the base image

def generate\_base\_image(prompt):

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

return response['data'][0]['url']

cool\_prompt= "Reunion of man, team, squad with katanas, ninja ,background forest , abstract, full hd render + 3d octane render +4k UHD + immense detail + dramatic lighting + well lit + black, purple, blue, pink, cerulean, teal, metallic colours, + fine details + octane render + 8k"

image\_url = generate\_base\_image(cool\_prompt)

img\_data = requests.get(image\_url).content

with open('cool.png', 'wb') as handler:

handler.write(img\_data)

#Saving our base image

base\_image=Image.open('cool.png')

# Rotate the base image by 45 degrees

rotated\_image\_45 = base\_image.rotate(45)

# Save the rotated image to a file

rotated\_image\_45.save('rotated\_45\_cool.png')

new\_base= Image.open('rotated\_45\_cool.png')

# Invert the colors of the base image

inverted\_image = ImageOps.invert(new\_base)

# Save the inverted image to a file

inverted\_image.save('final\_cool.png')

My Solution:

import os

import openai

import secret

from PIL import Image,ImageOps

from io import BytesIO

import requests

SIZE=512

URL="https://www.pngmart.com/files/13/PUBG-Squad-Team-Transparent-Background.png"

FILENAME="cool.png"

openai.api\_key = secret.api\_key

# Generate the base image

def generate\_base\_image(prompt):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size=f"{SIZE}x{SIZE}"

)

image\_url = response['data'][0]['url']

except Exception as e:

# This is a catch-all for any other exceptions

#print(f"Unexpected error: {e}")

image\_url = URL

finally:

#print(f"return image\_url: {image\_url}")

img\_data = requests.get(image\_url).content

with open(FILENAME, 'wb') as handler:

handler.write(img\_data)

return image\_url

def getAsRGB(image):

#print(f"getAsRGB image mode {image.mode} info {image.info}")

if image.mode != 'RGB':

if image.mode == 'P' and 'transparency' in image.info:

image = image.convert('RGBA').convert('RGB')

else:

image = image.convert('RGB')

#print(f"getAsRGB ret image mode {image.mode} info {image.info}")

return image

def imgInvert(image):

#print(f"imgInvert image mode {image.mode} info {image.info}")

if image.mode.endswith('A'):

image = image.convert(image.mode[:-1])

else:

# NotImplementedError("mode P support coming soon")

# or we could try: and then convert if NotImplementedError is received...

if image.mode == 'P':

image = getAsRGB(image)

return ImageOps.invert(image)

cool\_prompt= "Reunion of man, team, squad with katanas, ninja ,background forest , abstract, full hd render + 3d octane render +4k UHD + immense detail + dramatic lighting + well lit + black, purple, blue, pink, cerulean, teal, metallic colours, + fine details + octane render + 8k"

generate\_base\_image(cool\_prompt)

img=Image.open(FILENAME)

print (f"img: {img}")

rot = img.rotate(45, expand=True)

rot.save('rotated\_45\_cool.png')

inv = imgInvert(rot)

inv.save('final\_cool.png')

# **Learning Objectives**

### **Learners will be able to…**

* **Develop proficiency in conditional image generation techniques**
* **Demonstrate an understanding of prompt engineering for natural language processing**
* **Apply GPT-3 as a prompt generator in natural language processing tasks**
* **Evaluate the limitations of image-to-text applications and propose potential solutions**

# **Understanding Prompt Engineering**

A crucial aspect of generating relevant and visually appealing images using the DALL-E 2 API is crafting effective prompts. In this section, we will learn how to create more effective prompts to guide the DALL-E 2 API in generating the desired images.

* **Be clear and descriptive**: Use specific adjectives, nouns, and phrases to describe the desired image. For example, instead of “a dog,” try “a golden retriever playing in a park.”
* **Experiment with different prompt structures**: Change the order of words, use synonyms, or rephrase the prompt to achieve different results. For example, instead of “a futuristic city,” try “a city in the future” or “a city with advanced technology.”
* **Provide context**: Add context or additional information to the prompt to guide the model. For example, instead of “a sad robot,” try “a robot expressing sadness in its facial features.”
* **Test multiple prompts**: Generate images using different prompts and choose the one that produces the best results.

# **Combining DALL-E 2 API with GPT-3**

### **For Text-to-Image and Image-to-Text Applications**

In this section, we will discuss how to combine the DALL-E 2 API with GPT-3 to create powerful text-to-image and image-to-text applications. By leveraging the strengths of both models, you can build more versatile and interactive applications.

## **Text-to-Image Application**

A text-to-image application translates a given text prompt into an image. You can use GPT-3 to refine the text prompts before passing them to the DALL-E 2 API for image generation. Here’s an example:

Use GPT-3 to create a more descriptive text prompt based on user input:

import os

import openai

from PIL import Image,ImageOps

from io import BytesIO

import secret

# Set API key and prompt

openai.api\_key = secret.key

user\_input = "Create an image of a car"

# Generate more descriptive text with GPT-3

response = openai.Completion.create(

engine="text-davinci-002",

prompt=f"Create a more descriptive scene based on this user input: '{user\_input}'.",

max\_tokens=50,

n=1,

stop=None,

temperature=0.7,

)

descriptive\_text = response.choices[0].text.strip()

print(descriptive\_text)

The code above gets a user input, then uses GPT-3 to expand on that prompt. How to go about expanding on the prompt is by writing the following prompt : Create a more descriptive scene based on this user input:.

Now let’s try creating and saving the image that we would generate from our new and more detailed prompt.

# Generate the base image

response = openai.Image.create(

prompt=descriptive\_text,

n=1,

size="512x512"

)

image\_url = response['data'][0]['url']

img\_data = requests.get(image\_url).content

with open('base\_img.jpg', 'wb') as handler:

handler.write(img\_data)

Once you found an image or prompt you are comfortable working with. We are going to save on some tokens and copy the prompt being printed and set our variable descriptive\_text equal to it. From that point please comment out GPT code.

Below is an example of a descriptive text generated by the AI. Feel free to run it.

descriptive\_text = "The car is a sleek, silver convertible with bright red leather seats. It's parked in front of a beautiful mansion with a fountain in the middle."

### **Temperature**

In our code, we used the temperature with the value of 0.7. Temperature is a parameter that influences the randomness of the image generation process. A higher temperature value results in more diverse and potentially more creative prompts, while a lower temperature value produces more conservative and focused results.

My solution for prompt text and image creation

import os

import openai

from PIL import Image,ImageOps

from io import BytesIO

import secret

import requests

# Set API key and prompt

openai.api\_key = secret.key

user\_input = "Create an image of a car"

#Create a more descriptive scene based on this user input: 'Create an image of a car'.

DALLE="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fferrari-laferrari-blue\_Zm5paGyUmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=95988daa6aadf493947b6b58563648c861b912cf138ede3776209877c37669ca&ipo=images"

ChatGPT="A sleek, midnight-blue sports car sits gracefully under the soft glow of a streetlight, casting a warm halo around its polished exterior. The aerodynamic curves of the vehicle catch the ambient light, emphasizing its modern design. The cityscape in the background is painted in hues of orange and purple as the sun sets behind towering skyscrapers, reflecting off the car's tinted windows. The car's headlights illuminate the road ahead, and a subtle sheen of dew on the surface adds a touch of mystique to the scene, suggesting that it's a quiet evening filled with the anticipation of a thrilling drive."

"""

try:

# Generate more descriptive text with GPT-3

response = openai.Completion.create(

engine="text-davinci-002",

prompt=f"Create a more descriptive scene based on this user input: '{user\_input}'.",

max\_tokens=50,

n=1,

stop=None,

temperature=0.7,

)

descriptive\_text = response.choices[0].text.strip()

except Exception as exc:

descriptive\_text=ChatGPT

print(descriptive\_text)

"""

descriptive\_text = "The car is a sleek, silver convertible with bright red leather seats. It's parked in front of a beautiful mansion with a fountain in the middle."

try:

# Generate the base image

response = openai.Image.create(

prompt=descriptive\_text,

n=1,

size="512x512"

)

image\_url = response['data'][0]['url']

except Exception as exc:

image\_url = DALLE

img\_data = requests.get(image\_url).content

with open('base\_img.jpg', 'wb') as handler:

handler.write(img\_data)

# **Controlling Image Attributes**

## **Conditional Image Generation with DALL-E 2 API**

Conditional image generation using DALL-E 2 API allows developers to control various attributes of the generated images by specifying them in the prompt. This powerful feature enables users to create images with desired characteristics, such as specific styles, colors, or content. In this page, we will explore how to control image attributes using the DALL-E 2 API, providing examples and explanations of how the prompts can be crafted to achieve specific results.

As we go through the examples. We are going to keep the libraries we import and our API key.

import os

import openai

from PIL import Image,ImageOps

from io import BytesIO

import requests

import secret

# Set API key and prompt

openai.api\_key = secret.key

At the bottom of our page will be the code to generate, save and visualize our images.

image\_url=(response['data'][0]['url'])

img\_data = requests.get(image\_url).content

with open('att.jpg', 'wb') as handler:

handler.write(img\_data)

We want to keep that. All the following examples should go in the middle of the two codes.

Example 1: Controlling style

prompt = "A cubist painting of a cat"

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

In this example, we specify the desired style of the generated image (“cubist painting”) along with the subject (“a cat”). By including the style in the prompt, DALL-E 2 will generate an image of a cat in the cubist painting style.

Example 2: Controlling color

prompt = "A red sports car on a blue background"

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

In this example, we specify the desired colors of the generated image by including “red sports car” and “blue background” in the prompt. DALL-E 2 will generate an image of a red sports car with a blue background, as requested

Example 3: Controlling content

prompt = "A futuristic city skyline with flying cars and skyscrapers"

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

In this example, we specify the desired content of the image by describing a futuristic city skyline with flying cars and skyscrapers. DALL-E 2 will generate an image that matches the provided description, creating a scene with the specified elements.

Controlling image attributes using the DALL-E 2 API is a powerful way to generate images that match specific requirements or artistic visions. By crafting prompts that include the desired attributes, developers can guide DALL-E 2 to create images with specific styles, colors, and content. Experimenting with different prompts and combinations of attributes can lead to diverse and creative results.

Image-to-Text Application

For an image-to-text application, you can use DALL-E 2 to generate a variety of images and then use GPT-3 to describe the images or provide captions.

Use DALL-E 2 API to generate an image based on a text prompt:

# Generate the base image

response = openai.Image.create(

prompt="cute kitten playing with a ball of yarn",

n=1,

size="512x512"

)

image\_url = response['data'][0]['url']

print(image\_url)

img\_data = requests.get(image\_url).content

with open('kitten.jpg', 'wb') as handler:

handler.write(img\_data)

Feel free to copy and paste the image URL to compare. Before moving on please comment out the previous code. You can get the image\_urlfrom the try it button above if necessary.

Use GPT-3 to generate a description or caption for the generated image:

# Generate a description with GPT-3

response = openai.Completion.create(

engine="text-davinci-002",

prompt=f"Describe the following image: [img]{image\_url}[/img]",

max\_tokens=50,

n=1,

stop=None,

temperature=0.7,

)

image\_description = response.choices[0].text.strip()

print(image\_description)

It’s important to be aware that image-to-text applications may not always provide the most accurate descriptions or captions. There are several reasons for this:

Lack of visual context: GPT-3 is a text-based model and does not have direct access to the actual image content. Instead, it relies on the image URL, which may not always provide enough context for the model to generate a precise description.

Ambiguity in images: Images can often contain ambiguous or abstract elements, making it difficult for the model to understand the exact content or context of the image. This can result in inaccuracies or vague descriptions.

Model limitations: While GPT-3 is an advanced language model, it is not perfect and has its limitations. It may not always be able to generate the most accurate or relevant descriptions, especially for images with complex or highly specialized content.

To improve the accuracy of image-to-text applications, you can consider using specialized computer vision models, such as OpenAI’s CLIP, which is designed specifically for tasks involving both text and images. These models are better equipped to handle the challenges associated with understanding and describing visual content.

Coding Exercise

Generate Image with GPT and DALL-E API

Objective: Write a Python function generate\_image(prompt) that uses OpenAI’s GPT API to enhance a user’s text prompt and DALL-E API to generate an image based on that enhanced text, then saves this image as my\_img.png.

Function Requirements:

Your function generate\_image(prompt) should accomplish the following steps:

Accept a user’s prompt as an argument.

Refine this prompt by passing it to the GPT API.

Generate an image from the refined prompt using the DALL-E API.

Save the generated image as my\_img.png.

Your Python function must look like the template below:

def generate\_image(prompt):

"""

This function accepts a user's prompt, enhances it using the GPT API, then generates an image from the enhanced prompt using the DALL-E API, and saves it as `my\_img.png`.

Parameters:

prompt (str): The initial user's prompt.

Returns:

None

"""

# Step 1: Pass the user's prompt to the GPT API to get a refined prompt.

# Step 2: Pass the refined prompt to the DALL-E API to get the generated image.

# Step 3: Save the generated image as `my\_img.png`.

return None

Hint: You can test your code by calling the function with some prompts. But before submitting, make sure to delete the function call.

My solution to the code exercises

import os

import openai

from PIL import Image,ImageOps

from io import BytesIO

import secret

import requests

# Set API key and prompt

openai.api\_key = secret.key

user\_input = "Create an image of a car"

#Create a more descriptive scene based on this user input: 'Create an image of a car'.

FILENAME="my\_img.png"

SIZE=512

URL="https://www.pngmart.com/files/13/PUBG-Squad-Team-Transparent-Background.png"

DALLE="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fferrari-laferrari-blue\_Zm5paGyUmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=95988daa6aadf493947b6b58563648c861b912cf138ede3776209877c37669ca&ipo=images"

ChatGPT="A sleek, midnight-blue sports car sits gracefully under the soft glow of a streetlight, casting a warm halo around its polished exterior. The aerodynamic curves of the vehicle catch the ambient light, emphasizing its modern design. The cityscape in the background is painted in hues of orange and purple as the sun sets behind towering skyscrapers, reflecting off the car's tinted windows. The car's headlights illuminate the road ahead, and a subtle sheen of dew on the surface adds a touch of mystique to the scene, suggesting that it's a quiet evening filled with the anticipation of a thrilling drive."

def generate\_image(prompt):

"""

This function accepts a user's prompt, enhances it using the GPT API, then generates an image from the enhanced prompt using the DALL-E API, and saves it as `my\_img.png`.

Parameters:

prompt (str): The initial user's prompt.

Returns:

None

"""

# Step 1: Pass the user's prompt to the GPT API to get a refined prompt.

try:

# Generate more descriptive text with GPT-3

response = openai.Completion.create(

engine="text-davinci-002",

prompt=f"Create a more descriptive scene based on this user input: '{user\_input}'.",

max\_tokens=50,

n=1,

stop=None,

temperature=0.7,

)

descriptive\_text = response.choices[0].text.strip()

except Exception as exc:

descriptive\_text=ChatGPT

# Step 2: Pass the refined prompt to the DALL-E API to get the generated image.

try:

response = openai.Image.create(

prompt=descriptive\_text,

n=1,

size=f"{SIZE}x{SIZE}"

)

image\_url = response['data'][0]['url']

except Exception as e:

# This is a catch-all for any other exceptions

#print(f"Unexpected error: {e}")

image\_url = URL

# Step 3: Save the generated image as `my\_img.png`.

finally:

#print(f"return image\_url: {image\_url}")

img\_data = requests.get(image\_url).content

with open(FILENAME, 'wb') as handler:

handler.write(img\_data)

return None

#generate\_image(user\_input)

# **Learning Objectives**

### **Learners will be able to…**

* **Understand the concept of image animation and how it can be applied to generated images.**
* **Learn how to create a sequence of images with varying properties using the DALL-E 2 API.**
* **Explore the use of the Python Imaging Library (PIL) to process and manipulate the sequence of images for animation purposes.**
* **Learn how to create a GIF (Graphics Interchange Format) animation using the sequence of generated images.**
* **Understand the importance of animation settings, such as frame duration and loop count, and how they can be adjusted to create a smoother and more visually appealing animation.**

# **Main File**

Before we start, we are going to create a main file with some functions. This way we can use the functions across different files. This way we have access to all our libraries, API keys and image generation file.

import os

import openai

from PIL import Image, ImageOps,ImageChops

from io import BytesIO

import requests

# Set environment variables

openai.api\_key = os.getenv('OPENAI\_KEY')

# Generate the base image

def generate\_base\_image(prompt):

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

return response['data'][0]['url']

def download\_image(image\_url,x):

response = requests.get(image\_url)

img\_data = response.content

img = Image.open(BytesIO(img\_data))

with open(x+'.jpg', 'wb') as handler:

handler.write(img\_data)

return img

This script essentially provides the functionality to generate an image based on a text prompt using the OpenAI API and then download and save that image to the local file system.

Now in all files we can just import main and we will have access to our library and functions.

My version of main.py

import os

import openai

from PIL import Image, ImageOps,ImageChops

from io import BytesIO

import requests

URL="https://wonderfulengineering.com/wp-content/uploads/2014/10/image-wallpaper-15-1024x768.jpg"

# Set environment variables

openai.api\_key = os.getenv('OPENAI\_KEY')

# Generate the base image

def generate\_base\_image(prompt):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

url=response['data'][0]['url']

except Exception as exc:

url=URL

finally:

return url

def download\_image(image\_url,x):

response = requests.get(image\_url)

img\_data = response.content

img = Image.open(BytesIO(img\_data))

with open(x+'.jpg', 'wb') as handler:

handler.write(img\_data)

return img

# **Intro**

We’ll explore how to create animations using images generated by the DALL-E 2 API. Animations can be an effective way to showcase the capabilities of the DALL-E 2 API and bring generated images to life. We’ll be using the Python Imaging Library (PIL) to process and manipulate the generated images and create a GIF animation.

### **Creating a Sequence of Images**

The first step in creating an animation is to generate a sequence of images with varying properties. We’ll use the DALL-E 2 API to generate these images. For this example, let’s create an animation of a rotating Earth.

To generate a sequence of images, we can loop through different prompts or modify the prompt with changing properties. In this case, we’ll generate images of Earth from different angles. Here’s an example code snippet to generate the sequence of images:

import main

def generate\_earth\_image(angle):

prompt = f"Realistic Earth from space at {angle} degrees angle"

image\_url = main.generate\_base\_image(prompt)

image\_filename = f"earth\_{angle}\_degrees"

image = main.download\_image(image\_url, image\_filename)

return image

angles = range(0, 360, 10)

earth\_images = [generate\_earth\_image(angle) for angle in angles]

In this code, we define a function generate\_earth\_image that takes an angle as an argument and generates an image of Earth from that angle using the DALL-E 2 API. We then create a list of angles from 0 to 350 degrees in increments of 10 degrees and generate a corresponding image for each angle.

The files are provided for you because the code might take a bit to load since generating and saving a ton of pictures. IF YOU WANT,you can generate them yourself. Not recommended

# **Processing the Images**

Now that we have generated and downloaded the Earth images at different angles, it’s time to process them and create a GIF animation. We’ll be using the Python Imaging Library (PIL) to accomplish this.

First, let’s resize the images so the animation is smaller in size and easier to handle. In the following code, we resize each image in the earth\_images list to 256x256 pixels:

angles = range(0, 360, 10)

image\_filenames = [f"earth\_{angle}\_degrees.jpg" for angle in angles]

resized\_earth\_images = []

for filename in image\_filenames:

img = Image.open(filename)

resized\_img = img.resize((256, 256), Image.ANTIALIAS)

resized\_earth\_images.append(resized\_img)

We create a list of image filenames called image\_filenames for the Earth images at different angles. We then create an empty list resized\_earth\_images to store the resized images. In the for loop, we open each image using its filename, resize it, and append it to the resized\_earth\_images list.

### **Creating the GIF Animation**

Next, we’ll create a GIF animation using the resized images. We can do this using the save method of the PIL Image class. We’ll set the duration of each frame to 100 milliseconds and loop the animation indefinitely:

output\_gif = "rotating\_earth.gif"

resized\_earth\_images[0].save(

output\_gif,

save\_all=True,

append\_images=resized\_earth\_images[1:],

duration=100,

loop=0 # indefinite loop

)

In this code, we first specify the output GIF filename as "rotating\_earth.gif". Then, we call the save method on the first image in the resized\_earth\_images list. We set save\_all=True to indicate that we want to save multiple frames. The append\_images parameter is set to the rest of the images in the list, and we specify the duration and loop count using the duration and loop parameters, respectively.

Now, when you run this code, a GIF animation called “rotating\_earth.gif” will be created, showcasing the Earth rotating using the images generated by the DALL-E 2 API.

The images that the AI generated did not all look the same hence our current gif. The different images don’t have the same center there fore our gif looks less smooth

# **Optimizing Animation Settings**

We will explore various options to optimize the GIF animation created using the resized Earth images. We will focus on adjusting the frame duration, loop count, and image optimization settings to make the animation smoother and more visually appealing.

### **Adjusting the Duration**

You can adjust the duration of each frame in the animation to make the rotation appear faster or slower. The duration parameter in the save method determines the time each frame is displayed in milliseconds. A lower duration will result in a faster rotation, while a higher duration will make the rotation slower. Experiment with different values to find the optimal speed for your animation. Change the duration from 100 to 50 to 200 and compare.

duration = 50 # Adjust the frame duration to your preference

duration = 200 # Adjust the frame duration to your preference

Adjusting Loop Count

You can control the number of times the animation loops by setting the loop parameter in the save method. A value of 0indicates an infinite loop, while a higher value specifies the exact number of loops. For example, if you want the animation to loop only three times, set the loop parameter to 3

loop\_count = 3 # Adjust the loop count to your preference

Image Optimization

By default, the PIL library doesn’t optimize the images in the animation. You can enable image optimization by setting the optimize parameter to True in the save method. This can reduce the file size of the animation while maintaining visual quality.

optimize = True # Enable image optimization

With these optimizations in place, you should now have a smoother, more visually appealing animation that showcases the Earth rotating using the images generated by the DALL-E 2 API.

The optimize parameter, when set to True, enables image optimization in the save() method. This can help reduce the file size of the animation without significantly affecting the visual quality, resulting in a more efficient and visually appealing animation.

My example of gif animation

import os

import openai

from PIL import Image, ImageOps,ImageChops

from io import BytesIO

import requests

URL="https://wonderfulengineering.com/wp-content/uploads/2014/10/image-wallpaper-15-1024x768.jpg"

# Set environment variables

openai.api\_key = os.getenv('OPENAI\_KEY')

# Generate the base image

def generate\_base\_image(prompt):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

url=response['data'][0]['url']

except Exception as exc:

url=URL

finally:

return url

def download\_image(image\_url,x):

response = requests.get(image\_url)

img\_data = response.content

img = Image.open(BytesIO(img\_data))

with open(x+'.jpg', 'wb') as handler:

handler.write(img\_data)

return img

angles = range(0, 360, 10)

image\_filenames = [f"earth\_{angle}\_degrees.jpg" for angle in angles]

resized\_earth\_images = []

for filename in image\_filenames:

img = Image.open(filename)

resized\_img = img.resize((256, 256), Image.ANTIALIAS)

resized\_earth\_images.append(resized\_img)

output\_gif = "rotating\_earth.gif"

resized\_earth\_images[0].save(

output\_gif,

save\_all=True,

append\_images=resized\_earth\_images[1:],

duration=200,

optimize = True, # Enable image optimization

loop\_count = 1, # Adjust the loop count to your preference

#loop=10 # indefinite

# both loop\_count and loop work, loop overrides loop\_count

)

Adding Transitions and Visual Effects

In this section, we will explore how to enhance the GIF animation by adding transitions and visual effects to the images generated by the DALL-E 2 API. Adding transitions can make the animation smoother, while visual effects can create a more engaging and dynamic presentation.

1.Adding Crossfade Transitions

A crossfade transition blends two consecutive images, gradually transitioning from one image to the next. This can create a smoother rotation effect in the animation. Here’s an example of how to create a crossfade transition using the ImageChops module:

from PIL import ImageChops

def crossfade(image1, image2, alpha):

return ImageChops.blend(image1, image2, alpha)

crossfade\_frames = []

for i in range(len(resized\_earth\_images) - 1):

for alpha in (0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9):

frame = crossfade(resized\_earth\_images[i], resized\_earth\_images[i + 1], alpha)

crossfade\_frames.append(frame)

In this code snippet, we create a crossfade function that blends two images using a specified alpha value. We then generate a list of crossfade frames by blending consecutive images in the resized\_earth\_images list.

2.Adding Visual Effects

You can also add visual effects to the animation, such as changing the brightness, contrast, or color of the images. In this example, we will adjust the brightness of the images using the ImageEnhance module:

from PIL import ImageEnhance

def adjust\_brightness(image, factor):

enhancer = ImageEnhance.Brightness(image)

return enhancer.enhance(factor)

brightness\_factor = 1.5

brightened\_frames = [adjust\_brightness(frame, brightness\_factor) for frame in crossfade\_frames]

In this code snippet, we create an adjust\_brightness function that modifies the brightness of an image using a specified factor. We then create a list of brightened frames by applying the brightness adjustment to the crossfade\_frames list.

3.Creating the Enhanced Animation

Now that we have the crossfade transitions and visual effects in place, we can create an enhanced GIF animation using the modified frames:

output\_gif = "enhanced\_rotating\_earth.gif"

brightened\_frames[0].save(

output\_gif,

save\_all=True,

append\_images=brightened\_frames[1:],

duration=duration,

loop=loop\_count,

optimize=optimize

)

With these transitions and visual effects, your animation should be more engaging and dynamic, showcasing the power and flexibility of the DALL-E 2 API.

from PIL import ImageChops

def crossfade(image1, image2, alpha):

return ImageChops.blend(image1, image2, alpha)

crossfade\_frames = []

for i in range(len(resized\_earth\_images) - 1):

for alpha in (0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9):

frame = crossfade(resized\_earth\_images[i], resized\_earth\_images[i + 1], alpha)

crossfade\_frames.append(frame)

My Solution (added an invert to the final animation)

import os

import openai

from PIL import Image, ImageOps,ImageChops

from io import BytesIO

import requests

URL="https://wonderfulengineering.com/wp-content/uploads/2014/10/image-wallpaper-15-1024x768.jpg"

# Set environment variables

openai.api\_key = os.getenv('OPENAI\_KEY')

# Generate the base image

def generate\_base\_image(prompt):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

url=response['data'][0]['url']

except Exception as exc:

url=URL

finally:

return url

def download\_image(image\_url,x):

response = requests.get(image\_url)

img\_data = response.content

img = Image.open(BytesIO(img\_data))

with open(x+'.jpg', 'wb') as handler:

handler.write(img\_data)

return img

angles = range(0, 360, 10)

image\_filenames = [f"earth\_{angle}\_degrees.jpg" for angle in angles]

resized\_earth\_images = []

for filename in image\_filenames:

img = Image.open(filename)

resized\_img = img.resize((256, 256), Image.ANTIALIAS)

resized\_earth\_images.append(resized\_img)

output\_gif = "rotating\_earth.gif"

resized\_earth\_images[0].save(

output\_gif,

save\_all=True,

append\_images=resized\_earth\_images[1:],

duration=200,

optimize = True, # Enable image optimization

loop\_count = 1, # Adjust the loop count to your preference

#loop=10 # indefinite

# both loop\_count and loop work, loop overrides loop\_count

)

from PIL import ImageChops

def crossfade(image1, image2, alpha):

return ImageChops.blend(image1, image2, alpha)

crossfade\_frames = []

for i in range(len(resized\_earth\_images) - 1):

for alpha in (0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9):

frame = crossfade(resized\_earth\_images[i], resized\_earth\_images[i + 1], alpha)

crossfade\_frames.append(frame)

output\_gif = "enhanced\_rotating\_earth.gif"

from PIL import ImageEnhance

def adjust\_brightness(image, factor):

enhancer = ImageEnhance.Brightness(image)

return ImageOps.invert(enhancer.enhance(factor))

brightness\_factor = 1.5

brightened\_frames = [adjust\_brightness(frame, brightness\_factor) for frame in crossfade\_frames]

brightened\_frames[0].save(

output\_gif,

save\_all=True,

append\_images=brightened\_frames[1:],

duration=25,

optimize = True, # Enable image optimization

loop\_count = 1, # Adjust the loop count to your preference

#loop=10 # indefinite

# both loop\_count and loop work, loop overrides loop\_count

)

# **Coding Exercise**

In this exercise, you will use your skills in image manipulation and GIF creation to generate a visual representation of the four seasons. You will be creating an image of a well in each of the four seasons: Summer, Autumn, Winter, and Spring. Then, with the images generated, you will combine them into a GIF.

### **Objectives**

1.Generate the images for each season using the generate\_base\_image function, similar to the example you have already seen. The prompts should be something like "A well in the summer", "A well in the autumn", etc.

2.Download and save the generated images using the download\_image function. You should save each image with a unique name corresponding to its season.

3.Use the PIL library’s image manipulation capabilities to resize the images and create a GIF that loops through each season. Name the gif well\_seasons.gif.

Suggested Solution

import main

from PIL import Image

seasons = ['summer', 'autumn', 'winter', 'spring']

image\_urls = []

for season in seasons:

prompt = f"A well in the {season}"

image\_url = main.generate\_base\_image(prompt)

image\_urls.append(image\_url)

image\_filenames = []

for i, image\_url in enumerate(image\_urls):

img = main.download\_image(image\_url, seasons[i])

image\_filenames.append(f"{seasons[i]}.jpg")

resized\_images = []

for filename in image\_filenames:

img = Image.open(filename)

resized\_img = img.resize((256, 256), Image.ANTIALIAS)

resized\_images.append(resized\_img)

output\_gif = "well\_seasons.gif"

resized\_images[0].save(

output\_gif,

save\_all=True,

append\_images=resized\_images[1:],

duration=200,

loop=4,

optimize=True

)

My Soltion

import os

import openai

from PIL import Image, ImageOps,ImageChops

from io import BytesIO

import requests

*#URL="https://wonderfulengineering.com/wp-content/uploads/2014/10/image-wallpaper-15-1024x768.jpg"*

SPRING="https://pluspng.com/img-png/a-well-png-img-421.png"

SUMMER="https://cdn-icons-png.flaticon.com/512/3453/3453697.png"

FALL="https://www.starpng.com/public/uploads/preview/orange-autumn-leaves-hd-png-autumn-leaf-png-transparent-image-1015769217316c7nvoq9xk.png"

WINTER="https://pngimg.com/uploads/ice/ice\_PNG36841.png"

*# Set environment variables*

openai.api\_key = os.getenv('OPENAI\_KEY')

*# Generate the base image*

def generate\_base\_image(prompt):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

url=response['data'][0]['url']

except Exception as exc:

if "spring" in prompt:

url=SPRING

if "summer" in prompt:

url=SUMMER

if "autumn" in prompt:

url=FALL

if "winter" in prompt:

url=WINTER

finally:

return url

def download\_image(image\_url,x):

response = requests.get(image\_url)

img\_data = response.content

img = Image.open(BytesIO(img\_data))

with open(x+'.jpg', 'wb') as handler:

handler.write(img\_data)

return img

def make\_image(prompt, filename):

image = download\_image(generate\_base\_image(prompt), filename).resize((256,256), Image.ANTIALIAS)

return image

well\_images = [

make\_image("a well in spring", "well\_spring.jpg"),

make\_image("a well in summer", "well\_summer.jpg"),

make\_image("a well in autumn", "well\_autumn.jpg"),

make\_image("a well in winter", "well\_winter.jpg")

]

well\_images[0].save(

'well\_seasons.gif',

save\_all=True,

append\_images=well\_images[1:],

duration=200,

loop=0 *# indefinite loop*

)

# **Learning Objectives**

### **Learners will be able to…**

* **Create complex and creative image compositions**
* **Develop advanced blending techniques with custom functions and transformations**
* **Understand the principles of image composition and blending**
* **Master image compositing with masks**
* **Apply various blending modes to create unique effects**

Setting Up

We will explore various techniques to combine and blend multiple generated images, creating complex and visually engaging compositions. By the end of this lesson, you will be able to create unique and captivating images by combining the power of the DALL-E API with PIL’s image manipulation capabilities.

Image composition and blending are essential techniques in digital image processing, allowing you to create new images by combining multiple images or layers. By understanding how to manipulate image layers and control their transparency and visibility, you can create a wide range of visual effects and styles. In this lesson, we will cover:

Image Compositing: Learn how to combine multiple images using masks, controlling the transparency and visibility of different image layers.

Image Blending: Explore various blending modes, such as multiply, screen, and overlay, to create unique effects when combining two images.

Advanced Blending Techniques: Develop custom blend modes and gradient masks for greater control and flexibility in image composition.

Creative Image Compositions: Apply the techniques learned in this module to design and create complex image compositions with generated images from the DALL-E 2 API.

Generate base image

We are going to import our libraries and API key then we are going to create our function.

import os

import openai

import secret

from PIL import Image, ImageOps,ImageChops

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

# Generate the base image

def generate\_base\_image(prompt):

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

return response['data'][0]['url']

You can use the function below in your code to download images generated by the DALL-E 2 API using their URLs. The function uses the requests library to download the image data and BytesIO from the io module to load the data into a PIL Image object. We also save the image as a file for later use, just in case.

def download\_image(image\_url,x):

response = requests.get(image\_url)

img\_data = response.content

img = Image.open(BytesIO(img\_data))

with open(x+'.jpg', 'wb') as handler:

handler.write(img\_data)

return img

Simple Image Composition

Before diving into more advanced techniques, let’s start with a revision example of image composition. In this example, we will generate two images using the DALL-E 2 API:a moon and a night sky. Then, we will overlay the moon image on top of the night sky image to create a composite image.

Generate moon and night sky images

moon\_image\_url = generate\_base\_image('moon')

night\_sky\_image\_url = generate\_base\_image('night sky with stars')

Saving our new images

img\_data = requests.get(moon\_image\_url).content

with open('moon\_image.jpg', 'wb') as handler:

handler.write(img\_data)

img\_data = requests.get(night\_sky\_image\_url).content

with open('night\_sky.jpg', 'wb') as handler:

handler.write(img\_data)

After generating your images comment out the code that calls on new images to be generated, so we can keep our base images consistent.

#saving our images as variables.

moon\_image=Image.open('moon\_image.jpg')

night\_sky\_image=Image.open('night\_sky.jpg')

# Resize the moon image to fit the composition

moon\_image = moon\_image.resize((200, 200), Image.ANTIALIAS)

# Ensure the moon image has the correct mode with an alpha channel

moon\_image = moon\_image.convert('RGBA')

# Overlay the moon image on top of the night sky image

night\_sky\_image.paste(moon\_image, (150, 100), moon\_image)

# Save the composed image to a file

night\_sky\_image.save('night\_sky\_with\_moon.jpg')

My Solution to moon overlaid on night skyscraper

import os

import openai

import secret

from PIL import Image, ImageOps,ImageChops

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

URL="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fstarry-sky-night-stars\_Z2VubGaUmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=4c75494cc49cf1652a28d2ceb34b96d751b1538f7ace914f45a50104d60f2efd&ipo=images"

MOON="https://thumbs.dreamstime.com/b/full-moon-night-sky-showing-texture-surface-characteristic-craters-69137610.jpg"

# Generate the base image

def generate\_base\_image(prompt):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

url = response['data'][0]['url']

except Exception as exc:

url = URL

if "moon" in prompt:

url = MOON

finally:

return url

def download\_image(image\_url,x):

response = requests.get(image\_url)

img\_data = response.content

img = Image.open(BytesIO(img\_data))

if img.size[0] > 512:

resized = img.crop((240,145,575,480)).resize((512,512), Image.ANTIALIAS)

else:

resized = img

#print(f"img:{img.size} resized:{resized.size}")

resized.save(x+'.jpg')

return resized

"""

moon\_image\_url = generate\_base\_image('moon')

night\_sky\_image\_url = generate\_base\_image('night sky with stars')

download\_image(moon\_image\_url, 'moon\_image')

download\_image(night\_sky\_image\_url, 'night\_sky')

"""

#saving our images as variables.

moon\_image=Image.open('moon\_image.jpg')

night\_sky\_image=Image.open('night\_sky.jpg')

# Resize the moon image to fit the composition

moon\_image = moon\_image.resize((200, 200), Image.ANTIALIAS)

# Ensure the moon image has the correct mode with an alpha channel

moon\_image = moon\_image.convert('RGBA')

# Overlay the moon image on top of the night sky image

night\_sky\_image.paste(moon\_image, (150, 100), moon\_image)

# Save the composed image to a file

night\_sky\_image.save('night\_sky\_with\_moon.jpg')

Image Compositing with Masks

In this section, we will explore image compositing using masks to control the transparency and visibility of different image layers. By mastering the use of masks, you will be able to create complex and visually engaging image compositions using the DALL-E 2 API and PIL.

Alpha Masks

Alpha masks define the transparency of an image, allowing you to control which parts of the image are visible when composited with another image. In the previous example, we used the paste() function to overlay the moon image onto the night sky image using its own alpha channel as the mask. This ensures that only the moon’s visible pixels are pasted onto the night sky image. When you use an image’s own alpha channel as the mask during the compositing process, you’re essentially using the transparency information already embedded in the image to dictate where and how the image should be visible when overlaid onto another. This is particularly useful with images that have elements with varying degrees of transparency or complex shapes that would be difficult to manually isolate.

Custom Masks

You can also create custom masks to apply more advanced compositing techniques or control the visibility of image layers in a more precise manner. Custom masks can be created using the Image.new() function with the 'L' mode, which represents a grayscale image.

Here’s an example of creating a custom mask and using it to composite two images. Please note, if you are going to run it multiple time the generation and the download need to be commented out so you can keep your base image consistent.

from PIL import Image

# Generate two images using the DALL-E 2 API

image1\_url = generate\_base\_image('forest')

image2\_url = generate\_base\_image('sunset')

# Download and open the generated images

image1 = download\_image(image1\_url,'image1')

image2 = download\_image(image2\_url,'image2')

# Create a custom mask (grayscale gradient)

width, height = image1.size

mask = Image.new('L', (width, height))

for y in range(height):

for x in range(width):

mask.putpixel((x, y), x)

# Composite the two images using the custom mask

result = Image.composite(image1, image2, mask)

# Save the composited image to a file

result.save('composite\_custom\_mask.jpg')

In this example, the custom mask is a grayscale gradient from left (black) to right (white). When using Image.composite(), the black areas of the mask will take the corresponding pixels from image1, while the white areas will take the pixels from image2. Gray areas of the mask will result in a blend of the two images.

Advanced Masking Techniques

You can create more complex custom masks using a variety of techniques, such as drawing shapes, adding text, or even using another image as a mask. By combining these techniques, you can create intricate and visually stunning image compositions.

My Solution for both moon and sky, forest and sunset

import os

import openai

import secret

from PIL import Image, ImageOps,ImageChops

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

URL="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fstarry-sky-night-stars\_Z2VubGaUmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=4c75494cc49cf1652a28d2ceb34b96d751b1538f7ace914f45a50104d60f2efd&ipo=images"

MOON="https://thumbs.dreamstime.com/b/full-moon-night-sky-showing-texture-surface-characteristic-craters-69137610.jpg"

SUNSET="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fsunset-minimalist\_a2lobWaUmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=209b7c47ff8bf07f82231b0836cea88228ffde2fab29edb9d14b8b95827989d0&ipo=images"

FOREST="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fforest-minimal\_amxraG2UmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=2b7757b2f0b24ec3a251ce0bb58ef5097c6db226d906699eab019f409bba64d2&ipo=images"

# Generate the base image

def generate\_base\_image(prompt):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

url = response['data'][0]['url']

except Exception as exc:

url = URL

if "moon" in prompt:

url = MOON

if "forest" in prompt:

url = FOREST

if "sunset" in prompt:

url = SUNSET

finally:

return url

def download\_image(image\_url,x):

response = requests.get(image\_url)

img\_data = response.content

img = Image.open(BytesIO(img\_data))

if img.size[0] > 512:

resized = img.crop((240,145,575,480)).resize((512,512), Image.ANTIALIAS)

else:

resized = img

#print(f"img:{img.size} resized:{resized.size}")

resized.save(x+'.jpg')

return resized

moon\_image\_url = generate\_base\_image('moon')

night\_sky\_image\_url = generate\_base\_image('night sky with stars')

"""

download\_image(moon\_image\_url, 'moon\_image')

download\_image(night\_sky\_image\_url, 'night\_sky')

"""

#saving our images as variables.

moon\_image=Image.open('moon\_image.jpg')

night\_sky\_image=Image.open('night\_sky.jpg')

# Resize the moon image to fit the composition

moon\_image = moon\_image.resize((200, 200), Image.ANTIALIAS)

# Ensure the moon image has the correct mode with an alpha channel

moon\_image = moon\_image.convert('RGBA')

# Overlay the moon image on top of the night sky image

night\_sky\_image.paste(moon\_image, (150, 100), moon\_image)

# Save the composed image to a file

night\_sky\_image.save('night\_sky\_with\_moon.jpg')

# Generate two images using the DALL-E 2 API

image1\_url = generate\_base\_image('forest')

image2\_url = generate\_base\_image('sunset')

# Download and open the generated images

image1 = download\_image(image1\_url,'image1')

image2 = download\_image(image2\_url,'image2')

# Create a custom mask (grayscale gradient)

width, height = image1.size

mask = Image.new('L', (width, height))

for y in range(height):

for x in range(width):

mask.putpixel((x, y), x)

Image2 = download\_image(moon\_image\_url, 'moon\_image')

Image1 = download\_image(night\_sky\_image\_url, 'night\_sky')

# Composite the two images using the custom mask

#result = Image.composite(image1, image2, mask)

result = Image.composite(Image1, Image2, mask)

# Save the composited image to a file

result.save('composite\_custom\_mask.jpg')

Image Blending with Different Modes

Image Blending

We will explore image blending, which involves combining two images using various blending modes to create unique visual effects and styles. This will allow you to further enhance your image compositions and unlock even more creative possibilities with the DALL-E 2 API and PIL.

Blending Modes

Blending modes determine how the colors of two images interact with each other when combined. Some common blending modes include:

Normal: The top image simply covers the bottom image.

Multiply: The color values of the top and bottom images are multiplied, resulting in a darker image.

Screen: The color values of the top and bottom images are inverted, multiplied, and then inverted again, resulting in a lighter image.

Overlay: Combines Multiply and Screen modes, preserving the highlights and shadows of the bottom image.

PIL provides a built-in method called blend() for blending two images using the normal blending mode. However, to use other blending modes, we need to use the ImageChops module.

We will blend two images using various blending modes to demonstrate their effects on the final composition.

# Blend the images using the Multiply mode

image1 = Image.open('image1.jpg')

image2 = Image.open('image2.jpg')

multiply\_blend = ImageChops.multiply(image1, image2)

multiply\_blend.save('multiply\_blend.jpg')

Now let’s try looking at it with our moon and night sky images.

Your original composition pic of the moon and night sky might look like this:

But using a blend you can get more of an image that looks like this.

# Blend the images using the Multiply mode

image3 = Image.open('moon\_image.jpg')

image4 = Image.open('night\_sky.jpg')

multiply\_blend = ImageChops.multiply(image3, image4)

multiply\_blend.save('multiply\_blend2.jpg')

Custom Blend Modes

You can also create custom blend modes by defining your own functions that take the color values of the top and bottom images and return a new color value. This allows you to achieve unique and creative blending effects that may not be available with the built-in blending modes.

Here’s an example of creating a custom blend mode that calculates the average of the color values of the top and bottom images:

from PIL import ImageChops

def average\_blend(image1, image2):

return ImageChops.add(image1, image2, scale=0.5)

# Use the custom blend mode to blend two images

image1 = Image.open('image1.jpg')

image2 = Image.open('image2.jpg')

average\_blend\_result = average\_blend(image1, image2)

average\_blend\_result.save('average\_blend.jpg')

Creating custom blend modes can be a powerful way to achieve a unique look and feel for your image compositions. Experimenting with different blending functions can lead to interesting and unexpected results, allowing you to further enhance your compositions and unlock even more creative possibilities with the DALL-E 2 API and PIL.

The Overlay blending mode combines Multiply and Screen modes, preserving the highlights and shadows of the bottom image when the two images are combined.

My Solution testing all four blend modes:

import os

import openai

import secret

from PIL import Image, ImageOps,ImageChops

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

URL="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fstarry-sky-night-stars\_Z2VubGaUmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=4c75494cc49cf1652a28d2ceb34b96d751b1538f7ace914f45a50104d60f2efd&ipo=images"

MOON="https://thumbs.dreamstime.com/b/full-moon-night-sky-showing-texture-surface-characteristic-craters-69137610.jpg"

SUNSET="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fsunset-minimalist\_a2lobWaUmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=209b7c47ff8bf07f82231b0836cea88228ffde2fab29edb9d14b8b95827989d0&ipo=images"

FOREST="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fforest-minimal\_amxraG2UmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=2b7757b2f0b24ec3a251ce0bb58ef5097c6db226d906699eab019f409bba64d2&ipo=images"

# Generate the base image

def generate\_base\_image(prompt):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

url = response['data'][0]['url']

except Exception as exc:

url = URL

if "moon" in prompt:

url = MOON

if "forest" in prompt:

url = FOREST

if "sunset" in prompt:

url = SUNSET

finally:

return url

def download\_image(image\_url,x):

response = requests.get(image\_url)

img\_data = response.content

img = Image.open(BytesIO(img\_data))

if img.size[0] > 512:

resized = img.crop((240,145,575,480)).resize((512,512), Image.ANTIALIAS)

else:

resized = img

#print(f"img:{img.size} resized:{resized.size}")

resized.save(x+'.jpg')

return resized

moon\_image\_url = generate\_base\_image('moon')

night\_sky\_image\_url = generate\_base\_image('night sky with stars')

"""

download\_image(moon\_image\_url, 'moon\_image')

download\_image(night\_sky\_image\_url, 'night\_sky')

"""

#saving our images as variables.

moon\_image=Image.open('moon\_image.jpg')

night\_sky\_image=Image.open('night\_sky.jpg')

# Resize the moon image to fit the composition

moon\_image = moon\_image.resize((200, 200), Image.ANTIALIAS)

# Ensure the moon image has the correct mode with an alpha channel

moon\_image = moon\_image.convert('RGBA')

# Overlay the moon image on top of the night sky image

night\_sky\_image.paste(moon\_image, (150, 100), moon\_image)

# Save the composed image to a file

night\_sky\_image.save('night\_sky\_with\_moon.jpg')

# Generate two images using the DALL-E 2 API

image1\_url = generate\_base\_image('forest')

image2\_url = generate\_base\_image('sunset')

# Download and open the generated images

image1 = download\_image(image1\_url,'image1')

image2 = download\_image(image2\_url,'image2')

# Create a custom mask (grayscale gradient)

width, height = image1.size

mask = Image.new('L', (width, height))

for y in range(height):

for x in range(width):

mask.putpixel((x, y), x)

Image2 = download\_image(moon\_image\_url, 'moon\_image')

Image1 = download\_image(night\_sky\_image\_url, 'night\_sky')

# Composite the two images using the custom mask

#result = Image.composite(image1, image2, mask)

result = Image.composite(Image1, Image2, mask)

# Save the composited image to a file

result.save('composite\_custom\_mask.jpg')

#multiply\_blend = Image.blend(image1, image2, 0) # none of image2

#multiply\_blend = Image.blend(image1, image2, 1) # none of image1

#multiply\_blend = Image.blend(image1, image2, 0.7) # none of image1

#multiply\_blend = ImageChops.multiply(image1, image2)

#multiply\_blend = ImageChops.screen(image1, image2)

multiply\_blend = ImageChops.overlay(image1, image2)

multiply\_blend.save('multiply\_blend.jpg')

# Blend the images using the Multiply mode

multiply\_blend = ImageChops.multiply(Image1, Image2)

multiply\_blend.save('multiply\_blend2.jpg')

from PIL import ImageChops

def average\_blend(image1, image2):

return ImageChops.add(image1, image2, scale=0.5)

# Use the custom blend mode to blend two images

average\_blend\_result = average\_blend(image1, image2)

average\_blend\_result = average\_blend(Image1, Image2)

average\_blend\_result.save('average\_blend.jpg')

# **Advanced Blending Techniques**

We will dive deeper into advanced blending techniques, such as creating custom gradient masks and blend modes, to give you greater control and flexibility in image composition. We learned how to create a custom mask for image compositing. Similarly, you can create custom gradient masks to control the blending of two images. By creating masks with varying levels of transparency, you can achieve smooth transitions between the two images.

You can create custom blend modes by defining your own functions that take the color values of the top and bottom images and return a new color value. This allows you to achieve unique and creative blending effects that may not be available with the built-in blending modes.

Before we start we are going to create some variables that we will use in our function.

# set our images to a variable

image1 = Image.open('image1.jpg')

image2 = Image.open('image2.jpg')

image3 = Image.open('moon\_image.jpg')

image4 = Image.open('night\_sky.jpg')

def custom\_blend(image1, image2):

return ImageChops.add\_modulo(image1, image2).point(lambda x: x // 2)

# Blend the images using the custom blend mode

result = custom\_blend(image1, image2)

result2= custom\_blend(image3, image4)

# Save the blended image to a file

result.save('custom\_blend.jpg')

result2.save('custom\_blend2.jpg')

Custom Blend Function

The custom\_blend function returns the resulting image, which is the blended image with the average color value of the two input images.

The custom\_blend function takes two images, image1 and image2, as inputs. Its purpose is to blend these two images together by calculating the average color value of each corresponding pixel from both images.

ImageChops.add\_modulo(image1, image2) adds the pixel values of image1 and image2 together. It does this by adding the values of corresponding pixels in each image while ensuring that the resulting values don’t exceed the maximum allowed value for each color channel. In this case, the maximum allowed value is 255 for an 8-bit image. The add\_modulo function ensures that if the sum of two pixel values exceed 255, the result wraps around from 0, in a similar fashion to how numbers wrap around when using the modulo operation.

The resulting image from the add\_modulo() operation has pixel values that are double the average of the original images’ pixel values. In order to get the true average, we need to divide these values by 2. We do this using the point() function, which applies a given function to each pixel value in the image. In this case, we use a lambda function lambda x: x // 2 , which takes an input x (the pixel value) and returns the integer division of x by 2 (effectively dividing the pixel value by 2).

My full solution of custom blend:

import os

import openai

import secret

from PIL import Image, ImageOps,ImageChops

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

URL="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fstarry-sky-night-stars\_Z2VubGaUmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=4c75494cc49cf1652a28d2ceb34b96d751b1538f7ace914f45a50104d60f2efd&ipo=images"

MOON="https://thumbs.dreamstime.com/b/full-moon-night-sky-showing-texture-surface-characteristic-craters-69137610.jpg"

SUNSET="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fsunset-minimalist\_a2lobWaUmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=209b7c47ff8bf07f82231b0836cea88228ffde2fab29edb9d14b8b95827989d0&ipo=images"

FOREST="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fforest-minimal\_amxraG2UmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=2b7757b2f0b24ec3a251ce0bb58ef5097c6db226d906699eab019f409bba64d2&ipo=images"

# Generate the base image

def generate\_base\_image(prompt):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

url = response['data'][0]['url']

except Exception as exc:

url = URL

if "moon" in prompt:

url = MOON

if "forest" in prompt:

url = FOREST

if "sunset" in prompt:

url = SUNSET

finally:

return url

def download\_image(image\_url,x):

response = requests.get(image\_url)

img\_data = response.content

img = Image.open(BytesIO(img\_data))

if img.size[0] > 512:

resized = img.crop((240,145,575,480)).resize((512,512), Image.ANTIALIAS)

else:

resized = img

#print(f"img:{img.size} resized:{resized.size}")

resized.save(x+'.jpg')

return resized

moon\_image\_url = generate\_base\_image('moon')

night\_sky\_image\_url = generate\_base\_image('night sky with stars')

"""

download\_image(moon\_image\_url, 'moon\_image')

download\_image(night\_sky\_image\_url, 'night\_sky')

"""

#saving our images as variables.

moon\_image=Image.open('moon\_image.jpg')

night\_sky\_image=Image.open('night\_sky.jpg')

# Resize the moon image to fit the composition

moon\_image = moon\_image.resize((200, 200), Image.ANTIALIAS)

# Ensure the moon image has the correct mode with an alpha channel

moon\_image = moon\_image.convert('RGBA')

# Overlay the moon image on top of the night sky image

night\_sky\_image.paste(moon\_image, (150, 100), moon\_image)

# Save the composed image to a file

night\_sky\_image.save('night\_sky\_with\_moon.jpg')

# Generate two images using the DALL-E 2 API

image1\_url = generate\_base\_image('forest')

image2\_url = generate\_base\_image('sunset')

# Download and open the generated images

image1 = download\_image(image1\_url,'image1')

image2 = download\_image(image2\_url,'image2')

# Create a custom mask (grayscale gradient)

width, height = image1.size

mask = Image.new('L', (width, height))

for y in range(height):

for x in range(width):

mask.putpixel((x, y), x)

Image2 = download\_image(moon\_image\_url, 'moon\_image')

Image1 = download\_image(night\_sky\_image\_url, 'night\_sky')

# Composite the two images using the custom mask

#result = Image.composite(image1, image2, mask)

result = Image.composite(Image1, Image2, mask)

# Save the composited image to a file

result.save('composite\_custom\_mask.jpg')

#multiply\_blend = Image.blend(image1, image2, 0) # none of image2

#multiply\_blend = Image.blend(image1, image2, 1) # none of image1

#multiply\_blend = Image.blend(image1, image2, 0.7) # none of image1

#multiply\_blend = ImageChops.multiply(image1, image2)

#multiply\_blend = ImageChops.screen(image1, image2)

multiply\_blend = ImageChops.overlay(image1, image2)

multiply\_blend.save('multiply\_blend.jpg')

# Blend the images using the Multiply mode

multiply\_blend = ImageChops.multiply(Image1, Image2)

multiply\_blend.save('multiply\_blend2.jpg')

from PIL import ImageChops

def average\_blend(image1, image2):

return ImageChops.add(image1, image2, scale=0.5)

# Use the custom blend mode to blend two images

average\_blend\_result = average\_blend(image1, image2)

average\_blend\_result = average\_blend(Image1, Image2)

average\_blend\_result.save('average\_blend.jpg')

image3 = Image2 # moon

image4 = Image1 # night sky

def custom\_blend(image1, image2):

return ImageChops.add\_modulo(image1, image2).point(lambda x: x // 2)

# Blend the images using the custom blend mode

result = custom\_blend(image1, image2)

result2= custom\_blend(image3, image4)

# Save the blended image to a file

result.save('custom\_blend.jpg')

result2.save('custom\_blend2.jpg')

Combining Custom Gradient Masks with Custom Blend

Combining custom gradient masks with custom blend modes opens up even more creative possibilities for your image compositions. You can use these techniques to create smooth transitions between images or to blend images in unique and visually interesting ways.

Here’s an example of creating a custom gradient mask and using it with the custom\_blend function we defined earlier:

# Create a custom gradient mask (grayscale gradient)

width, height = image1.size

mask = Image.new('L', (width, height))

for y in range(height):

for x in range(width):

mask.putpixel((x, y), x)

# Apply the custom gradient mask to the second image

masked\_image2 = Image.composite(image2, Image.new('RGB', image2.size), mask)

# Blend the images using the custom blend mode

result = custom\_blend(image1, masked\_image2)

# Save the blended image to a file

result.save('custom\_blend\_gradient.jpg')

In this example, the custom gradient mask is applied to the second image, creating a smooth transition from left (transparent) to right (opaque). The resulting masked image is then blended with the first image using the custom\_blend function. This creates a smooth transition between the two images with a unique blending effect.

Feel free to experiment with different gradient masks and blend modes to create intricate and visually stunning image compositions using the DALL-E 2 API and PIL. By combining these advanced techniques, you can unlock even more creative possibilities and take your image compositions to the next level.

In this example, the custom gradient mask is applied to the second image, creating a smooth transition from left (transparent) to right (opaque). The resulting masked image is then blended with the first image using the custom\_blend function. This creates a smooth transition between the two images with a unique blending effect.

Feel free to experiment with different gradient masks and blend modes to create intricate and visually stunning image compositions using the DALL-E 2 API and PIL. By combining these advanced techniques, you can unlock even more creative possibilities and take your image compositions to the next level.

My custom solution experiment with a variety of custom masks

import os

import openai

import secret

from PIL import Image, ImageOps,ImageChops

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

URL="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fstarry-sky-night-stars\_Z2VubGaUmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=4c75494cc49cf1652a28d2ceb34b96d751b1538f7ace914f45a50104d60f2efd&ipo=images"

MOON="https://thumbs.dreamstime.com/b/full-moon-night-sky-showing-texture-surface-characteristic-craters-69137610.jpg"

SUNSET="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fsunset-minimalist\_a2lobWaUmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=209b7c47ff8bf07f82231b0836cea88228ffde2fab29edb9d14b8b95827989d0&ipo=images"

FOREST="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fforest-minimal\_amxraG2UmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=2b7757b2f0b24ec3a251ce0bb58ef5097c6db226d906699eab019f409bba64d2&ipo=images"

# Generate the base image

def generate\_base\_image(prompt):

try:

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

url = response['data'][0]['url']

except Exception as exc:

url = URL

if "moon" in prompt:

url = MOON

if "forest" in prompt:

url = FOREST

if "sunset" in prompt:

url = SUNSET

finally:

return url

def download\_image(image\_url,x):

response = requests.get(image\_url)

img\_data = response.content

img = Image.open(BytesIO(img\_data))

if img.size[0] > 512:

resized = img.crop((240,145,575,480)).resize((512,512), Image.ANTIALIAS)

else:

resized = img

#print(f"img:{img.size} resized:{resized.size}")

resized.save(x+'.jpg')

return resized

moon\_image\_url = generate\_base\_image('moon')

night\_sky\_image\_url = generate\_base\_image('night sky with stars')

"""

download\_image(moon\_image\_url, 'moon\_image')

download\_image(night\_sky\_image\_url, 'night\_sky')

"""

#saving our images as variables.

moon\_image=Image.open('moon\_image.jpg')

night\_sky\_image=Image.open('night\_sky.jpg')

# Resize the moon image to fit the composition

moon\_image = moon\_image.resize((200, 200), Image.ANTIALIAS)

# Ensure the moon image has the correct mode with an alpha channel

moon\_image = moon\_image.convert('RGBA')

# Overlay the moon image on top of the night sky image

night\_sky\_image.paste(moon\_image, (150, 100), moon\_image)

# Save the composed image to a file

night\_sky\_image.save('night\_sky\_with\_moon.jpg')

# Generate two images using the DALL-E 2 API

image1\_url = generate\_base\_image('forest')

image2\_url = generate\_base\_image('sunset')

# Download and open the generated images

image1 = download\_image(image1\_url,'image1')

image2 = download\_image(image2\_url,'image2')

# Create a custom mask (grayscale gradient)

width, height = image1.size

mask = Image.new('L', (width, height))

for y in range(height):

for x in range(width):

mask.putpixel((x, y), x)

Image2 = download\_image(moon\_image\_url, 'moon\_image')

Image1 = download\_image(night\_sky\_image\_url, 'night\_sky')

# Composite the two images using the custom mask

#result = Image.composite(image1, image2, mask)

result = Image.composite(Image1, Image2, mask)

# Save the composited image to a file

result.save('composite\_custom\_mask.jpg')

#multiply\_blend = Image.blend(image1, image2, 0) # none of image2

#multiply\_blend = Image.blend(image1, image2, 1) # none of image1

#multiply\_blend = Image.blend(image1, image2, 0.7) # none of image1

#multiply\_blend = ImageChops.multiply(image1, image2)

#multiply\_blend = ImageChops.screen(image1, image2)

multiply\_blend = ImageChops.overlay(image1, image2)

multiply\_blend.save('multiply\_blend.jpg')

# Blend the images using the Multiply mode

multiply\_blend = ImageChops.multiply(Image1, Image2)

multiply\_blend.save('multiply\_blend2.jpg')

from PIL import ImageChops

def average\_blend(image1, image2):

return ImageChops.add(image1, image2, scale=0.5)

# Use the custom blend mode to blend two images

average\_blend\_result = average\_blend(image1, image2)

average\_blend\_result = average\_blend(Image1, Image2)

average\_blend\_result.save('average\_blend.jpg')

image3 = Image2 # moon

image4 = Image1 # night sky

def custom\_blend(image1, image2):

return ImageChops.add\_modulo(image1, image2).point(lambda x: x // 2)

# Blend the images using the custom blend mode

result = custom\_blend(image1, image2)

result2= custom\_blend(image3, image4)

# Save the blended image to a file

result.save('custom\_blend.jpg')

result2.save('custom\_blend2.jpg')

import math

import random

# Create a custom gradient mask (grayscale gradient)

width, height = image1.size

mask = Image.new('L', (width, height))

for y in range(height):

for x in range(width):

mask.putpixel((x, y), ((256 - int(math.sqrt((x-256)\*(x-256) + (y-256)\*(y-256)))) % 255))

# mask.putpixel((x, y), (int(math.sqrt((x-256)\*(x-256) + (y-256)\*(y-256))) % 255))

# mask.putpixel((x, y), random.randint(0,int(math.sqrt((x-256)\*(x-256) + (y-256)\*(y-256))) % 255))

# mask.putpixel((x, y), random.randint(0, 255))

# mask.putpixel((x, y), (x + y) // 2)

# mask.putpixel((x, y), 255 - (x + y) // 2)

# mask.putpixel((x, y), 255-x)

# mask.putpixel((x, y), 255-y)

# mask.putpixel((x, y), y)

# mask.putpixel((x, y), x)

# Apply the custom gradient mask to the second image

masked\_image2 = Image.composite(image2, Image.new('RGB', image2.size), mask)

# Blend the images using the custom blend mode

result = custom\_blend(image1, masked\_image2)

# Save the blended image to a file

result.save('custom\_blend\_gradient.jpg')

Coding Exercise

Objective: The goal of this assignment is to make you familiar with the OpenAI’s DALL-E API. By the end of this assignment, you will be able to generate and blend images using DALL-E and PIL.

The task is to create a function, combine, that performs the following operations:

Take two textual prompts as input.

Use these prompts to generate images using the DALL-E API.

Download these generated images. Name the images: image1.png and image2.png

Blend these images using a blending function.

Save the final blended image to a file named final\_blended.png.

Solution from the course

import os

import openai

import secret

from PIL import Image, ImageChops

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

# Function to generate an image using DALL-E

def generate\_base\_image(prompt):

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

return response['data'][0]['url']

# Function to download the image

def download\_image(image\_url, x):

response = requests.get(image\_url)

img\_data = response.content

img = Image.open(BytesIO(img\_data))

with open(x+'.png', 'wb') as handler:

handler.write(img\_data)

return img

# Function to blend the images

def custom\_blend(image1, image2):

return ImageChops.add\_modulo(image1, image2).point(lambda x: x // 2)

# The required function that combines the above operations

def combine(prompt1, prompt2):

# Generate the images

image1\_url = generate\_base\_image(prompt1)

image2\_url = generate\_base\_image(prompt2)

# Download and open the generated images

image1 = download\_image(image1\_url, 'image1')

image2 = download\_image(image2\_url, 'image2')

# Blend the images

result = custom\_blend(image1, image2)

# Save the final image

result.save('final\_blended.png')

# Call the combine function with two prompts

My Solution to the exercises

import os

import openai

import secret

from PIL import Image, ImageOps,ImageChops

from io import BytesIO

import requests

openai.api\_key = secret.api\_key

URL="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fstarry-sky-night-stars\_Z2VubGaUmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=4c75494cc49cf1652a28d2ceb34b96d751b1538f7ace914f45a50104d60f2efd&ipo=images"

MOON="https://thumbs.dreamstime.com/b/full-moon-night-sky-showing-texture-surface-characteristic-craters-69137610.jpg"

SUNSET="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fsunset-minimalist\_a2lobWaUmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=209b7c47ff8bf07f82231b0836cea88228ffde2fab29edb9d14b8b95827989d0&ipo=images"

FOREST="https://external-content.duckduckgo.com/iu/?u=https%3A%2F%2Fimages.wallpapersden.com%2Fimage%2Fdownload%2Fforest-minimal\_amxraG2UmZqaraWkpJRqZmetamZn.jpg&f=1&nofb=1&ipt=2b7757b2f0b24ec3a251ce0bb58ef5097c6db226d906699eab019f409bba64d2&ipo=images"

# Generate the base image

def generate\_base\_image(prompt):

try:

#print(f"generate {prompt}")

response = openai.Image.create(

prompt=prompt,

n=1,

size="512x512"

)

url = response['data'][0]['url']

except Exception as exc:

url = URL

if "moon" in prompt:

url = MOON

if "plane" in prompt:

url = MOON

if "forest" in prompt:

url = FOREST

if "sunset" in prompt:

url = SUNSET

finally:

return url

def download\_image(image\_url,x):

response = requests.get(image\_url)

img\_data = response.content

img = Image.open(BytesIO(img\_data))

if img.size[0] > 512:

resized = img.crop((240,145,575,480)).resize((512,512), Image.ANTIALIAS)

else:

resized = img

filename=x+'.png'

#print(f"{filename}: img:{img.size} resized:{resized.size}")

resized.save(filename)

return resized

def make\_image(prompt, filename):

url = generate\_base\_image(prompt)

return download\_image(url, filename)

def average\_blend(image1, image2):

return Image.blend(image1, image2, 0.8)

# return ImageChops.add(image1, image2, scale=0.5)

def combine(prompt1, prompt2):

image1 = make\_image(prompt1, 'image1')

image2 = make\_image(prompt2, 'image2')

blend = average\_blend(image1, image2)

blend.save('final\_blended.png')

#combine("moon", "forest")

# **Learning Objectives**

### **Learners will be able to…**

* **Develop a program that interacts with DALL-E**
* **Create images using Dall-E**
* **Apply filters to images and resize images using Dall-E**

My command to format copied examples from the course:

cls; cat | perl -pne 's{\t}{ }xmsg; chomp; s{\A(\s\*)}{"\t" x ((length($1)/2))}xmsge; $\_ .= "\n"; END {print qq{#formatted\n}}' > xxx; perl -e 'print "\n" x 20'; cls; cat xxx

HEREIAM