

# CIML Summer Institute 2025

## Prompt Engineering

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# Popular Chatbots

- OpenAI ChatGPT
  - <http://www.chatgpt.com>
- Google Gemini
  - <https://gemini.google.com/>
- Meta AI
  - <https://www.meta.ai/>
- Use one or all of the above to follow along with the exercises.

# What is Prompt Engineering?

- **Large Language Models (LLMs)**
  - Powerful AI tools
  - Need guidance to provide accurate & useful info
- **Prompt Engineering**
  - Definition: The art & science of crafting inputs (prompts) to LLMs to tell them what to do
  - Process of designing, refining, and optimizing input prompts to guide LLM toward producing desired outputs
  - Important for both NLP and image generation tasks

# Why is Prompt Engineering Important?

- **Good prompt engineering can provide**
  - Enhanced accuracy in results from LLMs
  - Better control over LLM outputs
  - Ability to tailor responses to specific tasks
  - Ways to elicit LLM outputs with different formats/styles
- **Effective prompt engineering**
  - Is essential for leveraging LLMs effectively

# What Makes a Good Prompt?

- **Clarity**

- What do you want the LLM to do?
- Provide instructions that clearly specifies what you want (e.g., detailed explanation, concise summary, text generation)

- **Specificity**

- What do you want included in the response?
- Provide details about format, style, length, etc.

- **Context**

- What is some background information related to your question?
- Provide context to guide response

# Prompt Engineering Tips

## DOs

- Be specific and clear
- Provide context
- Provide information about tone and intended audience as needed
- Provide output format as needed (length, bullet points, etc.)
- Iterate on prompts
- Can regenerate response or select alternate responses
- Create new chats for new topics

## DONT's

- Don't assume output is absolutely correct. Need to verify
- Don't need to have perfect prompt at beginning
- Don't include sensitive or personally identifying information. Don't use info not publicly available. Data goes back to chatbot company.

# Prompt Refining

**Desc:**

Reformulate or rephrase prompt to get desired response

**Prompt:**

Provide an explanation of quantum computing

**Response:**

Regular computers use bits, which are zeros or ones, to process information. Quantum computers, on the other hand, use qubits, which can be zeros, ones, or both at the same time. This is because they exploit the strangeness of quantum mechanics, the science that governs the behavior of matter at the atomic and subatomic level.

Here's a bit more detail on how it works:

- Qubits and superposition: ...
- Quantum phenomena: ...

Overall, quantum computing is a revolutionary technology with the potential to solve problems that are currently beyond our reach. While it's not going to replace your laptop anytime soon, it has the potential to make significant breakthroughs in various fields.

# Prompt Refining

## Refined Prompt #1:

Provide an explanation of quantum computing, summarized in one paragraph.

### Response:

Quantum computing utilizes the strange laws of quantum mechanics to tackle problems that would take regular computers an impractical amount of time. Unlike our computers that use bits (0 or 1), quantum computers use qubits which can be both 0 and 1 at the same time. This lets them explore many solutions simultaneously, making them super-fast for specific tasks like drug discovery or materials science simulations. However, they are still in early stages and complex to build and program.

## Refined Prompt #2:

Provide an explanation of quantum computing for a 4th grader, summarized in one paragraph.

### Response:

Regular computers use bits, which are like switches that are either on (1) or off (0). Quantum computers are like superpowered computers that use qubits, which can be both on and off at the same time! This lets them solve certain problems super fast, kind of like having a bunch of extra brains working together to find the answer. It's a new technology that's still being explored, but it could one day help us design new medicines, create unbreakable codes, and do other amazing things!



# Shot Prompting

- **Description**
  - Providing minimal examples in prompt to guide model towards desired response
- **Zero-shot**
  - No examples given
- **One-shot**
  - A single example is given
- **Few-shot**
  - A few examples (usually 2-5) are given

# Shot Prompting

## Zero-shot

### Prompt:

Extract the relationship between entities in the following sentence: Bill Gates founded Microsoft in 1975

### Response:

Bill Gates is the founder of Microsoft.

## Few-shot

### Prompt:

Extract the relationship between entities in the following sentence.

Here's an example:

Q: Steve Jobs co-founded Apple.

A: Entity:Steve Jobs; Relation:co-founded; Entity:Apple

Here's another example:

Q: Elon Musk started SpaceX

A: Entity:Elon Musk; Relation:started;Entity:SpaceX

Now extract the relationship between entities in this sentence:  
Bill Gates founded of Microsoft in 1975

### Response:

Entity: Bill Gates; Relation: founder; Entity: Microsoft

# Prompting Examples

# Getting Specific Information

What is the Linux command to uncompress a tar.gz file?

What are some polite ways to say "I disagree with the conclusions"

How do transformers work?

What is the longest word in English?

# Translation

Can you translate this from French to English: Je ne parle Francais

How do you say this in Japanese: Sorry, I don't speak Japanese

What does this mean: Hella fit; at first I was triggered and shook, but then looked closer, saw it was popping and legit, in fact it is totally lit!

# Summarization

## **Prompt:**

Can you summarize "To Kill a Mockingbird"?

## **ChatGPT:**

"To Kill a Mockingbird" is a classic novel written by Harper Lee, published in 1960. The story is set in the fictional town of Maycomb, Alabama, during the 1930s, and it revolves around the Finch family, particularly the young girl Scout Finch and her older brother Jem. The narrative is primarily a retrospective account by Scout, looking back on her childhood...

## **Gemini:**

To Kill a Mockingbird, narrated by the young Scout Finch, unfolds in the Depression-era Southern town of Maycomb, Alabama. It explores themes of racial injustice, prejudice, and the power of empathy through the lens of childhood innocence.

# Content Generation

## Prompt:

Generate a lab report for a chemistry class where students conducted the flame tests on various compounds.

### CHATGPT:

**Title:** Flame Tests on Various Compounds

#### Abstract:

The flame test is a qualitative analysis technique used to identify the presence of certain metal ions based on the characteristic colors emitted when exposed to a flame. In this experiment, flame tests were conducted on various compounds to observe and identify the distinctive flame colors associated with different metal ions.

#### Objective:

To perform flame tests on a set of unknown compounds and identify the metal ions present based on the observed flame colors.

#### Materials and Methods:

##### 1. Compounds:

### GEMINI:

#### Flame Test Lab Report

**Experiment Title:** Identification of Elements Using Flame Tests

**Date:** [Date of Experiment]

**Group Members:** [List your group members]

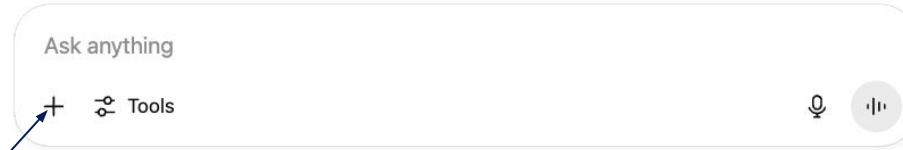
**Instructor:** [Instructor Name]

#### Abstract:

This experiment aimed to identify various elements present in unknown compounds using the principles of flame tests. By observing the characteristic colors emitted by the excited electrons of metals in the flame, we were able to identify the presence of specific elements in each sample. The observed colors were compared to reference values to confirm the element's identity.

# Ask about Uploaded Content

What are you working on?



Click to upload file

**Prompt:**

What is this paper about?



# Code Generation

## Prompt:

Can you provide Python code to read in a dataframe with Name, Dept, remove missing values, then group by Dept?

## Response:

```
import pandas as pd

# Read the DataFrame from a CSV file (replace 'your_data.csv' with your actual file path)
df = pd.read_csv('your_data.csv')

# Remove rows with missing values in any column (including Name and Dept)
df_cleaned = df.dropna()

# Group the DataFrame by the Dept column
grouped_by_dept = df_cleaned.groupby('Dept')

# You can now perform operations on each department group
# For example, print the size (number of rows) of each department
print(grouped_by_dept.size())
```

# Code Interpretation

## Prompt:

Given the Penguins dataset in Python, what does this line of code do?

```
sub_df = df[(df['flipper_length_mm'] == 9) & (df['bill_length_mm'] < 4)]
```

## Response:

This line of code filters the penguins dataframe (df) to create a new dataframe (sub\_df) containing only penguins that meet specific criteria based on their flipper and bill measurements.

Here's a breakdown:

- `sub_df = df[ ... ]`: This assigns the result of the filtering operation within the brackets to a new dataframe named `sub_df`.
- `(df['flipper_length_mm'] == 9)`: This part filters the dataframe to include only rows where the value in the `flipper_length_mm` column is exactly equal to 9 millimeters.
- `&`: The `&` symbol represents the logical AND operator. It ensures that only penguins meeting both the flipper length and bill length criteria are included in the new dataframe.
- `(df['bill_length_mm'] < 4)`: This part filters the dataframe to include only rows where the value in the `bill_length_mm` column is strictly less than 4 millimeters.

In summary, this code snippet creates a dataframe `sub_df` containing penguins with a flipper length of exactly 9 millimeters and a bill length strictly less than 4 millimeters.

# Code Debugging

## Prompt:

Can you debug this code?

```
import pandas as pd
df = pd.DataFrame({'A': ['1', '2', '3']})
df['A'] + 1
```

The error is `TypeError: can only concatenate str (not "int") to str`

## Response:

The error arises because you're trying to perform arithmetic (+) between a string ('1', '2', '3') and an integer (1). In Python, you cannot directly concatenate (join) strings and integers.

To fix this, we need to convert the string elements in column 'A' to numerical data types (integers in this case) before attempting any mathematical operations. Here's the corrected code:

```
import pandas as pd
df = pd.DataFrame({'A': ['1', '2', '3']})
df['A'] = pd.to_numeric(df['A'])
df['A'] = df['A'] + 1
print(df)
```

# Internet Search

## **Prompt:**

What will the weather be in San Diego this weekend?

## **Response:**

This weekend in San Diego (June 28–29, 2025) looks lovely:

Saturday (June 28): Cool start with early low clouds, clearing to sunny skies. High around 74 °F (23 °C), low 62 °F (17 °C).

Sunday (June 29): Similar pattern—morning clouds giving way to sunshine. High near 74 °F, low 62 °F.

# Creative Writing

## Prompt

**Write a limerick about Yoda and Gandalf on whether macaroni & cheese should be eaten with a spoon or a fork.**

### ChatGPT

In a forest where shadows blend,  
Yoda and Gandalf did contend.  
For mac and cheese, they say,  
Is spoon or fork the way?  
In the end, they used both, my friend!

### Gemini

A wise Jedi named Yoda, quite green,  
Debated with Gandalf, a magical scene.  
"Fork or a spoon?"  
The argument boomed,  
"A spork!" Yoda winked, "The best in between!"

# Image Creation

Prompt: A flying superhero cat

💡 Image created



# Text to Video

Sora - AI model that can create realistic and imaginative scenes from text instructions <https://openai.com/sora>

Prompt: The camera directly faces colorful buildings in burano italy. An adorable dalmation looks through a window on a building on the ground floor. Many people are walking and cycling along the canal streets in front of the buildings.



Prompt: Five gray wolf pups frolicking and chasing each other around a remote gravel road, surrounded by grass. The pups run and leap, chasing each other, and nipping at each other, playing.

Prompt: Archeologists discover a generic plastic chair in the desert, excavating and dusting it with great care.



# API Prompting

- **Description**

- Access LLM programmatically
- API: OpenAPI
  - Need to have OpenAPI account
  - Pay-as-you-go or subscription plan



# Prompt Engineering Resources

- <https://help.openai.com/en/articles/6654000-best-practices-for-prompt-engineering-with-the-openai-api>
- <https://arxiv.org/pdf/2201.11903>
- <https://konfuzio.com/en/python-tutorial-complexity/>

# OpenAI API Resources

- Create account: <https://platform.openai.com/>
- Get API key: <https://platform.openai.com/api-keys>
- Add payment: <https://openai.com/api/pricing/>
- Documentation: <https://platform.openai.com/docs/overview>
- Models: <https://platform.openai.com/docs/models>
- API Reference:  
<https://platform.openai.com/docs/api-reference/fine-tuning>