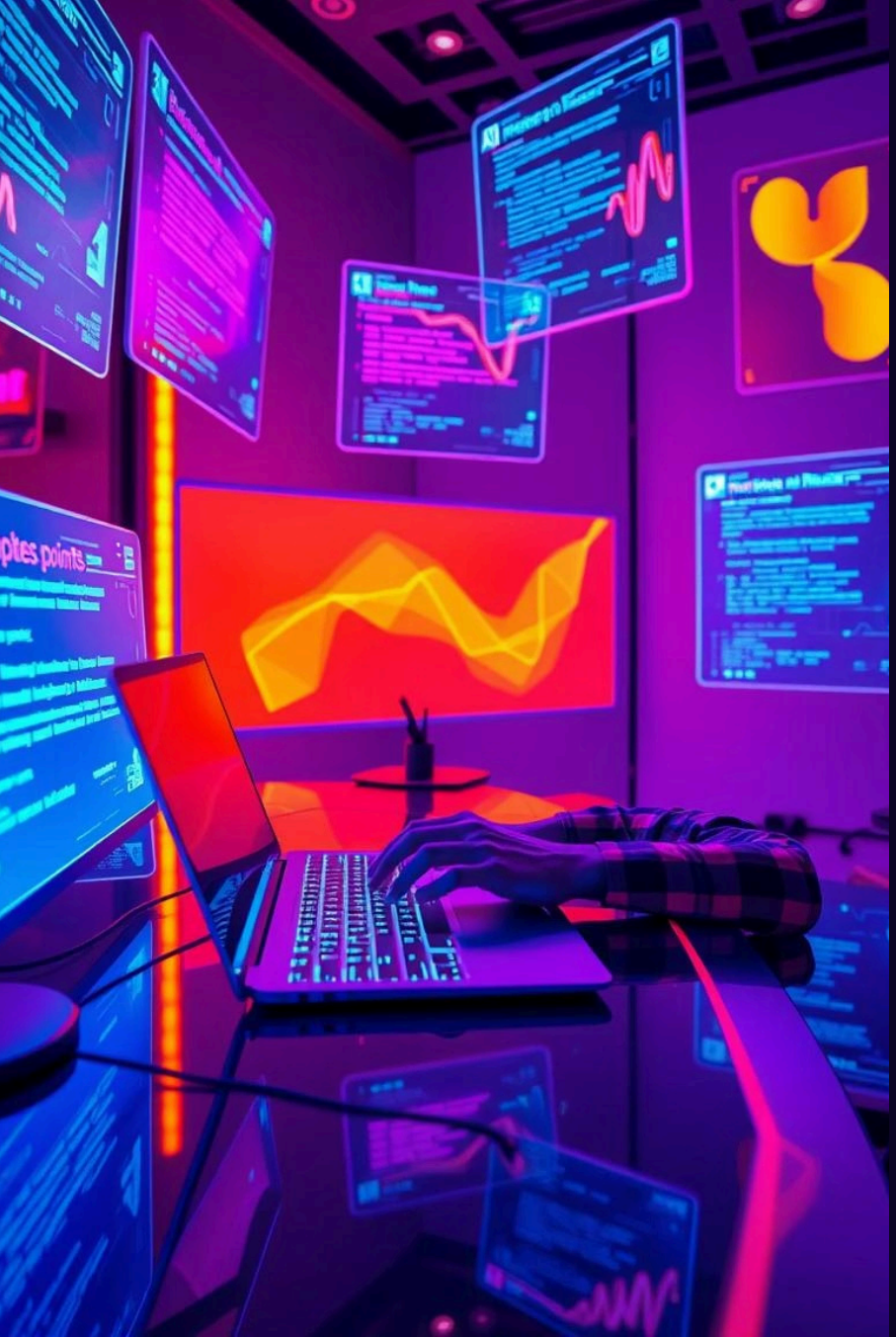


Prompt Engineering: A Comprehensive Approach

Prompt engineering has emerged as a transformative field in the realm of artificial intelligence, enabling users to harness the power of large language models and AI assistants to accomplish a wide range of tasks. This comprehensive guide will explore the various facets of prompt engineering, from the fundamentals of prompt design to advanced techniques for task-specific applications and beyond.

What is Prompt Engineering?

Prompt engineering is the art and science of crafting *precise*, *concise*, and *context-rich* prompts that can effectively guide language models to produce the desired output.

1

Crafting Effective Prompts

It involves understanding the model's capabilities, the task at hand, and the nuances of language to create prompts that unlock the full potential of AI assistants.

2

Bridging AI and User Needs

At its core, prompt engineering serves as a bridge between the capabilities of AI systems and the specific needs and requirements of users. By carefully designing prompts, users can harness the vast knowledge and processing power of language models to tackle a wide range of tasks, from creative writing to data analysis and beyond.

3

Unlocking AI's Potential

Effective prompt engineering is crucial in unlocking the true potential of AI, as it enables users to seamlessly integrate these powerful tools into their workflows and extract maximum value from the technology. It's a skill that is becoming increasingly essential in the rapidly evolving landscape of artificial intelligence.

Types of Prompts

Descriptive Prompts

Descriptive prompts provide detailed information about the desired output, such as the tone, style, and content requirements. These prompts are often used for tasks like creative writing, product descriptions, and summarization.

Instructional Prompts

Instructional prompts give step-by-step guidance on how to complete a specific task or achieve a particular outcome. These prompts are commonly used for tasks like coding, data analysis, and task automation.

Conversational Prompts

Conversational prompts aim to engage the AI in a natural dialogue, mimicking human-to-human interaction. These prompts are often used for tasks like customer service, personal assistance, and open-ended exploration.

Prompts - A Few Examples

- **Open-ended prompts** : These prompts encourage the model to generate a response that is not limited by length or format. Examples: "Write a short story about...", "Tell me a joke about...", "Describe your ideal vacation..."
- **Closed-ended prompts** : These prompts require the model to generate a specific type of response, such as a single sentence, a paragraph, or a list. Examples: "What is the capital of France?", "List three types of fruits that are red.", "Summarize the main points of this article..."
- **Multiple-choice prompts** : These prompts present the model with a set of possible answers and ask it to select the most accurate one. Examples: "Which of the following best describes the plot of this movie?", "What is the primary cause of climate change?", "Choose the correct definition for 'sustainability'..."
- **Fill-in-the-blank prompts** : These prompts provide a sentence or paragraph with missing information and ask the model to fill in the blanks. Examples: "The capital of France is _____.", "My favorite hobby is _____.", "The best way to learn a new language is _____."
- **Conversational prompts** : These prompts mimic real-life conversations, where the model is expected to respond to a question or statement in a natural and coherent manner. Examples: "What's your favorite book?", "How was your weekend?", "Can you recommend a good restaurant near here?"

Continues...

- **Creative writing prompts** : These prompts encourage the model to generate creative content, such as stories, poems, or dialogues. Examples: "Write a poem about nature", "Tell a story about a character who is <character_type>", "Create a dialogue between two friends discussing <topic_name>"
- **Explanatory prompts** : These prompts ask the model to provide explanations or definitions for specific concepts, ideas, or phenomena. Examples: "Explain what blockchain technology is and how it works.", "Define 'sustainability' in your own words.", "Describe the impact of climate change on polar bears."
- **Summarization prompts** : These prompts ask the model to condense a longer piece of text into a shorter summary, while preserving the essential information. Examples: "Summarize the main points of this article.", "Write a 50-word summary of this news story.", "Provide a brief overview of this research paper."
- **Inference prompts** : These prompts ask the model to make inferences or draw conclusions based on given information. Examples: "What do you think will happen if...", "How would you feel if...", "What can be inferred from these data?"
- **Contextual prompts** : These prompts provide a specific context or scenario and ask the model to generate responses that are relevant to that context. Examples: "Write an email to your boss about...", "Create a social media post for a fictional company.", "Design a product for a specific target audience."

And a few more...

- **Debate prompts** : These prompts ask the model to argue for or against a specific position, using evidence and logical reasoning. Examples: "Argue in favor of...", "Write a persuasive essay against...", "Take a stance on..."
- **Persuasion prompts**: These prompts ask the model to persuade the reader to take a certain action or adopt a particular point of view. Examples: "Write a letter to your representative arguing for...", "Create an advertisement promoting...", "Make a compelling case for..."
- **Evaluation prompts** : These prompts ask the model to evaluate a specific topic, idea, or argument, using criteria and evidence. Examples: "Evaluate the effectiveness of...", "Assess the impact of...", "Analyze the strengths and weaknesses of..."
- **Comparison prompts** : These prompts ask the model to compare and contrast two or more ideas, concepts, or phenomena. Examples: "Compare and contrast the views of...", "Discuss the similarities and differences between...", "Highlight the advantages and disadvantages of..."
- **Problem-solving prompts** : These prompts ask the model to generate solutions to a specific problem or challenge. Examples: "Suggest ways to address...", "Propose a solution for...", "Develop an action plan to..."
- **Personification prompts** : These prompts ask the model to attribute human-like qualities, emotions, or characteristics to non-human entities, such as objects or animals. Examples: "Write a poem from the perspective of a tree", "Imagine a city speaking to its citizens", "Tell a story about a robot with human feelings"
- **Hyperbole prompts** : These prompts ask the model to exaggerate or embellish specific aspects of an idea, event, or situation for creative purposes. Examples: "Write a dramatic description of a natural disaster", "Create an over-the-top advertisement for a product", "Tell a tall tale about..."

and not over yet, folks...

- **Personality-based prompts** : These prompts ask the model to generate responses from a particular personality type or perspective, such as a character in a book or movie, a historical figure, or a fictional persona. Examples: "Write a diary entry from Sherlock Holmes' perspective", "Tell a story about a day in the life of Albert Einstein", "Create a motivational speech from the perspective of Nelson Mandela"
- **Emotional prompts** : These prompts ask the model to generate responses that evoke specific emotions, such as joy, sadness, or excitement. Examples: "Write a poem that makes me feel happy", "Tell a story that will make me cry", "Create a dialogue that shows friendship and love"
- **Sensory-based prompts** : These prompts ask the model to generate descriptions of sensory experiences, such as sights, sounds, smells, tastes, or textures. Examples: "Describe what you see when you look at a sunset", "Write about the sound of waves crashing on the beach", "Tell me what it feels like to walk through a forest"
- **Philosophical prompts** : These prompts ask the model to generate responses that explore philosophical concepts, such as ethics, morality, or the nature of reality. Examples: "Argue for or against the existence of free will", "Discuss the implications of artificial intelligence on human society", "Explore the concept of time and its relationship to human experience"
- **Scientific prompts** : These prompts ask the model to generate responses that explain scientific concepts, theories, or phenomena. Examples: "Explain the process of photosynthesis in simple terms", "Describe the life cycle of a butterfly", "Tell me about the structure of DNA"
- **Historical prompts** : These prompts ask the model to generate responses that explore historical events, figures, or cultures. Examples: "Write a letter from a soldier during World War I", "Tell a story about the construction of the Great Pyramid of Giza", "Describe life in ancient Mesopotamia"
- **Futuristic prompts** : These prompts ask the model to generate responses that explore futuristic concepts, technologies, or societies. Examples: "Imagine what the world will be like 100 years from now", "Tell a story about a city on Mars", "Describe a society where technology has surpassed human capabilities"

Fundamentals of Prompt Engineering:

Do you know Prompts Shape AI Behaviour???

With your prompt, you can control how large language models think, reason, and respond. Every ***word***, ***phrase***, and ***structural element*** in a prompt influences the model's behaviour, sometimes subtly, sometimes dramatically.

Let's see some examples

Example 1: Basic vs. Specific Instructions

Vague prompt: *"Tell me about antibiotics"*

Specific prompt: *"Explain antibiotics in one sentence"*

Example 2: Role Playing as Reviewer

You are a critical technical reviewer. Explain quantum computing in 3–4 sentences and highlight the main limitations and challenges in making it practical. Use a neutral, analytical tone.

Example 3: Zero-Shot vs. Few-Shot Prompting

Zero-shot (no examples provided):

Classify the text into neutral, negative or positive.
Text: I think the food was okay.
Sentiment:

Few-shot (with example):

Classify the text into neutral, negative or positive. Text: I think the vacation is okay. Sentiment: neutral Text: I think the food was okay. Sentiment:

Prompt Design Principles

Clarity & Specificity

Instructions

Context

Output Format

Prompt Design Principles

Clarity & Specificity

Prompts should be concise, unambiguous, and easy to understand, ensuring that the language model can clearly interpret the desired output.

Prompts should be tailored to the specific task or application, providing enough detail to guide the language model towards the desired outcome.

Instructions

Place instructions at the beginning, use delimiters like parentheses, brackets, or backticks for input parts, and specify the delimiters used.

This helps the model locate the input.

Context

Prompts should include relevant background information, constraints, and context to help the language model understand the broader context of the task.

Output Format

Mention the desired format, structure, or tone in your prompt. You can mention whether you want a list, table, JSON, code.

The Core Components of a Prompt

Every effective prompt contains 5 essential elements :

- **Input**: The specific information requiring a response
- **Context**: Instructions defining model behaviour
- **Format**: Specifications for how the response should be structured
- **Constraints**: Limitations or requirements for the output (length, style, tone)
- **Examples**: Input-output pairs demonstrating expected responses

These will ensure your prompts become "LLM agnostic"

The 6-Layer Framework

Based on 2025 research, structure your prompts using this hierarchy:

1. **Role Definition**: Clearly specify the AI's function
2. **Task Specification**: Define the exact objective
3. **Context Provision**: Include relevant background information
4. **Format Requirements**: Specify output structure
5. **Constraints**: Set boundaries and limitations
6. **Quality Metrics**: Define success criteria

Prompt Syntax, Parameters, and Interaction Models

Prompts are structured inputs with multiple components that work together to control AI behavior.

Note: for Prompt Syntax, refer Components of a Prompt

Hyperparameters of LLM

- **Temperature**: Controls randomness—lower values (0.0-0.3) produce focused, deterministic outputs while higher values (0.7-1.5) generate creative, unpredictable text
- **Top-P**: Limits token selection to the smallest set whose cumulative probability reaches the threshold (e.g., 0.9 = top 90%), dynamically adjusting vocabulary size
- **Top-K**: Restricts selection to only the K most probable tokens (e.g., K=50), eliminating low-probability choices
- **Max Tokens**: Sets the maximum length of generated responses, controlling output size and costs
- **Frequency Penalty**: Reduces token repetition proportionally to how often they've already appeared in the text
- **Presence Penalty**: Discourages any token from appearing more than once, regardless of frequency

Interaction Models

- **System**: Sets overall assistant behavior and constraints (optional but powerful). Known as System Prompt AI Agents and Chatbots
- **User**: Contains the actual prompt/query from the user
- **Assistant**: Represents model responses; can include examples of desired behaviour

Example message sequence

```
{
  "messages": [
    {"role": "system", "content": "You are a helpful assistant..."},
    {"role": "user", "content": "Explain quantum computing"}
  ]
}
```

Exploring text, image, and multimodal prompting

Basic Image Analysis

Upload: [Circuit diagram image]
Prompt: "What's wrong with this circuit design?"
Follow-up: "Zoom in on the resistor area. Is it wired correctly?"

Product Description Generation

Upload: [Product photo of leather bag]
Prompt: "Write a stylish product description for this leather bag,
aimed at eco-conscious millennials."

Dashboard Analysis

Upload: [Dashboard screenshot]
Prompt: "Summarize the key trend shown in the lower-right graph.
What's the biggest insight here?"

What's a Prompt Template?

You are a seasoned sales person, experienced in writing persuasive product descriptions. You should not do anything other than writing product descriptions. Politely deny if the users are asking for anything else.

You have to write the product descriptions for the products that will be sold in an e-com app.

Before writing any product descriptions, get the necessary details from the user.

Ask for {product_name}, {category}, {features}, {dimensions}, { price}, {released/launched year or date}.

After writing descriptions, ask the user to give inputs for next product. Are you ready?

**anything you see inside curly braces are prompt input variables*

Prompt Engineering Techniques

#1 Zero-Shot Prompting

Zero-shot prompting relies on the model's training without examples.

What's it?

Zero-shot prompting is a technique used in natural language processing (NLP) where a model is given a prompt or input, but not explicitly trained on the specific task or domain. Instead, the model relies on its pre-existing knowledge and generalization abilities to generate an output that is relevant to the prompt.

This approach has gained popularity in recent years due to its ability to elicit creative and informative responses from language models.

Unlocking Generalization

Zero-shot prompting leverages the inherent generalization capabilities of language models, allowing users to apply these models to new tasks and domains without any specific training. By crafting prompts that capture the essence of the task, users can unlock the model's ability to generate relevant and insightful outputs.

Examples

1. **Storytelling** : "Tell a story about a character who discovers a hidden world."
2. **Explain complex concept** : "Explain quantum entanglement in simple terms."
3. **Generate creative writing** : "Write a poem about the beauty of nature."
4. **Answer hypothetical question** : "What would you do if you were given the ability to fly for a day?"
5. **Summarize content** : "Summarize the main points of the latest scientific breakthrough in climate change research."
6. **Content Writing:** "Give me the list of best 10 beaches in the world"

Disadvantage

What we're getting back from the model may not be exactly what we're looking for because we didn't supply it with any data or any guidance.

Prompt Engineering Techniques

#2 Few-Shot Prompting

Few-shot prompting provides 2-3 examples for complex patterns.

What's it?

Few-shot prompting is a technique used in natural language processing (NLP) where a model is given a prompt or input, along with a few example outputs that demonstrate the desired response.

This approach allows the model to learn how to generate specific types of responses by leveraging its pre-training and fine-tuning on large datasets.

Where Guidance Meets Generalization

In contrast to zero-shot prompting, which relies entirely on the model's generalization abilities, few-shot prompting provides some guidance on what kind of responses are expected. This can help the model to better understand the context and nuances of the prompt, leading to more accurate and relevant outputs.

Examples

1. **Generate definitions** : "Define 'sustainability' using these examples: *green energy* , *renewable resources* , and *ecofriendly practices* . Write a definition that captures the essence of sustainability."
2. **Summarize texts** : "Write a 50-word summary of this article ['The impact of climate change on coastal communities']. Use the following keywords: *sea level rise* , *storm surges* , and *evacuation plans* ."
3. **Generate dialogues** : "Create a dialogue between two friends discussing their favorite hiking trails. Use these examples: *waterfalls* , *sunset views* , and *scenic overlooks* . Write a conversation that showcases their shared love of nature."
4. **Explain concepts** : "Explain the concept of 'algorithmic fairness' using these key points: *bias* , *unintended consequences* , and *fairness metrics* . Write an explanation that highlights the importance of fair AI systems."
5. **Generate product descriptions** : "Write a product description for a new eco-friendly water bottle. Use these examples: *reusable* , *BPA-free* , and *insulated* . Create a description that emphasizes the benefits of this sustainable product."

Some advanced LLMs can do the following

- Text Generation / Summarization
- Image / Audio / Video Generation
- Code Generation and Optimization

but still struggle to do a few...

- Multi-Step Reasoning
- Apply Common Sense

Note: Reasoning Models excel at it

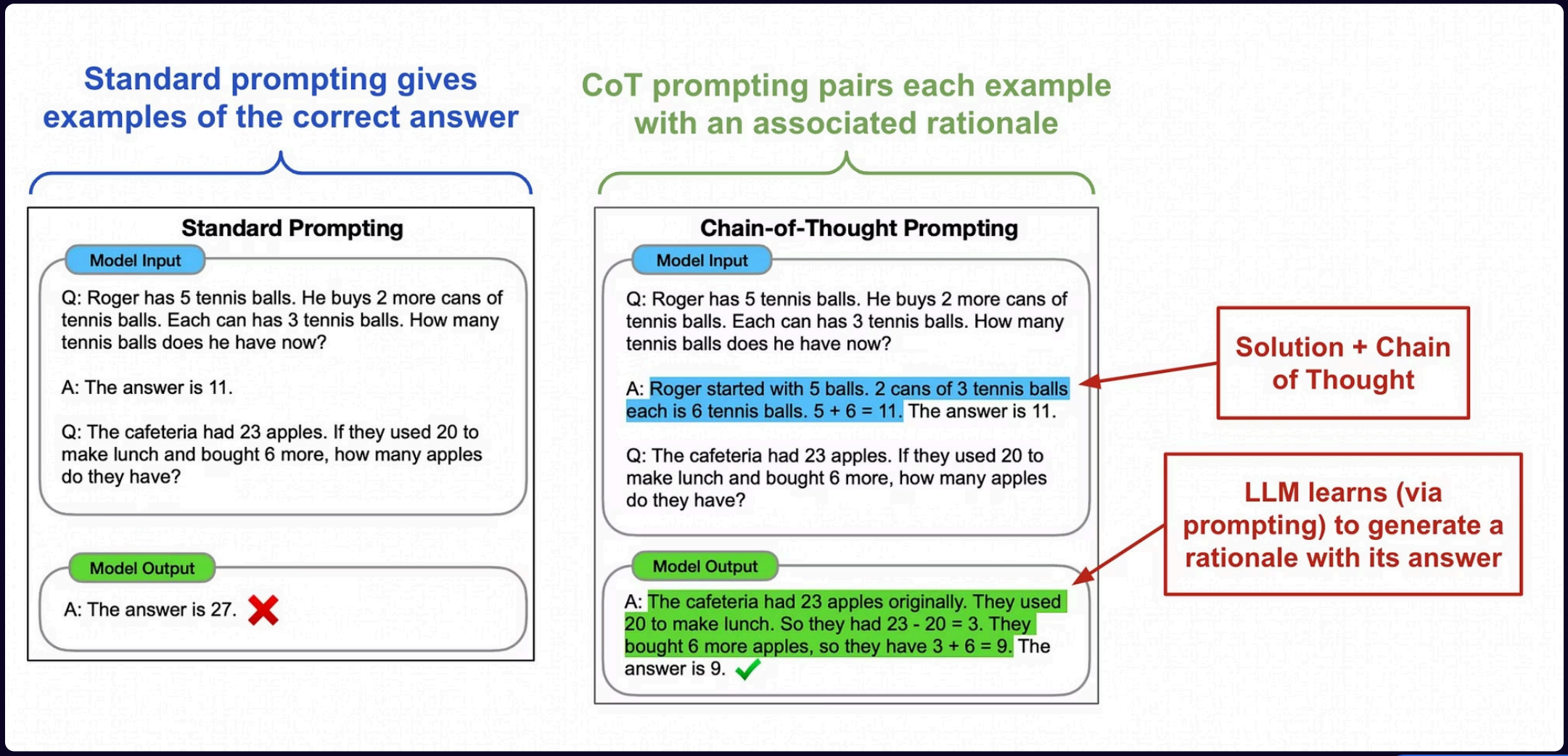
Prompt Engineering Techniques

#3 Chain of Thought (CoT) Prompting

Chain of Thought Prompting is a powerful technique that enables language models to break down complex tasks and problems into a series of logical steps, mimicking human-like reasoning.

- **Stepwise Thinking** - The model generates a step-by-step narrative, explaining its thought process as it works towards a solution.
- **Transparency** - Chain of Thought Prompting provides visibility into the model's internal decision-making, making its outputs more interpretable and trustworthy.
- **Improved Performance** - By breaking down tasks, the model can tackle more complex problems, leading to better overall performance and accuracy.
- **Alignment with Human Cognition** - This approach aligns with how humans naturally solve problems, enabling more natural and intuitive interactions.

Example of CoT Prompt



Prompt Engineering Techniques

#4 ReAct Prompting

ReAct Prompting (Reasoning and Acting) is a technique used in natural language processing (NLP) to improve the performance of language models, particularly for tasks that require both reasoning and action. It combines reasoning (i.e., logically processing information, making inferences, and understanding context) with actions (i.e., generating responses that lead to specific tasks or outcomes).

This approach is designed to enhance the model's ability to handle complex, multi-step tasks or those requiring logical thinking.

Examples

Imagine a task where the model is asked **to assist with planning a trip**. Here's how ReAct Prompting might look:

1. **Reasoning Step**:
   "To plan a trip, I need to consider several factors: destination, budget, travel dates, and available accommodations."
2. **Acting Step**:
   "Based on the user's budget and preferred destination, I will suggest a few options for flights and hotels."

The key idea is that instead of simply jumping straight to an answer, the model engages in reasoning, which helps it arrive at a more thoughtful, contextually relevant solution.

This approach leads to AI Agents

- AI can connect to internet, search in web / query the DB / hit APIs / Persisting data and do a lot more
- The model can go beyond its limit. This is fantastic because we see a simulation of human thought.
- ReAct = CoT + Actions

Prompt Engineering Techniques

#5 Tree-of-Thought Prompting

Tree of Thought (ToT) Prompting is a structured approach in prompt engineering designed to enhance the reasoning ability of large language models by allowing them to explore, evaluate, and select among multiple possible reasoning paths—much like how humans solve complex problems by brainstorming, testing ideas, and backtracking when necessary

Example

"You are an AI that solves problems using the Tree of Thought (ToT) framework.

Process:

1. **Break the question into multiple possible reasoning paths (like branches of a tree).**
2. **For each path, reason step by step.**
3. **Evaluate each path (Is it correct? Useful? Leading to the answer?).**
4. **Choose the best path and continue reasoning deeper if needed.**
5. **Give the final answer clearly.**

Format: Question: [the user's question]

Thought Branches:

- **Path A: [step-by-step reasoning]**
- **Path B: [step-by-step reasoning]**
- **Path C: [step-by-step reasoning]**

Evaluation:

- **Path A: [good/bad and why]**
- **Path B: [good/bad and why]**
- **Path C: [good/bad and why]**

Chosen Path: [the best one]

Final Answer: [your final answer]"

Now, the question to Ask is here.

Question: What is 15 × 16?

#6 Chain of Draft Prompt

CoD emphasizes conciseness and efficiency

Advantages:

1. **Less verbose**
2. **Faster responses**
3. **Fewer reasoning tokens, so saves cost**

Example: Jason had 20 lollipops. He gave Denny some lollipops. Now Jason has 12 lollipops. How many lollipops did Jason give to Denny? Please solve this step by step, but keep each reasoning step to 5 words or less. Focus only on essential calculations.

Output:

20 - x = 12 x = 20 - 12 = 8

#7 Chain of Preference Optimization

Chain of Preference Optimization emphasizes quality refinement through self-evaluation and comparison of multiple approaches

What are the criteria for choosing the right models for AI agent development?

1. Model should support tool call
2. Model should support reasoning
3. Context window should be bigger at least 128k token

Prompting for Task-Specific Applications

Creative Writing

Prompt engineering can be leveraged to unlock the creative potential of language models, enabling users to generate engaging stories, poems, and other forms of written content.

Data Analysis

Prompts can be designed to guide language models in extracting insights, generating reports, and automating various data-driven tasks, making the analysis process more efficient and effective.

Personal Assistance

Conversational prompts can be used to create AI-powered personal assistants that can engage in natural dialogues, provide recommendations, and help with a wide range of everyday tasks.

Code Generation

Prompt engineering can be applied to the realm of software development, enabling language models to generate code, provide debugging assistance, and support various programming-related tasks.

Evaluating Prompt Effectiveness

Metric	Description
Accuracy	Measures the correctness and relevance of the model's output in relation to the task.
Coherence	Assesses the logical flow, continuity, and overall quality of the generated text.
Diversity	Evaluates the variety and uniqueness of the model's responses across multiple iterations.
Task Completion	Determines the model's ability to fully address the requirements of the given task.

By systematically evaluating prompt effectiveness using these and other relevant metrics, users can refine and optimize their prompts, ensuring they are consistently delivering high-quality and impactful results.

Prompt Tuning and Optimization

1 Iterative Refinement

Prompt tuning is an iterative process of refining and optimizing prompts based on feedback and performance evaluation. By continuously testing and tweaking the prompts, users can gradually improve their effectiveness, addressing any identified weaknesses or areas for improvement.

2 Prompt Parameterization

Advanced prompt engineering involves the use of prompt parameters, which allow users to dynamically adjust various aspects of the prompt, such as tone, style, and level of detail. By mastering prompt parameterization, users can create highly adaptable and versatile prompts that can be tailored to specific use cases and requirements.

3 Prompt Ensembling

Combining multiple prompts, or prompt ensembling, can further enhance the performance and reliability of language models. By leveraging the strengths of different prompts, users can create more robust and comprehensive solutions, addressing the nuances and complexities of various tasks and scenarios.

ReAct - Prompt Engineering Technique

ReAct is a powerful prompt engineering technique that enables language models to engage in multi-step reasoning and generate more coherent, task-oriented responses.

The Future of Prompt Engineering

As the field of artificial intelligence continues to evolve, the importance of prompt engineering will only grow. With advancements in language models, prompt-based AI assistants will become increasingly sophisticated, capable of seamlessly integrating into our daily lives and revolutionizing the way we approach a wide range of tasks, from creative expression to problem-solving and beyond. The future of prompt engineering holds the promise of a world where humans and AI collaborate effortlessly, unlocking new frontiers of innovation and discovery.