



Prompt Engineering



Today we will understand **how AI actually processes language** and how to design better prompts.

Prompt engineering and optimization involve designing, testing, and refining input text (prompts) to guide AI models like LLMs to produce accurate, relevant, and high-quality output



Prompt Engineering



Tokenization – Why AI Sees Numbers, Not Words

AI models **do not understand language like humans.**

They convert text into **tokens**, which are basically **numbers representing pieces of words.**

Humans see: I love machine learning

AI sees: [101, 1045, 2293, 3698, 4083, 102]



What is Tokenization?

Tokenization = Breaking text into smaller units (tokens).

Tokens can be:

- Words
- Parts of words
- Characters
- Symbols
- Punctuation

Example

Sentence: Unbelievable performance!

Possible tokens: ["Un", "believ", "able", "performance", "!", ""]



Why Tokenization Matters in Prompt Engineering

1) Token Limit

Every AI model has a **maximum token capacity**.

Example:

GPT models have input + output token limits
If prompt is too long → information gets cut

2) Cost Calculation

Most APIs charge **per token used**.

More tokens = More cost



3) Prompt Clarity

Bad tokenization can change meaning.

Example:

Let's eat grandma

Let's eat, grandma

Comma changes tokens → meaning changes



Hallucinations – Why AI Lies & How to Stop It



What is Hallucination?

Real Example

Prompt: Who won FIFA World Cup 2050?

AI may confidently give wrong answer.

Hallucination happens when AI:

- Generates false information
- Sounds confident, but information is incorrect or invented

AI is predicting text, NOT verifying facts.



Hallucinations – Why AI Lies & How to Stop It



Why Hallucination Happens

1. Prediction Based Model

AI predicts **most probable next word**, not truth.

2. Missing Information

If prompt lacks details → AI guesses.

3. Ambiguous Prompts

Vague instructions lead to creative (but wrong) answers.



Hallucinations – Why AI Lies & How to Stop It



How to Reduce Hallucinations

- **Provide Context**

Bad Prompt: Explain diabetes.

Better Prompt: Explain Type 2 diabetes for class 10 students in 100 words.



Hallucinations – Why AI Lies & How to Stop It



How to Reduce Hallucinations

- **Ask AI to Admit Uncertainty**

Example: What is the cure for Type 2 diabetes. If unsure, say "I don't know".

- **Use Source Requirement**

Example: What is the cure for Type 2 diabetes. If unsure, say "I don't know". Provide answer with references.



Hallucinations – Why AI Lies & How to Stop It



How to Reduce Hallucinations

- **Break Tasks into Steps**

Instead of:

Write research paper

Use:

Step 1: Create outline

Step 2: Expand sections



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How to Reduce Hallucinations

- **Break Tasks into Steps**

Instead of:

"Read this 10-page financial report and write a 500-word summary of why the company is failing and what their debt-to-equity ratio means for their future."

- **Why this fails:** The AI has to hold the data, the analysis, and the creative writing in its "memory" all at once. It might fabricate a ratio or hallucinate a reason for failure just to finish the writing task.



How to Reduce Hallucinations

- Break Tasks into Steps

By breaking this down, you force the AI to verify the facts before it starts "writing."

Step 1: Data Extraction

"List all mentions of 'Debt' and 'Total Equity' found in the 'Financial Highlights' section of this report. Provide the page numbers."

Step 2: Logic & Calculation

"Using the numbers extracted in Step 1, calculate the Debt-to-Equity ratio ($D/E = \frac{\text{Total Liabilities}}{\text{Total Shareholders' Equity}}$). Show your work."

Step 3: Interpretation

"Based on the calculated ratio and the 'Risk Factors' section of the report, list three specific reasons the company is facing financial instability."

Step 4: Final Synthesis

"Now, use all the verified facts from the previous steps to write a 500-word summary of the company's outlook."





Hallucinations – Why AI Lies & How to Stop It



How to Reduce Hallucinations

- **Use Role Prompting**

You are a certified medical professional...



Hallucinations – Why AI Lies & How to Stop It



How to Reduce Hallucinations

- **Use Role Prompting**

The "Generic" Prompt (High Hallucination Risk)

Bad Prompt: "What should I do if my heart is racing?"

Risk: The AI might give overly cautious, irrelevant, or dangerously vague advice because it's pulling from its entire training set—which includes forums, blog posts, and fiction.



How to Reduce Hallucinations

- Use Role Prompting



The "Role-Prompted" Example (Lower Hallucination Risk)

Better Prompt: "You are a board-certified cardiologist with 20 years of experience. Based on clinical emergency protocols, what is the step-by-step procedure for a patient experiencing a sudden resting heart rate over 120 BPM? If you are unsure of specific diagnostic criteria, state that you cannot provide medical advice for that detail."

Why this works:

Domain Alignment: By assuming the role, the model weights "medical journal" data more heavily than "internet forum" data.

Tone Shift: It shifts from a conversational buddy to a professional authority, which often suppresses the AI's tendency to "people please" with made-up answers.

Specific Constraints: You've combined the role with an "uncertainty" clause, which is proven to reduce hallucinations by up to 30–50%.



The Golden Prompt Formula



Prompt = Context + Task + Constraint + Output Format

1. Context (Background Information)

Gives AI situation or environment.

Without context → AI guesses

The "No Context" Prompt (The Guessing Game)

Bad Prompt: "Write a plan to improve customer retention."

The Problem: The AI doesn't know if you are a local coffee shop, a billion-dollar SaaS company, or a non-profit. It will likely give you a "generic list" (loyalty cards, email newsletters) that might be totally irrelevant to your business model.



The Golden Prompt Formula



Prompt = Context + Task + Constraint + Output Format

The "High Context" Example (The Grounded Response)

Better Prompt :

"**[Background]**: We are a mid-sized B2B software company that sells a project management tool to construction firms. Our subscription is \$500/month.

[The Situation]: We've noticed that customers usually leave (churn) after the 3rd month because the software feels too complex for their field workers.

[Goal]: Create a 30-day retention plan specifically focused on simplifying the 'onboarding' phase for non-technical users."



The Golden Prompt Formula

Prompt = Context + Task + Constraint + Output Format



2. Task (What AI Should Do)

Clear action instruction.

Example: Analyze the dataset and find trends in sales from the column `monthly_sales`.



The Golden Prompt Formula



Prompt = Context + Task + Constraint + Output Format

3. Constraint (Rules & Limitations)

Controls AI output.

Examples:

- Word limit
- Tone
- Audience level
- Style
- Technology restriction

Example: Explain in simple language under 150 words the concept of calculus. My audience is high school students with weak math background. Do not use complex math formulas.



The Golden Prompt Formula



Prompt = Context + Task + Constraint + Output Format

4. Output Format (Structure)

This dramatically improves results.

Examples:

- Table
- Bullet points
- JSON
- Code
- Step-by-step guide

Example: Provide output in table format.



The Golden Prompt Formula



Prompt = Context + Task + Constraint + Output Format

Weak Prompt:

Explain neural networks

Strong Prompt Using Formula

Context: You are teaching beginners in AI.

Task: Explain neural networks.

Constraint: Use simple language and include real-life analogy.

Output Format: Provide explanation in bullet points.





Practical Demo Idea

Ask students:

Count tokens in:

"Machine learning is powerful."

Then show them using tokenizer tools like:

OpenAI tokenizer

HuggingFace tokenizer