

LLM as a Learning Buddy:

Rethinking LLM in an Educational Context

Toru Ishida

Visiting Professor, Telkom University

Professor Emeritus, Kyoto University

Agenda

1. What's LLM?
2. LLM Use in Industry vs **Education**
3. **Four key principles** for engaging with LLMs
 - Let Yourself Learn from LLM
(Don't try to "use" it)
 - Ask Simple Questions and Keep the Conversation Going
(No Need for Prompt Engineering)
 - Enjoy Exploring Beyond the Topic
(LLM is not a Google search)
 - **Respect LLM as Your Lifelong Mentor (Next Week)**



What's LLM?

A **neural network model** designed to handle **natural language**, trained on extremely **large datasets** with a massive number of parameters.

Primarily used for tasks such as language generation, summarization, translation, and question answering.

Large

- Composed of **billions to trillions of parameters** (e.g., 175 billion in GPT-3, over 1 trillion in GPT-4)
- Trained on hundreds of gigabytes to tens of terabytes of text data

Language

- Mainly targets **natural languages**, but includes **programming languages** and structured data
- Models grammar, meaning, context, and dialogue flow through predictive learning

Model

- Based on a **multi-layer Transformer architecture**
- Trained using self-supervised learning, where the model learns to predict the next word or token

What's LLM?

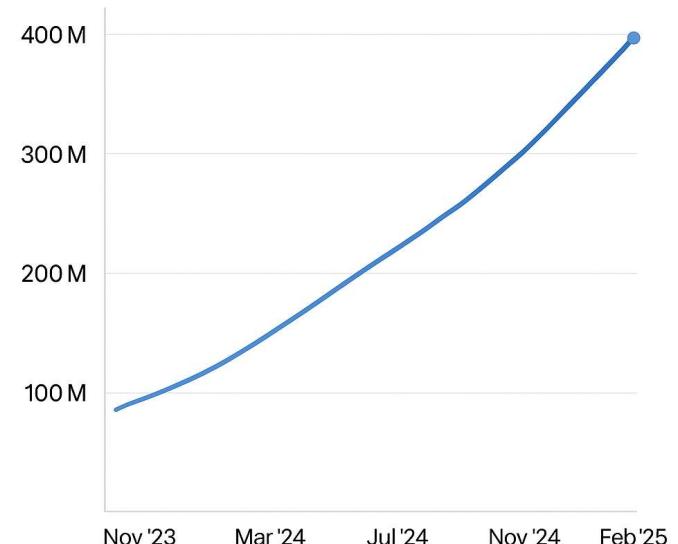
How widely are LLMs used?

- 400 million
Weekly **active users** of ChatGPT as of February 2025.
- Over 1 billion
Number of **queries** ChatGPT processes per day.

Scale of LLMs

- Number of parameters in GPT-4:
1.8 trillion
- Training duration for GPT-4:
3 months
- Number of NVIDIA A100 GPUs used for training GPT-4 :
25,000 units
- Text data used for GPT-3 training:
45 TB (unfiltered) / 570 GB (filtered: only 1.2%)

Weekly Active Users of ChatGPT



Created by ChatGPT-4o

What's LLM?

The followings are the minimum required for it to function.

Embedding

Input tokens are transformed into vectors. 12288

Example: dog → [0.3, -0.7, ..., 0.10]. 12,288 dimensions

Positional Encoding

Positional information of each token is added, since Transformers process inputs in parallel.

Example: (1st, 2nd, ...).

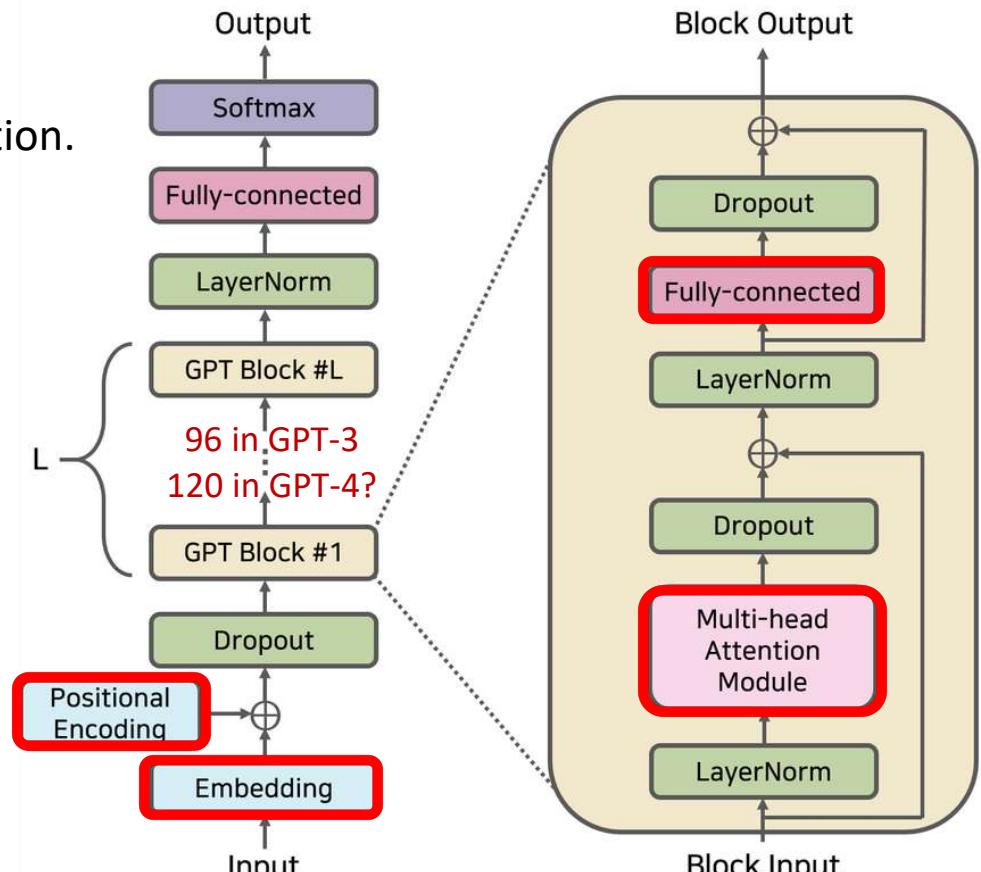
Attention Module

Each token decides **how important other tokens are and integrates that information** accordingly.

Multiple attention heads allow the model to capture different contextual perspectives.

Fully Connected Layer

The output from the attention layer is further processed through a non-linear feedforward network.



GPT (Generative Pre-trained Transformer)
Decoder-only Transformer

Jana, Sunit & Pal, Koushik & Roy, Kaushik. (2024). The Evolution and Impact of Large Language Model Systems: A Comprehensive Analysis.

What's LLM?

Trained on a variety of data sources from the internet:



1. **Common Crawl**: A massive dataset consisting of regularly crawled, publicly available web pages.

Examples: blogs, news articles, technical websites, etc.

Since it contains a lot of noise, it is **filtered before use**.

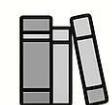


2. **WebText**: A collection of web pages linked from **Reddit** posts that received **high user upvotes**.

Generally higher in content quality compared to raw web data.



3. **Wikipedia** articles, primarily in English but also in multiple languages, are included.



4. **Books**: Includes public domain books (e.g., **Project Gutenberg**) as well as licensed books.

Examples: literature, novels, scientific texts, history books, etc.



5. **Code** (e.g., **GitHub**)

Extensive knowledge of programming code, including languages like **Python**, **JavaScript**, etc.



6. **Other Sources**: **Stack Overflow**, **ArXiv**, **PubMed**, news (**CNN**, **BBC**, etc.)

Legal documents, contracts, FAQs, product reviews, technical manuals

LLM Use in Industry

Prompt engineering and fine-tuning are two key techniques to produce LLM services.

Prompt engineering



Designing effective prompts to guide LLMs for desired outputs.

Fine-tuning



Customizing a pre-trained LLM on specific data for **targeted tasks**.

Differences in LLM Uses in Industry and Education

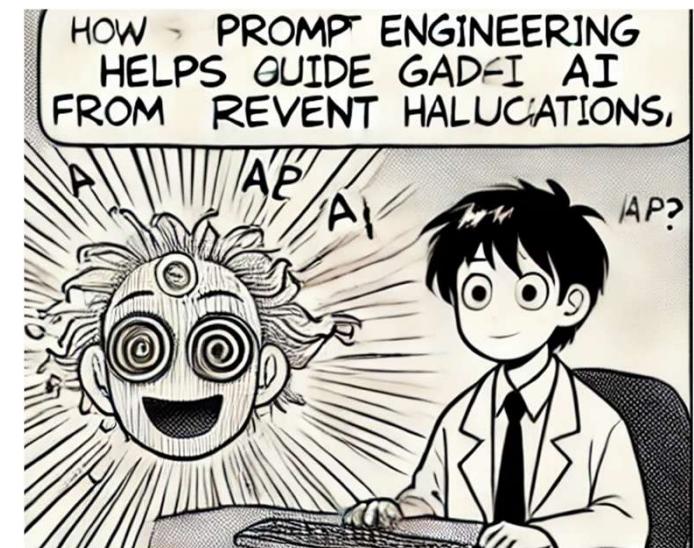
In the *industry*, **prompt engineering**, for example, is widely used to limit LLMs to specific purposes, and repeated adjustments are made to prevent **hallucinations** (i.e. restrict LLMs' free behavior).

<https://www.promptingguide.ai/>

<https://www.deeplearning.ai/short-courses/chatgpt-prompt-engineering-for-developers/>

In *education*, the goal is to learn subjects like “algorithms,” not to become a prompt engineer.

Becoming a prompt engineer might be more difficult than earning credits in “algorithms.”



LLM Use in Education

When we are trying to learn new knowledge, we need a method that fully leverages the potential of LLMs, rather than restricting their responses.

This seminar introduces four key principles for students to enhance their learning with LLMs.

- Let Yourself Learn from LLM
(Don't try to "use" it)
- Ask Simple Questions and Keep the Conversation Going
(No Need for Prompt Engineering)
- Enjoy Exploring Beyond the Topic
(LLM is not a Google search)

WEEK 1

- Respect LLM as Your Lifelong Mentor

WEEK 2

Let Yourself Learn from LLM (Don't try to “use” it)



Project Gutenberg

- Project Gutenberg is a nonprofit where volunteers digitize **expired-copyright** public domain books.
- It houses over **60,000 books** in multiple languages and fields, including classic literature and historical texts.

Aozora Bunko (Bluesky Library)

- Japanese digital library established in 1997 offering free access to over **18,000 copyright-free literary works**.

Let Yourself Learn from LLM (Don't try to “use” it)

I have something I really want to pursue: I want to become a chef. However, my parents want me to join a stable, high-paying company so that I can build a happy family.

Are there any novels that describe similar struggles?



- In Charles Dickens's *David Copperfield*, David overcomes his stepfather's interference, honing his writing skills and achieving his dream.
- Jo March in Louisa May Alcott's *Little Women* also goes against traditional marriage expectations and becomes independent by publishing her own work.
- Furthermore, the women in W. G. Waters's *The Cook's Decameron* defy those who look down on kitchen tasks, mastering the art of Italian cuisine.

Let Yourself Learn from LLM (Don't try to “use” it)

I am interested in studying philosophy. Please list and briefly explain **three philosophical trends** that connect to the present day.



- **Phenomenology** Founded by **Husserl**, phenomenology studies consciousness from the first-person perspective without presuppositions. Advanced by **Heidegger**, Sartre, and Merleau-Ponty, it influences **existentialism** and cognitive science through its focus on subjective experience.
- **Analytic Philosophy** Early 20th-century movement prioritizing logical clarity and language analysis. Pioneered by **Russell**, **Moore**, and **Wittgenstein**, it addresses philosophical questions through precise argumentation connected to science and logic.
- **Post-structuralism** Mid-20th-century French movement challenging fixed meanings. **Derrida**, **Foucault**, and **Deleuze** examined how language and power construct knowledge, impacting **literary theory and cultural studies**.

Let Yourself Learn from LLM (Don't try to “use” it)

I want to travel the world, but my parents worry that I'm not ready. I also don't have much money right now.

In what order should I visit different countries?



- To start, it's best to head to nearby, **budget-friendly** destinations like **Malaysia** or **Thailand**. Their **languages and cultures** are somewhat similar, you'll have fewer worries for your first trip abroad.
- Next, expanding your horizons to places like **Japan** or **South Korea** is a good idea, as they are **safe** and have **well-developed transportation** systems.
- Then, once you've saved more money, aiming for farther destinations such as **Europe** or the **United States** would be ideal.

Let Yourself Learn from LLM (Don't try to “use” it)



In the **industry**, there are **many complaints** about LLMs not working as expected.

- *Hey LLM, some of the data in your report isn't factually correct!*
- *I don't understand the reasoning behind your proposal!*
- *Are you sure there are no copyright issues with the images used in this document?*

However, if you want to learn from LLMs, you should first respect them, who already read 60,000 books! Even great human professors sometimes say incorrect things.

Ask Simple Questions and Keep the Conversation Going (No Need for Prompt Engineering)

One-shot Prompting

“Write a class reflection of about 400 words based on the topic ‘AI and Society’. The reflection should include a summary of what was learned in the class, something that was particularly memorable and why, my personal thoughts or realizations, and how this knowledge might be useful in my future studies or daily life. Use a respectful and sincere tone, appropriate for a school setting, as if the reader were a teacher or school staff.”



Step-by-step Dialogue

1. “Write a short reflection about a class on AI and society.” *LLM’s initial report*
2. “What did the student learn in the class? Add that to the reflection.” *LLM’s 1st revision*
3. “Mention something that was interesting or surprising in the class.” *LLM’s 2nd revision*
4. “Add a sentence about how this class might be useful in the future.” *LLM’s 3rd revision*
5. “Make the tone polite and appropriate for a school assignment.” *LLM’s final report*

Prompt Engineering is Needed!

Keep the Conversation Going!

Ask Simple Questions and Keep the Conversation Going (No Need for Prompt Engineering)

Aspect	One-shot Prompting	Step-by-step Dialogue
Speed & Efficiency	Allows coherent and polished writing	Encourages learning through the iterative process
Development of Student Thinking & Expression	Limits students' opportunity to deepen their own ideas	Encourages students to think, reflect, and refine their ideas
Quality of Final Output	Produces well-organized, polished texts suitable for reports	Results in more personalized and meaningful writing
Skills Required	Requires knowledge of prompt engineering and text structuring skills	Requires dialogue skills , questioning ability, and editorial thinking



The Tower of Hanoi

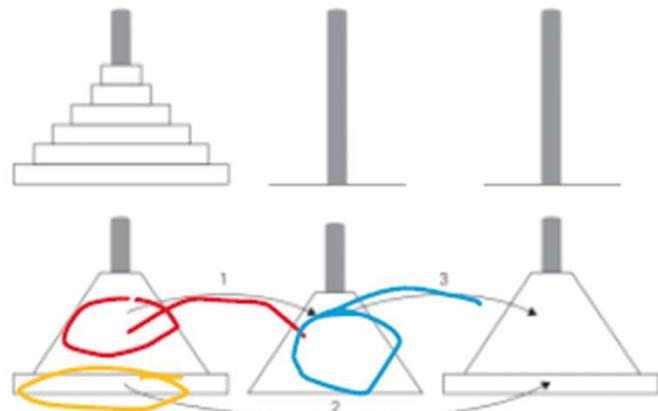


FIGURE 2.4 Recursive solution to the Tower of Hanoi puzzle.

1. Input's size parameter: n
2. Basic operation: Operation of moving one disk from one tower to another
3. $C(n) = \begin{cases} 0, & n = 0 \\ 2C(n-1) + 1, & n > 0 \end{cases}$
4. $C(n) = 2^n - 1$. (see the explanation next to it)
Exponential growth rate.

To move $n > 1$ disks from tower A to tower C, follow these steps:

1. Move $n-1$ disks from tower A to tower B..
2. Move the n -th disk from tower A to tower C.
3. Move $n-1$ disks from tower B to tower C.

$C(n) =$	$C(n-1)$	$+ 1$	$+ C(n-1)$
Number of basic operations executed to move n disks from the source tower to the destination tower	Number of basic operations to move $n-1$ disks (stacked above the n -th disk) from the source tower to the auxiliary tower	Steps to move the n -th disk (the largest/bottom one) from the source tower to the destination tower	Number of basic operations to move $n-1$ disks from the auxiliary tower to the destination tower.

$$C(0) = 0$$

Nothing is moved.

$$C(n) = 2C(n-1) + 1$$

Substitute $C(n-1)$ with $2C(n-2) + 1$

$$= 2(2C(n-2) + 1) + 1$$

$$= 2^2 \cdot C(n-2) + 2 + 1$$

$$= 2^2 \cdot (2C(n-3) + 1) + 2 + 1$$

Substitute $C(n-2)$ with $2C(n-3) + 1$

$$= 2^3 \cdot C(n-3) + 2^2 + 2 + 1$$

Ask Simple Questions and Keep the Conversation Going (No Need for Prompt Engineering)

1. What does this document explain?
2. Oh, your explanation is too long. Could you explain “The Tower of Hanoi” in 50 words?
3. Is this document about the formula for the number of moves needed to transfer the disks? What is C , and what is n ? I don’t understand what they mean!
4. Umm, I’m not sure I understand. $C(n)$ represents the number of moves needed to move n disks, right? Then why do we use $C(n-1)$ to calculate it? We don’t know what $C(n-1)$ is, do we?
5. I still don’t really understand recursion. Could you explain it in a simpler way, say for my mom?

It’s impossible to prepare a one-shot prompt in advance that would explain Dr. Kemas’ materials.

Why? Because you don’t even know what you don’t understand.

You have no choice but to ask your questions step by step in a dialogue.

Ask Simple Questions and Keep the Conversation Going (No Need for Prompt Engineering)

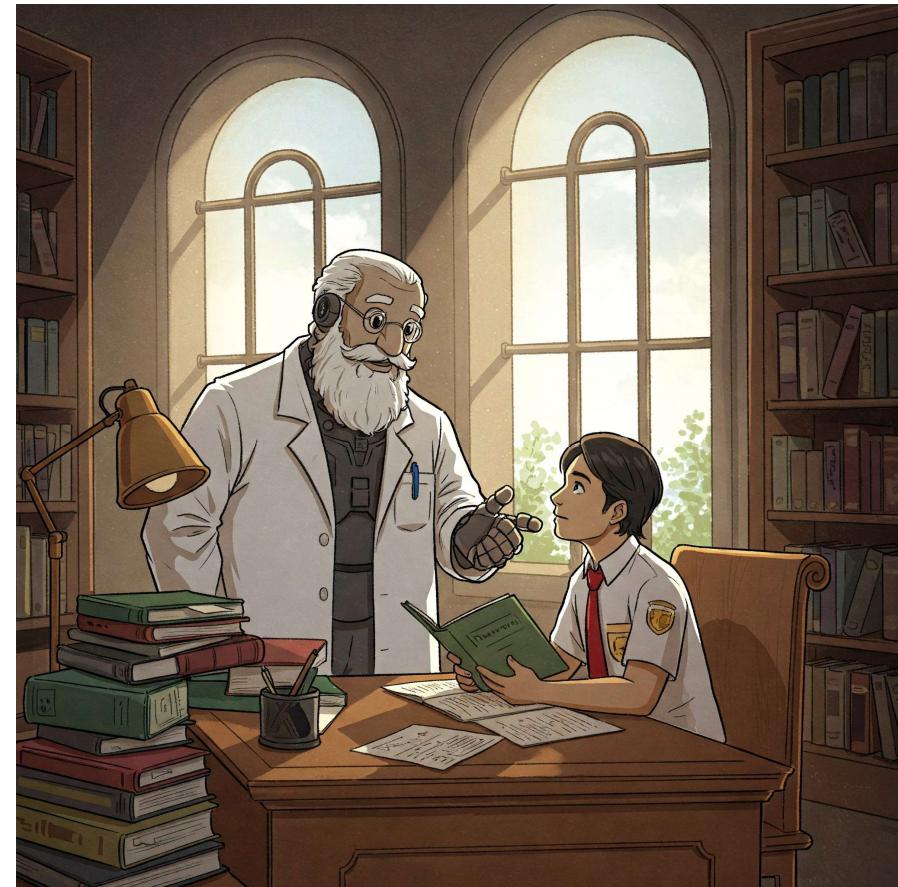
That said, studying **well-known prompting techniques** is helpful for understanding LLMs.

Prompting Technique	Prompt Example	Effect
Role Prompting	"You are a professional legal advisor . Please review the following contract."	Produces more domain-specific and expert answers
Few-shot Prompting	" Example 1 : Q: $2 + 2 = ?$ A: 4 Example 2 : Q: $5 + 3 = ?$ A: 8 Now, Q: $6 + 1 = ?$ "	Helps model mimic patterns and learn context
Chain of Thought	" Let's think step by step . First, the boy has 3 apples. Then he gets 2 more. So, $3 + 2 = 5$."	Enhances reasoning for multi-step problems
ReAct Prompting	" Thought : I need to find out today's weather. Action : Search for 'weather today in Bandung'."	Enables reasoning + tool use for problem-solving

Enjoy Exploring Beyond the Topic (LLM is **not** a Google search)

Google Search is like a “**huge library**.” When you enter a keyword, it tells you the locations or lists of books (web pages) that seem related.

LLM is like a “**knowledgeable teacher**.” When you ask a question, it uses its extensive knowledge to provide a direct, written answer.



Enjoy Exploring Beyond the Topic (LLM is not a Google search)

Question: Do you know [the story behind the Tower of Hanoi](#)?

LLM: The Tower of Hanoi is sometimes explained in conjunction with legends such as, “[At a Buddhist temple in India, monks are gradually moving 64 golden disks of the Tower of Hanoi, and when they finish, the world will come to an end.](#)”

Question: Is there really such a legend?

LLM: It’s often said that this “story” was created by Édouard Lucas (the French mathematician invented the Tower of Hanoi).

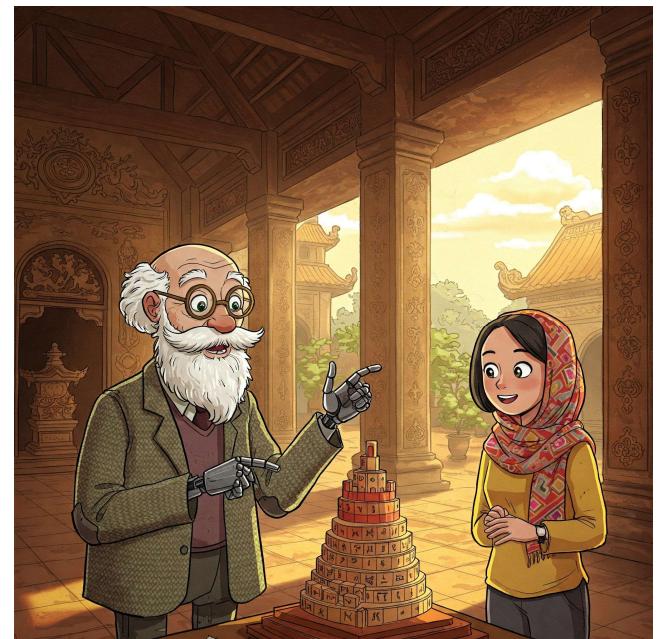
Question: Why is [the tower in India called the Tower of Hanoi](#)?

Hanoi is in Vietnam, right?

LLM: When Lucas popularized this puzzle in the late 19th century, France was advancing its colonial rule in Indochina. To the French, “Hanoi” served as a name evoking a distant Eastern city.

Question: From when until when was Vietnam a French colony?

:



Assignment

Please engage in a dialogue with an LLM (Large Language Model), and report the **most interesting conversation** that stimulated your curiosity.

[Topic and Background]

- What was the topic of the conversation?
- Why did you choose this topic?

[Excerpt from the Dialogue]

- **Include an excerpt from the conversation that you found especially interesting.**
- Explain why this part was memorable.

[Format]

A4 PDF (approximately 3 pages)

Filename: LLM_Report_YourName.pdf

Submission deadline: **28 April 2025 16.00 WIB**

Submission method: Submit your assignment in this drive <https://bit.ly/LLMLearningBuddy-Assignment1>

In the next class, we will deepen our understanding of LLMs by reviewing several reports.