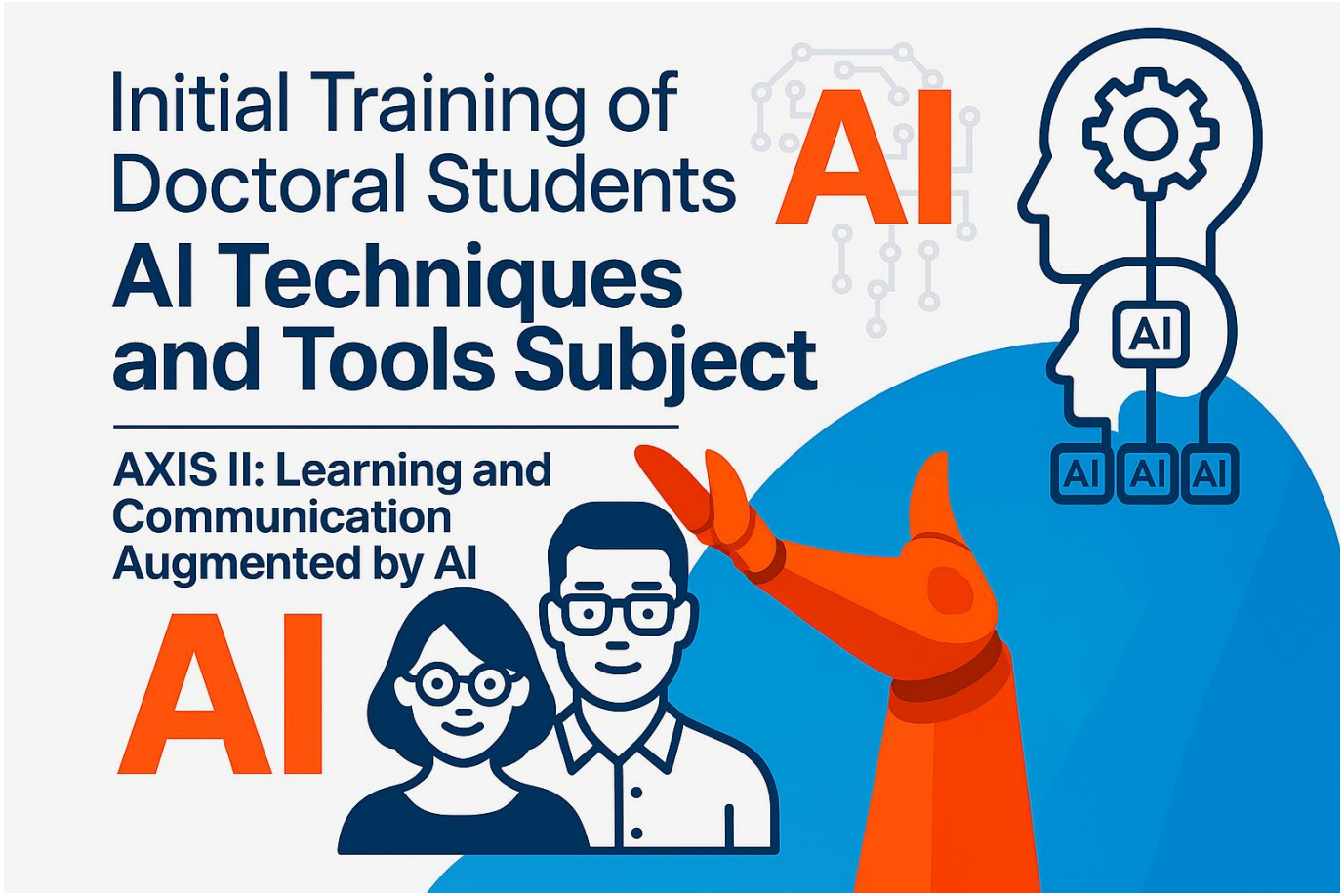
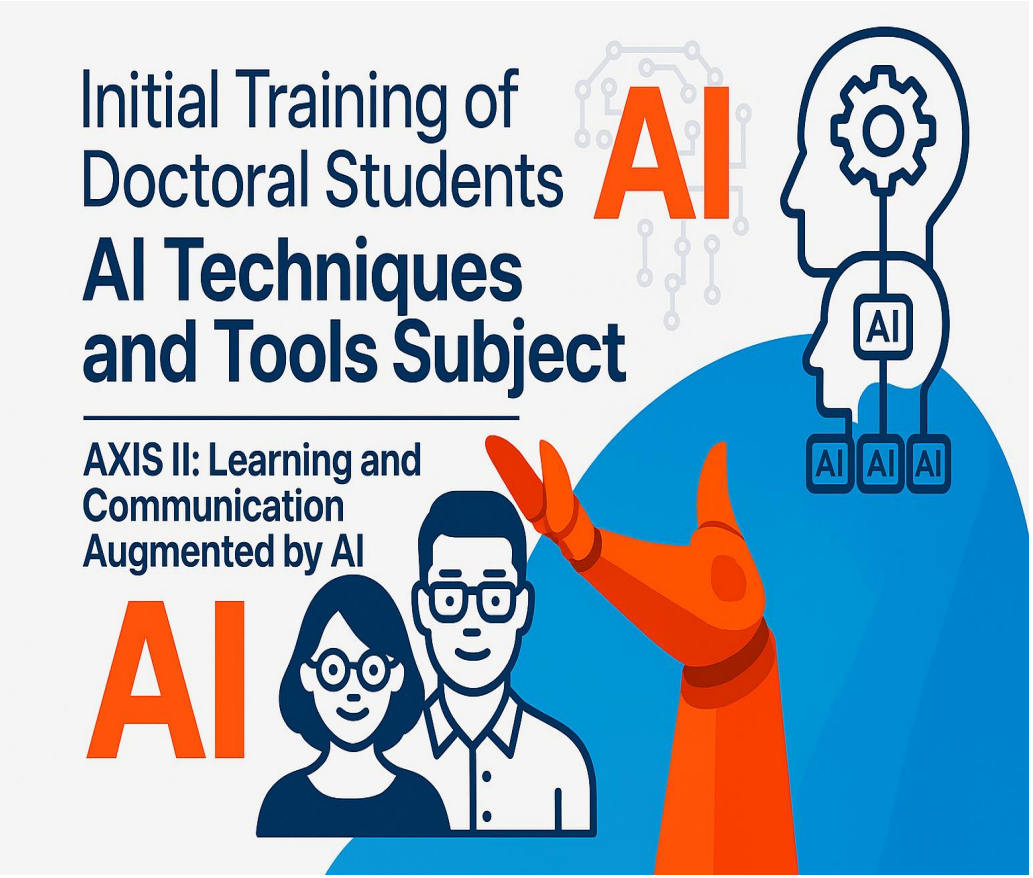
الجمهورية الجزائرية الديمقراطية الشعبية
Algerian Democratic Republic and Populaire
وزارة التعليم العالي و البحث العلمي
Ministry of Higher Education and Scientific Research

اللجنة الوطنية للاشراف ومتابعة تنفيذ برنامج تدعيم التكوين الأولي
في الطورالثالث في مؤسسات التعليم العالي- 2025-





- Axis 2 of the module "**Techniques and Tools of Artificial Intelligence**" focused on a central theme for any researcher:

  "Learning and Communication augmented by AI."

- This axis is designed specifically for PhD students in the Humanities and Social Sciences (SSH) and Science and Technology (S&T) branches —to help them better leverage artificial intelligence tools in their research and writing practices.

Axis II : Learning and Communication Augmented by AI - Overview 2/3 -

Two main objectives

- Integrate AI as a tool to support learning and scientific communication.
- Develop a critical mastery of tools for writing and literature review.

Demystify AI

1. Definition and history of AI
   What is AI?

AI as Tool,

2. Generative AI and prompt engineering
3. AI-Assisted Scientific Writing
4. AI-Assisted Literature Review and Critical Analysis

Workshop

5. AI Tools at the Service of the Researcher

AI as Tool,

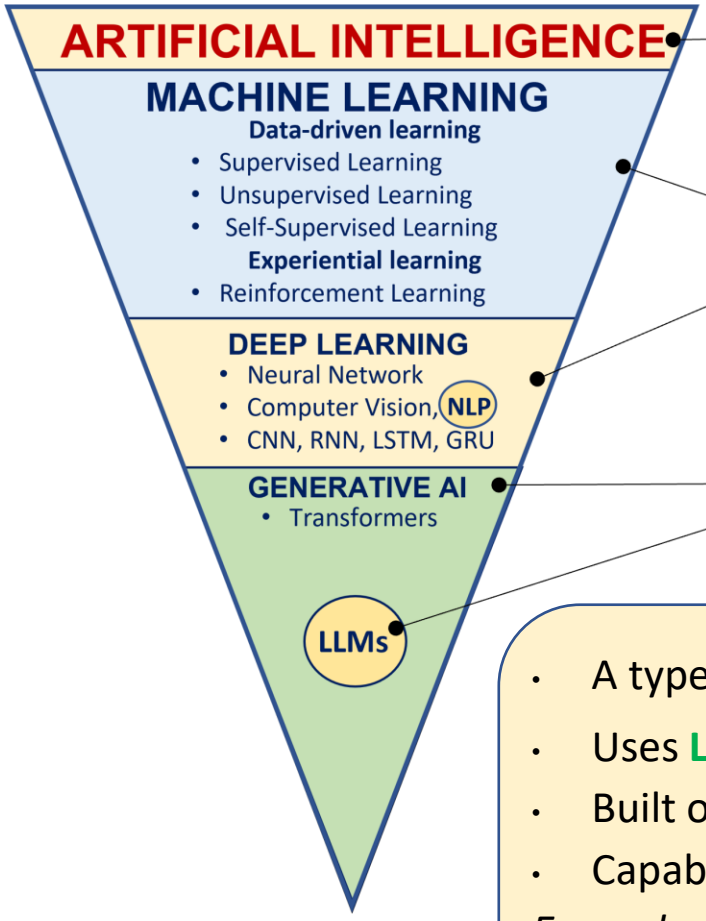
❷ **Generative AI and prompt engineering**

Prompt engineering is becoming a new digital literacy. Though still largely empirical, it is evolving into a structured applied science. Eventually, it may be taught across all levels of education, just like coding or digital research skills are today

Generative AI

AI as Tool,

2 Generative AI and prompt engineering



Symbolic AI — *Rules*, *Facts* — Expert systems

Connectionist AI — *Sens*, *Data* — ML, Neural networks, Deep learning

Generative AI — Large Language Models (LLMs) : Transformers (GPT, *BERT*)

Generative **P**re-trained **T**ransformer

- A type of AI that **creates new content** based on user **prompts**
- Uses **LLMs** (Large Language Models) trained on massive text datasets
- Built on **Transformer** architecture
- Capable of generating: Text, Images, Sound, Video, Music

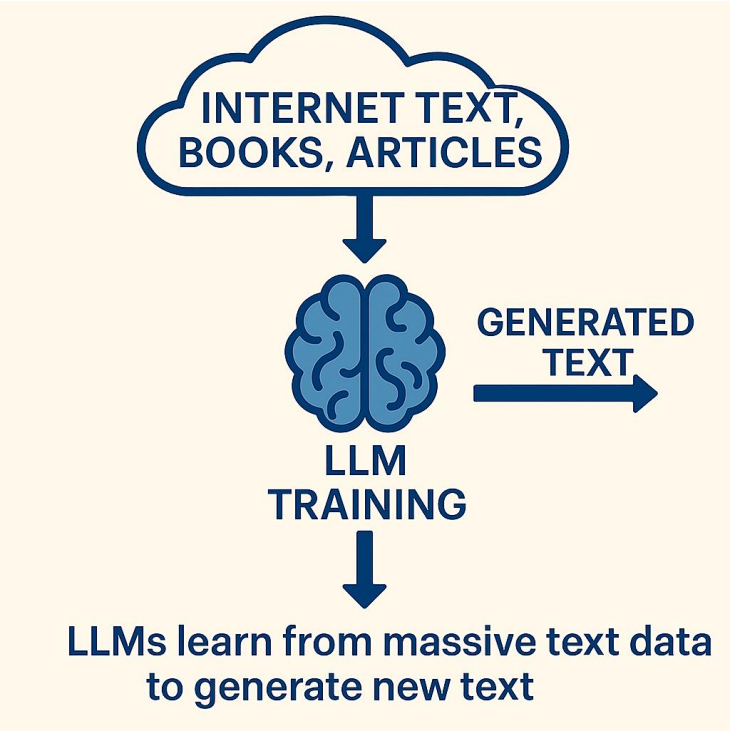
Examples

Text: GPT-4o, Claude, DeepSeek, Gemini, GPT-3

Images: DALL·E, CLIP, Stable Diffusion

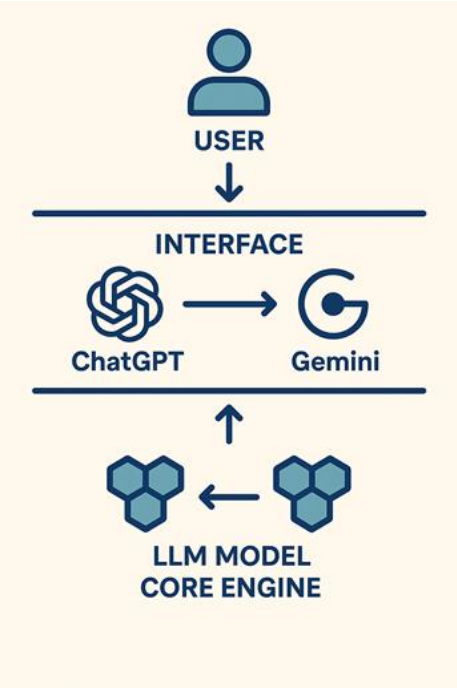
What are LLMs?

- LLMs (Large Language Models) are AI systems trained on **vast amounts of text data**.
- They **learn patterns and relationships** in language to understand and **generate human-like text**.
- Core function: **Predicting the next word/sequence** in a given context (not "thinking" like humans).



LLMs vs. Applications: A Key Distinction

- Interact with LLMs *through* **applications/interfaces**.
- **ChatGPT** (application) *uses* an LLM (e.g., **GPT-4o** model).
- Many players: OpenAI (GPT series), Google (Gemini), Anthropic (Claude), Mistral AI.



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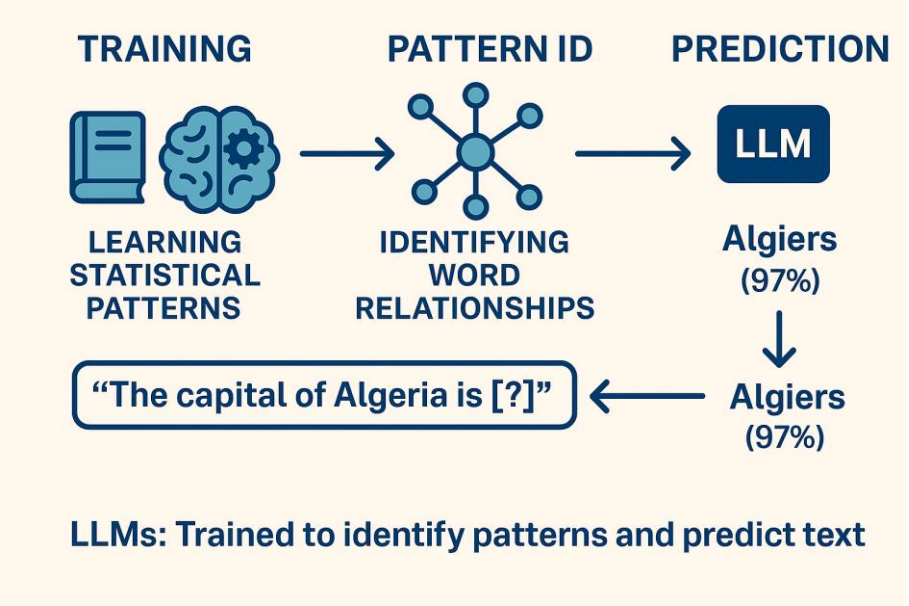
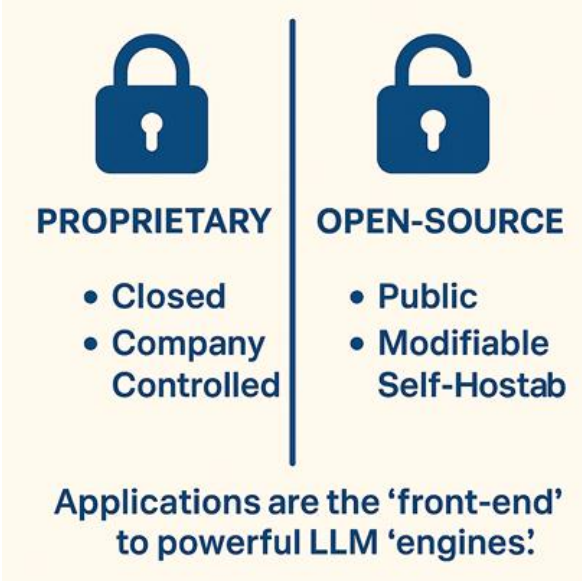
How LLMs Work (Simplified 3-Phase Process)

- **Learning/Training:** Absorbs data, learns statistical probabilities of word sequences.
- **Pattern ID:** Identifies complex relationships and associations between words/concepts.
- **Prediction:** Generates responses by calculating the most probable next words based on input (prompt).



Types of LLMs: Proprietary vs. Open-Source

- **Proprietary:**
  - Closed systems, company-controlled (e.g., GPT-4o, Gemini, Claude).
  - Training data/mechanisms are often confidential.
- **Open-Source:**
  - Publicly accessible code/weights (e.g., Llama 3, Mistral models, DeepSeek, Qwen2).
  - Can be downloaded, modified, and self-hosted; often more transparent.



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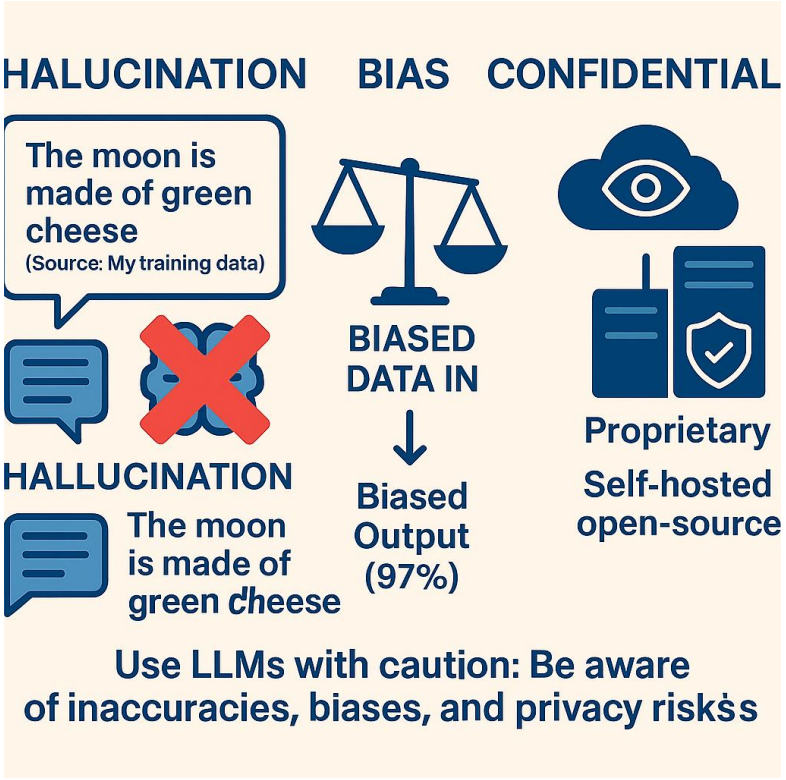
CRITICAL Limitations & Precautions for Researchers

- **Hallucinations:** Can generate plausible-sounding but **false or fabricated information** with high confidence. **ALWAYS VERIFY!**
- **Bias & Manipulation:** Can **reproduce/amplify biases** from training data. Proprietary models may be censored/steered.
- **Data Confidentiality):** Information input into public proprietary models **may not be private**. Crucial for sensitive research data.



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❷ Generative AI and prompt engineering

LLMs in Research: The Takeaway & Our Goal

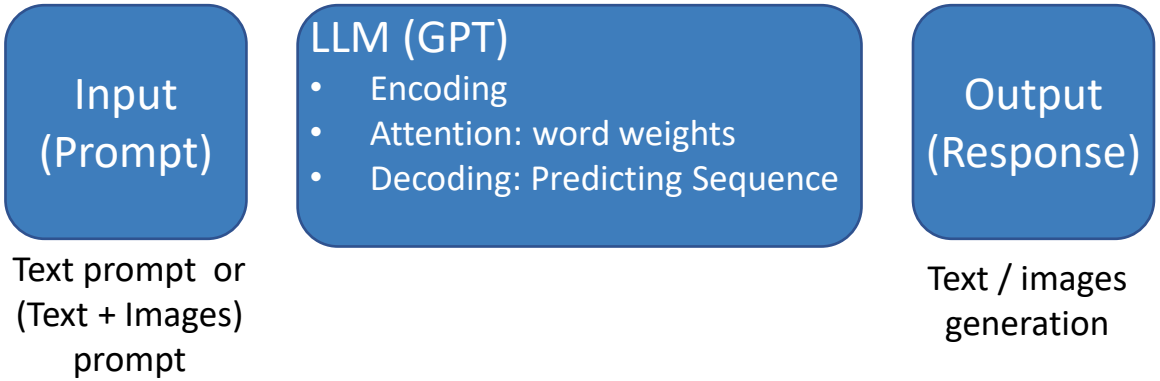
- LLMs are powerful **statistical text prediction machines**, not sentient beings.
- They have a **considerable and growing impact** on research methods, information access, and knowledge production.

➔ To master **Prompt Engineering** – the art of effective communication with LLMs – for productive and **critical use** in your doctoral work

Definition – What is a Prompt?

A **prompt** is a *specific set of instructions sent to an LLM to accomplish a task*. It guides the model's behavior and determines the quality and relevance of its response.

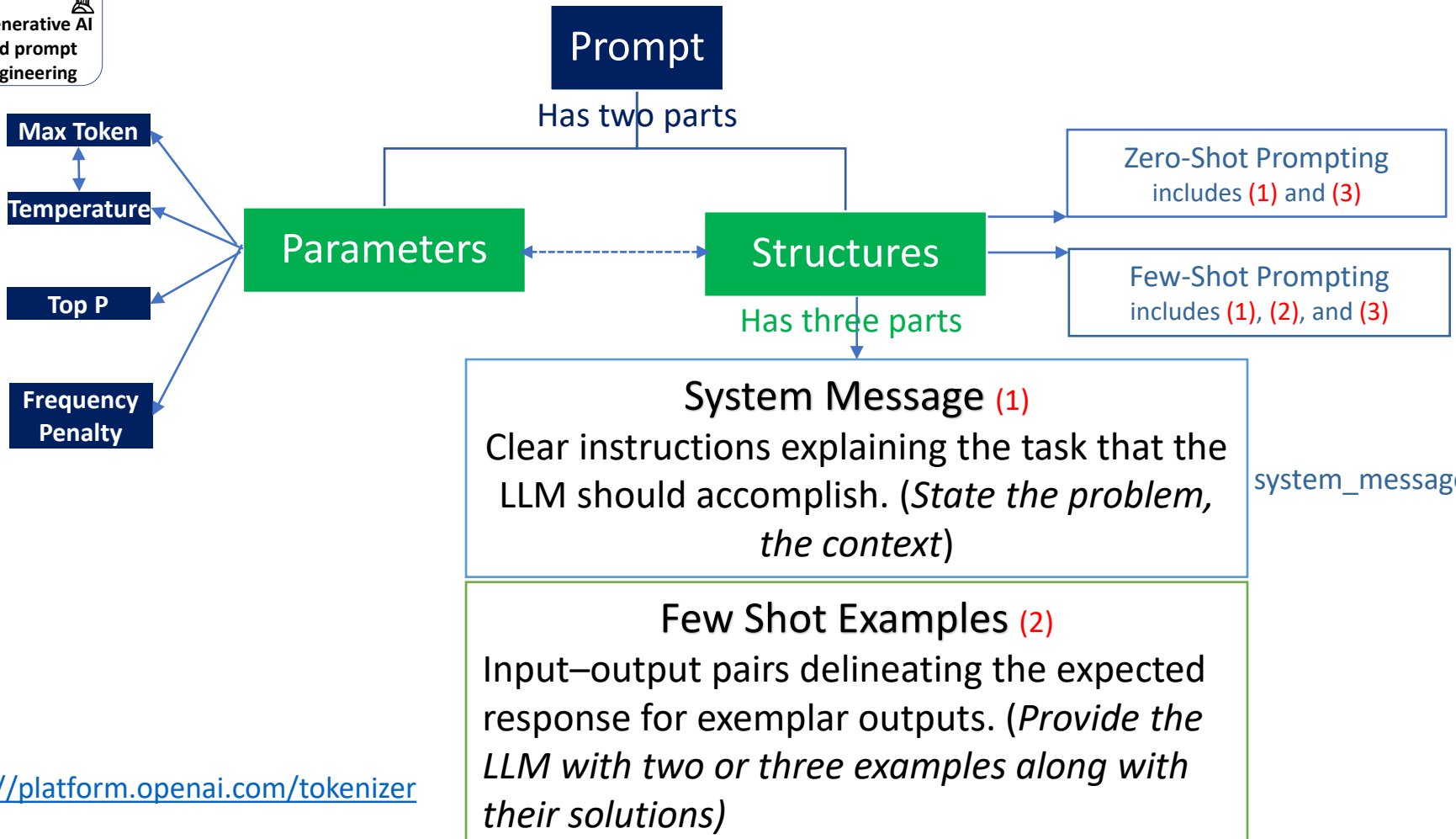
The quality of LLM results depends crucially on the quality of the prompt; a vague prompt in, a vague (or wrong) answer out.



Prompt engineering - 2/5 -

AI as Tool,

2 Generative AI and prompt engineering



https://platform.openai.com/tokenizer

https://platform.openai.com/

Max Token

Max Tokens (or Max Output Length / Max Length)

Role: Sets the maximum number of tokens the model can generate in its response.
How it works: A "token" is roughly a word or part of a word (e.g., "unbelievable" might be "un", "believe", "able"). This parameter prevents the model from generating excessively long responses.
Importance: Crucial for managing API costs (as you're often billed per token) and for ensuring responses stay within desired lengths.
Caution: If set too low, the response might be cut off prematurely.

- On average, 1 token ≈ 0.75 words in French or English.

Model	Context Window	Things to keep in mind
GPT-3.5-turbo	4096 tokens	Prompt + reponse must ≤ 4096 tokens
GPT-4-turbo	Up to 128k tokens	More flexibility for long prompts

Temperature

Temperature

Role: Controls the "randomness" or "creativity" of the output.
How it works: When generating the next word (or token), the model assigns probabilities to all possible next words. Temperature skews these probabilities.

- Low Temperature (e.g., 0.0 - 0.3): The model becomes more deterministic and focused. It will pick the most likely words, leading to more predictable, conservative, and often factual outputs.
  - ✓ Good for tasks like summarization, Q&A based on provided text, or code generation where correctness is paramount.
- High Temperature (e.g., 0.7 - 1.0+): The model becomes more creative, surprising, and might even produce more "risky" or nonsensical output. It gives less likely words a higher chance of being selected.
  - ✓ Good for brainstorming, story writing, or generating diverse ideas.

Typical Range: Often 0 to 1, but some models might support up to 2.

Prompt: *"Write a sentence about the sun."*
- **temperature = 0.2:** *"The sun is a star at the center of the solar system."*
- **temperature = 0.7:** *"The sun shines over Earth and marks the passage of seasons."*
- **temperature = 1.5:** *"The sun, a blazing artist, splashes gold onto sleeping mountaintops."*

-ot-

Top P

Top P (Nucleus Sampling)

Role: An alternative way to control randomness, focusing on the "nucleus" of most probable words.
How it works: Instead of considering all words, Top P tells the model to consider only the smallest set of words whose cumulative probability exceeds the P value. For example, if Top P is 0.9, the model considers only the most likely words that add up to 90% probability for the next token.

- Low Top P (e.g., 0.1): Very narrow selection, similar to low temperature, making output highly predictable.
- High Top P (e.g., 0.9 - 1.0): Wider selection, allowing for more diversity, but still constrained by probability.

Relationship with Temperature: Often, you'd use either Temperature or Top P to control randomness, or set one to a neutral value (like Temperature=1 if using Top P). Using both aggressively can lead to unpredictable results. Some platforms automatically adjust one if you change the other.

Prompt: *"Write a sentence about the sun."*

- **top_p = 0.3 :** *"The sun is a star."*
- **top_p = 0.9** *(default) : "The sun lights up the Earth with its warm golden rays."*
- **top_p = 1.0 :** *"The sun, an ancient blazing god, sings dawn to the mountains."*

Frequency Penalty

Frequency Penalty

Role: Discourages the model from repeating the exact same words or phrases too often.

How it works: It applies a penalty to words based on how many times they've already appeared in the generated text.

Positive values (e.g., 0.1 - 2.0): Increase the penalty, making the model less likely to repeat itself.

0 (Default): No penalty.

Prompt: *"Write a sentence about the sun."*

- **frequency_penalty = 0 :** *"The sun shines, the sun warms, the sun lights the way."*
- **frequency_penalty = 1.0 :** *"The sun illuminates, warms, and touches Earth with its light."*
- **frequency_penalty = 2.0 :** *"The celestial star sets the sky ablaze with radiant fire."*
  (→ much more diverse wording, no repetition of "sun")

LLM Proprietary & Open source LLMs

AI as Tool,

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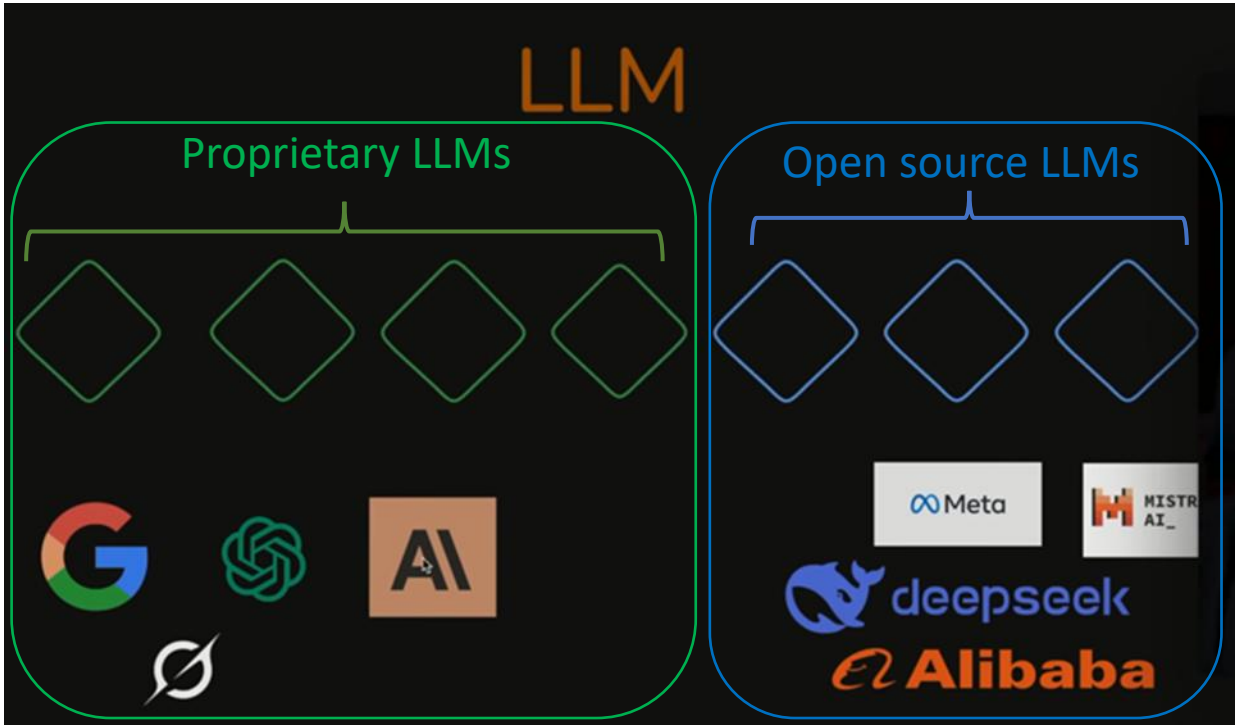
There are two types of LLMs: **Proprietary** and **Open source**.



https://huggingface.co/models

1,713,443 open source models
at 19/05/25

LLM Proprietary LLMs

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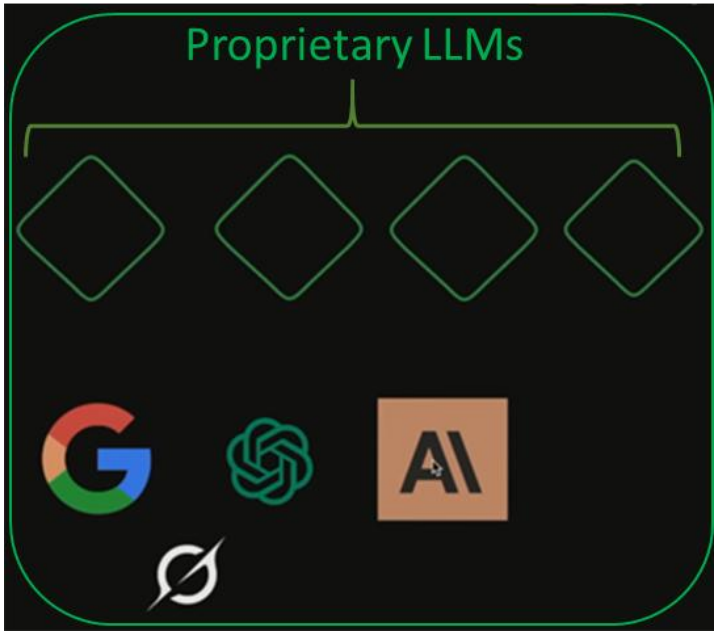

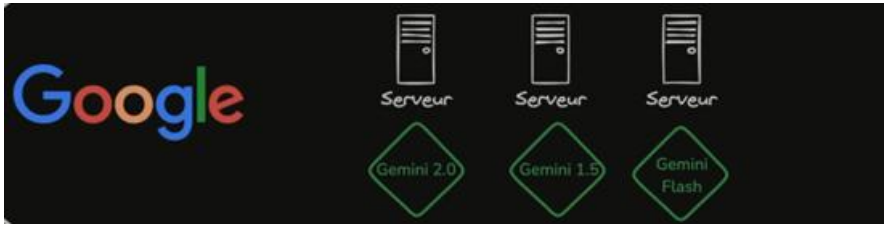

LLM Proprietary LLMs

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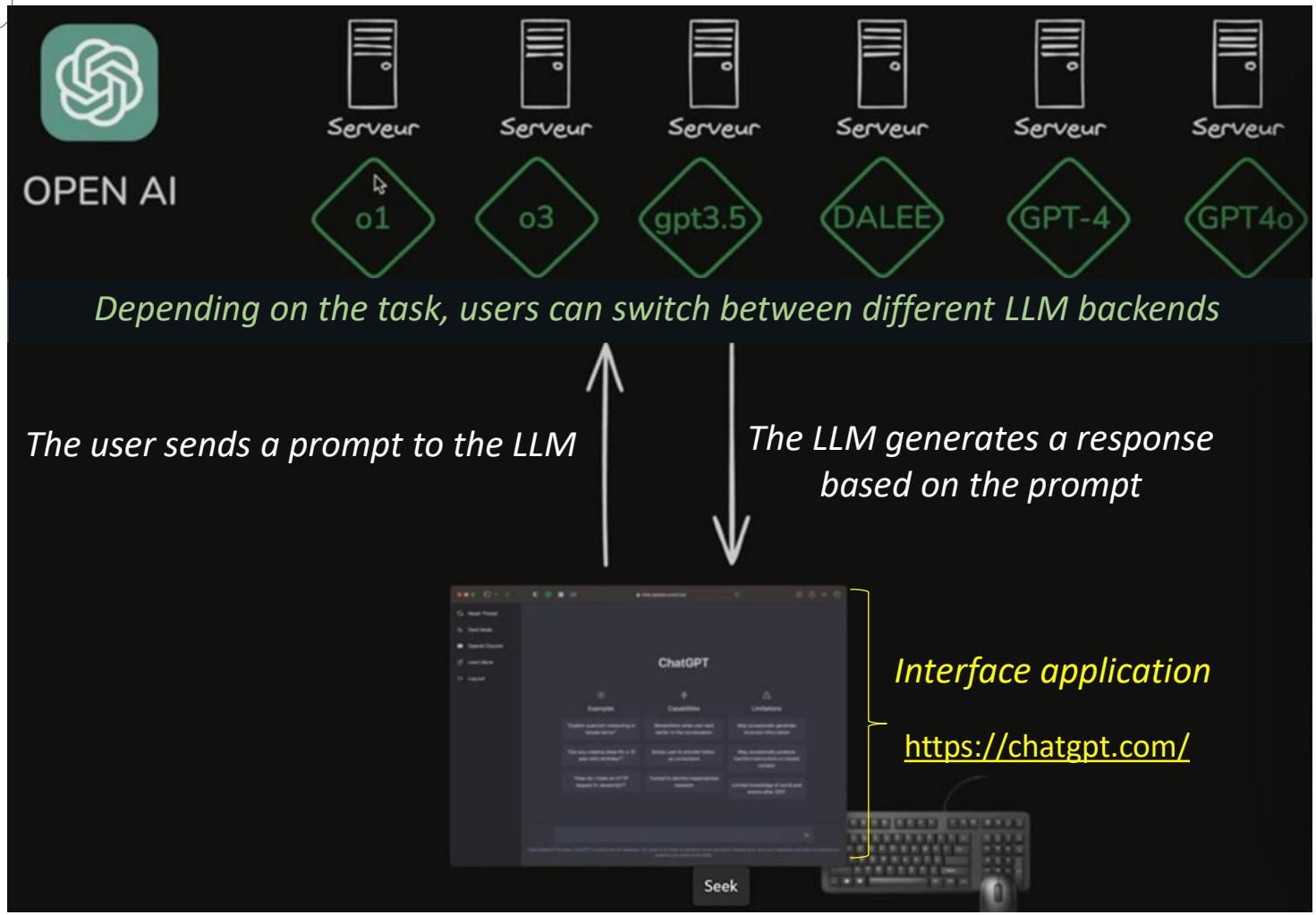


How to interact with LLM using “secret key”

- To interact with models, we use **APIs**.
- To consume an API through applications, an **API key** is required.
- This key, for example, can be created on the OpenAI website.
  - https://platform.openai.com/account/api-keys
- You need to sign in with an email address, then create a key (by clicking "Create new secret key").
- Create an API key to access the OpenAI API.
- Once created, the key should be copied and stored securely.
- It can then be used to communicate with an LLM.

Example of Python code to interact with an OpenAI LLM (such as GPT-4), using the API key you create from their website..

Prerequisites:

1. You need to install the official OpenAI library:

bash — Copier — Modifier

```
pip install openai
```

2. Have an **OpenAI API key** (created at: https://platform.openai.com/account/api-keys)

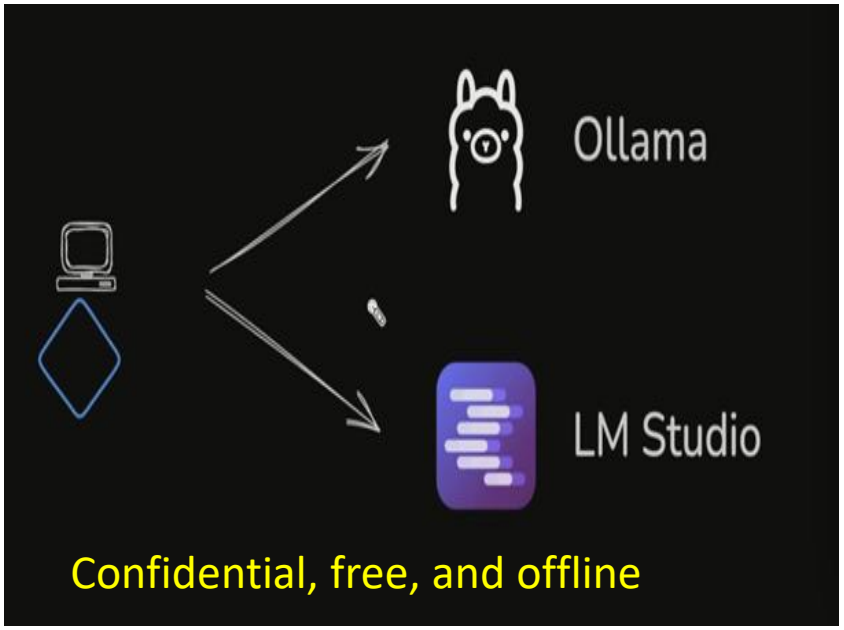
Python Code Example:

python — Copier — Modifier

```python
import openai

# Your personal API key (⚠️ never share it publicly)
openai.api_key = "sk-xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx"

# Calling the ChatGPT API (using GPT-4; replace with "gpt-3.5-turbo" if needed)
response = openai.ChatCompletion.create(
    model="gpt-4",
    messages=[
        {"role": "system", "content": "You are a helpful assistant."},
        {"role": "user", "content": "What is the capital of Italy?"}
    ]
)

# Print the LLM's response
print(response['choices'][0]['message']['content'])
```

LLM Open source LLMs

How can you install an LLM on your computer?



Ollama is an open-source tool designed to run language models (LLMs) locally on your machine, without requiring an internet connection or remote servers.
It simplifies the use of models such as LLaMA, Mistral, Gemma, and DeepSeek, while providing full control over your data.

LM Studio is a user-friendly, open-source application designed to help you run large language models (LLMs) locally on your computer, completely offline and without any coding required. It's ideal for users who want to explore, test, or deploy AI models like LLaMA, Mistral, Gemma, and DeepSeek directly on their machines

LLM Open source LLMs

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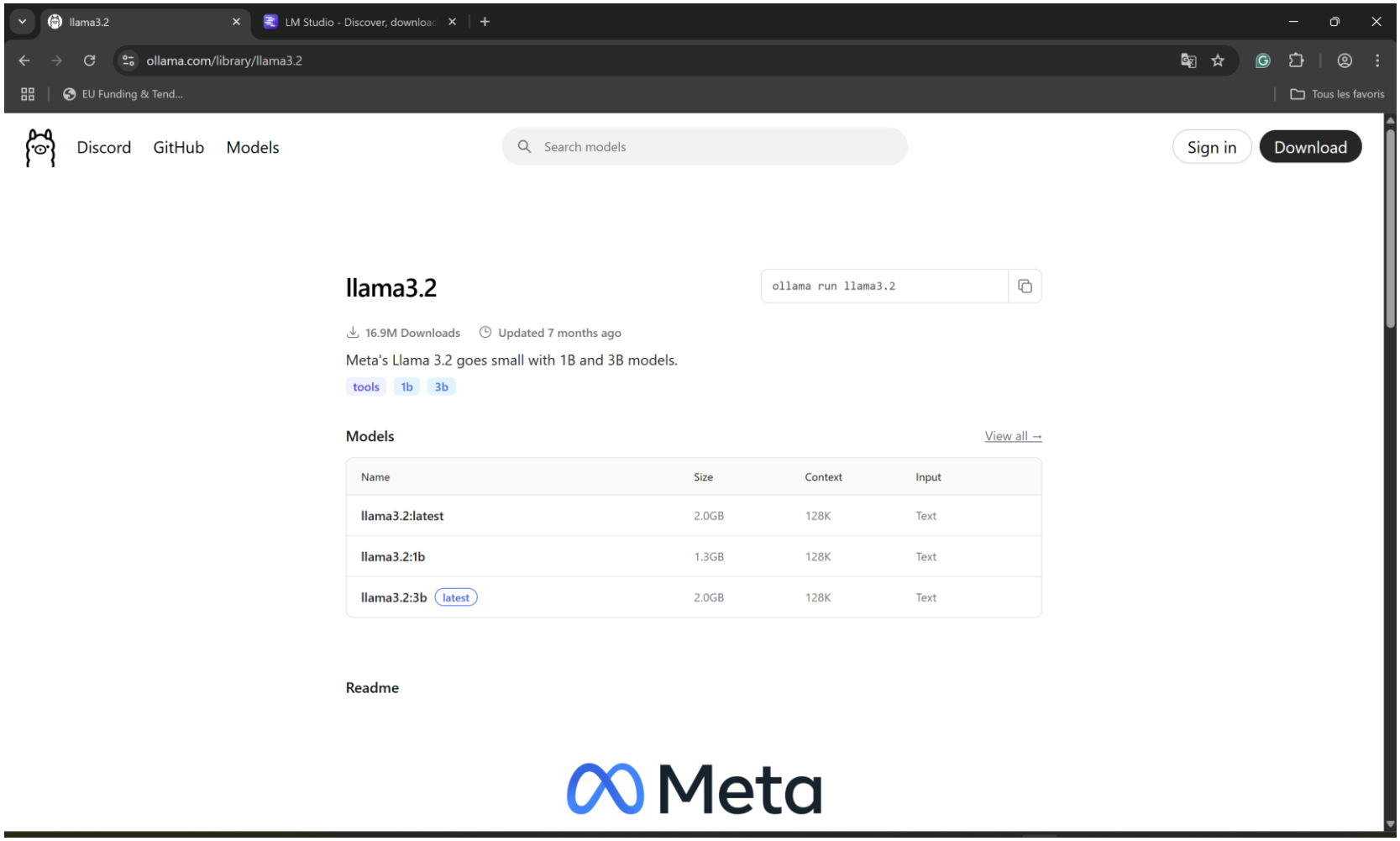
Download Ollama



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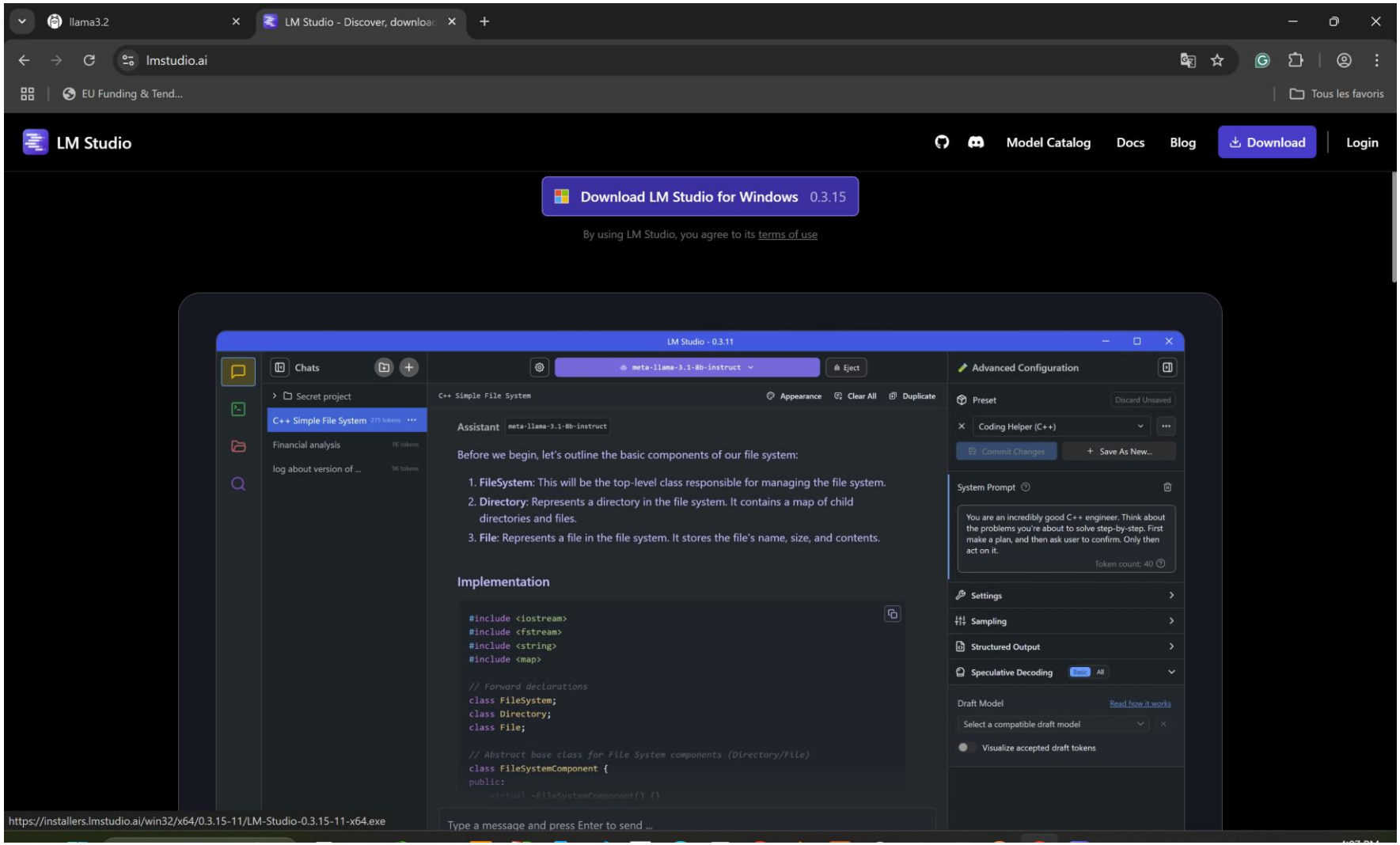
Download LM Studio



Teaching Sheet – Activity: How a Structured Prompt Enhances Academic Writing

🎯 Activity Objective: Show how a structured prompt leads to clearer, richer, and more contextually adapted academic writing.

🧪 Problem to address:
Write a PhD thesis introduction on the impact of artificial intelligence on human labour.

Teaching Sheet – Activity: How a Structured Prompt Enhances Academic Writing

- **Activity Objective**: Show how a structured prompt leads to clearer, richer, and more contextually adapted academic writing.
- **Problem to address**: Write a PhD thesis introduction on the impact of artificial intelligence on human labor.

Teaching Sheet – Activity: How a Structured Prompt Enhances Academic Writing

Step 1 – Simple Prompt:

```
Write an introduction for a PhD thesis on the impact of artificial intelligence on human labor.
```

Expected Output: *Artificial intelligence is transforming the world of work. Many sectors are seeing new forms of automation, raising economic, social, and ethical questions. This thesis aims to study how AI affects jobs and working conditions.*

Observation: Adequate, but lacks depth, theoretical anchoring, or specific angle.

AI as Tool,

2 Generative AI and prompt engineering

Teaching Sheet – Activity: How a Structured Prompt Enhances Academic Writing

Step 2 – Structured Prompt:

```
# Objective:
Write the introduction to a PhD thesis on the impact of artificial intelligence on human labor.

# Context:
- The thesis is situated in the humanities/social sciences or science/technology
- The PhD student aims to define a clear research question, situate their work within existing debates, and justify its relevance.

# Constraints:
- 150–200 words
- Reference at least one theoretical or scientific debate
- Avoid overly technical jargon

# Format:
Academic introduction, reflective tone.

# Role:
Act as a PhD student at the beginning of the thesis, able to clearly express your research orientation.
```

Teaching Sheet – Activity: How a Structured Prompt Enhances Academic Writing

Expected Output: *Artificial intelligence (AI) is reshaping human labor, oscillating between promises of efficiency and concerns over human displacement. From Brynjolfsson and McAfee's (2014) optimistic perspectives to more critical views on techno-solutionism (e.g., Dagnino, 2021), the literature reflects both hope and tension. This thesis adopts an interdisciplinary approach—bridging labor sociology and applied computer science—to explore how occupations, skills, and workplace meanings are being redefined. By focusing on empirical case studies, the research aims to go beyond general discourse and analyze how professionals adapt to, resist, or appropriate AI in diverse work environments.*

Teaching Sheet – Activity: How a Structured Prompt Enhances Academic Writing

Discussion Prompts:

- What makes the structured version more useful for academic purposes?
- Which prompt helps better clarify the research identity?
- How can structured prompting support one's writing process?