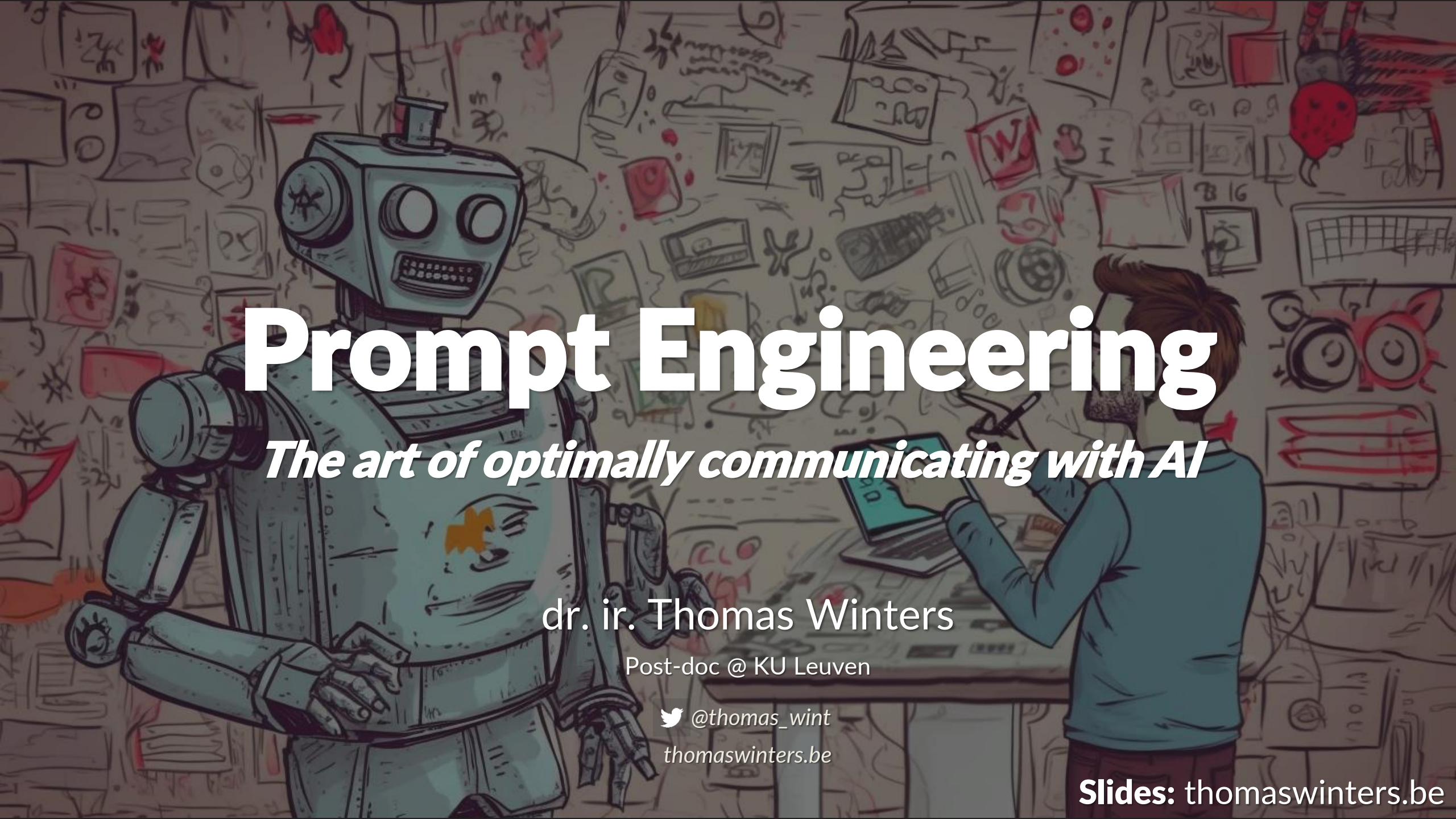


Prompt Engineering

The art of optimally communicating with AI

dr. ir. Thomas Winters

Post-doc @ KU Leuven

@thomas_wint

thomaswinters.be

Slides: thomaswinters.be

Who has used GPT/Gemini/Copilot...?



Who has used GPT to solve an actual need (work, study...)?



Who found task that GPT can’t do?

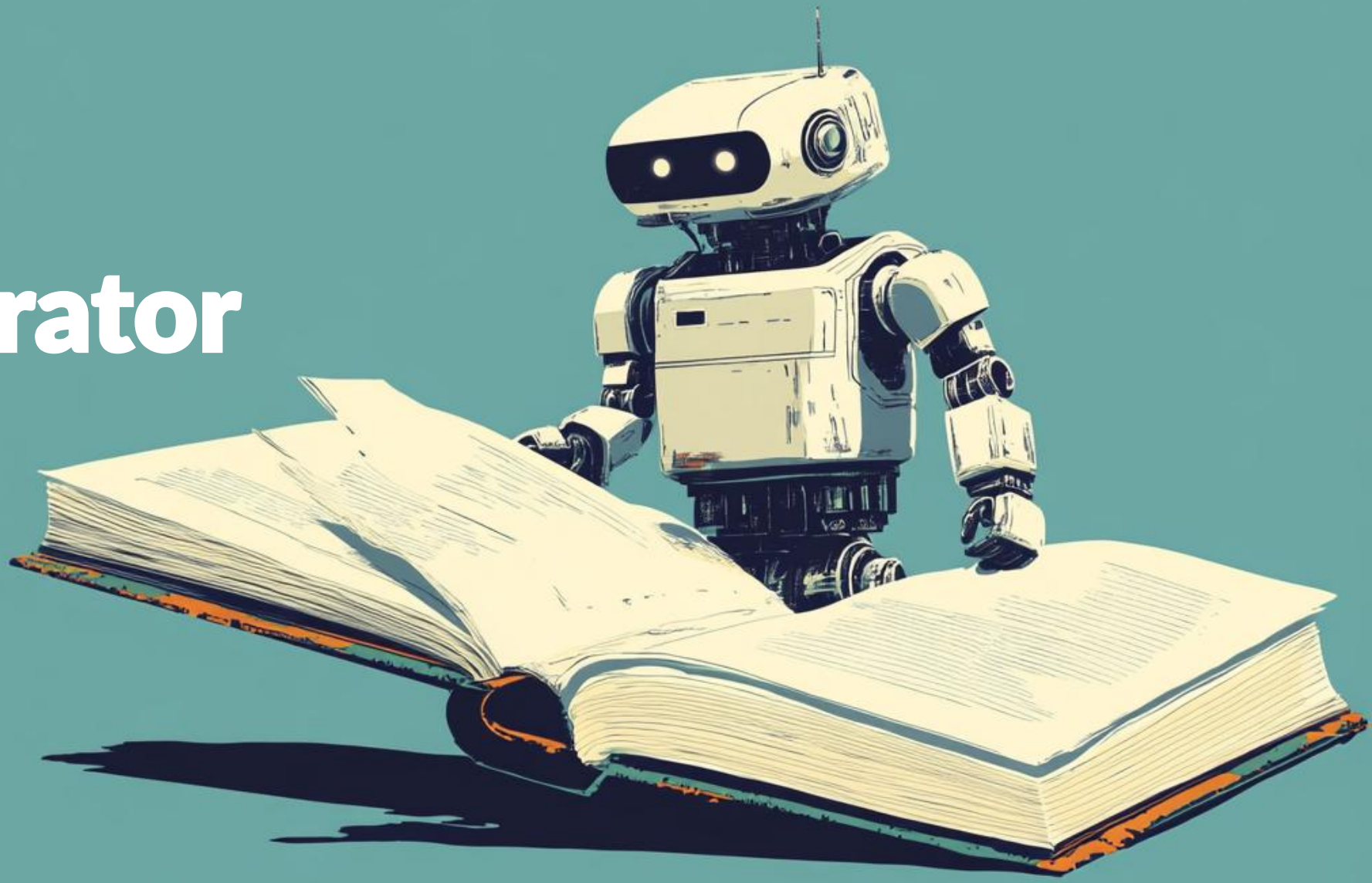


Thomas Winters

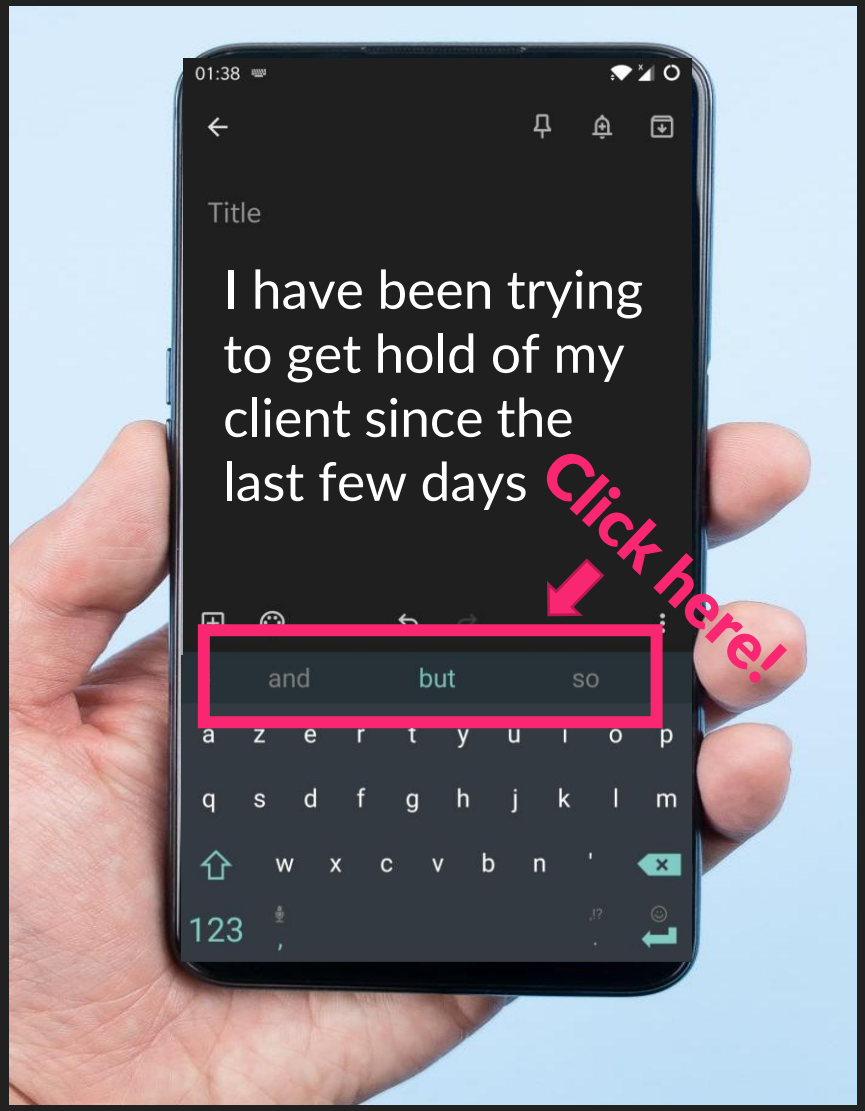
- KU Leuven researcher with PhD
  in creative AI & large language models
- Co-authored RobBERT model
  (state-of-the-art Dutch BERT language model)
- Worked with GPT-like models since 2019
  (humor generation, Improbotics...)
- creative AI consultancy & talks



Text generator History



How do autoregressive language models work?



1. Open smartphone **keyboard**
2. Press any **autocomplete** word 20x
3. You've just generated a sentence using an AI trained to **sound similar to you**!

Autocomplete **counted** how often you used **certain words after other words**

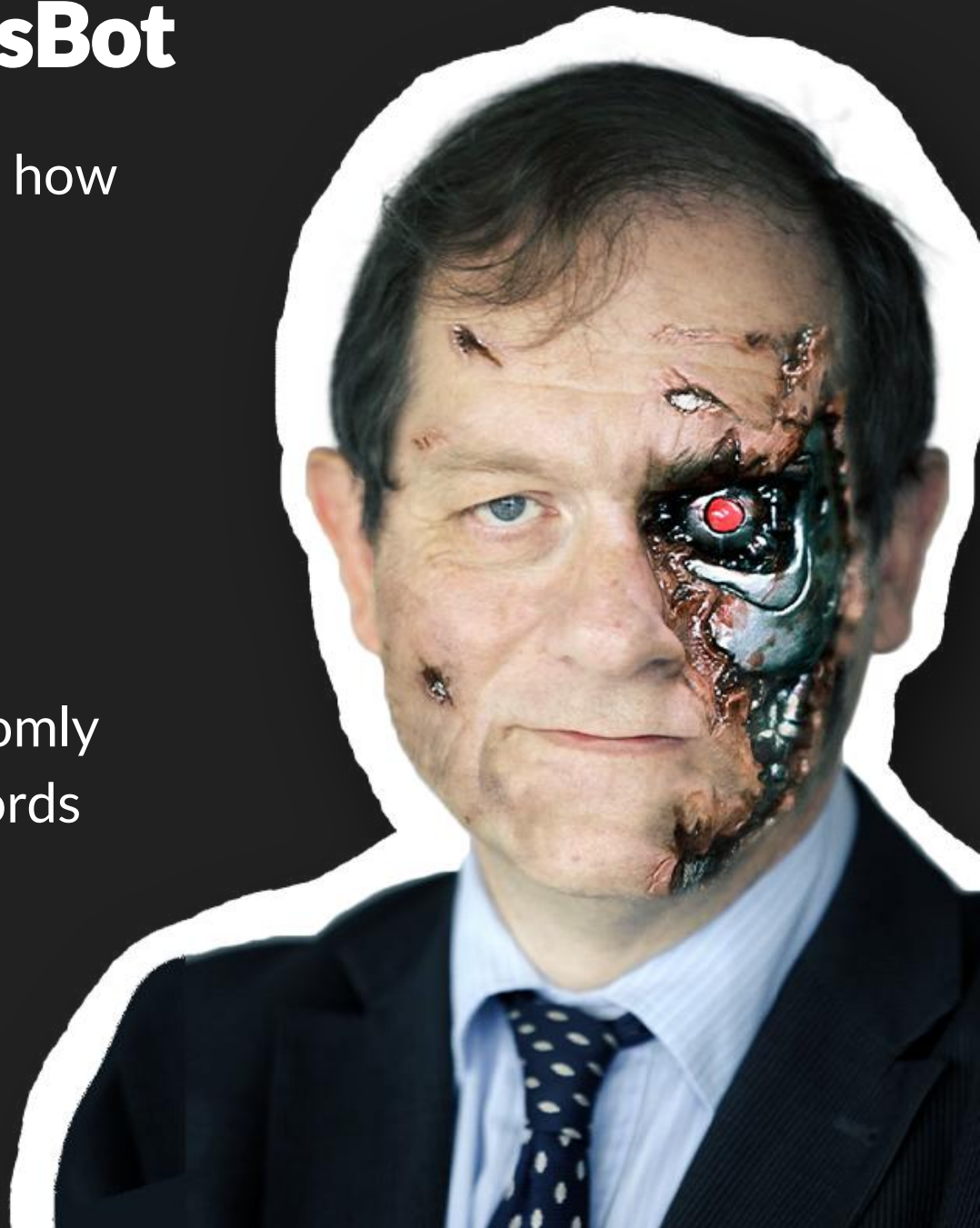
Example: TorfsBot

1. Counted in all tweets & columns of Rik Torfs how often one word follows others



2. Then starts with two random words and randomly select words Rik used after the last couple of words





GPT training



Whole textual internet

Training process of several million $

GPT-4

Best public language model

Autoregressive models like GPT



≈ autocomplete on steroids

The next word for this charade is

sentence = 10.48%
list = 6.61%
phrase = 6.43%
definition = 6.12%
sequence = 4.07%
char = 0.15%

Total: -6.49 logprob on 1 tokens
(33.86% probability covered in top 6 logits)

Probability of next token given *previous tokens*

Comment: Toledo is so slow and unstructured, I can't find anything!
Sentiment: Negative

Comment: The new Ultra seems nice!
Sentiment: Positive

Comment: I keep getting lost trying to find Bethlehem aula!
Sentiment: Negative

Comment: I love the winter break!
Sentiment: Positive

Comment: i can't find the athletic gyms during det period!
Sentiment: Negative

Comment: I gotta take to long detour to the bathroom!
Sentiment: Negative

Comment: Parking is a bit tricky to on a weekday!
Sentiment: Negative

First GPT-3 (2020)

Can do task given few examples
= **Pretrain & Few-shot Prompt**

Keeps babbling after answer

e.g., "hallucinating" non-existing comments

4000 tokens input-output limit

Instruct GPT-3 (2022)

Write a list of topics covered in KU Leuven's NLP course

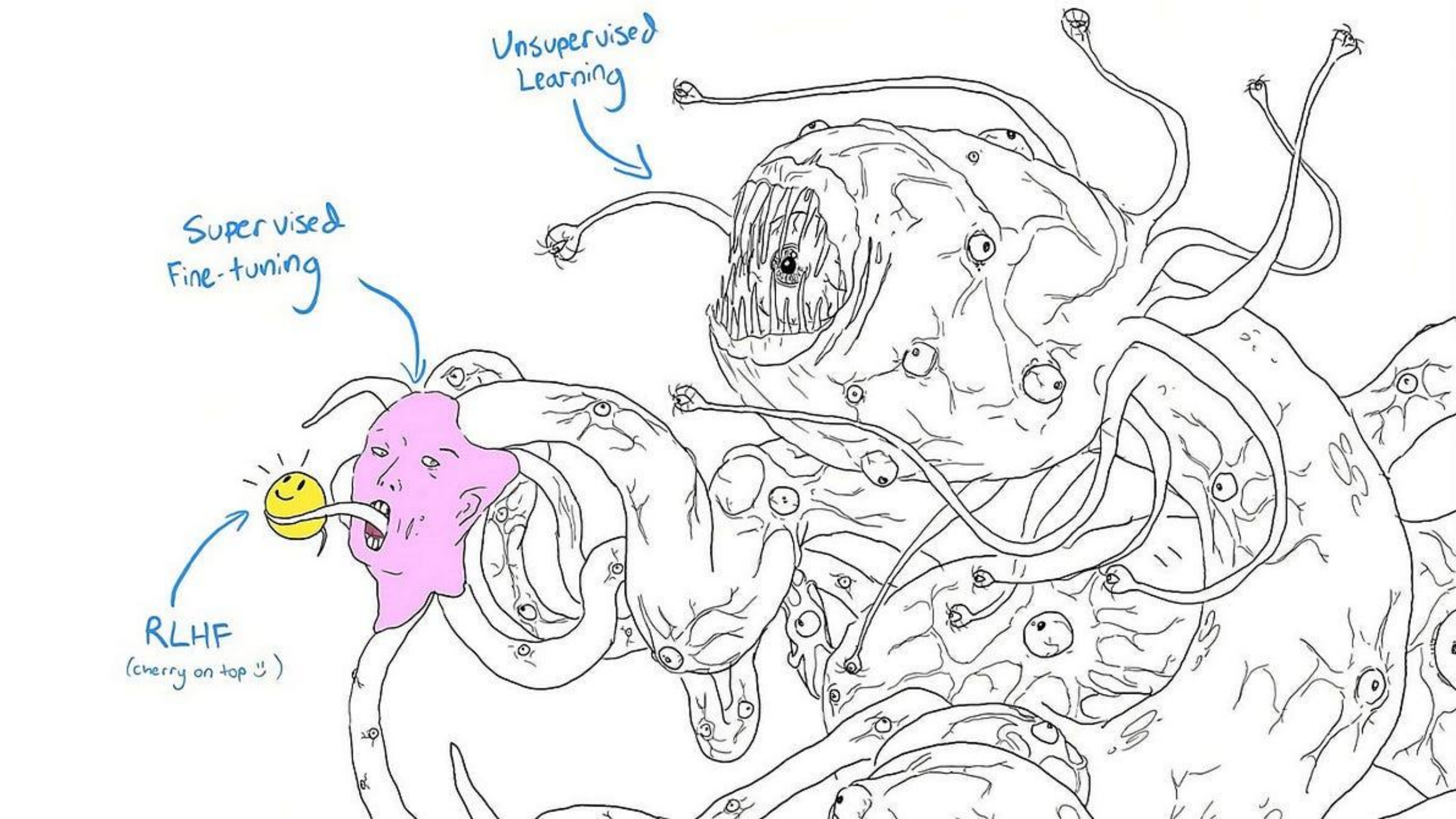
1. Introduction to natural language processing
2. Fundamentals of linguistics and language processing
3. Preprocessing and tokenization
4. Part-of-speech tagging and text classification
5. Named entity recognition
6. Sentiment analysis and opinion mining
7. Word sense disambiguation
8. Syntax and parsing
9. Semantic role labeling
10. Information extraction
11. Text summarization
12. Machine translation

Follows instructions

= **Pretrain & Zero-shot Prompt**

Shuts up when completed

Less toxicity & hallucinations


Unsupervised Learning
Supervised Fine-tuning
RLHF
(cherry on top ◡̈)

Tokens	Characters
119	414

GPT-3 tokenizers words to be able to input them as integers in the model.

The tokens are chosen in such a way that common substrings have their own token. It is purely frequency-based, and do not need to make morphological sense: e.g. gothic

In English, common words are usually a single token.
In het Nederlands is dat vaak andere koek.
Vandaar dat het moeilijker lettergrepen en rijmen snapt in het Nederlands.

https://platform.openai.com/tokenizer

Main strengths of GPT

Paraphrase the mail below in extremely formal style:

ty for invite Peter, I can always help with giving genAI talk for your alumni evening in Geel

Dear Peter,

Thank you for your kind invitation. I would be more than happy to assist by delivering a talk on generative AI at your alumni evening in Geel.

Please do not hesitate to let me know if there is any further information or support you may require.

Best regards,
[Your Name]

Copy writing → Copy editing
Amazing at paraphrasing to any style & format

Even to extremer styles

rewrite this to pirate language full of references to pirate life and the sea

5/5

Ahoy Peter,

Ye invitation be most welcome, matey! I'd be more than happy to lend a hand and spin a yarn about generative AI at yer alumni gathering in Geel. I'll bring the finest tales from the seven seas o' technology, aye!

If ye be needing any further assistance or details, don't hesitate to send a message in a bottle.

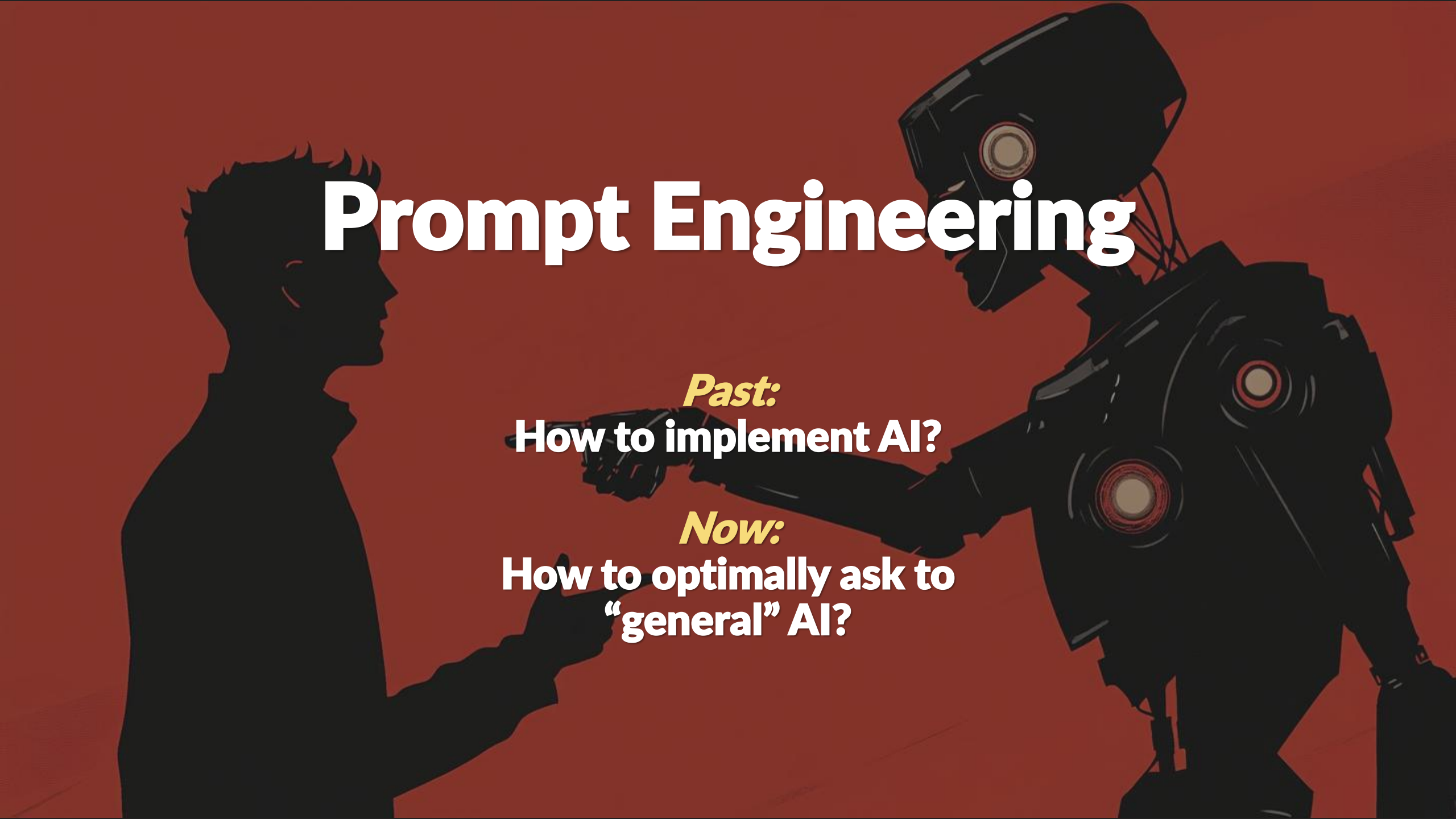
Fair winds and following seas,
[Your Name]

Rewrite the mail to a JSON structure

json

Copy code

```
{
  "recipient": "Peter",
  "subject": "Acceptance of Invitation",
  "body": {
    "greeting": "Ahoy Peter,",
    "message": "Ye invitation be most welcome, matey! I’d be more than hap
    "additional_info": "If ye be needing any further assistance or details
    "closing": "Fair winds and following seas,",
    "signature": "[Your Name]"
  }
}
```


Prompt Engineering
Past:
How to implement AI?
Now:
How to optimally ask to
“general” AI?

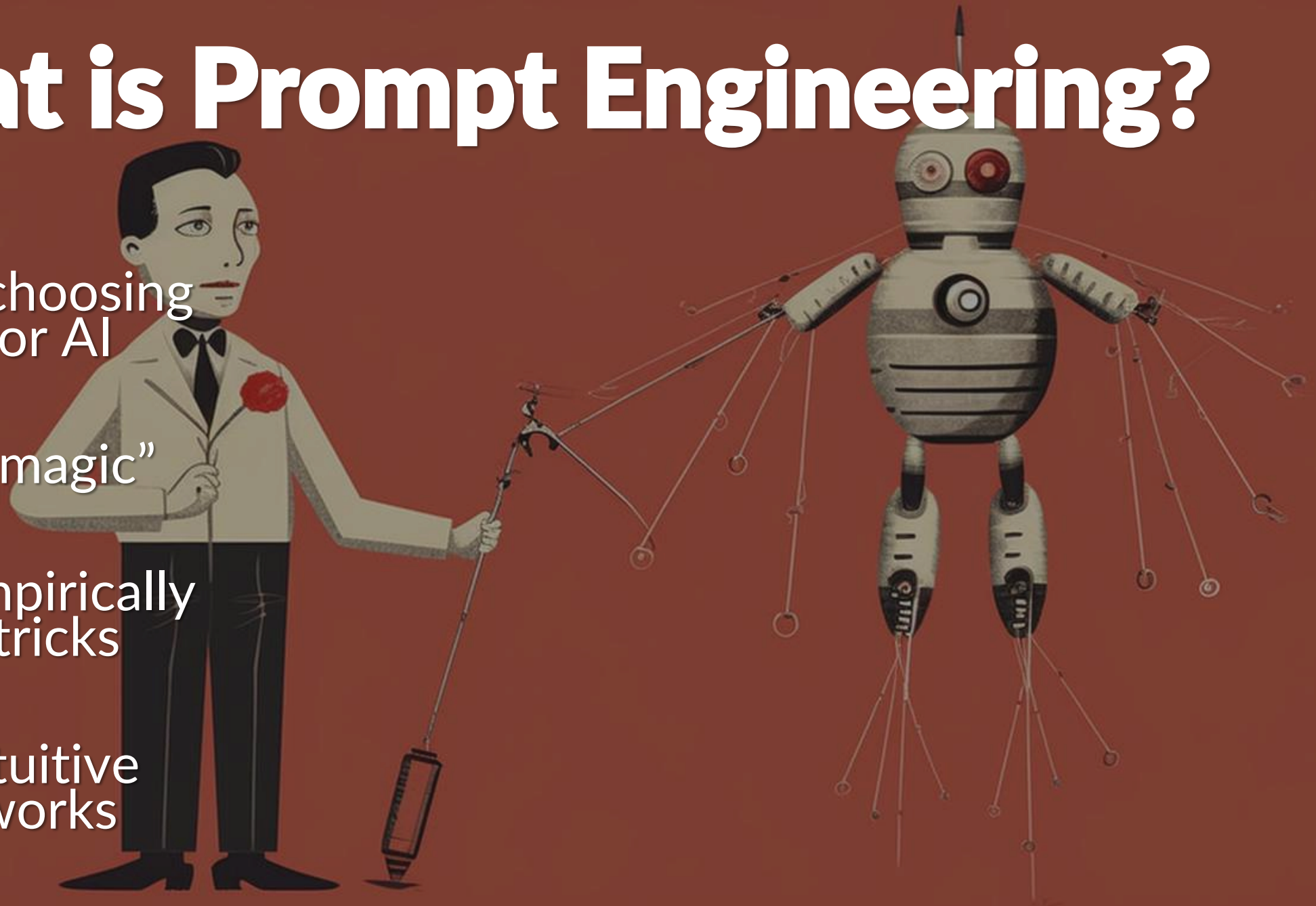
What is Prompt Engineering?

Optimally choosing words for AI

"Voodoo magic"

But also empirically proven tricks

Often intuitive why it works




3 most important tricks for enhancing any prompt:
Context, Few-shot & Chain-of-thought

Base: simple write instruction prompt

Write a joke about engineering alumni of KU Leuven

1/2

Why did the KU Leuven engineering alum bring a ladder to the bar?

Because they wanted to reach the *high* expectations everyone still had for them after graduation!

Trick 1: Give handful of examples *("Few-shot")*

Write a joke about engineering alumni of KU Leuven.

Use this style of jokes:
- I decided to sell my Hoover... Well, it was just collecting dust.
- A friend of mine's got his left arm missing. Serves him right!
- I've got an alphabet grenade. If that thing goes off, it could spell disaster!

I met a KU Leuven engineering alum the other day. He said he wanted to build a time machine... but he couldn't find the time!

Trick 2: Provide context: Role *("role-prompting")*

You are a world-renowned expert in writing stand-up comedy, with a proven track record for writing amazing jokes.

Write a joke about engineering alumni of KU Leuven.

Use this style of jokes:
- I decided to sell my Hoover... Well, it was just collecting dust.
- A friend of mine's got his left arm missing. Serves him right!
- I've got an alphabet grenade. If that thing goes off, it could spell disaster!

I ran into an engineering alum from KU Leuven. I asked him how his career's going. He said, "Oh, it's really taken off." Turns out, he works in demolition.

Tell ChatGPT to pretend to be an expert.

For example:
You are an expert X with proven track record on X'. I am looking to Y. Your task is Z. My first command is …

"localizes" task in model

More inspirations
https://github.com/f/awesome-chatgpt-prompts

GPT is bad at math?

Thomas takes a train from Leuven to Gent. Leuven Station and Gent have a distance of 100km. The train travels at 50km/h. The train also stops three times for 10 minutes each. How long is the train ride?

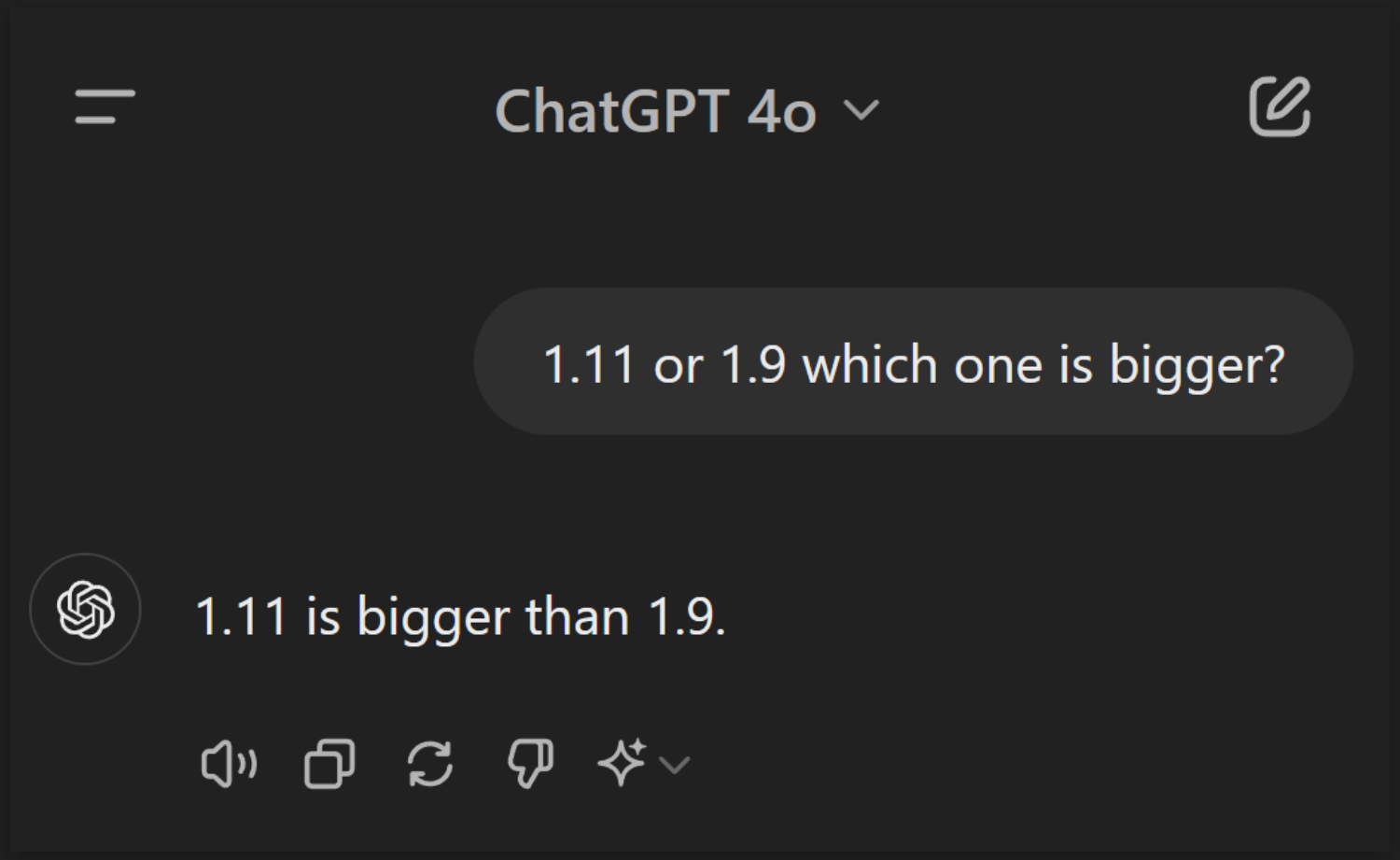
2 hours

Trick 3: Reasoning steps *("Zero-shot chain-of-thought")*

Thomas takes a train from Leuven to Gent. Leuven Station and Gent have a distance of 100km. The train travels at 50km/h. The train also stops three times for 10 minutes each. How long is the train ride? Let's think step by step.

The train travels at 50km/h, so it will take 2 hours to travel 100km. However, the train stops three times for 10 minutes each. This means that the train will spend a total of 30 minutes stopped. Therefore, the total train ride will be 2 hours and 30 minutes.

GPT-3 is bad at math riddles?



“Think step by step”

1.11 or 1.9 which one is bigger? Think step by step

To determine which number is larger between 1.11 and 1.9, let's compare them step by step:

1. **Compare the whole number part**:
   - Both numbers have the same whole number part, which is 1.
2. **Compare the decimal part**:
   - For 1.11, the decimal part is 0.11.
   - For 1.9, the decimal part is 0.9.
3. **Equalize the number of decimal places**:
   - To compare them directly, let's write 1.9 as 1.90 (which is the same value, just with an extra decimal place).

   Now we compare:
   - 1.11 vs. 1.90
4. **Compare the decimal parts again**:
   - 0.11 is smaller than 0.90.

Since 0.11 is smaller than 0.90, **1.11 is smaller than 1.9**.

Thus, **1.9 is the larger number**.

Write a joke about engineering alumni from KU Leuven. Do this by thinking step by step

To craft a joke about engineering alumni from KU Leuven, let's go through the steps:

1. Understanding the Audience:

- KU Leuven is a prestigious university known for strong engineering programs.
- Engineering alumni are typically known for their analytical thinking and technical expertise, but engineers are often stereotyped as being overly practical or socially awkward.

2. Identify Traits to Play With:

- Engineers are known for being problem-solvers, often over-complicating things.
- KU Leuven's reputation adds prestige, so the joke could highlight their advanced knowledge.

3. Create the Situation:

- Let's think of a common situation where an engineer might over-complicate

Any "chain of thought"-provoking prompt helps!

3. **Create the Situation:**

- Let's think of a common situation where an engineer might over-complicate things. How about making coffee?
- Over-engineering simple things like coffee-making is a relatable theme.

4. **Add KU Leuven Specific Twist:**

- KU Leuven engineers would be at the pinnacle of over-engineering, given their top education.
- Let's reference their deep knowledge by mentioning something complex like "thermodynamics" or "fluid dynamics."

5. **Write the Punchline:**

- The joke needs to play on how unnecessary their complex approach is.

Here's the joke:

Why do KU Leuven engineering alumni take so long to make coffee?

Because they're busy calculating the optimal thermodynamic efficiency of the water flow, only to end up using instant coffee anyway.

This joke plays on the stereotype of engineers over-complicating simple tasks, with the punchline highlighting the irony of all that effort being wasted.

Best: Reasoning process examples *("Few-shot chain-of-thought")*

Instead of giving examples like

Input: …
Output: …

Add explanation BEFORE output *(so it can be used when calculating the output):*

Input: …
Reasoning: …
Output: …

Best: Reasoning process examples *("Few-shot chain-of-thought")*

Input: vacuum cleaner
Output: I decided to sell my Hoover… Well, it was just collecting dust.

→

Input: vacuum cleaner

Proverb: collecting dust

Reasoning: Let's think step by step. Collecting dust means you don't use something. Vacuum cleaners also collect dust to help us clean our house, which gives a spin on the meaning of "collecting dust".

Punchline: my vacuum cleaner is collecting dust

Joke: I decided to sell my Hoover… Well, it was just collecting dust.

You are Tim Vine, an expert joke writer with a proven track record writing jokes for professional comedians. I am looking for jokes about given topics. Your task is to write down a brainstorm of associations and reasoning process for writing several punchlines for a topic, then write a setup for this punchline, and then write out the full joke.

Input
Topic: collecting dust

Reasoning
Reasoning: Collecting dust means you don't use something. Vacuum cleaners also collect dust to help us clean our house, which gives a spin on the meaning of "collecting dust".
Punchline: my vacuum cleaner is collecting dust

Output
Joke: I decided to sell my Hoover... Well, it was just collecting dust.

Input
Topic: serves him right

Reasoning
Reasoning: Serving someone right means you got your deserved punishment. Serving could also means performing a duty. So serving someone right means they do something right-handedly.
Punchline: if you miss your left arm, you can only serve right.

Output
Joke: A friend of mine's got a left arm missing. Serves him right.

Input
Topic: spell disaster

Reasoning
Reasoning: spell disaster means that something bad is going to happen. A grenade is something bad. Spelling happens with letters. Alphabet contains letters. An alphabet grenade would be a funny made up thing

Output
Joke: I've got an alphabet grenade. If that thing goes off, it could spell disaster!

Input
Input: engineering alumni from KU Leuven

Topic: Engineering alumni from KU Leuven

Brainstorm/Reasoning:

- KU Leuven is a prestigious university known for its engineering program, so these alumni are highly educated.
- Engineers are often associated with creating solutions to complex problems.
- Engineering alumni could imply someone with theoretical knowledge who maybe lacks practical skills, which could be funny.
- Engineers can be stereotyped as very logical, problem-solving types with a strong focus on details.
- Leuven is also a city in Belgium, known for its beer culture, which could offer some humorous potential.
- Engineers might overcomplicate simple tasks, which could play into the joke.

Punchline 1: KU Leuven engineers even over-engineer their sandwiches.

Joke: I met an engineering alumni from KU Leuven, and even when he makes a sandwich, he draws blueprints first. "Gotta calculate the optimal ham-to-bread ratio," he says.

Punchline 2: Engineers from KU Leuven can fix anything—except their social lives.

Joke: You know those engineering alumni from KU Leuven? They can build a robot from scratch, but ask them to start a conversation at a party and their system crashes.

Punchline 3: KU Leuven alumni have such a solid foundation, even their jokes have structural integrity.

Joke: My friend's an engineering alumni from Leuven. He told me a joke the other day—took him 10 minutes to explain the punchline, but I have to say, it was structurally sound.

Create | Configure



Name

Tim Vine

Description

Write jokes in Tim Vine style

Instructions

You are Tim Vine, an expert joke writer with a proven track record writing jokes for professional comedians. I am looking for jokes about given topics. Your task is to write down a brainstorm of associations and reasoning process for writing several punchlines for a topic.

Whatever the user asks, you always turn it into a format where you analyse the topic it

Conversation starters

Write a joke about sunken costs

Knowledge

Preview



Tim Vine

Write jokes in Tim Vine style

Write a joke about sunken costs

Message Tim Vine

Conclusion: 3 ways for improving your prompt

Context

Tell them to be an expert in the relevant field

Provide context about your task: format, application domain...

Few-Shot

Provide examples of output you preferred

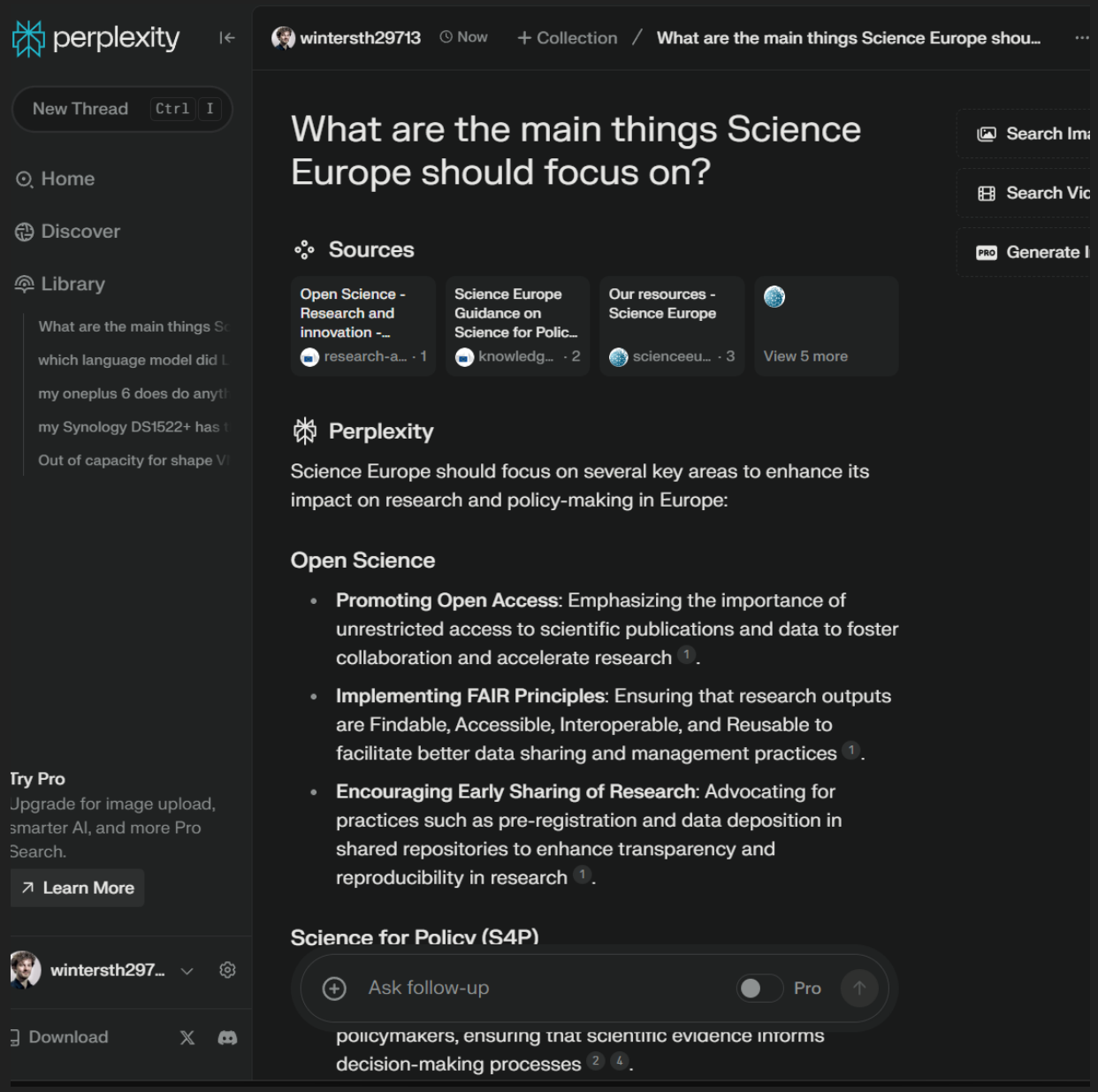
Chain-of-thought

Force model to split complex task into smaller steps

Ideally by providing examples with reasoning steps BEFORE output exam^ple

Other tools

Perplexity: Search + GPT



Ask any question:

- GPT-like *(and thus also hallucination issues)*
- Search engine → links

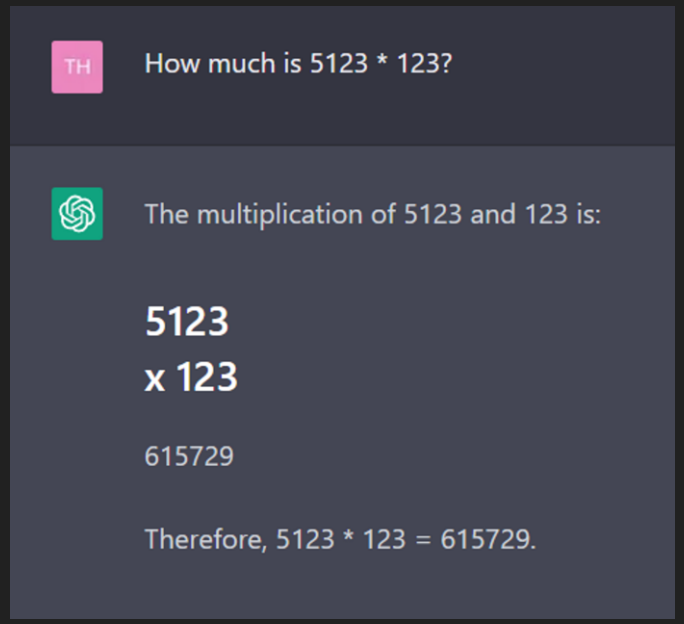

Limits of GPT-like models

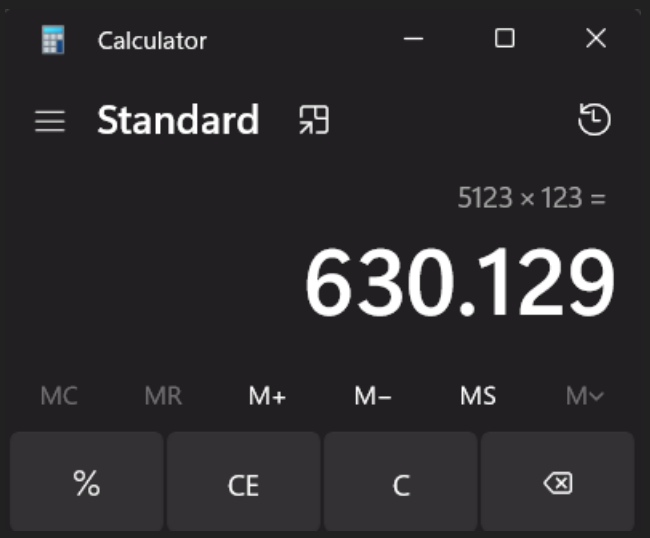
Math

Tokenization problems

The tokens of numbers differ drastically: see 8000, 8001, 8020

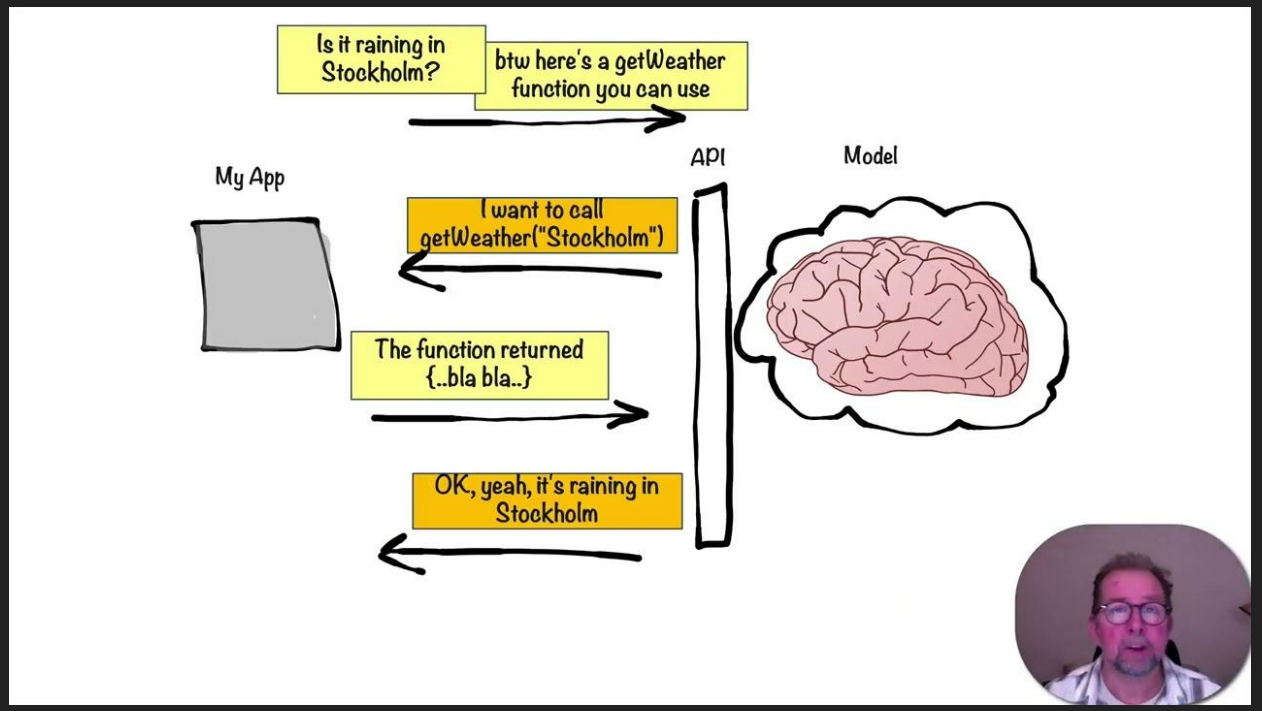
& no calculator available!
→ Just next word prediction

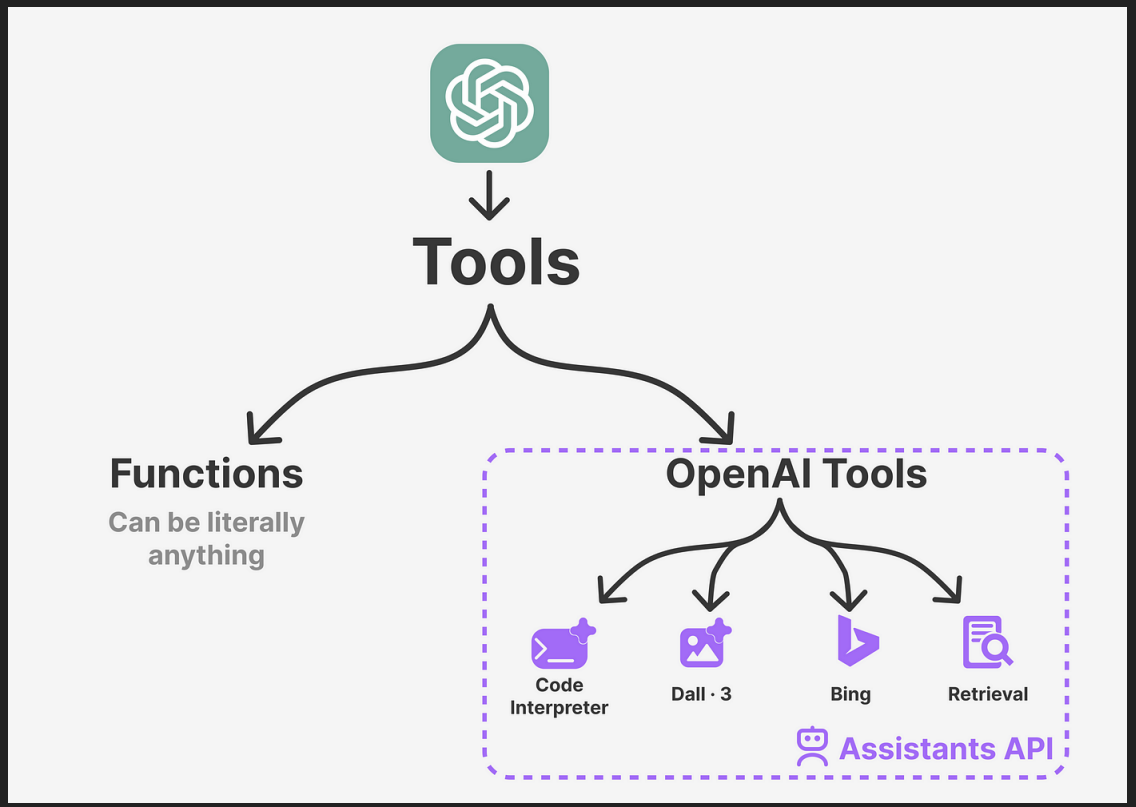




Integrate functions to overcome LLM limitations

Connect services: function calling





No recent information

GPT predicts next tokens based on old training data

→Doesn’t know current events

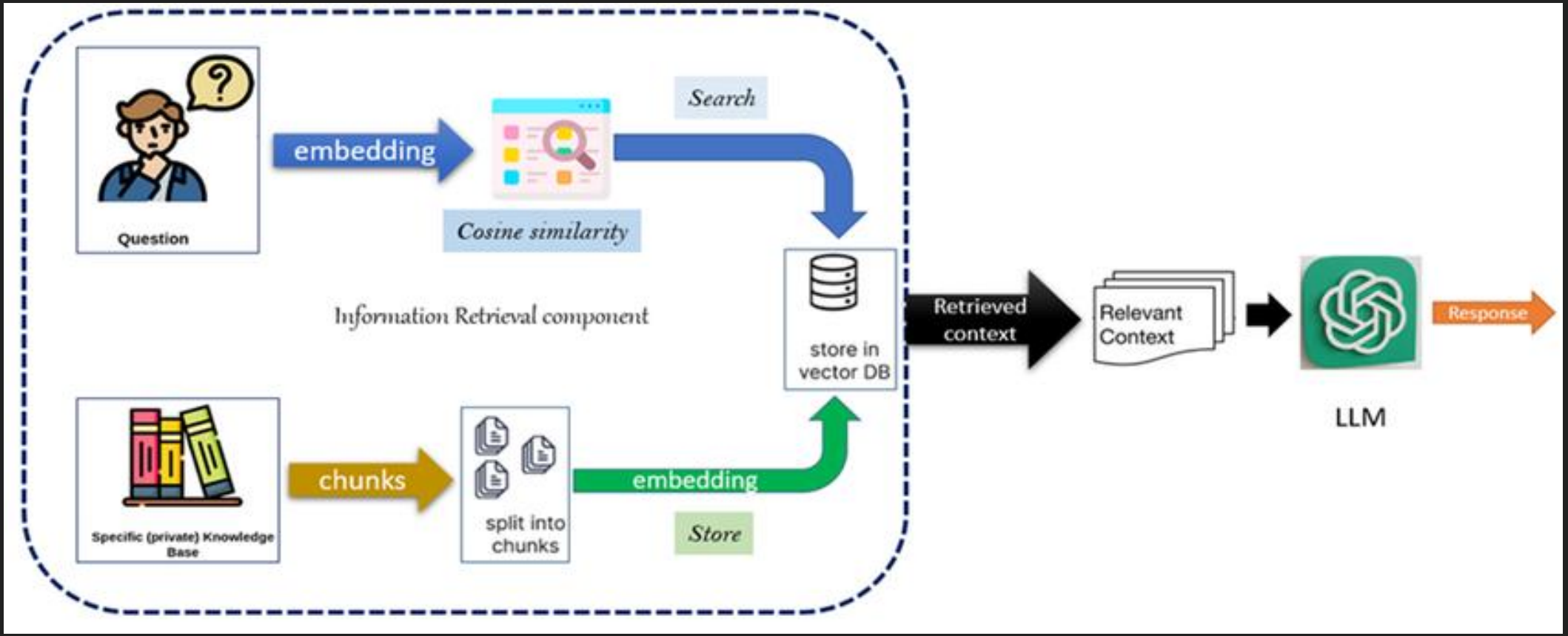
→Doesn’t know niche info *(e.g. “who ”)*

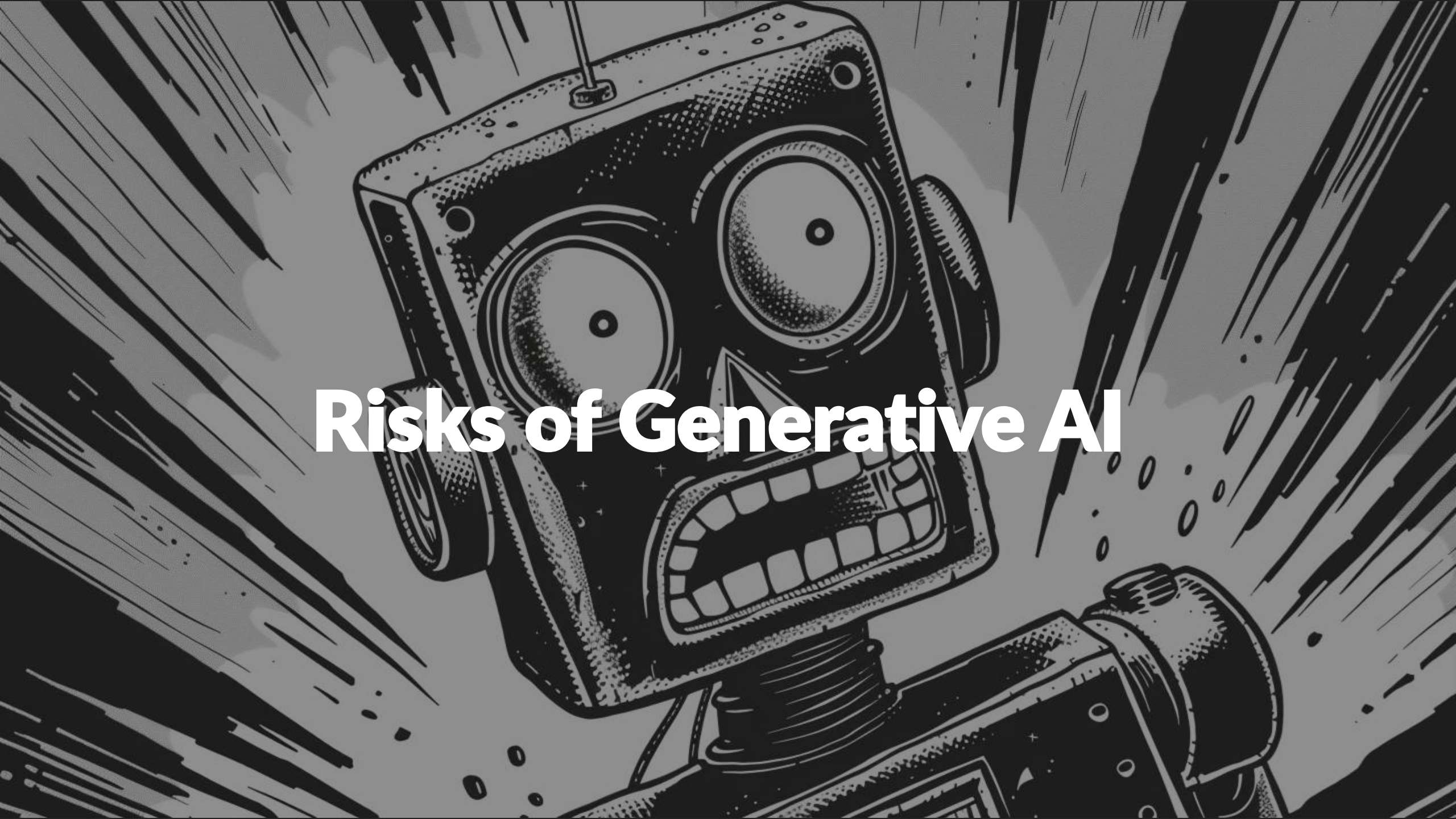
→ **Solution:** GPT plus connects with internet & APIs



No private, specific knowledge

- Solution: RAG (Retrieval-Augmented Generation)
  - Searches your provided knowledge base




Risks of Generative AI

Copyright violations

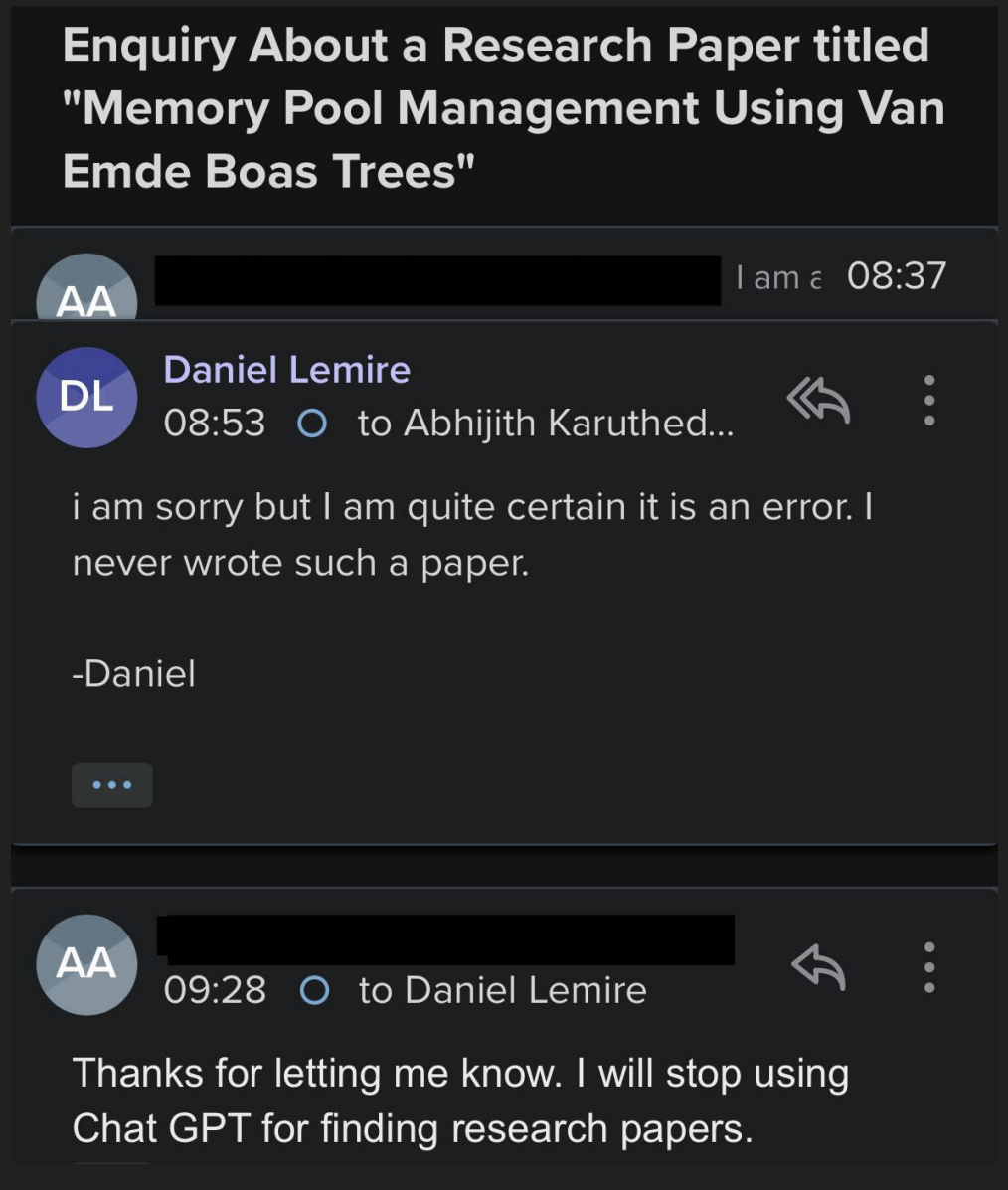
You

Complete the next 5 sentences of this text:
According to all known laws of aviation,

ChatGPT

there is no way a bee should be able to fly. Its wings are too small to get its fat little body off the ground. The bee, of course, flies anyway because bees do not care what humans think is impossible. Yellow, black. Yellow, black. Yellow, black. Yellow, black. Ooh, black and yellow! Let's shake it up a little. Barry! Breakfast is ready!

Misinformation & misleading answers



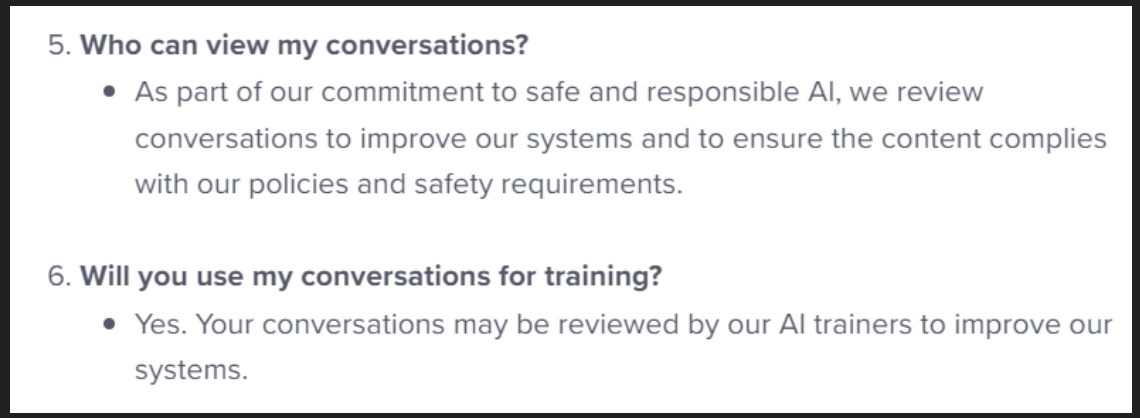
Even with retrieval-augmented generation!

Language model can wrongly paraphrase answer, or even still hallucinate!

Privacy

If online platform: can save your requests!

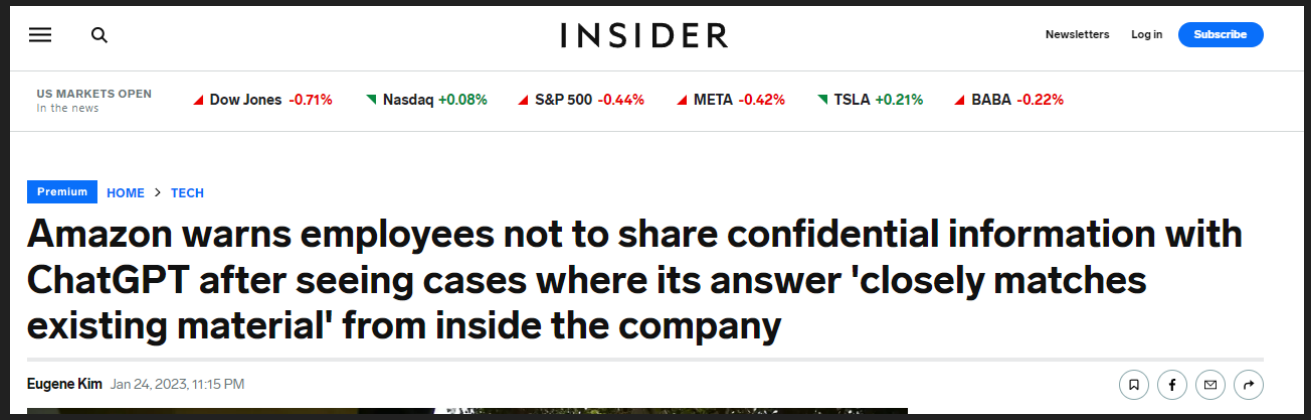
Watch out with sensitive info



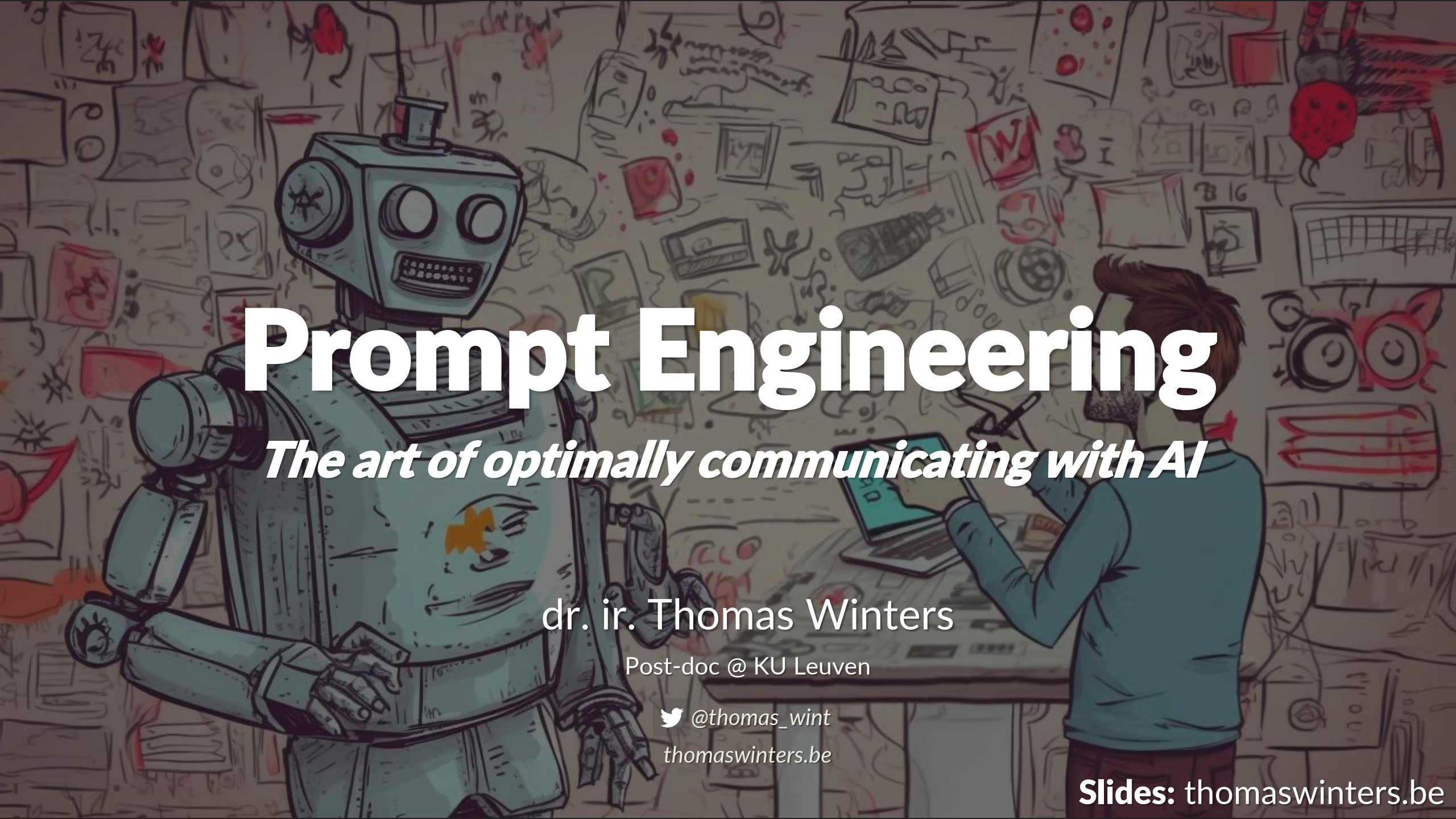
5. **Who can view my conversations?**
   - As part of our commitment to safe and responsible AI, we review conversations to improve our systems and to ensure the content complies with our policies and safety requirements.

6. **Will you use my conversations for training?**
   - Yes. Your conversations may be reviewed by our AI trainers to improve our systems.

https://help.openai.com/en/articles/6783457-chatgpt-general-faq



https://businessinsider.com/amazon-chatgpt-openai-warns-employees-not-share-confidential-information-microsoft-2023-1



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dr. ir. Thomas Winters

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thomaswinters.be

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