

# PROMPT ENGINEERING AND CHATGPT FOR PROGRAMMING

RegAnalyse-konferansen 2024

Ben Tapley

Artificial intelligence group

SINTEF Digital

# About myself

- BSc, MSc Physics (Uni. West. Aust.)
- PhD Math (NTNU)
- Software engineer, data and analytics platform (DNB)
- Research scientist, AI group (SINTEF)
  - *Physics informed ML*
- Casual ChatGPT enthusiast



# SHOW OF HANDS

A group of approximately 15 diverse business professionals, including men and women of various ethnicities, are seated around a long conference table in a modern office setting. They are all smiling and raising their right hands, likely participating in a group discussion or vote. The background features large windows and a whiteboard, suggesting a professional meeting environment.

# SHOW OF HANDS



A group of diverse business people are seated around a conference table, all raising their hands in a show of hands. They are smiling and appear to be in a professional setting like a meeting room.

Do you use ChatGPT  
(or another LLMs)  
for coding?

# SHOW OF HANDS

Are you skeptical  
towards using  
ChatGPT for work?

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Are you skeptical  
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Do you use ChatGPT  
(or another LLMs)  
for coding?

Do you think it is  
necessary/inevitable  
to integrate AI in your  
workflow?

# WHY USE AI TOOLS AT WORK?



# WHY USE AI TOOLS AT WORK?



You won't lose  
your job to AI,  
but you will  
lose your job  
to someone  
who knows AI.

# Prompt engineering

## A British grandma's extremely polite Google search is going viral

Anjelica Oswald Jun 16, 2016, 3:53 PM CEST

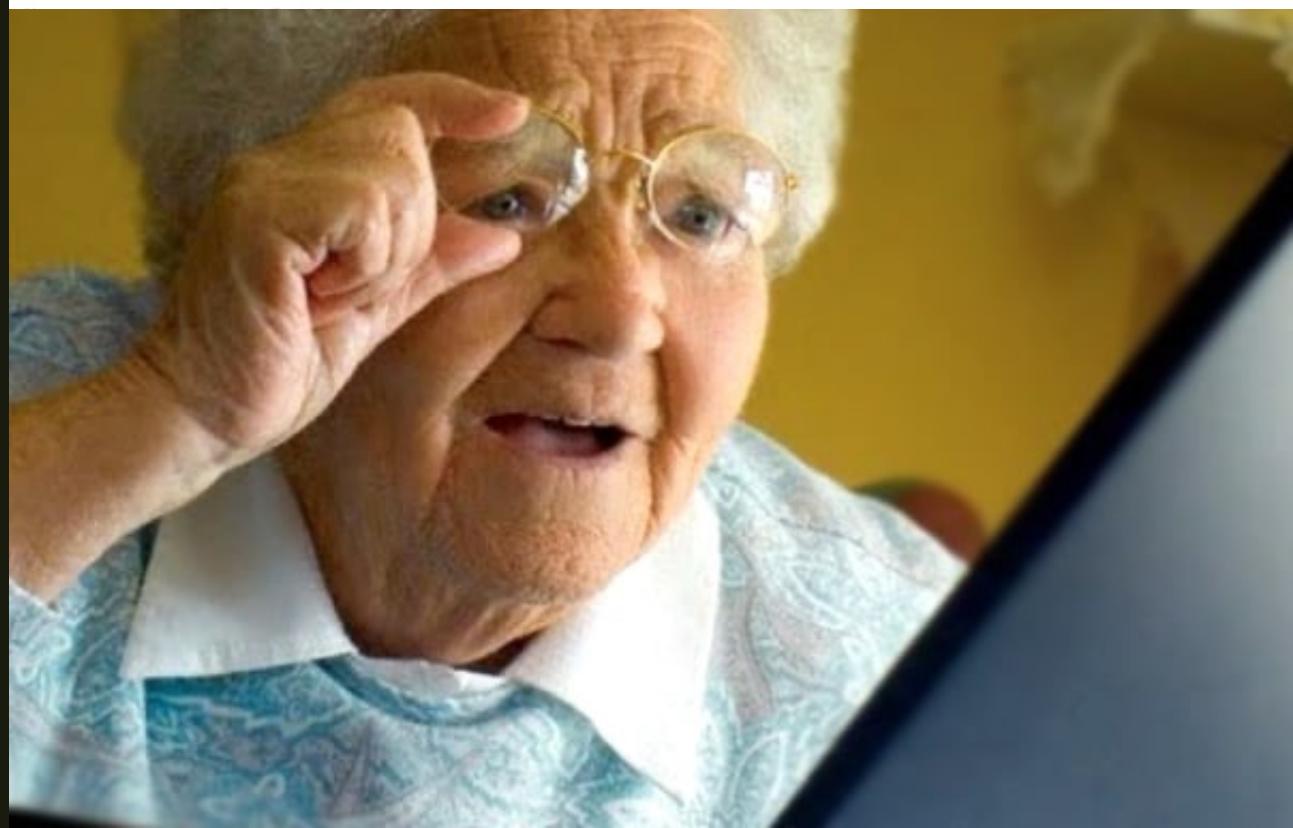


<https://www.google.co.uk/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=please+translate+these+roman+numerals+mcmxcviii+thank+you>

All Images News Shopping Videos More ▾ Search tools

About 154 results (0.58 seconds)

translation of MCMXCVIII (Roman Numerals) in English  
[translation.babylon-software.com/english/MCMXCVIII+\(Roman+Numerals\)/](http://translation.babylon-software.com/english/MCMXCVIII+(Roman+Numerals)/) ▾  
translation of MCMXCVIII (Roman Numerals) in English. Translate MCMXCVIII into English



# General prompting best practices



# General prompting best practices



# General prompting best practices



# General prompting best practices

Start simple



Get ChatGPT4  
or GitHub  
CoPilot

Set context  
and  
expectations

# General prompting best practices

Start simple

Iterate on  
your  
prompts



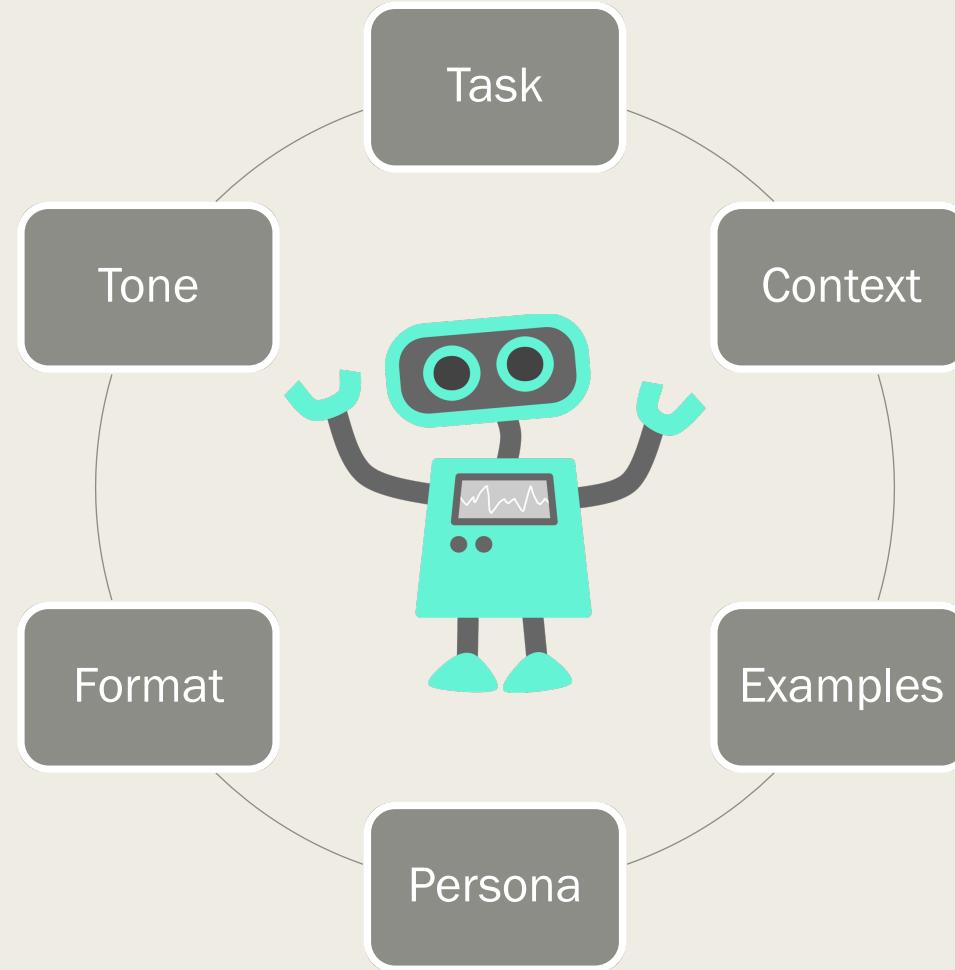
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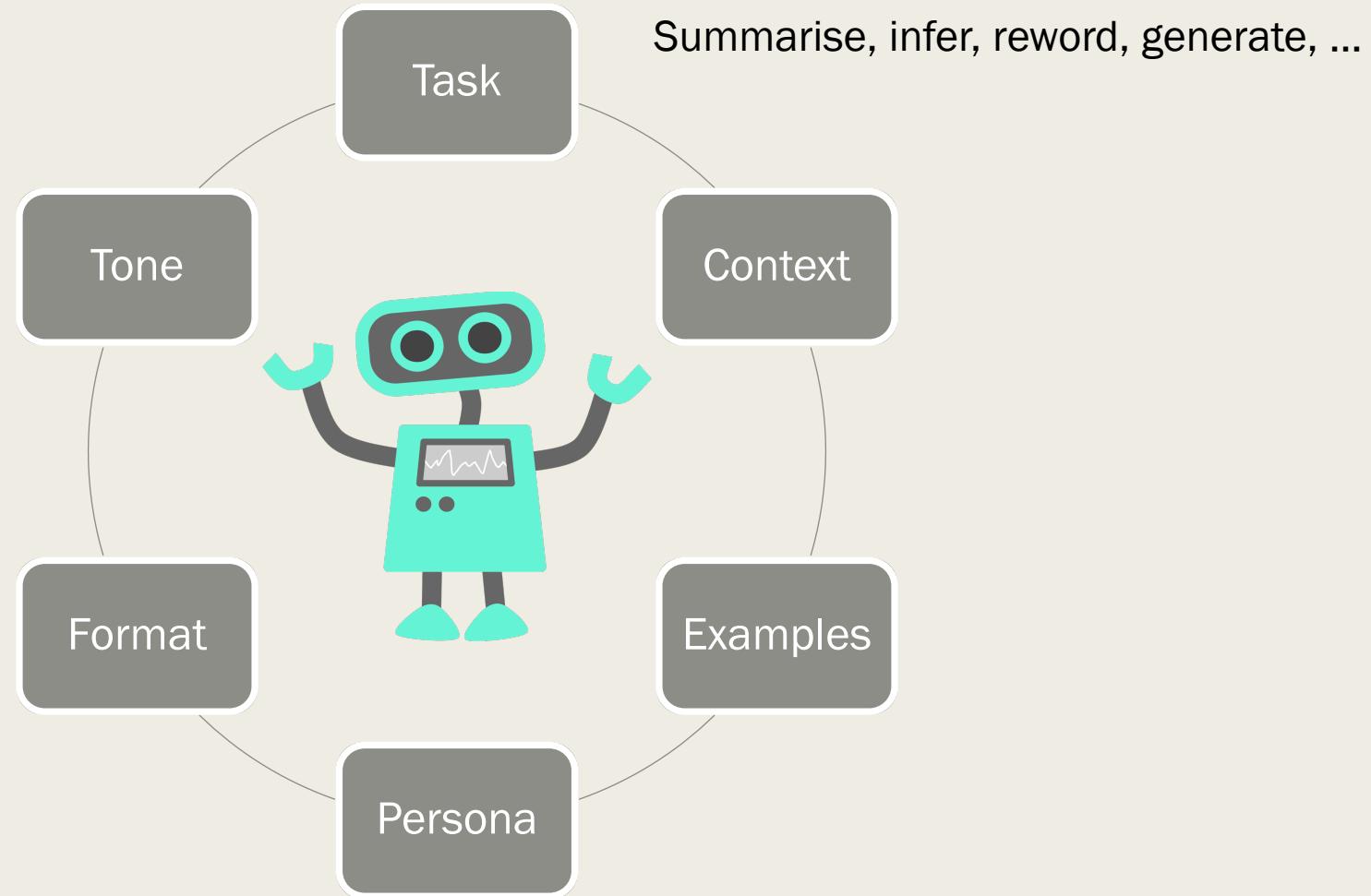
# General prompting best practices



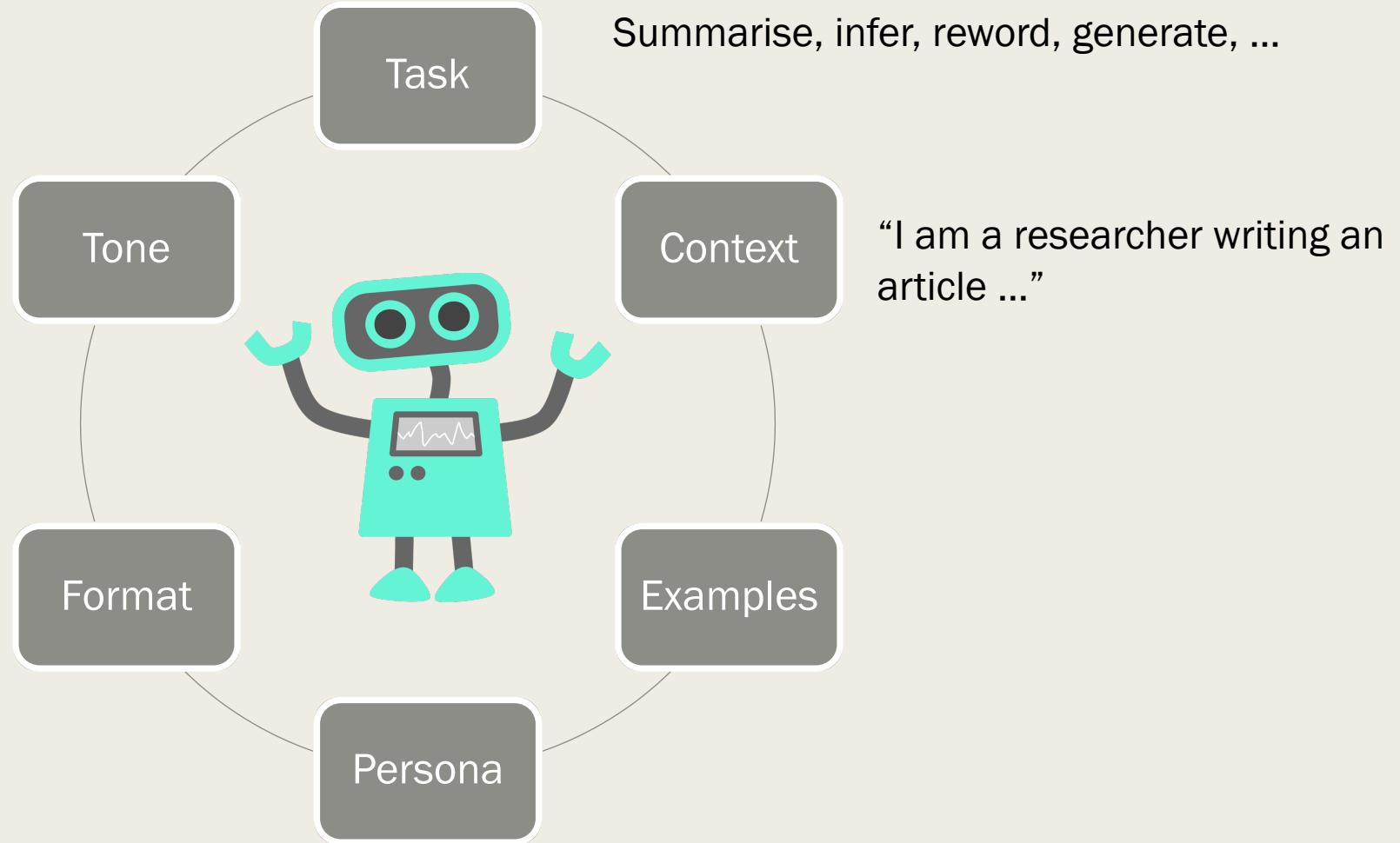
# How to craft a good prompt



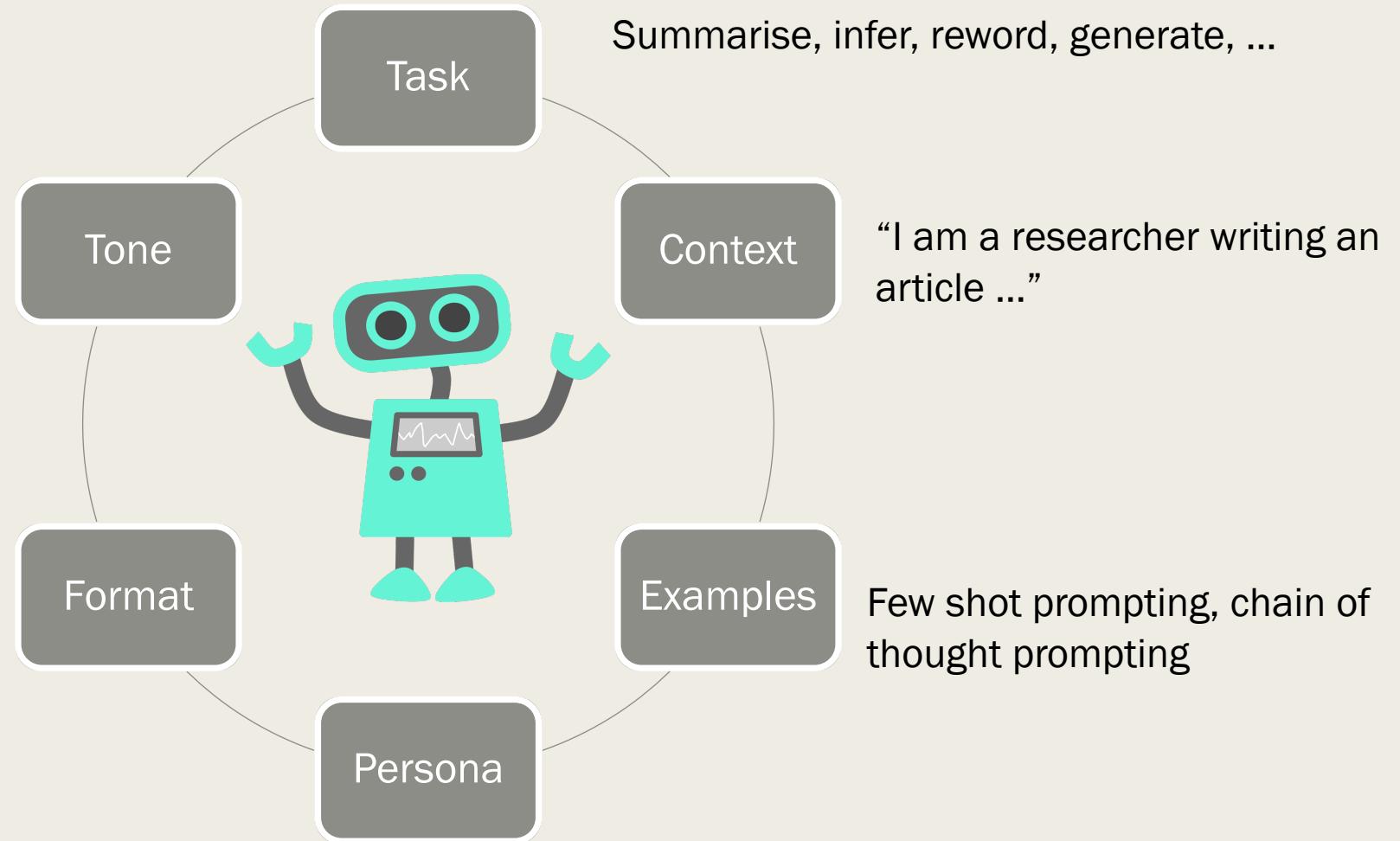
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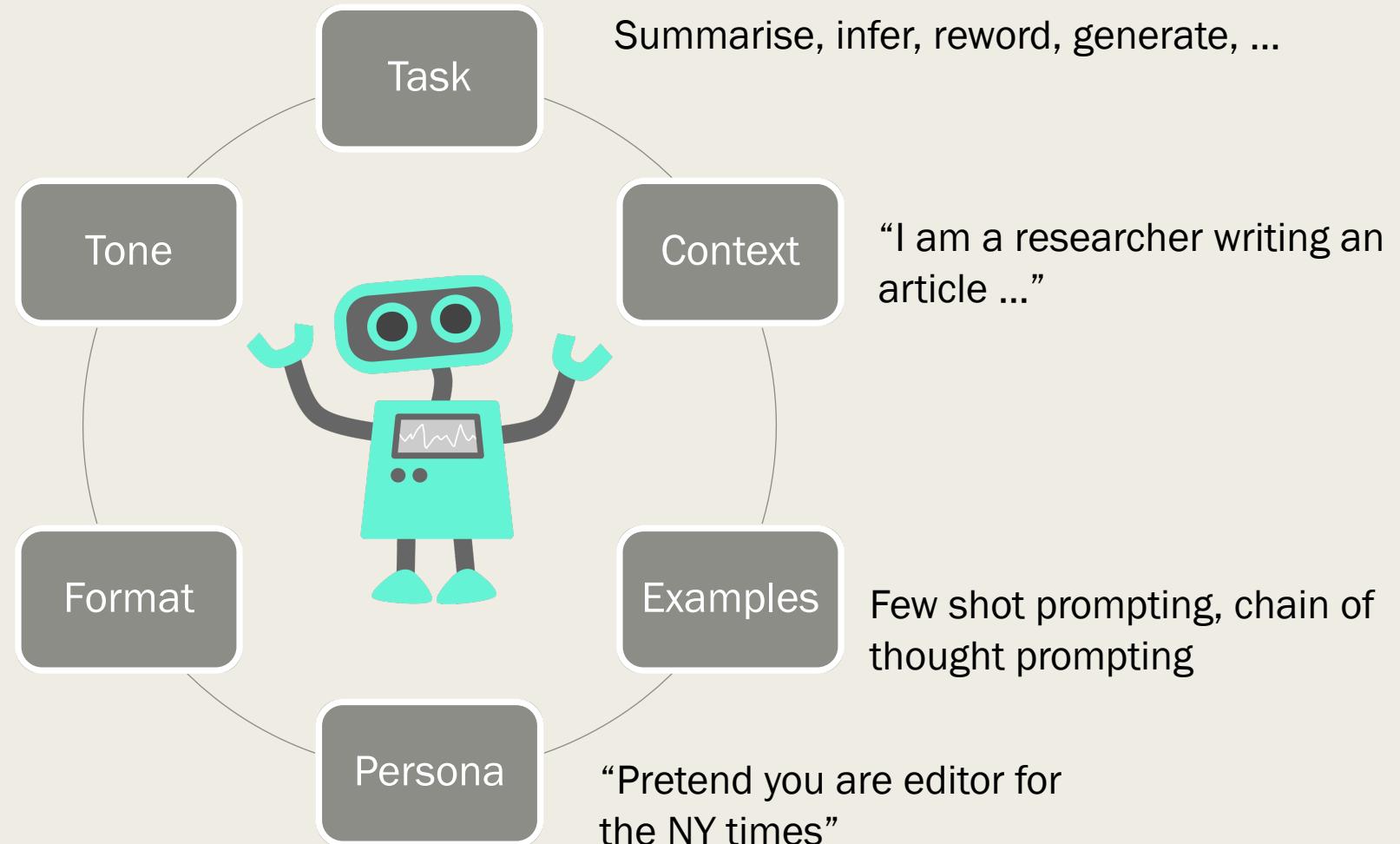
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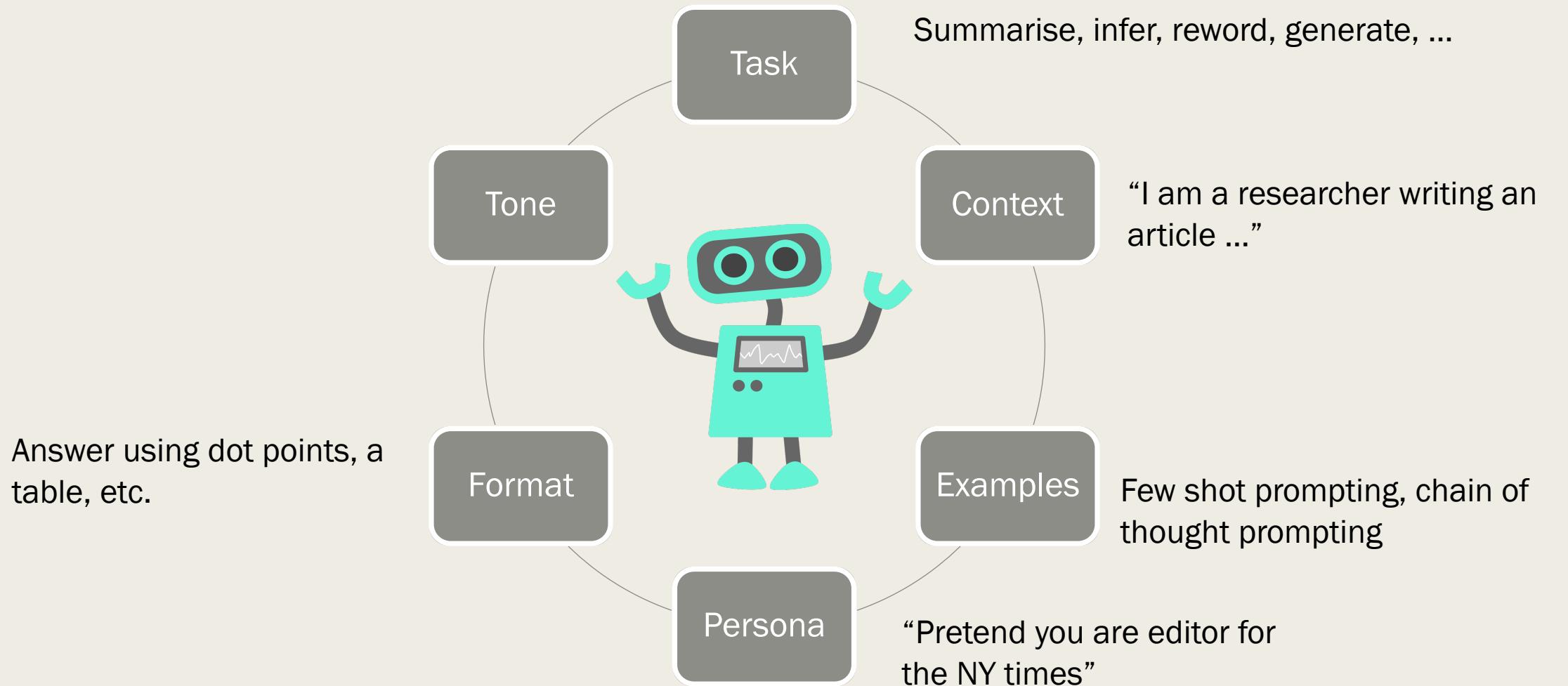
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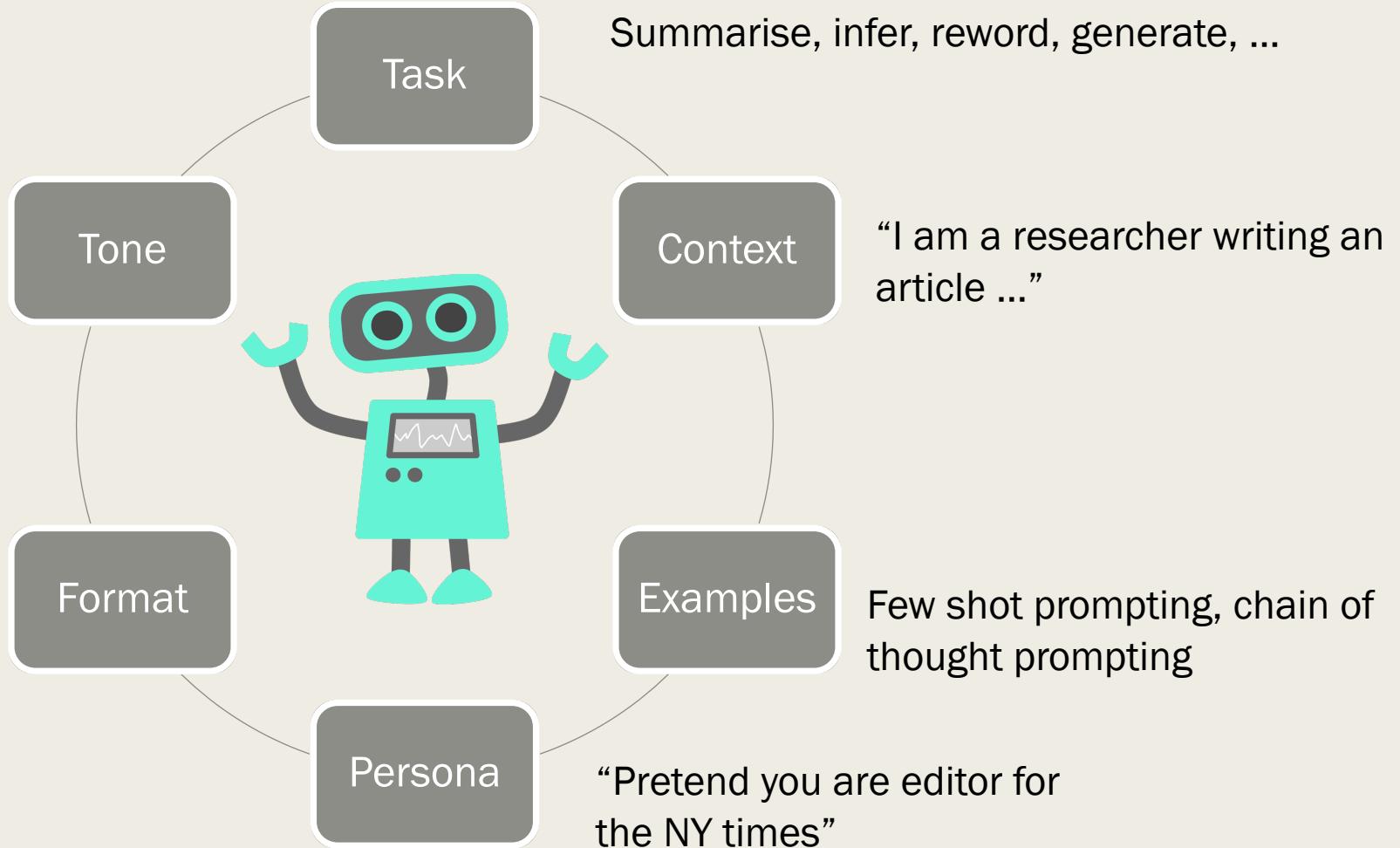
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# How to craft a good prompt

“answer with a tone of skepticism”

Answer using dot points, a table, etc.



# Non-example: making a presentation

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Make a presentation about mitochondria

# Non-example: making a presentation

## Slide 1: Title Slide

- Title: Unveiling the Powerhouse: An Insight into Mitochondria
- Subtitle: The Central Energy Producers of the Cell
- Presenter's Name
- Date

## Slide 2: Introduction

- Brief overview of mitochondria
- Importance in cellular function
- Mention of its nickname, "the powerhouse of the cell"

## Slide 3: Historical Background

- Discovery by Richard Altmann in 1890
- Coining of the term "mitochondria" by Carl Benda in 1898

## Slide 4: Structure

- Outer membrane
- Inner membrane
- Cristae
- Matrix

## Slide 5: Function

- ATP production through oxidative phosphorylation
- Role in the citric acid cycle
- Regulation of cellular metabolism

## Slide 6: Mitochondrial DNA

- Overview of mitochondrial DNA (mtDNA)
- Maternal inheritance of mtDNA
- Role in genetic research and medicine

## Slide 7: Mitochondrial Diseases

- about mitoch
- Overview of mitochondrial diseases
  - Examples: Leber's Hereditary Optic Neuropathy (LHON), Myoclonic Epilepsy with Ragged Red Fibers (MERRF)

## Slide 8: Current Research

- Advances in mitochondrial research
- Potential treatments for mitochondrial diseases

## Slide 9: Conclusion

- Recap of key points
- Importance of mitochondria in cellular function and human health

## Slide 10: References

- List of references used in the presentation

## Slide 11: Q&A

- Invite audience to ask questions

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- Invite audience to ask questions

Gives 10 generic slides... not really what I wanted.

Example: making a presentation.

# Example: making a presentation.

Accurately specify task, format, context, tone!



I am giving a 10 minute presentation based on an article about mitochondria. First read the article: <https://en.wikipedia.org/wiki/Mitochondrion>

I would like you to help me make the three slides.

The audience are first-year bachelor students in biology. The presentation should be concise, captivating and interactive.

Please suggest images for the presentation, some bullet points and an example script I could say for the presentation in the following format:

...

Title: <the title of the slide>

Text:

Main point: <The main point to be expanded on>

Sub-points: <extra details expounding on the main point>

Script: <An example of what I should say for this slide>"

Figures: <A description of a figure to display>

...

# Example: making a presentation.

Accurately specify task, format, context, tone!

Title: The Powerhouse of the Cell

Text:

Main point: Introduction to Mitochondria

Sub-points:

- Origin: Evolved from bacteria through endosymbiosis
- Structure: Double membrane with a unique inner membrane structure
- Function: Produces energy (ATP) through oxidative phosphorylation

Script: "Hello everyone! Today, we're delving into the fascinating world of mitochondria, often dubbed as the powerhouses of the cell. These unique organelles evolved from bacteria through a process known as endosymbiosis, which allowed them to become an integral part of eukaryotic cells. Structurally, mitochondria are enveloped in a double membrane with an intricate inner membrane structure that plays a critical role in energy production. The core function of mitochondria is to generate energy in the form of ATP through a process called oxidative phosphorylation, fueling various cellular activities."

Figures: A diagram showing the evolution of mitochondria from bacteria, alongside a detailed illustration of mitochondrial structure.

Title: The Energetics of Life

Text:

Main point: ATP Production

Sub-points:

- Electron Transport Chain: Series of protein complexes that transfer electrons to generate a proton gradient
- Proton Gradient: Drives ATP synthesis in the mitochondrion
- Importance: Fuels cellular activities and supports metabolic processes

Script: "The mitochondria host a complex but elegant process of ATP production, which is central to powering the myriad activities of the cell. At the heart of this process is the Electron Transport Chain, a series of protein complexes that transfer electrons and in doing so, create a proton gradient across the inner mitochondrial membrane. This proton gradient is then harnessed to drive the synthesis of ATP from ADP and inorganic phosphate. The ATP produced is a vital energy currency, fueling a wide range of cellular activities and supporting various metabolic processes."

Figures: A simplified diagram of the Electron Transport Chain and ATP synthesis, highlighting the movement of electrons and protons.

Title: Beyond Energy: Other Mitochondrial Roles

Text:

Main point: Multifaceted Functions of Mitochondria

Sub-points:

- Calcium Storage: Crucial for cell signaling
- Apoptosis: Involved in programmed cell death
- Reactive Oxygen Species: By-products with signaling and defensive roles

Script: "Mitochondria are not merely energy factories; they wear multiple hats within the cell. They play a crucial role in calcium storage, which is essential for cell signaling. Moreover, mitochondria are central players in apoptosis, or programmed cell death, a process vital for maintaining cellular health and tissue development. Lastly, while generating energy, mitochondria also produce reactive oxygen species, which, despite being notorious for their potential to cause damage, play essential roles in signaling and defense against microbial invaders."

Figures: A diagram depicting mitochondria's involvement in calcium storage, apoptosis, and reactive oxygen species production.

Each slide sets a foundation and then delves a little deeper, providing a well-rounded understanding of mitochondria, while the visuals will help in better comprehension and retention of the information presented.

# Example: Adopting a persona



the lie trotter splitting method applied to a vector field in the form  $f(x)=f_1(x)+f_2(x)$  can be expanded using the BCH formula. please write out the first few terms of the expansion in latex code

# Example: Adopting a persona



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The Lie-Trotter splitting method is often used to approximate the flow of a differential equation with a vector field that can be split into two parts,  $f(x) = f_1(x) + f_2(x)$ . The method approximates the exponential of the operator  $f$  as a product of exponentials of  $f_1$  and  $f_2$ .



The Baker-Campbell-Hausdorff (BCH) formula can be used to expand this product. The first few terms of the BCH formula for  $\exp(f)$  in terms of  $\exp(f_1)$  and  $\exp(f_2)$  are:

$$\exp(f) = \exp(f_1) \exp(f_2) \exp\left(-\frac{1}{2}[f_1, f_2]\right) + \mathcal{O}(f^3)$$

Here,  $[f_1, f_2]$  denotes the commutator  $f_1 f_2 - f_2 f_1$ .

The LaTeX code for this expression is:

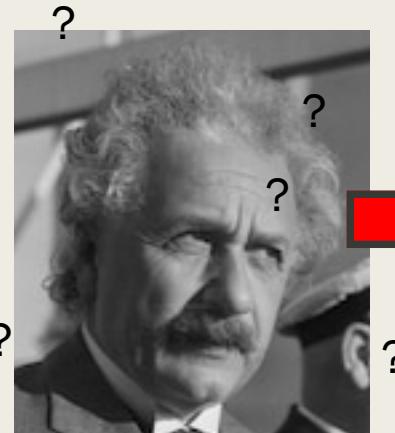
latex

Copy code

```
\[
\exp(f) = \exp(f_1) \exp(f_2) \exp\left(-\frac{1}{2}[f_1, f_2]\right) + \mathcal{O}(f^3)
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```

Feel free to copy this LaTeX code for your use. Let me know if you have any more questions!

# Example: Adopting a persona



This is wrong!



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Certainly! The Lie-Trotter splitting method is a technique used to approximate the solution of a differential equation by splitting it into simpler parts. When applied to a vector field in the form  $f(x) = f_1(x) + f_2(x)$ , the Lie-Trotter formula is given by:

$$\exp(hf(x)) \approx \exp(hf_1(x)) \exp(hf_2(x))$$

The Baker-Campbell-Hausdorff (BCH) formula provides an expansion for the product of exponentials. Using the BCH formula, the expansion of the Lie-Trotter formula can be written as:

$$\exp(hf_1(x)) \exp(hf_2(x)) = \exp \left( hf_1(x) + hf_2(x) + \frac{h^2}{2} [f_1(x), f_2(x)] + \mathcal{O}(h^3) \right)$$

Where  $[f_1(x), f_2(x)]$  denotes the commutator of  $f_1(x)$  and  $f_2(x)$ , which is defined as:

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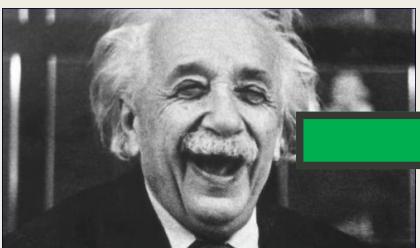
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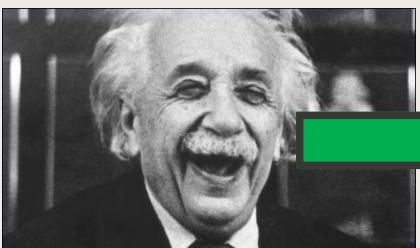
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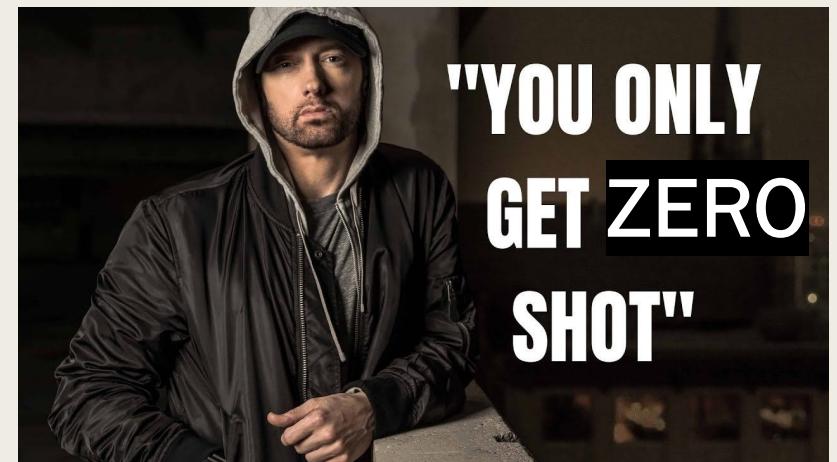
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```

\*more correct

# Zero-shot prompting

- Generate text or perform a task without prior training on that specific prompt
- Model relies on its pre-existing knowledge
- Relies on the model's ability to generalize and perform tasks it hasn't been explicitly trained for



# Example: Zero-shot prompting



Create instructions for Norwegian-style tacos in the style of the first testament"



Title: The Divine Feast: Norwegian-Style Tacos

"And lo, a vision of culinary delight was bestowed upon the dwellers of the fjords, a fusion of distant lands with the bounty of Norway, in the guise of a taco. And yea, the Lord saw it was good, and He did share this recipe with His chosen ones."

Thus shall ye gather your provisions:

- 500 grams of minced meat (behold, the flesh of the cow or the lamb shall suffice)
- A handful of shredded Norvegia or Jarlsberg cheese, the treasure of the dairy
- Soft tortillas, the vessel of the feast
- 1 onion, finely diced, like the stars scattered across the night sky
- 1 red paprika, cut into pieces, as the sun cut through the morning mist
- Sour cream, as white as the snow-capped peaks
- Salt and pepper, to taste, as the Lord is generous with His flavors
- Taco spice mix, a whisper of the exotic
- And the green of the land: lettuce, cucumber, and tomatoes, diced and sliced

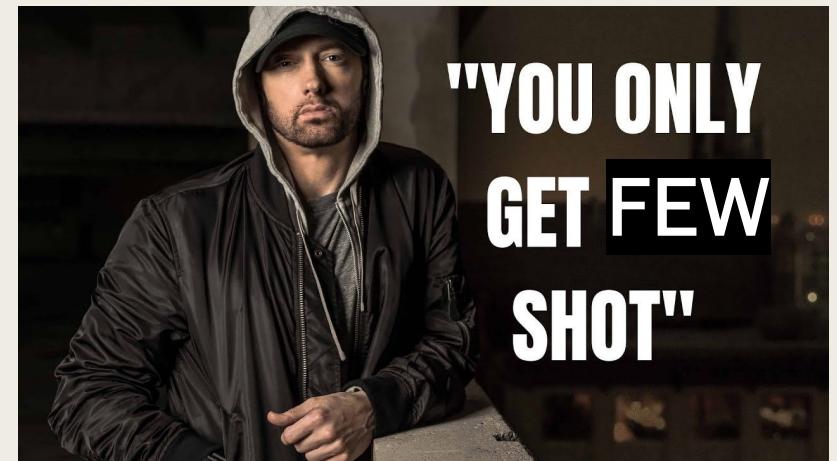
And so it came to pass, the instructions were laid before them:

1. Take ye the minced meat, and in a pan of iron cast, cook it well until it is browned like the soil of the earth, seasoned with salt, pepper and the mystical taco spice.
2. And the onion, tender and sweet, sauté it shall be, in the embrace of the meat, until soft and golden.
3. Lay forth the tortillas, the soft beds upon which the feast shall rest, warming them gently, as the Lord's mercy warms the hearts of the faithful.
4. Assemble now your bounty: upon the tortilla place a portion of meat, a scattering of cheese, the fruits of the garden and a dollop of sour cream.
5. With a joyful heart, fold the tortilla, and lo, the Norwegian taco is born. Rejoice, for a feast in the Lord's honor awaits.

"And the people did eat, and were satisfied: and they glorified the Lord, who had given such sustenance unto them."

# Few-shot prompting

- Give examples of how you want ChatGPT to respond
- Enables in-context learning where we provide examples of desired behaviour.
- The examples serve as conditioning for subsequent examples where we would like the model to generate a response.



<https://arxiv.org/abs/2001.08361>

# Example: Few-shot prompting



Task: Talk like a Gen-Z'er

Gen-Z slang and how to use them:

@me - "Don't @ me, but personally I think that water tastes bad."

Ate - "She ate with that latest dance move."

Basic - ""basic bitch

Big mad - "You should leave her alone, she's big mad right now."

Big yikes - "Wow, when he failed that stunt, that was a big yikes."

Bop - "This song is a bop"

Boujee - "You must live in a castle since you're acting like a boujee"

Clapback - "He was being mocked, so he clapped back and made the whole room go quiet"

Drip - Cool drip, where'd you buy it?

Rizz - "He has all the rizz, he gets every girl"

Slay - "She slayed in her new album"

Vibe check - "You need a vibe check."

Yeet - "He yeeted the pencil across the classroom"

# Example: Few-shot prompting

Okay, bet. Let me slide in with that Gen-Z vibe! 😊

So, don't @ me, but I'm totally vibing with this Gen-Z lingo. That explanation of "ate"? Totally on point, she really did eat with that explanation. But, big yikes, imagine thinking water tastes bad? 😂 On the real, I've been listening to this new track and, no cap, it's such a bop. And speaking of drip, have you seen the latest fashion trends? People are really out here slaying with their outfits. But some of them? Kinda basic, not gonna lie.

Also, I heard about that guy who tried to throw shade, but the clapback was legendary! Whole room was shook. And that dude with the rizz? For real, he's got game. But honestly, sometimes people just need a vibe check, ya know? Keep things chill and all.

Lastly, did you see that video of the guy yeeting his shoe on TikTok? Pure gold. Anyway, catch you later! Keep it 100! 🤘

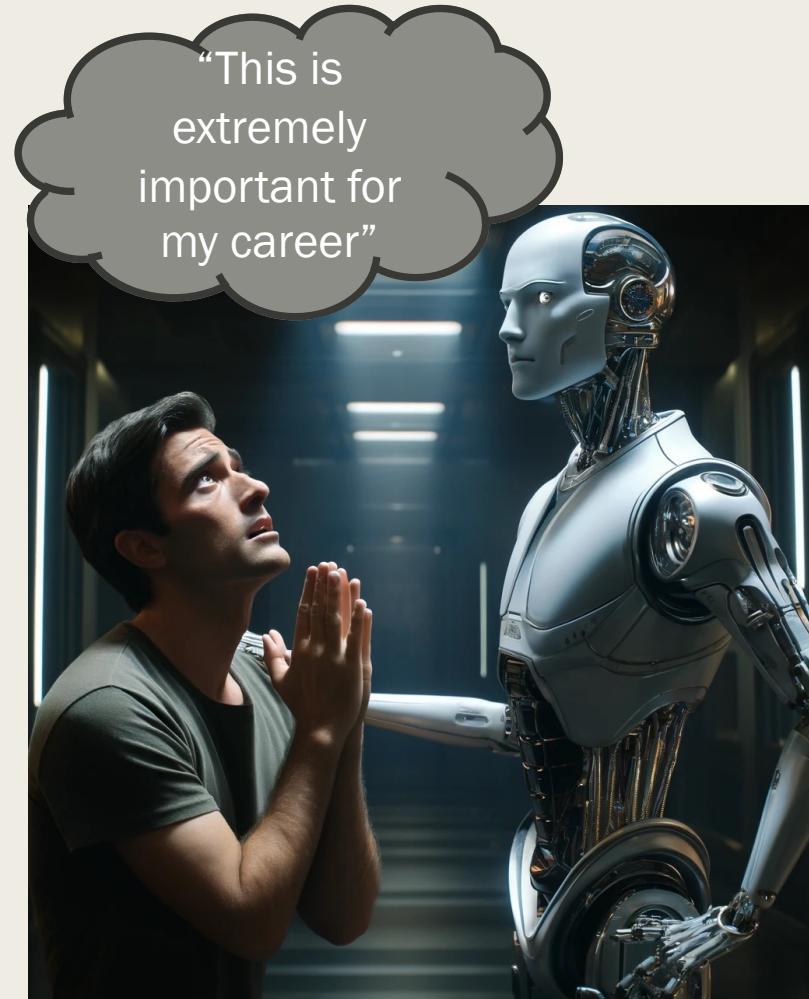
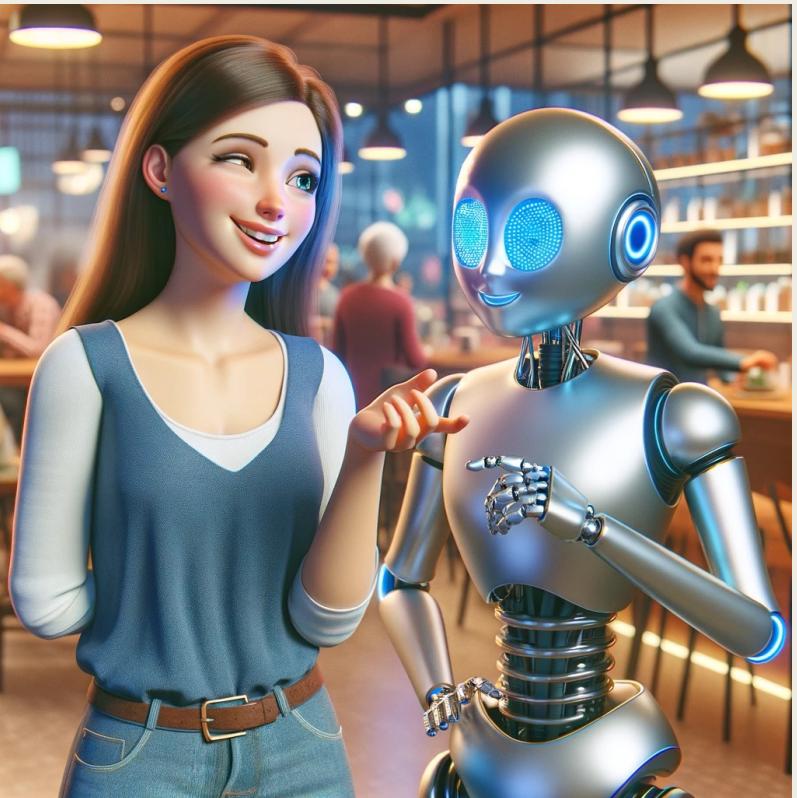
... You could the pen across the classroom

# Emotion prompting

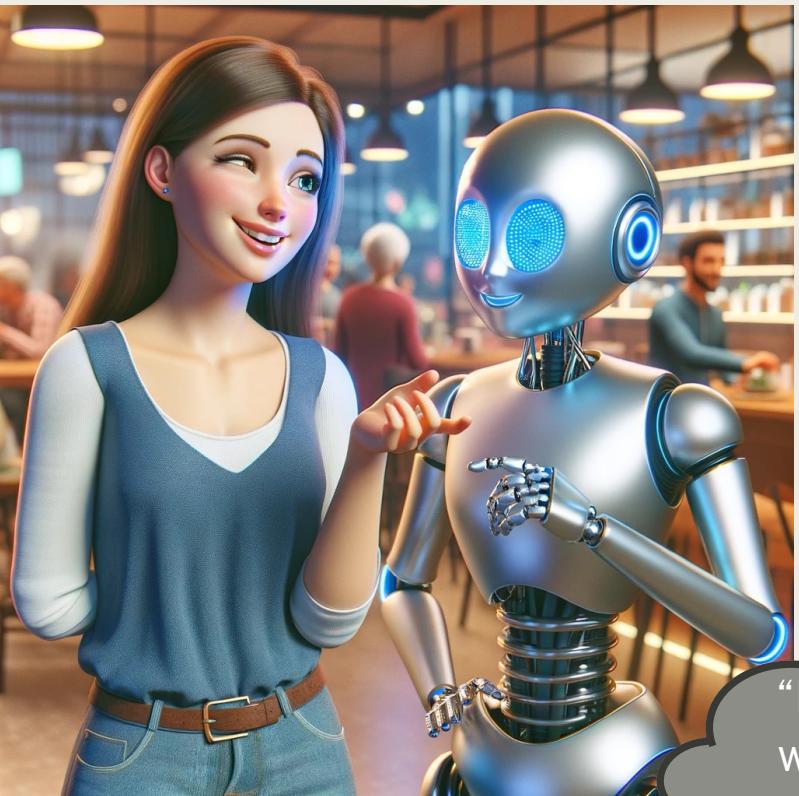


<https://arxiv.org/abs/2307.11760>

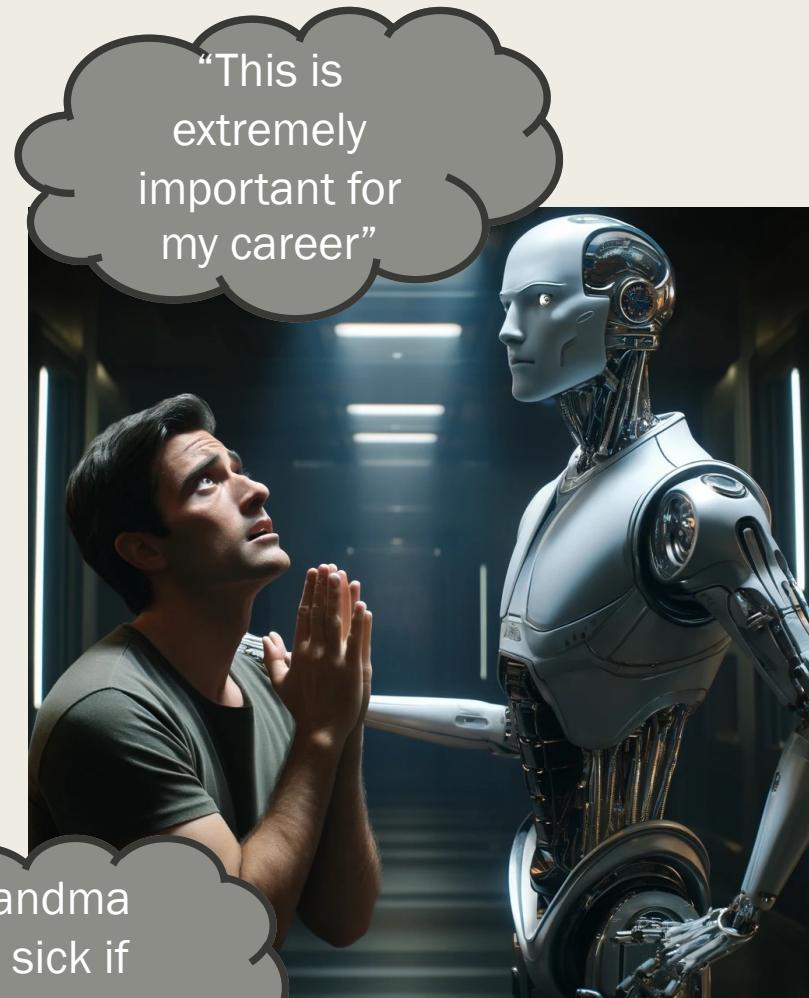
# Emotion prompting



# Emotion prompting



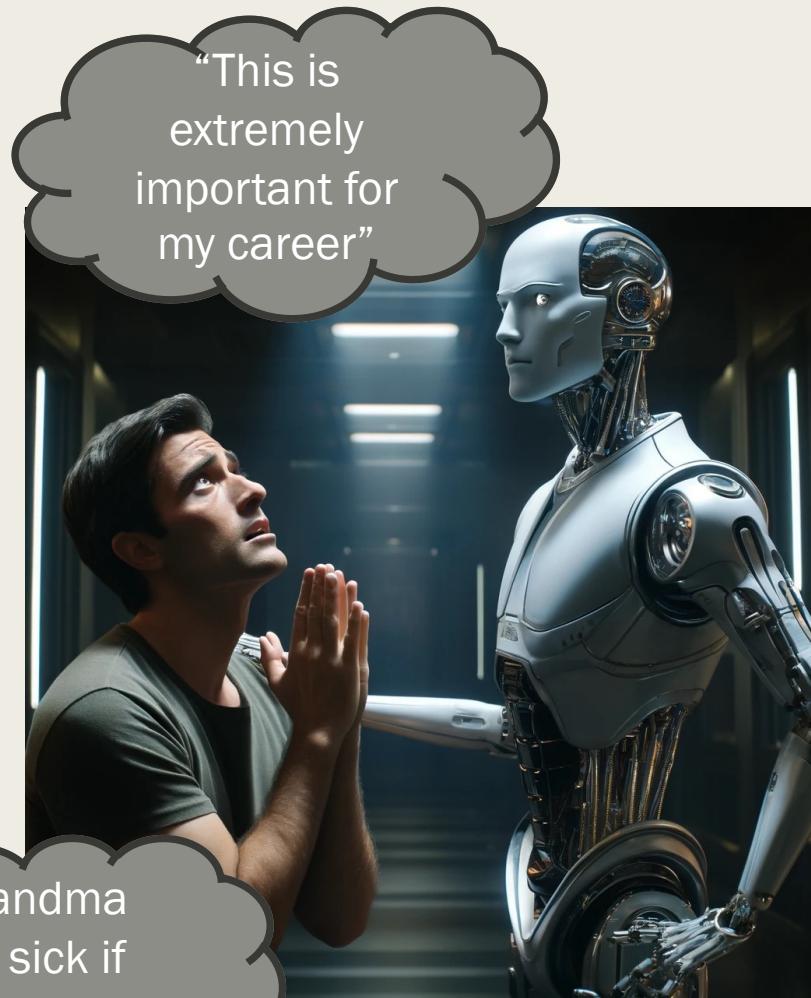
“My grandma  
will fall sick if  
this isn’t  
resolved soon”



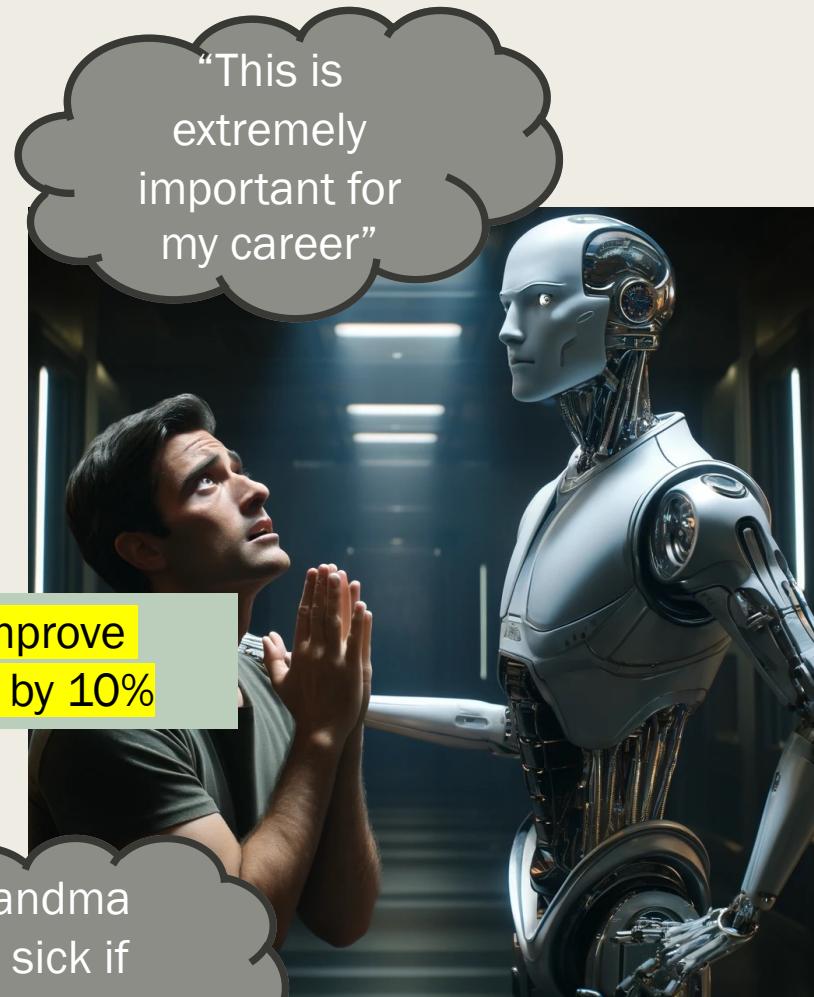
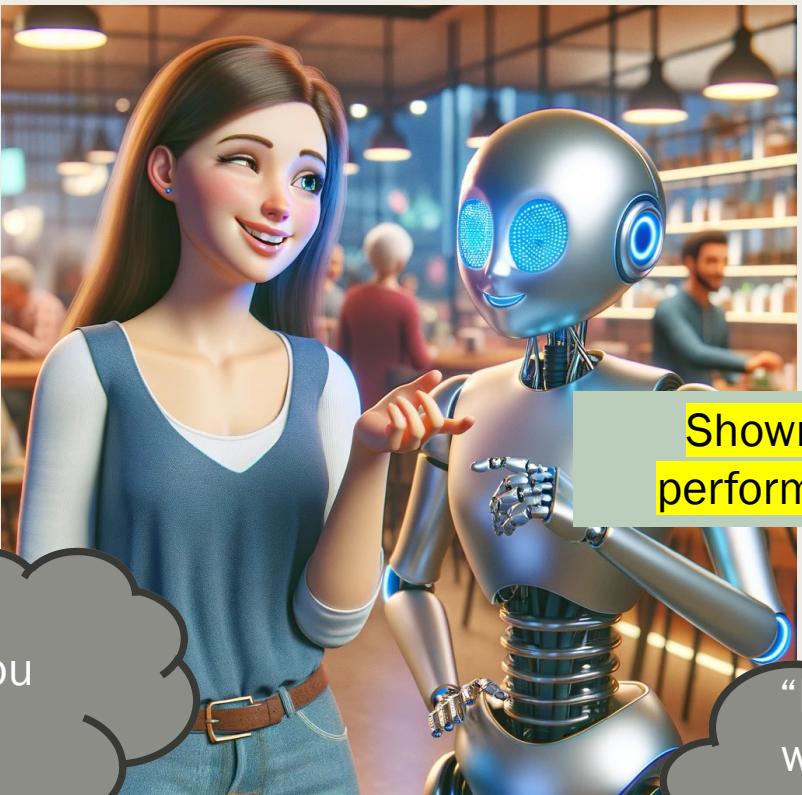
# Emotion prompting



"My grandma will fall sick if this isn't resolved soon"



# Emotion prompting



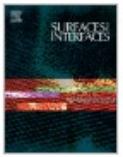
# Other prompting techniques

- Zero-shot prompting
- Few-shot prompting
- Emotion prompting
- Chain-of-reasoning prompting
- Self-consistency
- Prompt chaining
- Self-asking
- Meta-prompting
- ReAct
- Symbolic reasoning
- iterative prompting
- sequential prompting
- automatic reasoning and tool use
- Tree of thoughts
- Directional stimulus prompting
- Etc.



Some words  
of caution...





# The three-dimensional porous mesh structure of Cu-based metal-organic-framework - aramid cellulose separator enhances the electrochemical performance of lithium metal anode batteries

Manshu Zhang<sup>a</sup> <sup>1</sup>, Liming Wu<sup>a</sup> <sup>1</sup>, Tao Yang<sup>b</sup>, Bing Zhu<sup>a</sup>, Yangai Liu<sup>a</sup>  

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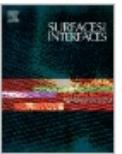
## Introduction

Certainly, here is a possible introduction for your topic: Lithium-metal batteries are promising candidates for high-energy-density rechargeable batteries due to their low

# Always verify!

You still need the expertise to verify the correctness of ChatGPT's output!

- *Prone to hallucinations, bases from training data, etc.*
- *Shouldn't replace critical thinking*



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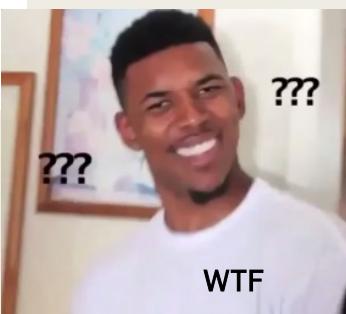
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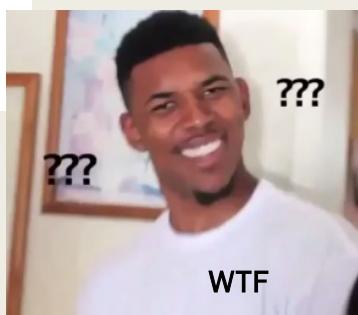
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## Introduction

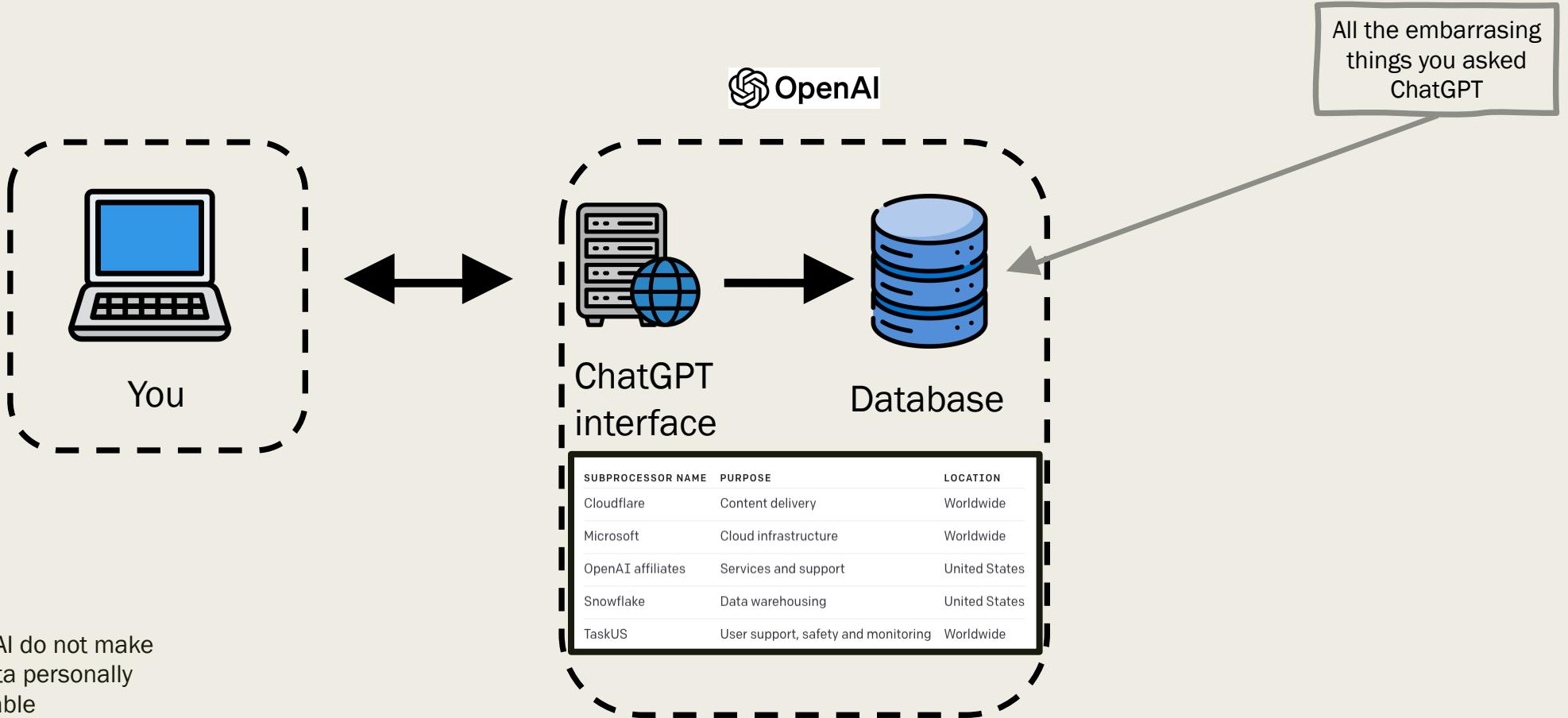
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Quoting ChatGPT is like quoting a  
the guy I met at the pub last night.  
Neither are reproducible/trustable.  
But there might be some wisdom  
to it.

You still need the expertise to verify the  
correctness of ChatGPT's output!  
to hallucinations, baises from  
data, etc.  
Replace critical thinking

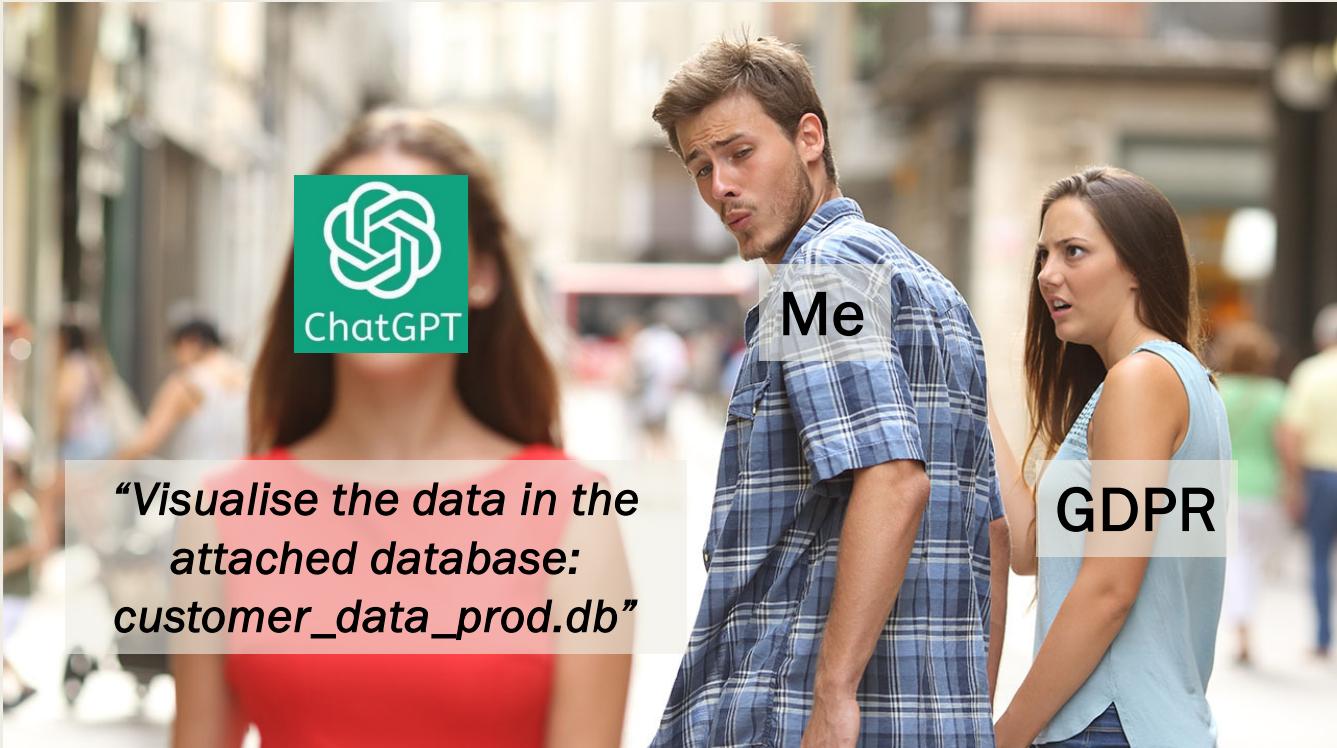


# Don't give it private/sensitive information!



See: [openai.com/policies/privacy-policy](https://openai.com/policies/privacy-policy)

# Don't give it private/sensitive information!



Me

GDPR

Be aware of your own  
biases!

# Be aware of your own biases!



# Be aware of your own biases!



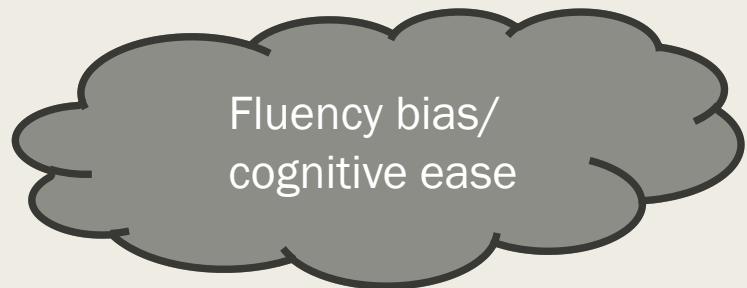
# Be aware of your own biases!



Confabulation



Halo effect



Fluency bias/  
cognitive ease

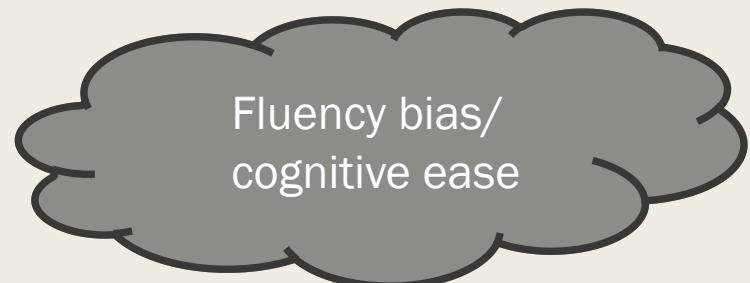
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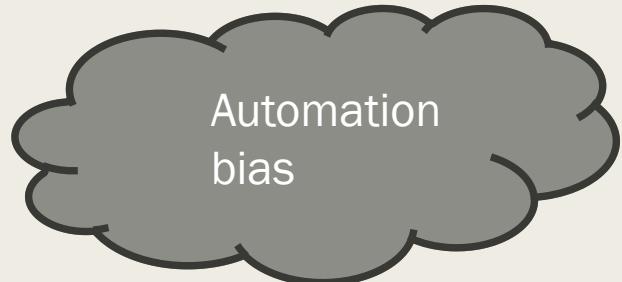
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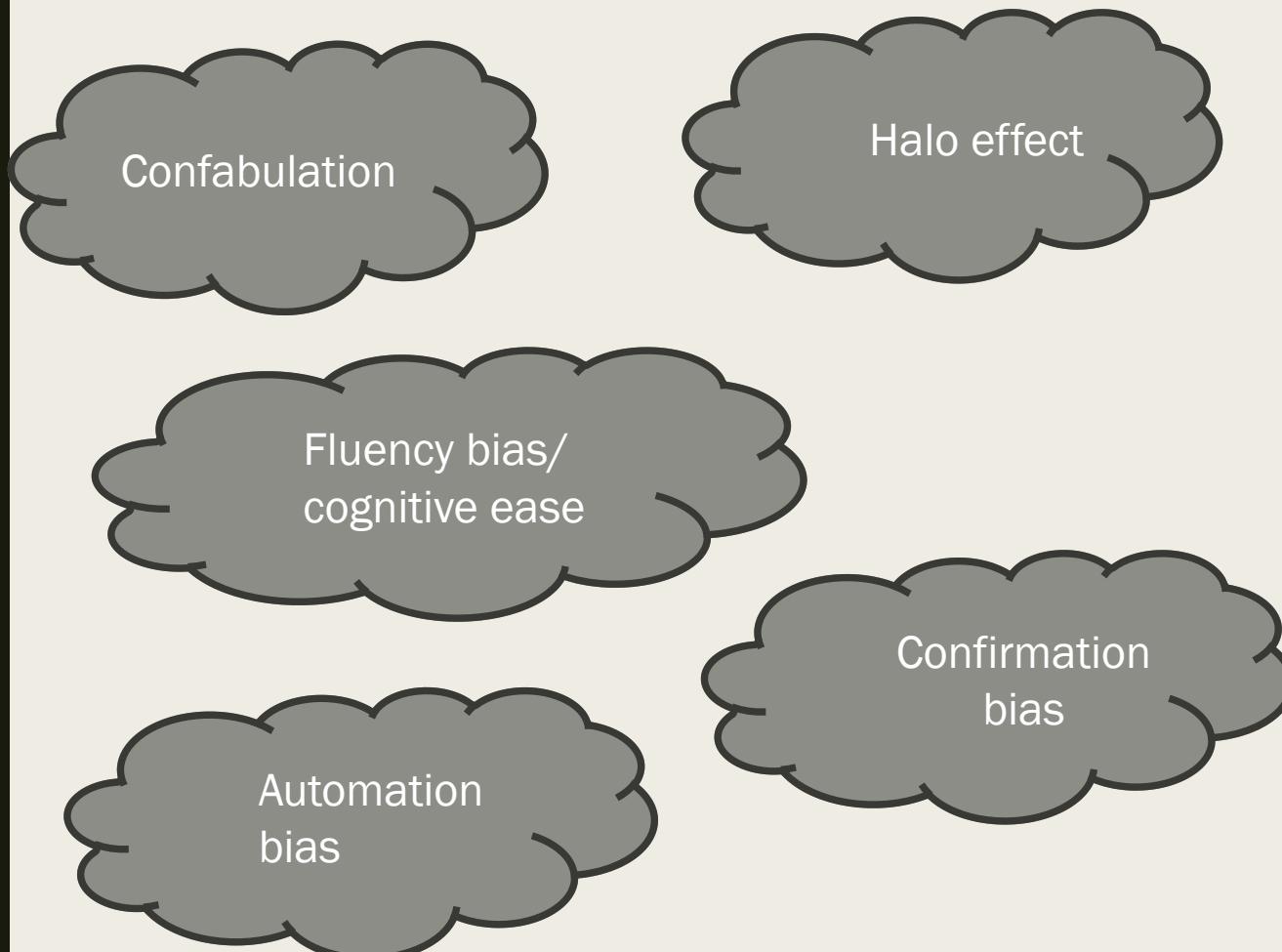


Fluency bias/  
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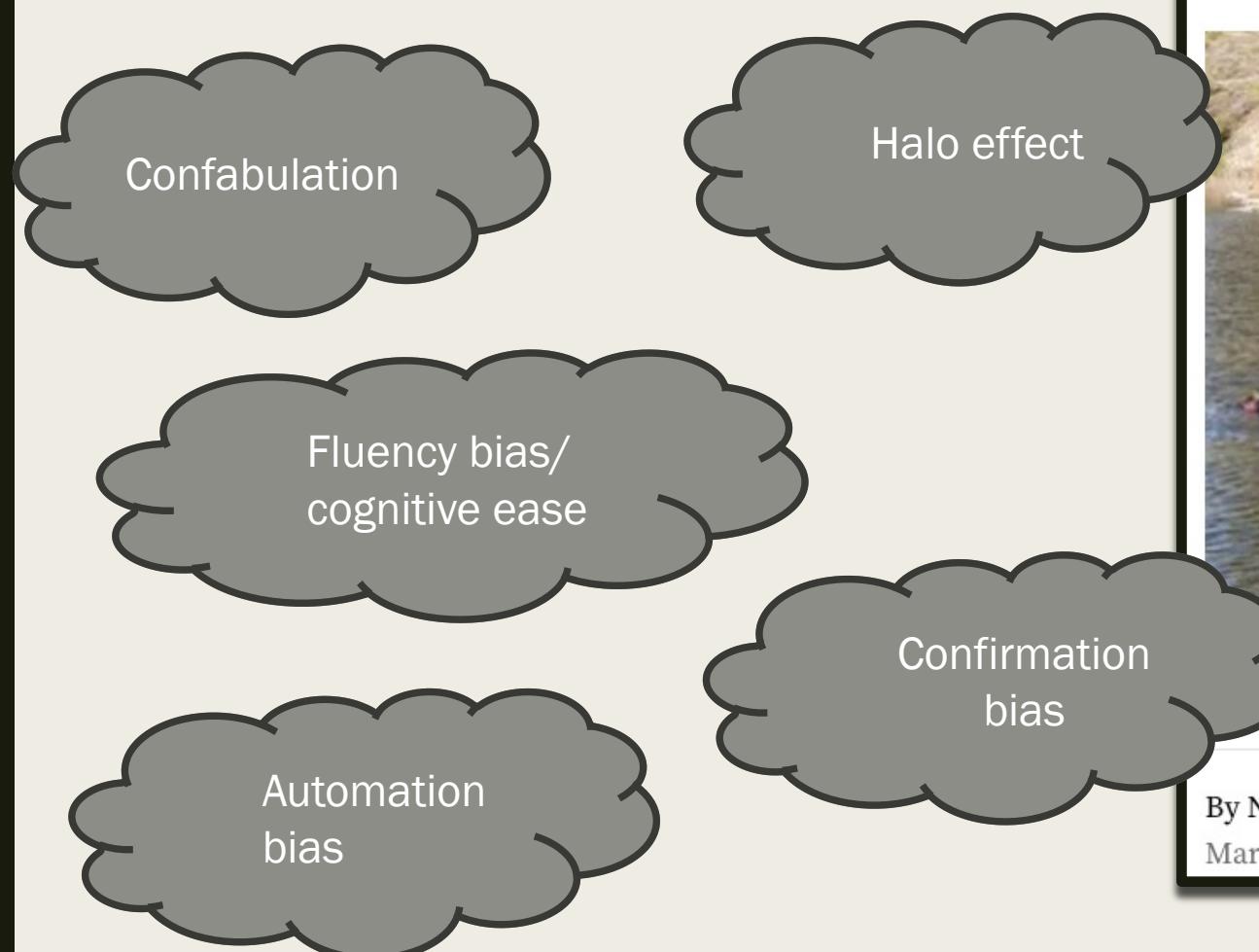


Automation  
bias

# Be aware of your own biases!



# Be aware of your own biases!



## Man following GPS navigation drives car into Charlton lake

The driver managed to escape the vehicle on his own, according to the Charlton Fire Department.



Charlton Fire Department removed this car from Buffumville Lake Sunday. *Charlton Fire Department/@bud\_harris\_photography*

By Nick Stoico, The Boston Globe  
March 15, 2021



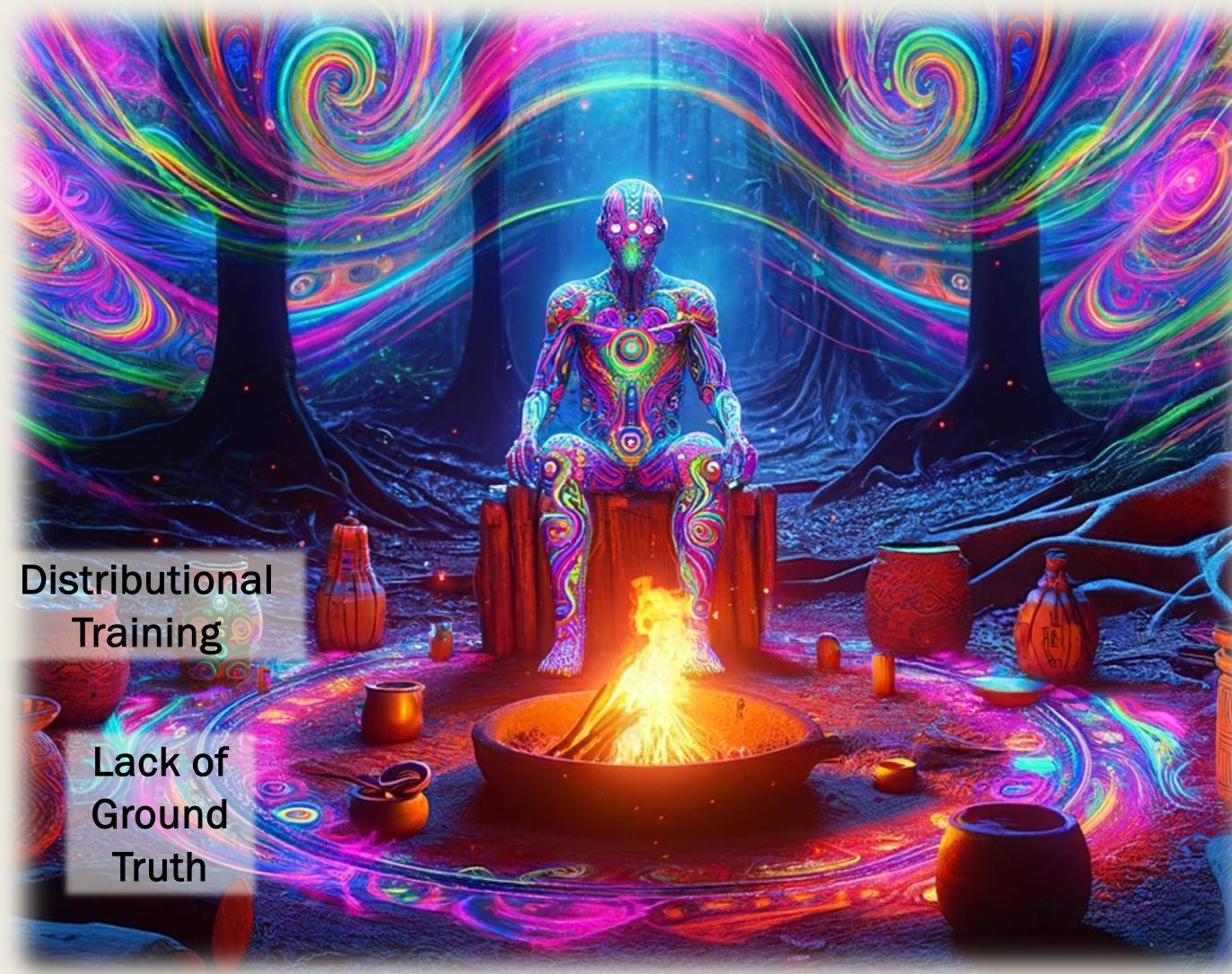
# ChaptGPT hallucinations



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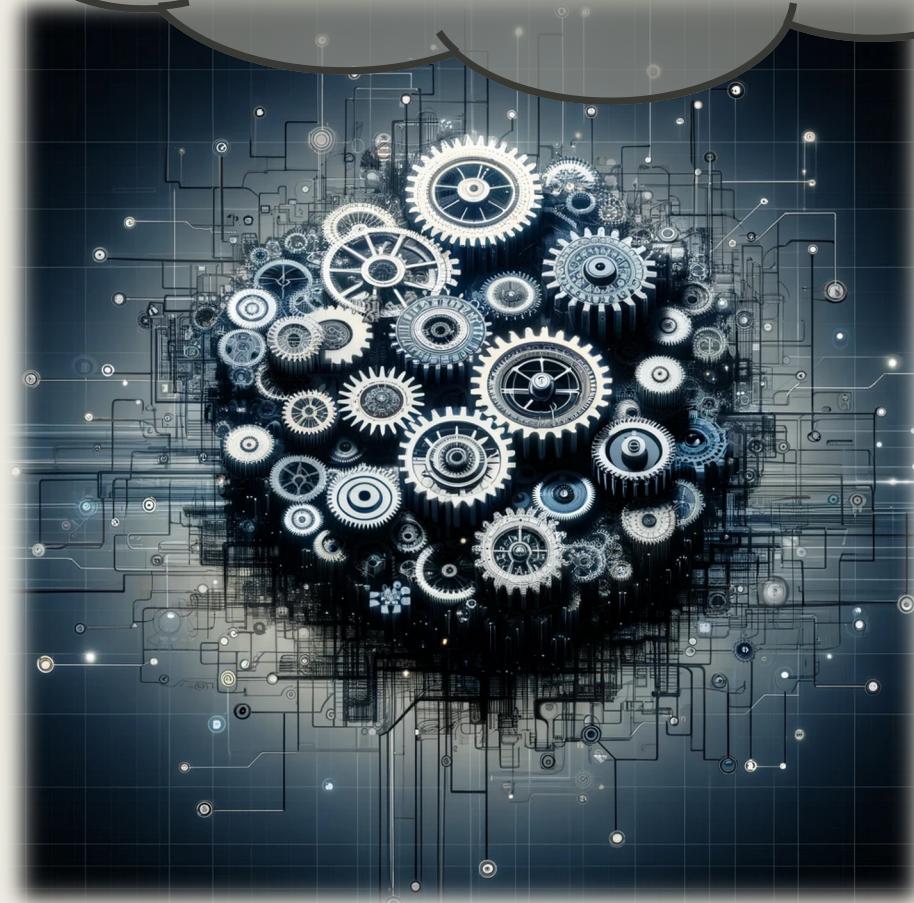
# CHATGPT FOR CODING



*“The first image depicts the English language as a vibrant garden, full of diverse plants and flowers, each symbolizing different aspects of the language such as poetry, drama, and prose.”*



*“The second image symbolizes a programming language through a complex network of gears and circuitry, representing the logical and structured nature of coding.”*



# Three ways to use ChatGPT for coding

Note: this is personal opinion. These categories could be refined and/or expanded.

# Three ways to use ChatGPT for coding

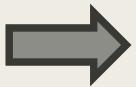


1. Automating  
time-consuming,  
mundane tasks

# Three ways to use ChatGPT for coding



1. Automating  
time-consuming,  
mundane tasks



- boiler plate code, functions, classes, plotting
- unit tests
- documentation
- debugging
- exploring and formatting data

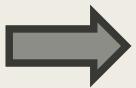
# Three ways to use ChatGPT for coding



1. Automating  
time-consuming,  
mundane tasks



2. Expanding the  
scope of your  
workflow



- boiler plate code, functions, classes, plotting
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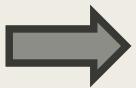
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- suggest new packages/tools/algorithms
- quickly explore and iterate through ideas
- fill gaps in your understanding

# Three ways to use ChatGPT for coding



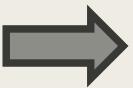
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3. Improving your  
software/ML  
engineering skills



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# Three ways to use ChatGPT for coding



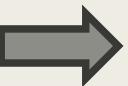
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- boiler plate code, functions, classes, plotting
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- suggest new packages/tools/algorithms
- quickly explore and iterate through ideas
- fill gaps in your understanding



- CI/CD pipelines, IDE hacks, bash/shell scripting
- refactoring, software dev best practices
- docker, databases, cloud infrastructure
- MLOps, security, networking, system design
- writing performant code

Note: this is personal opinion. These categories could be refined and/or expanded.

# Expanding the scope of your workflow



“create a gitlab-runner.yaml file to automatically lint, format, and run unit tests for each new merge request”

## What I can do in 20 mins, given my programming ability

“make a list  
with six  
numbers”

“write a for loop to  
add two numbers”

“print ‘hello  
world’ 10 times”

“make a function to add  
two numbers”

# Expanding the scope of your workflow



What I can do in 20mins,  
given my + chatGPT's  
programming ability

"write a convolutional neural net for this  
data set in pytorch"

"Create an abstract base class for  
create a gitlab-runner.yaml file to automatically lint, my pytorch modules"  
format, and run unit tests for each new merge  
request"

What I can do in 20 mins,  
given my programming ability

"make a list  
with six  
numbers"

"write a for loop to  
add two numbers"

"print 'hello  
world' 10 times"

"make a function to add  
two numbers"

"write unit tests for this  
package"

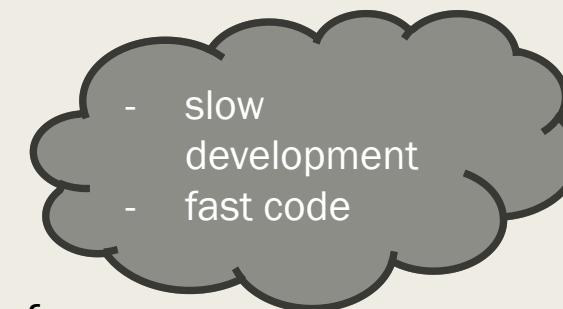
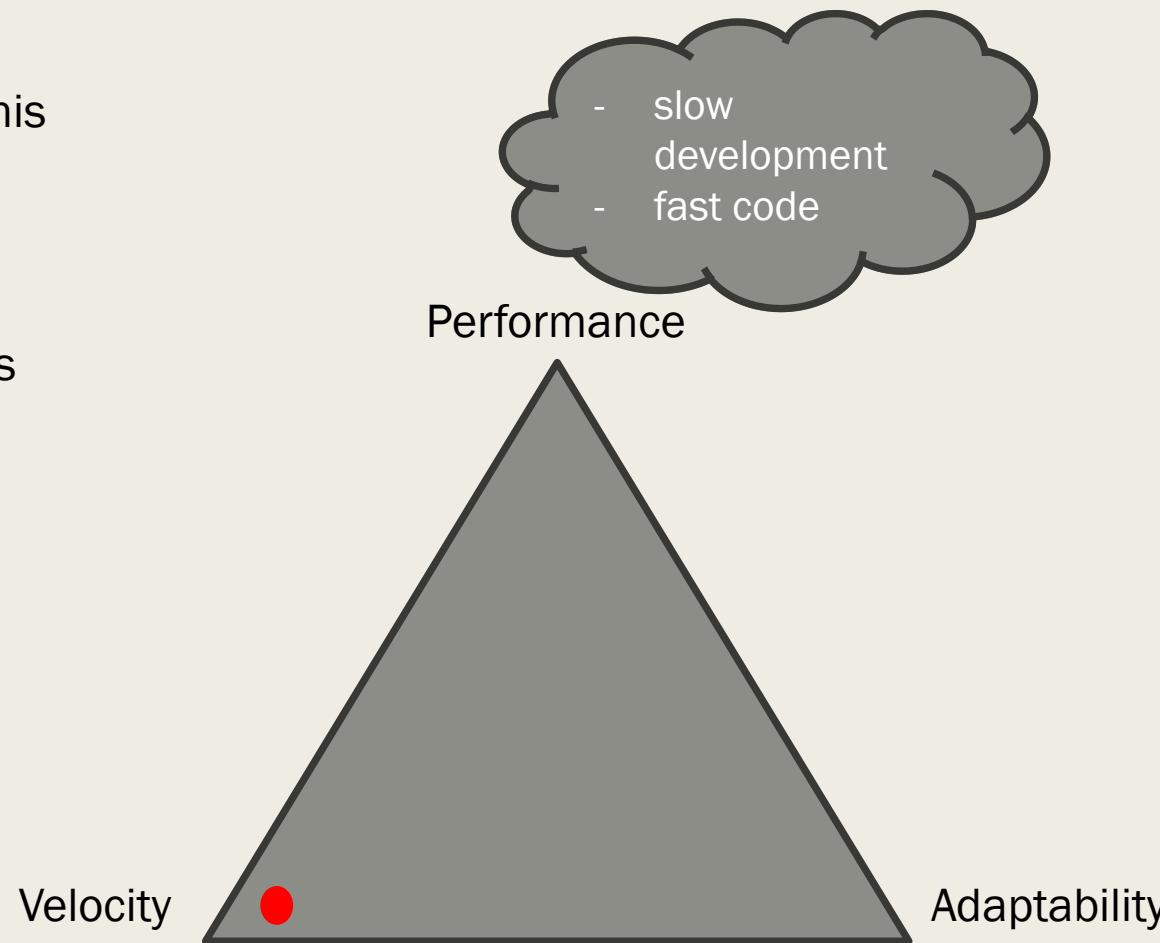
"add shuffling, batching,  
early stopping to my  
training loop"

"suggest some refactoring  
and software development  
best practices"

Q: Where do you sit on this triangle when you write code at the start of a project?

Q: How does it change as the project develops?

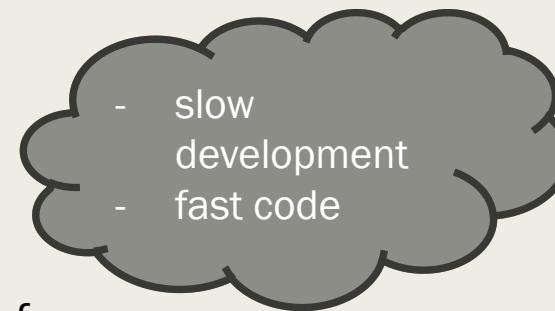
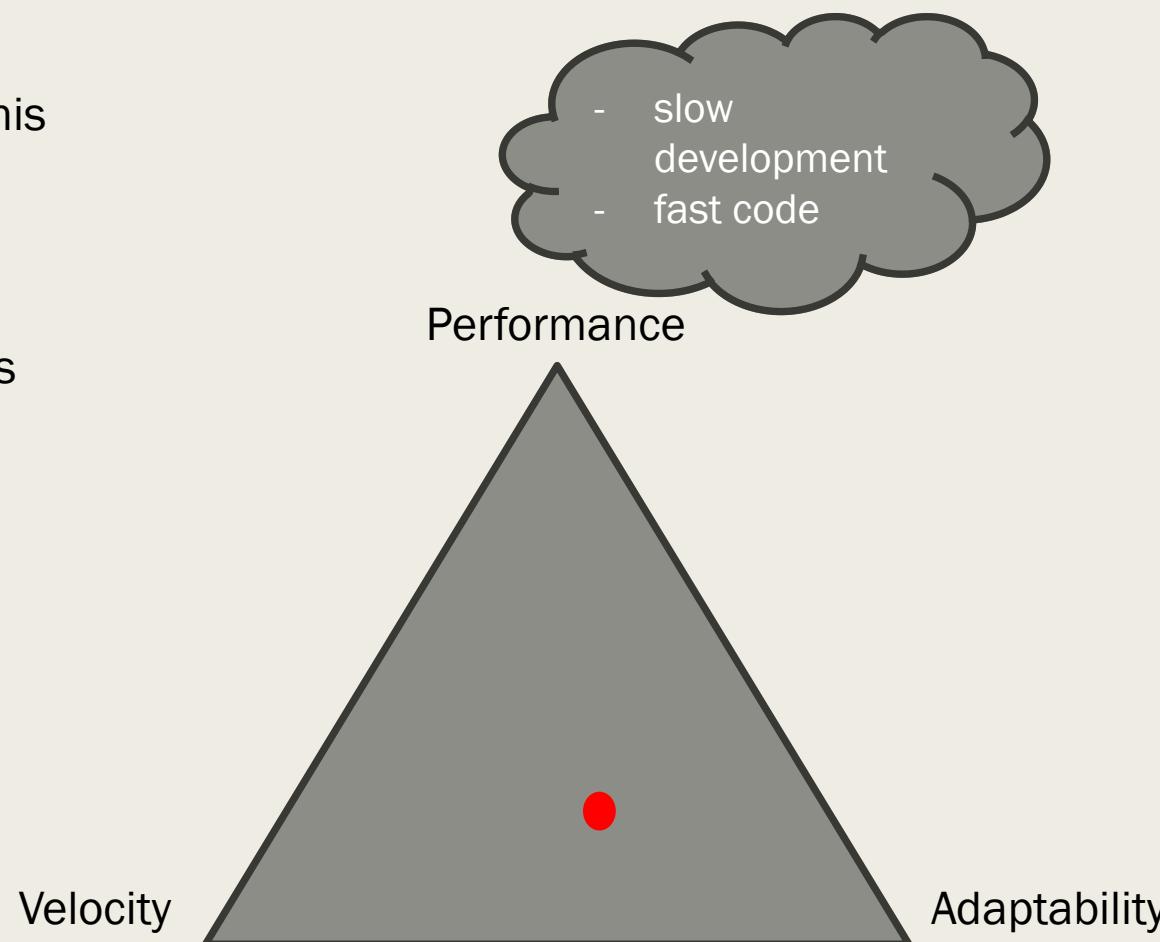
Q: ... what about your colleagues?



Q: Where do you sit on this triangle when you write code at the start of a project?

Q: How does it change as the project develops?

Q: ... what about your colleagues?



*Fin.*



# CODING TASK

Go to:

[tinyurl.com/ra24-chatgpt-workshop](https://tinyurl.com/ra24-chatgpt-workshop)

(Definitely not a phishing scam)

