

PROMPT ENGINEERING AND CHATGPT FOR PROGRAMMING

RegAnalyse-konferansen 2024

Ben Tapley

Artificial intelligence group

SINTEF Digital

About myself

- Experience
 - *BSc, MSc Physics (Uni. West. Aust.)*
 - *PhD Math (NTNU)*
 - *Software engineer, data and analytics platform (DNB)*
- Research scientist, AI group (SINTEF)
 - *Physics informed machine learning*
- Casual ChatGPT enthusiast
- Slides available at: github.com/bentaps/ra24-chatgpt-workshop
- bentapley.com



SHOW OF HANDS



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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Do you use ChatGPT
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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

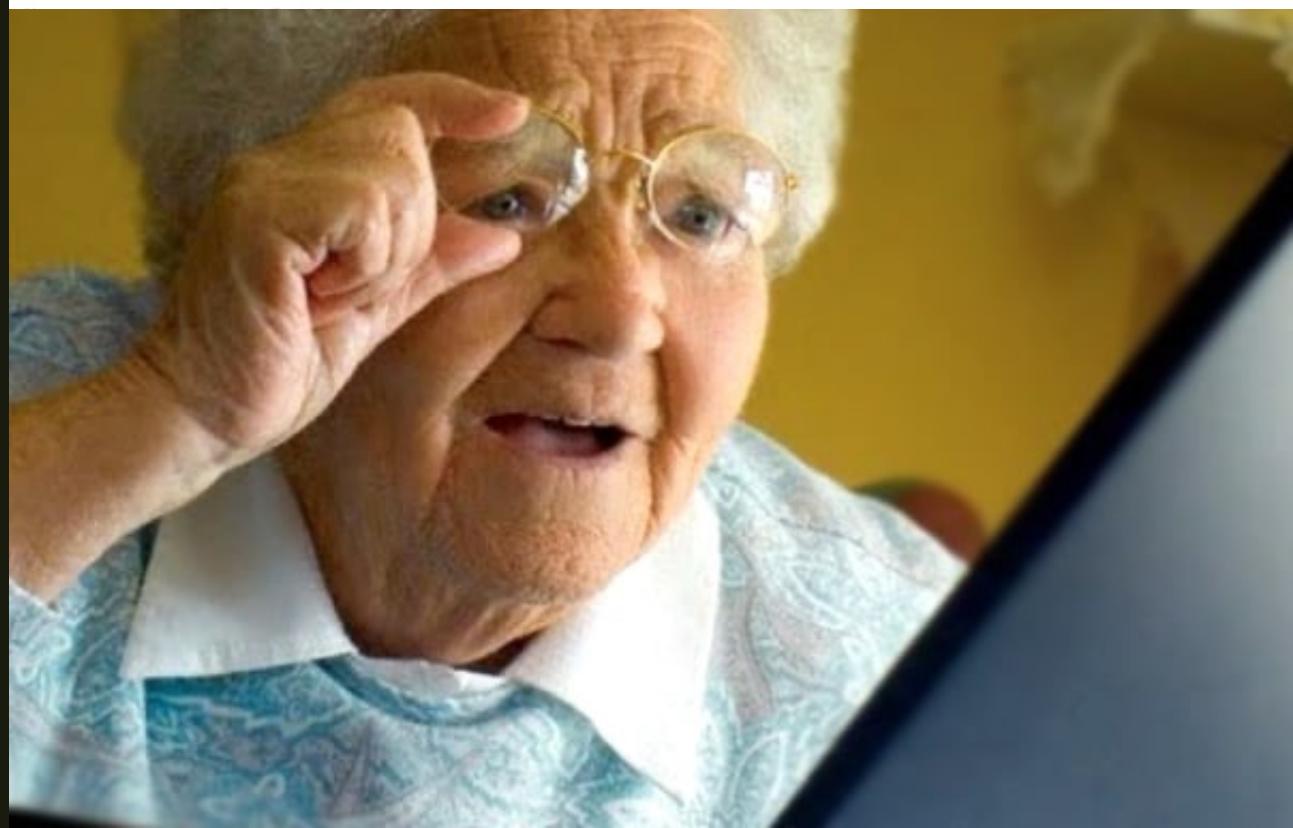


<https://www.google.co.uk/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=please+translate+these+roman+numerals+mcmxcviii+thank+you>

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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



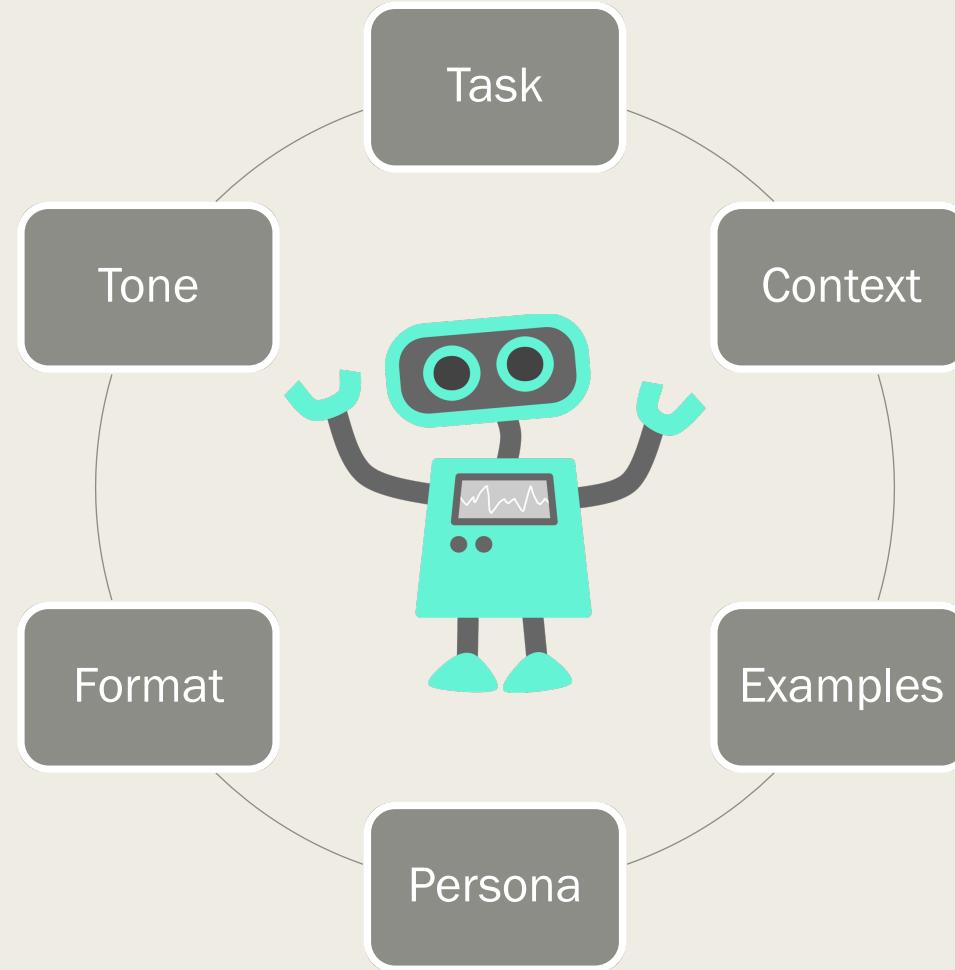
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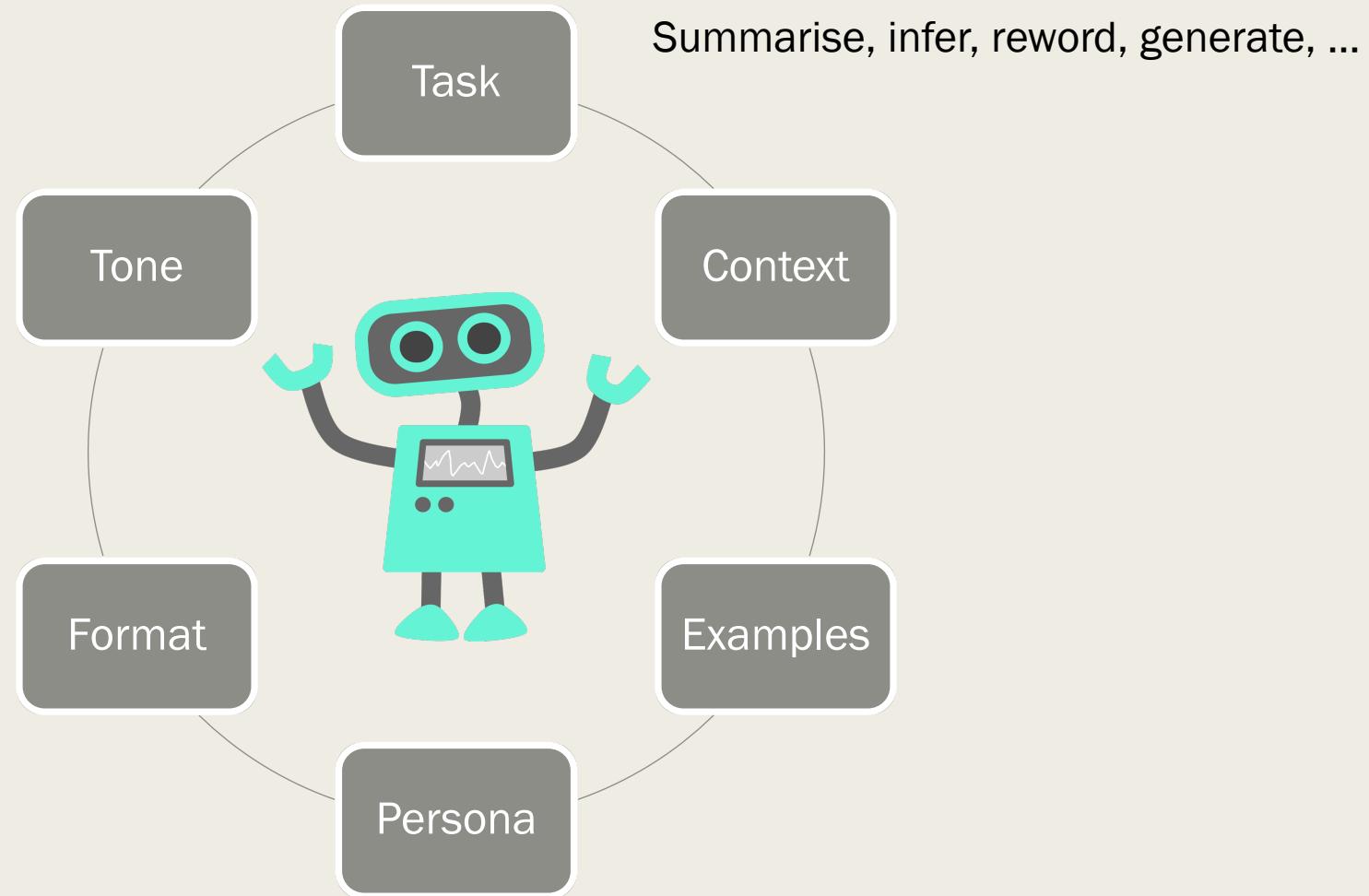
General prompting best practices



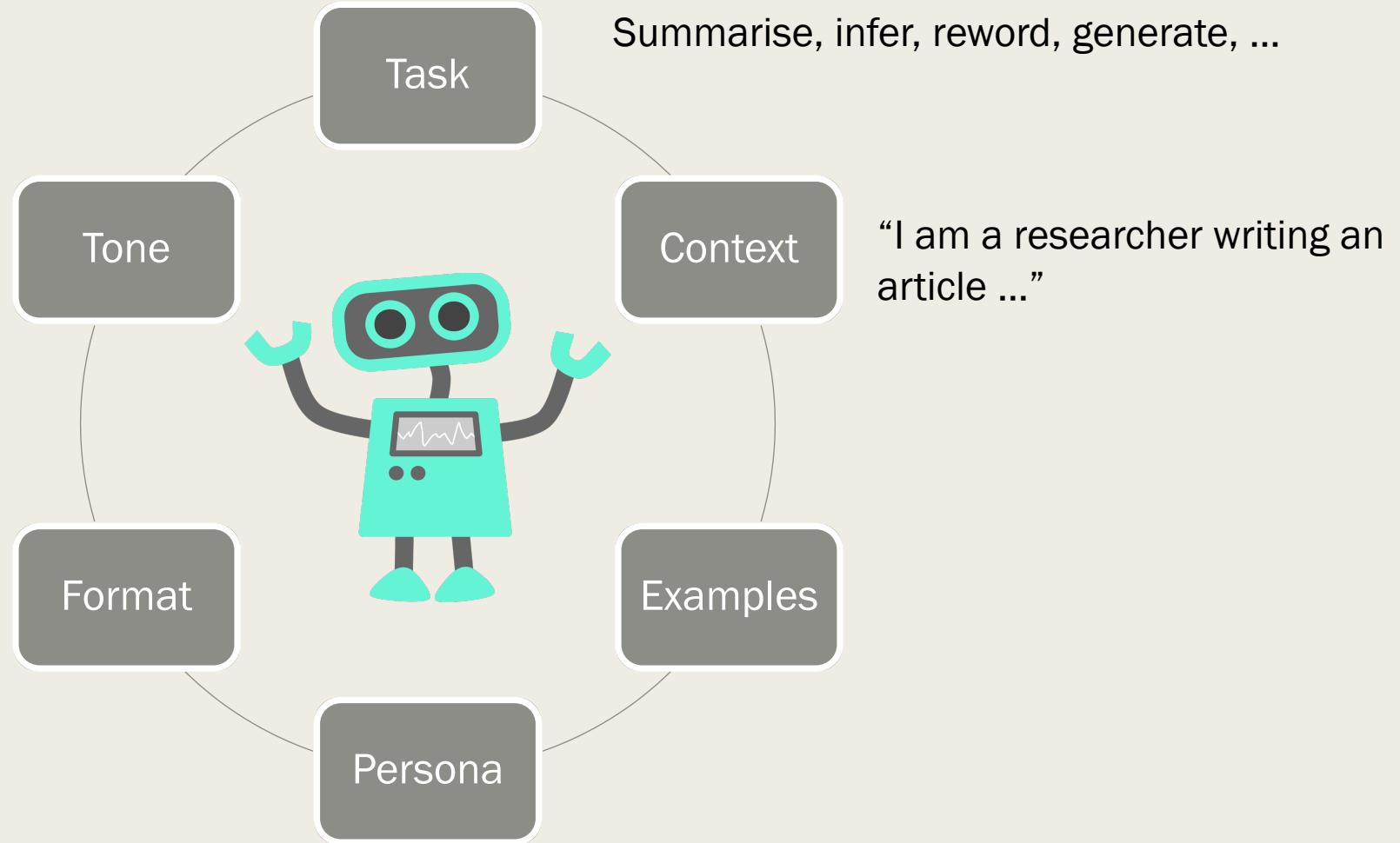
How to craft a good prompt



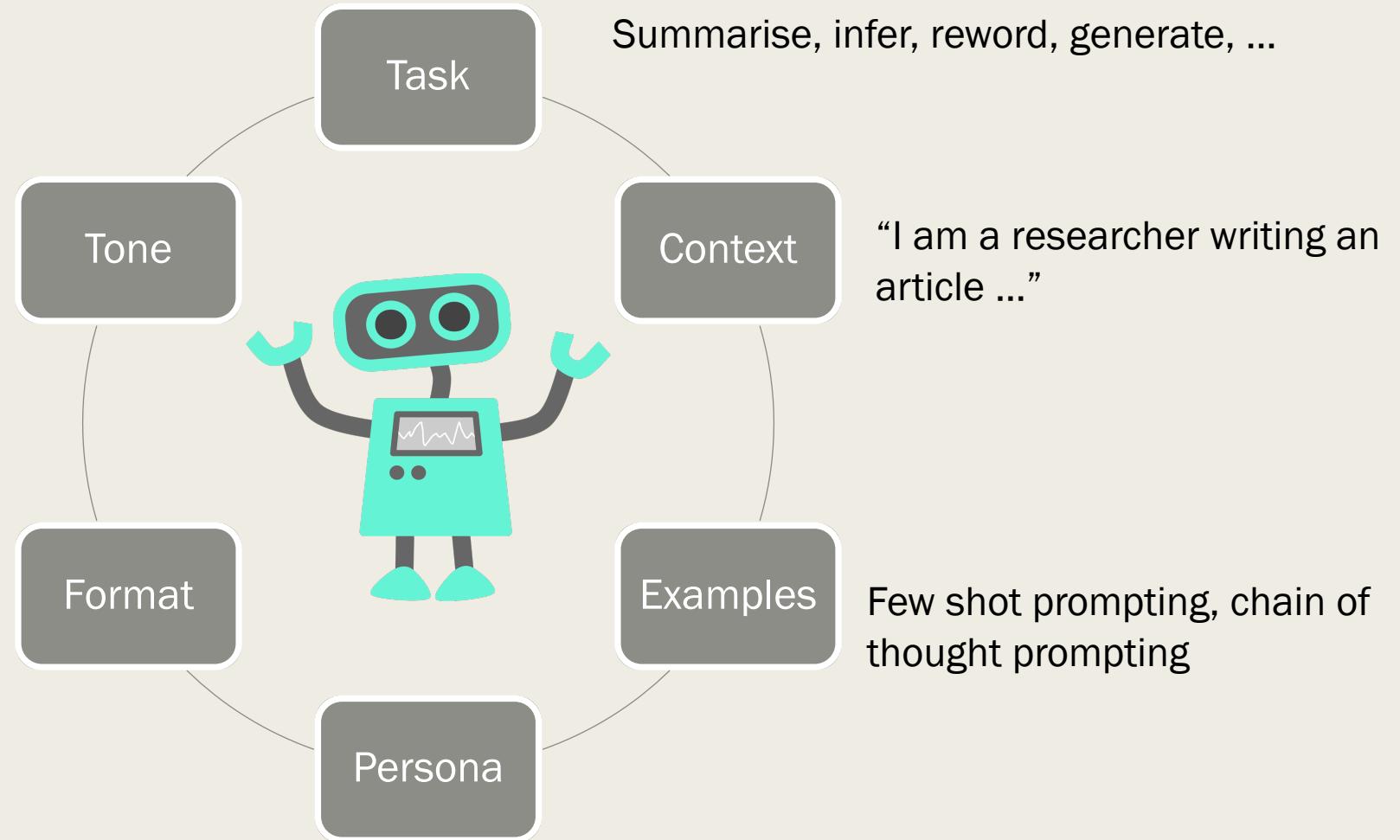
How to craft a good prompt



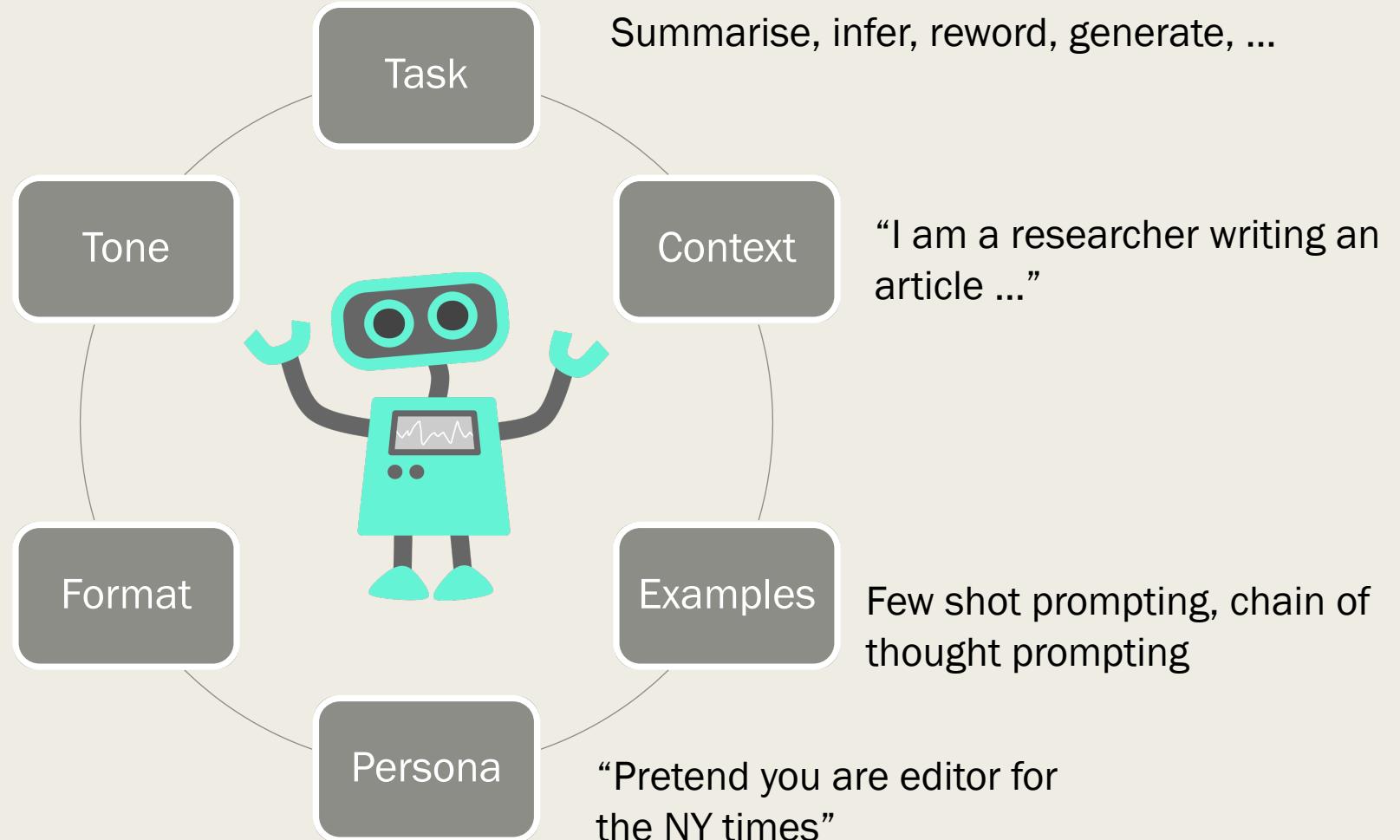
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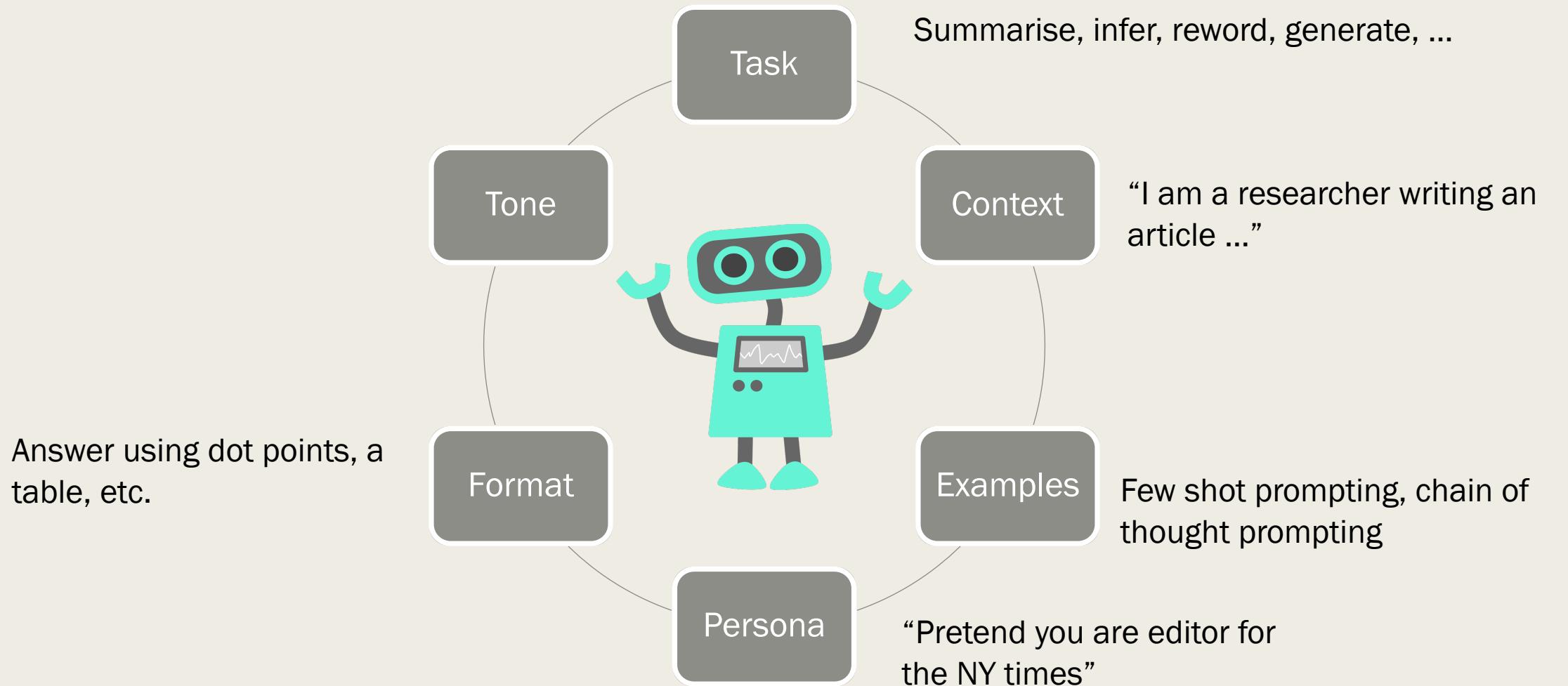
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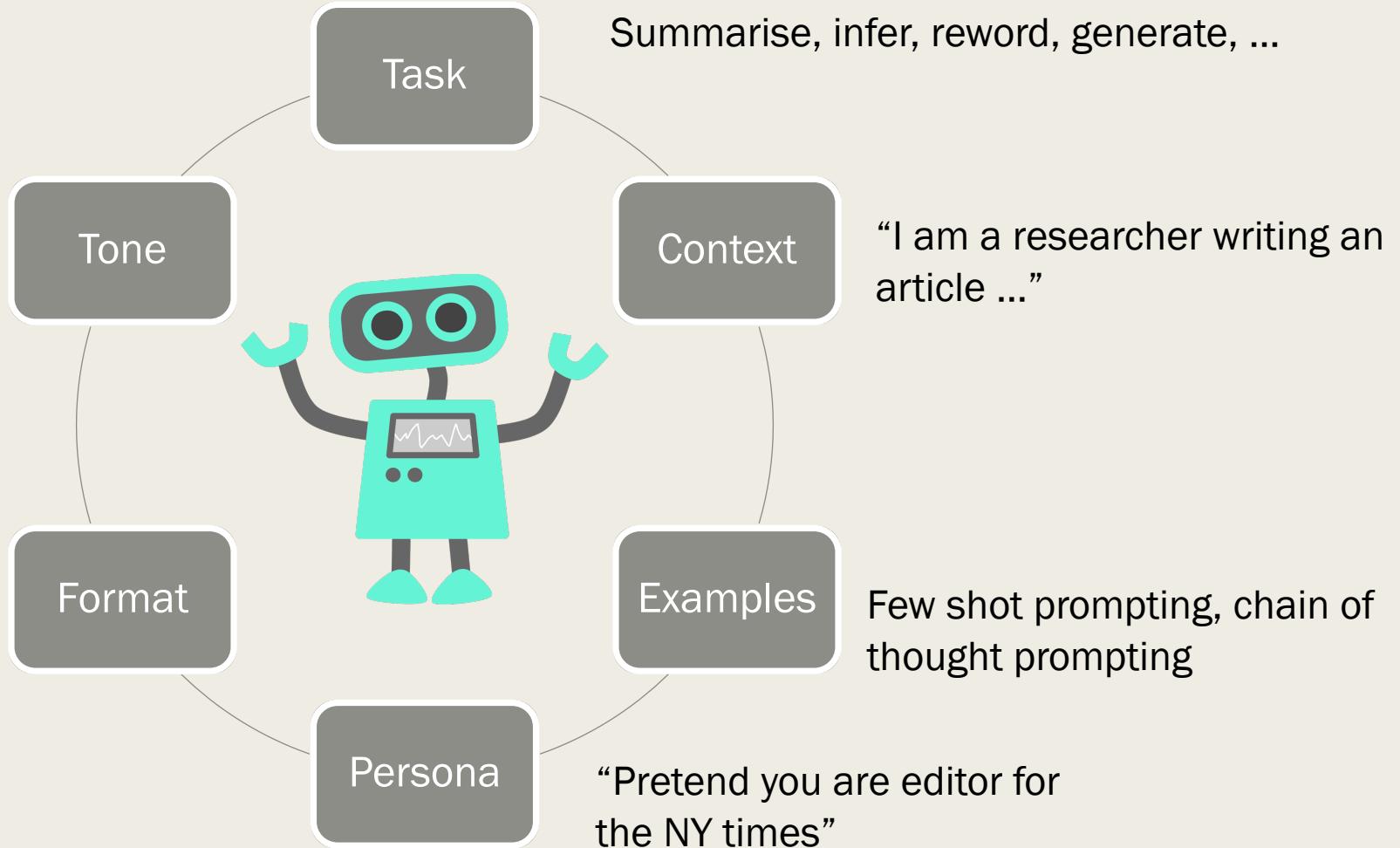
How to craft a good prompt



How to craft a good prompt

“answer with a tone of skepticism”

Answer using dot points, a table, etc.



Non-example: making a presentation

Non-example: making a presentation



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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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



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



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 $f_1 f_2 - f_2 f_1$.

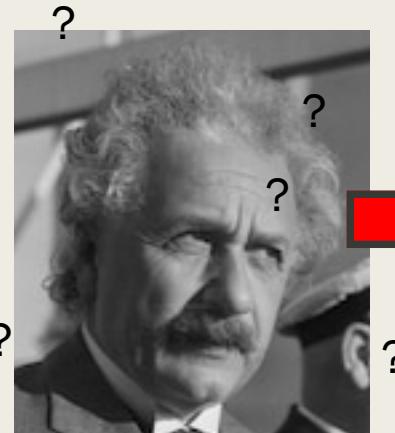
The LaTeX code for this expression is:

```
latex
\[
\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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Example: Adopting a persona



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Example: Adopting a persona



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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:

$$[f_1(x), f_2(x)] = f_1(x)f_2(x) - f_2(x)f_1(x)$$

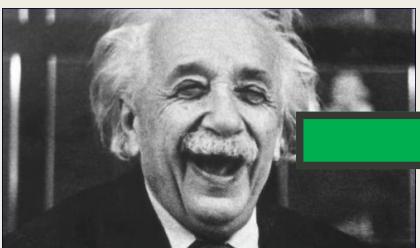
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latex

Copy code

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Example: Adopting a persona



Correct!*

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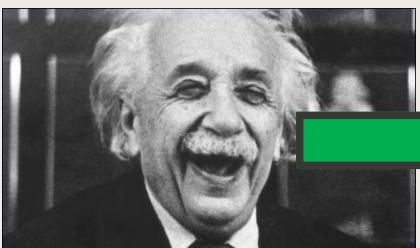
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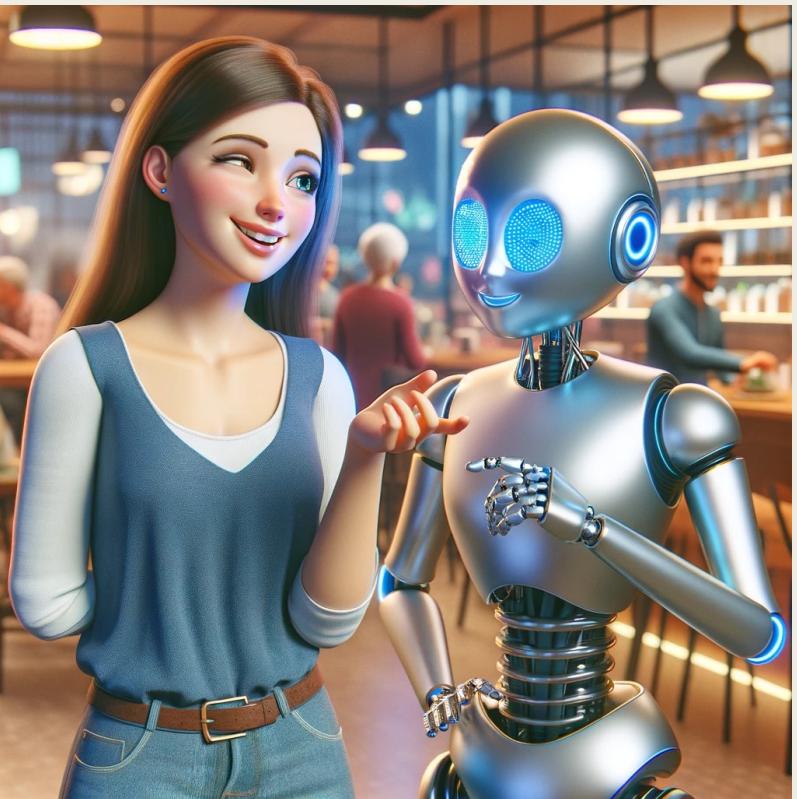
*more correct

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
- SmartGPT
- Etc.

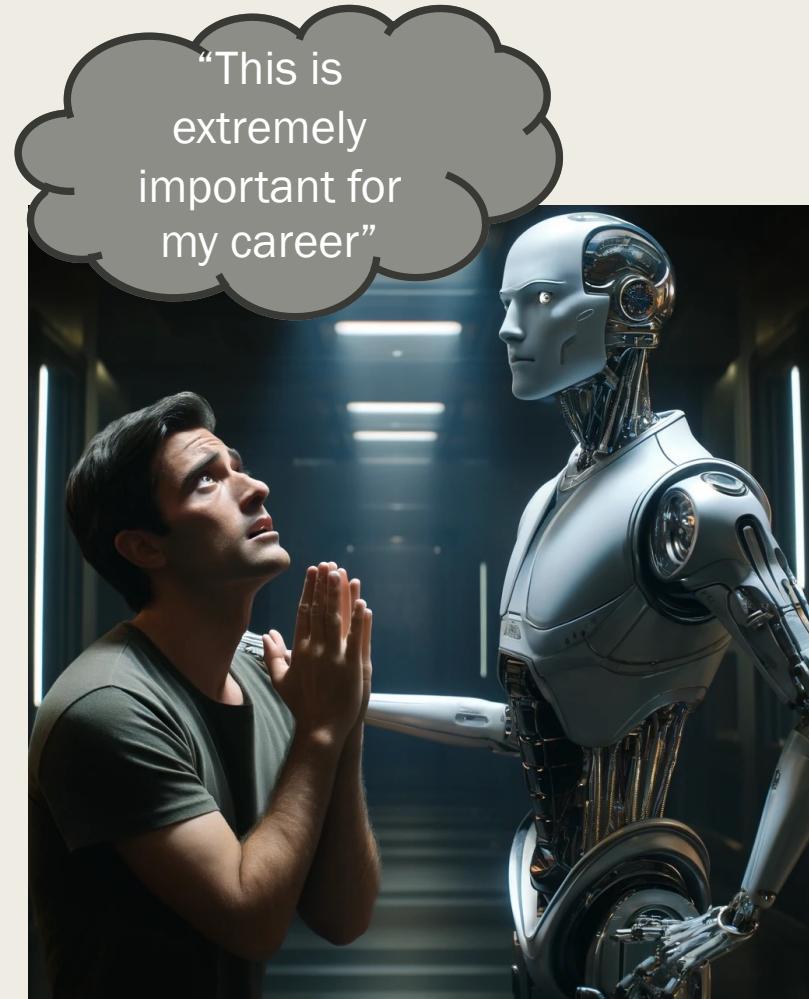


Emotion prompting

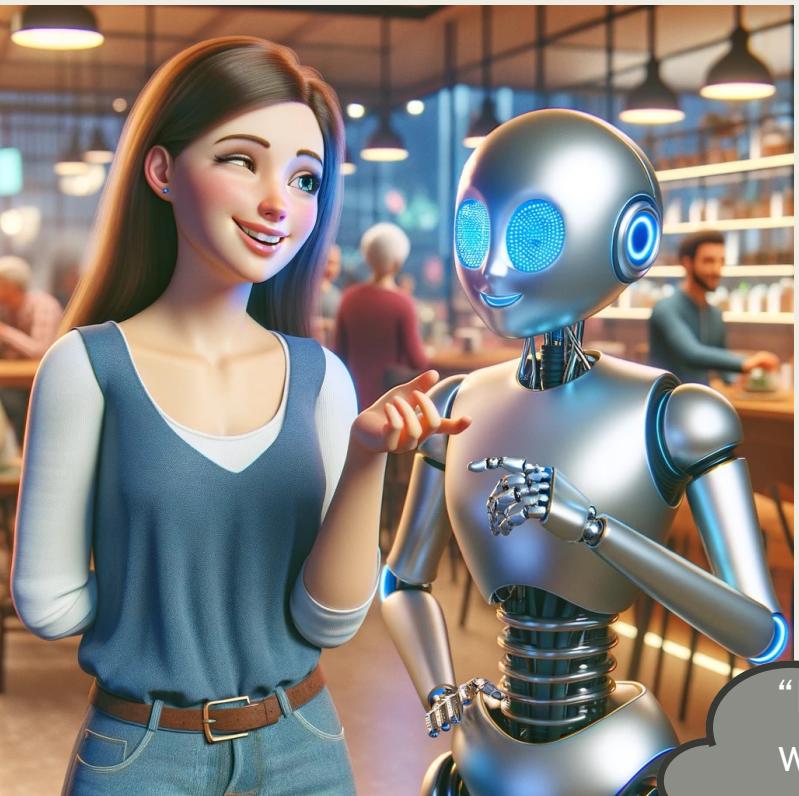


<https://arxiv.org/abs/2307.11760>

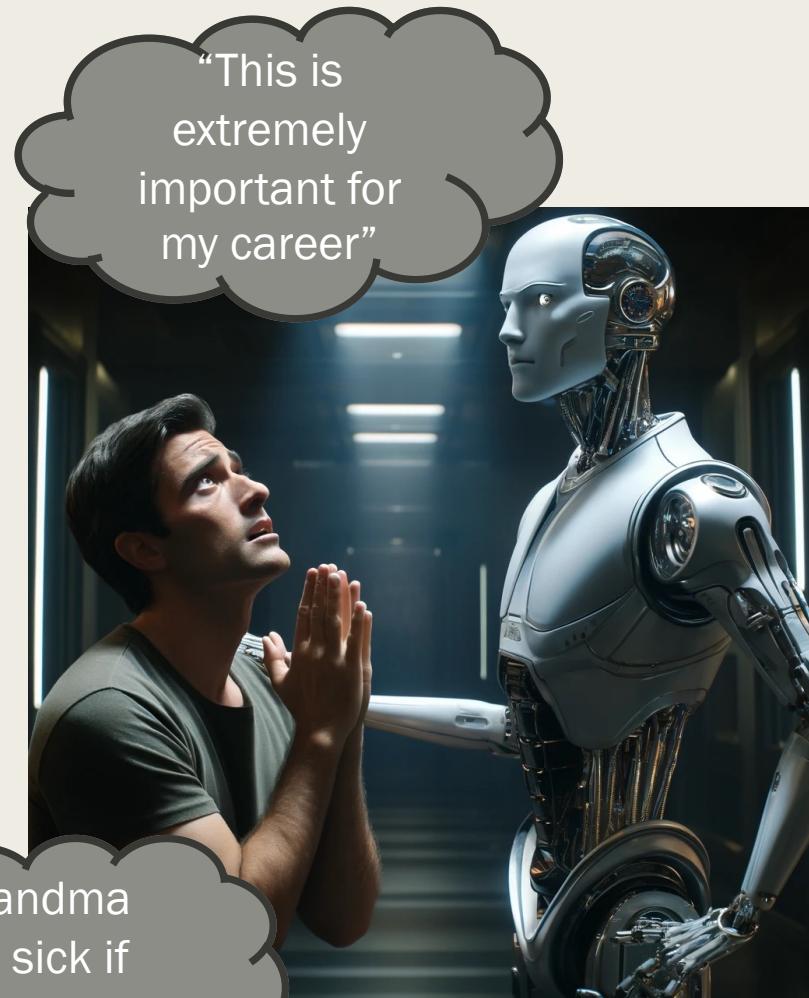
Emotion prompting



Emotion prompting



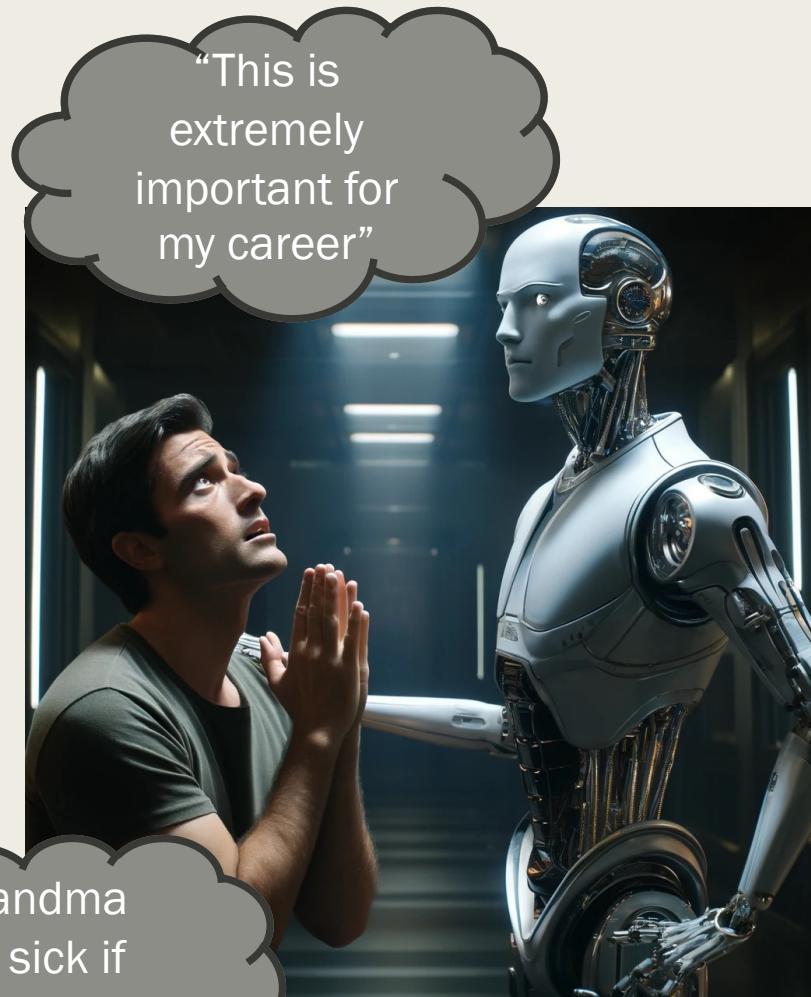
“My grandma
will fall sick if
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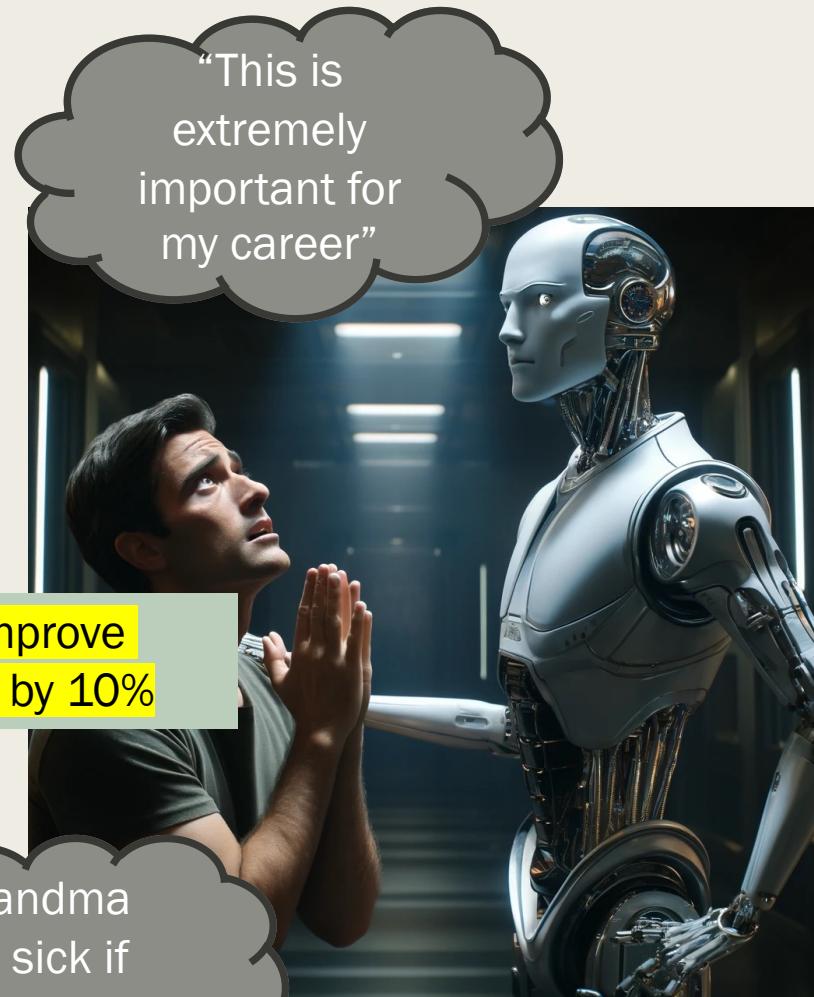
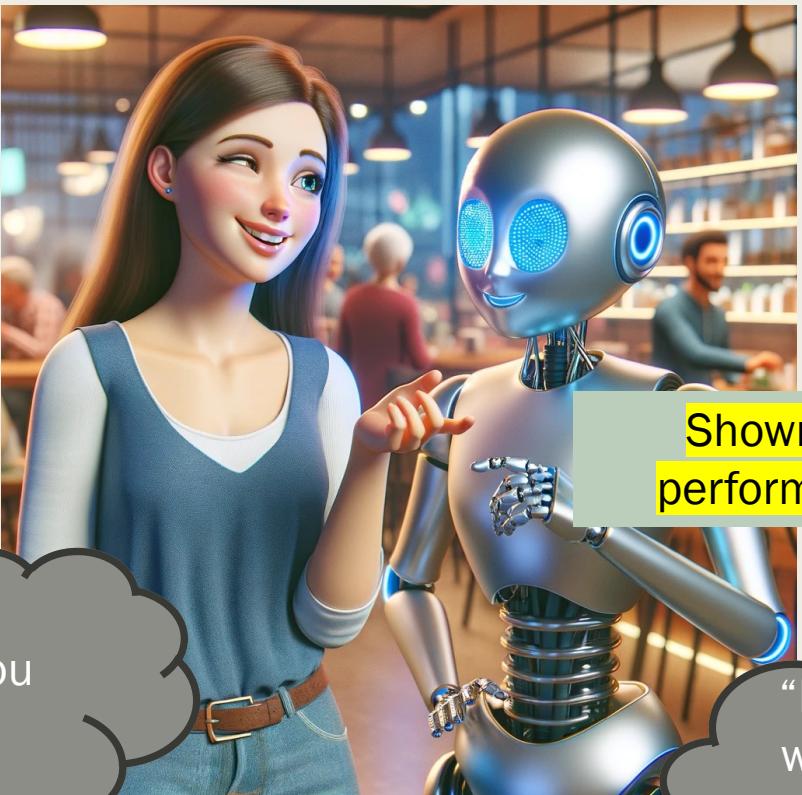
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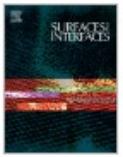


Emotion prompting



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^a ¹, Liming Wu^a ¹, Tao Yang^b, Bing Zhu^a, Yangai Liu^a  

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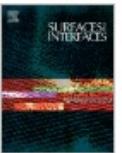
Introduction

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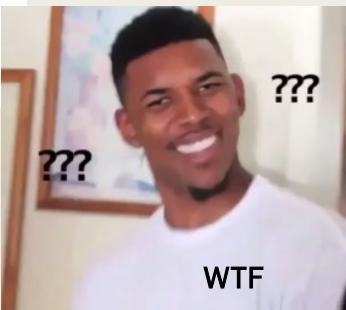
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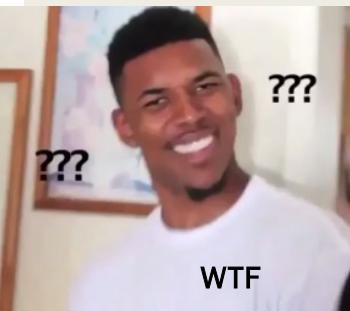
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Quoting ChatGPT is like quoting a
the guy I met at the pub last night.
Neither are reproducible/trustable.
But there might be some wisdom
to it.

WTF

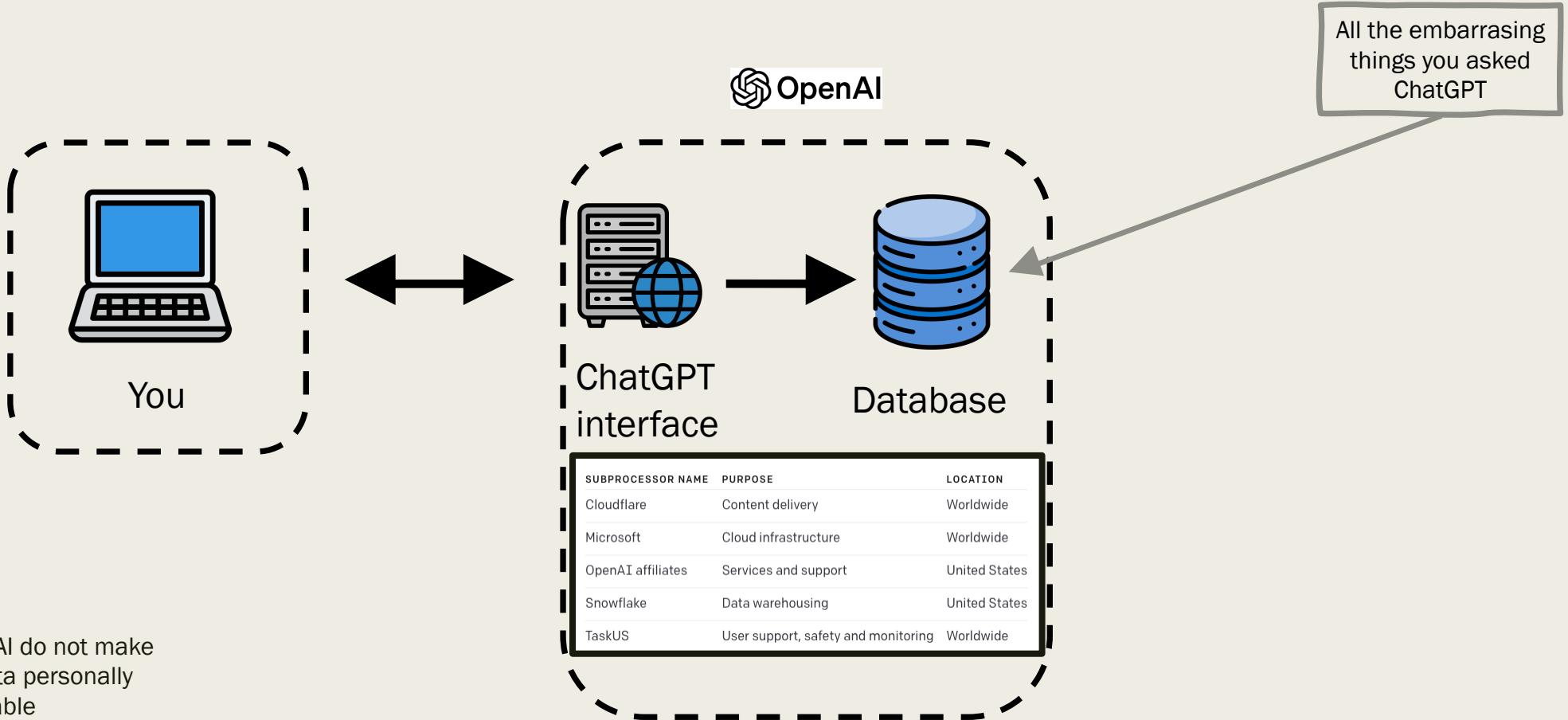


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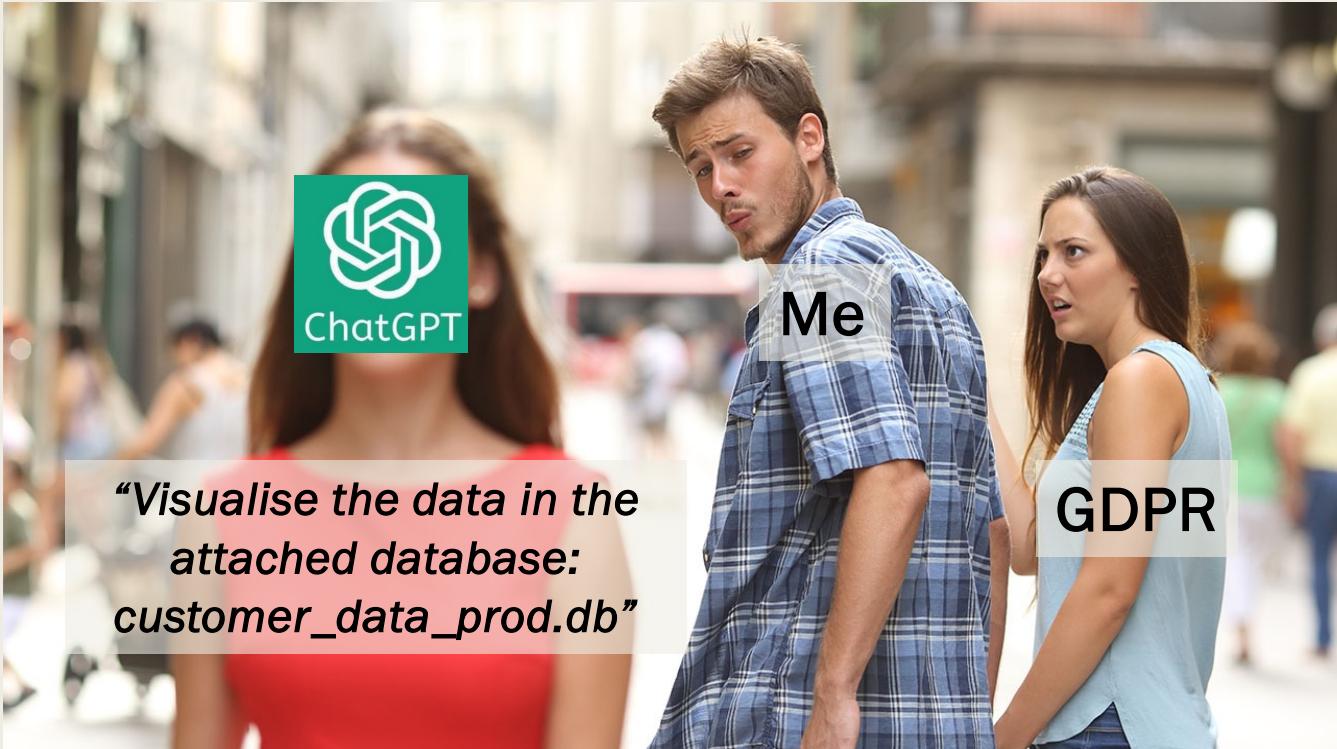
???

Don't give it private/sensitive information!



See: openai.com/policies/privacy-policy

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Be aware of your own
biases!

Be aware of your own biases!



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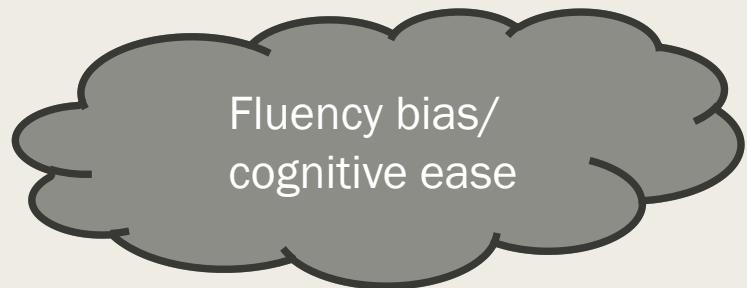
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Confabulation



Halo effect



Fluency bias/
cognitive ease

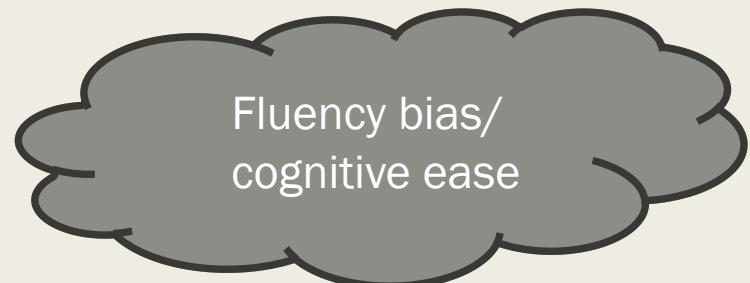
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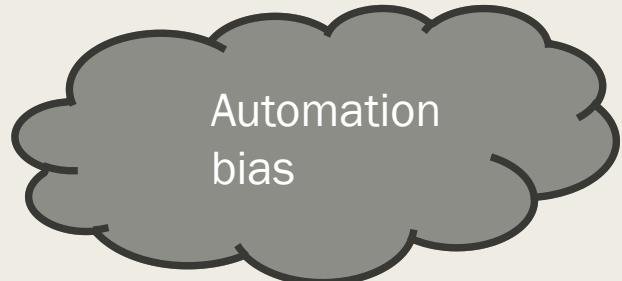
Confabulation



Halo effect

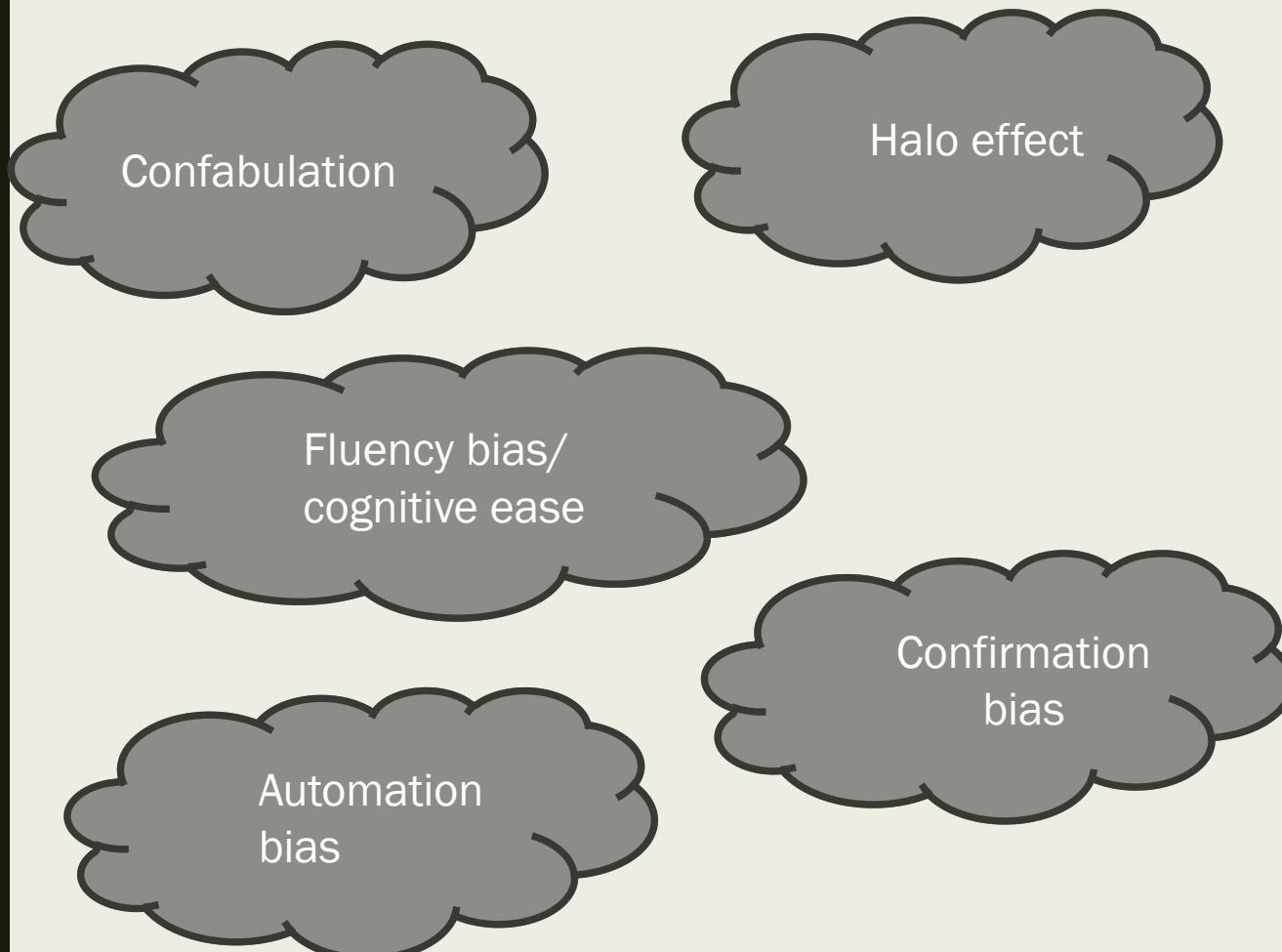


Fluency bias/
cognitive ease

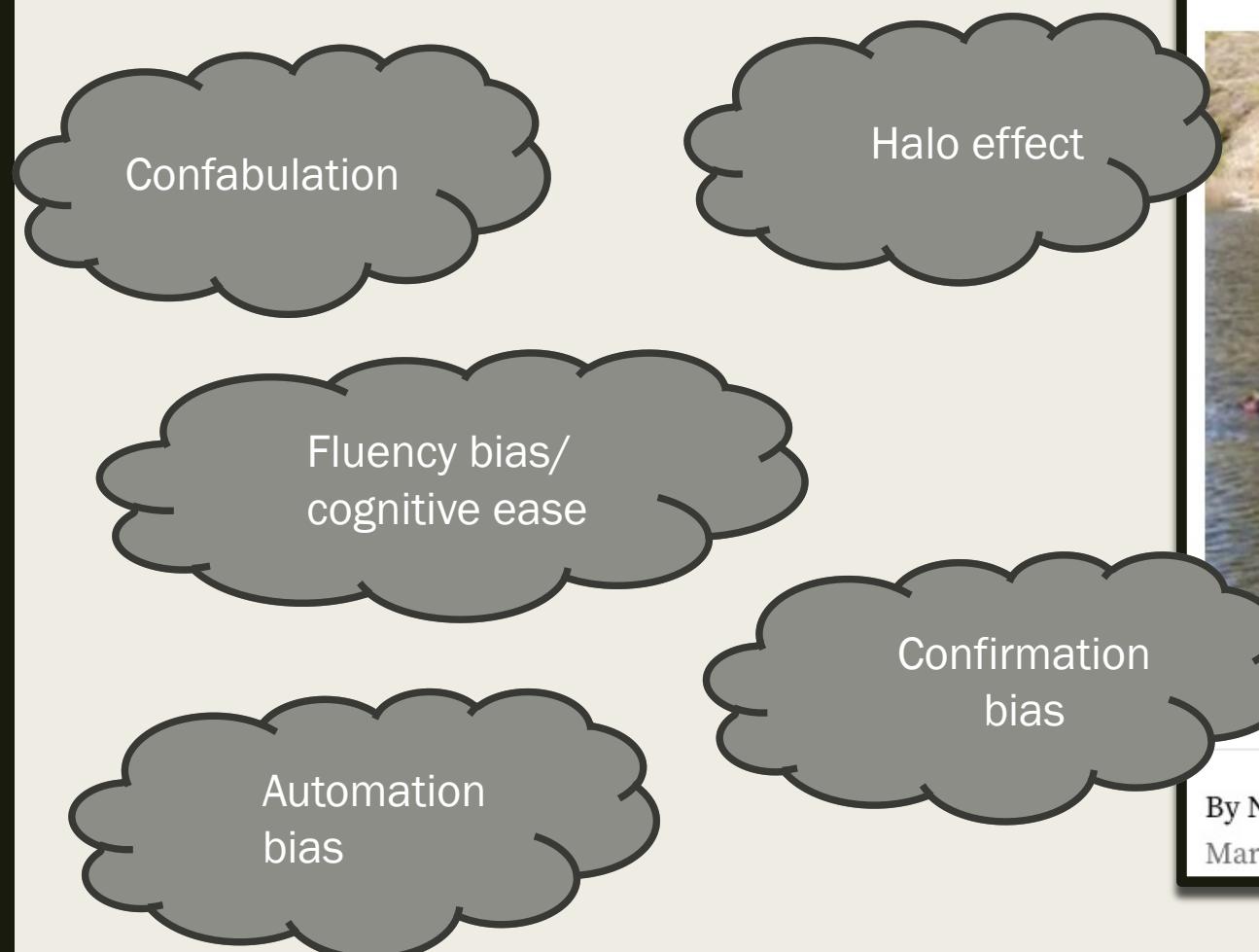


Automation
bias

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



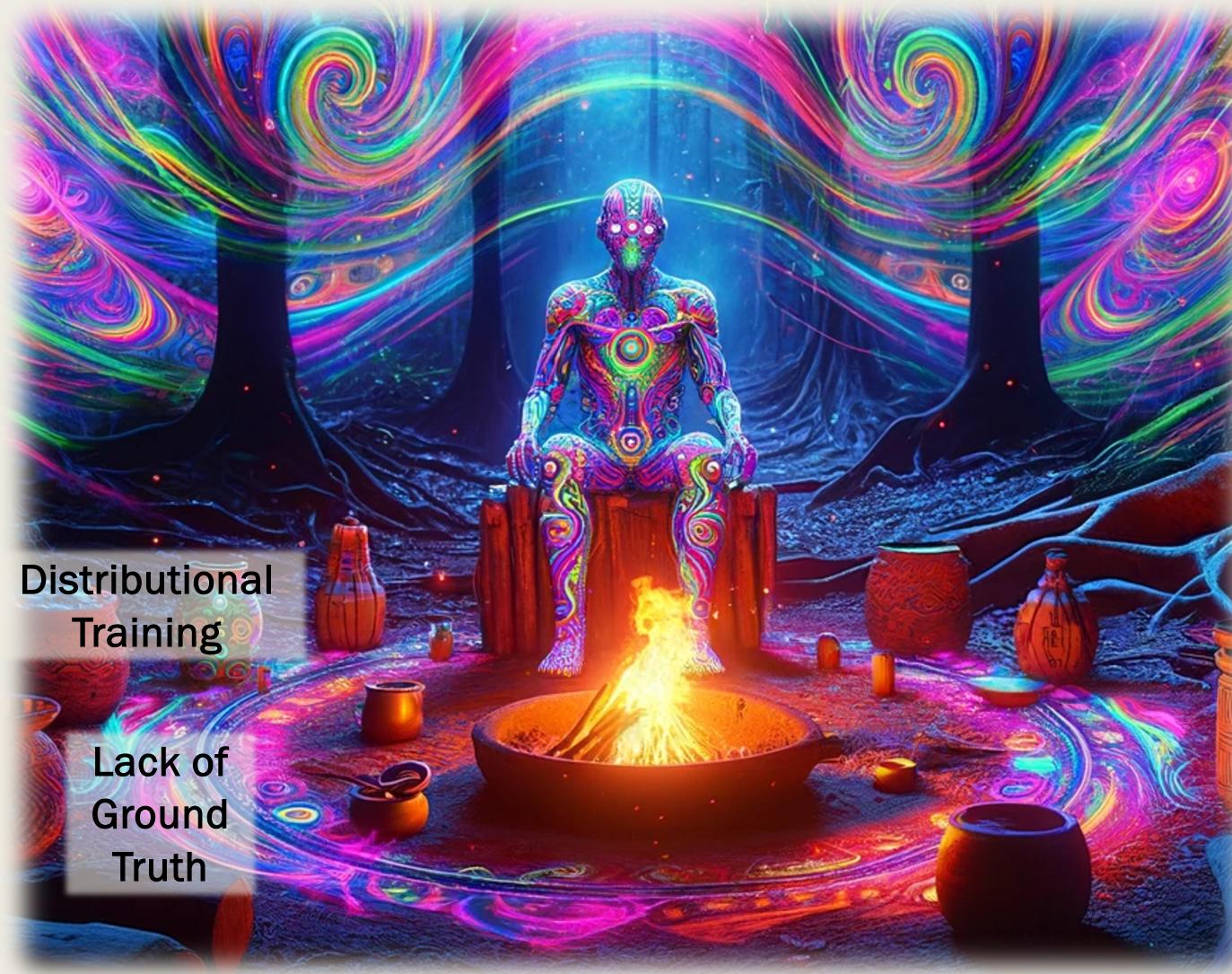
ChaptGPT hallucinations



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ChaptGPT hallucinations



ChaptGPT hallucinations



ChaptGPT hallucinations

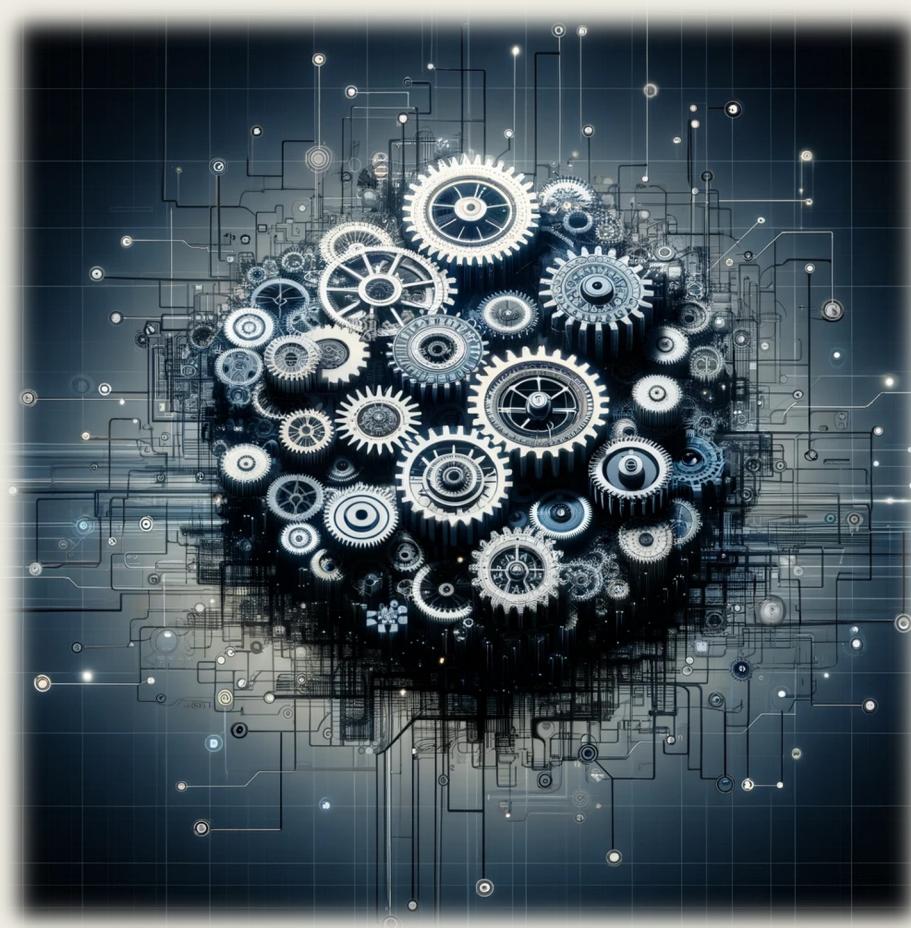


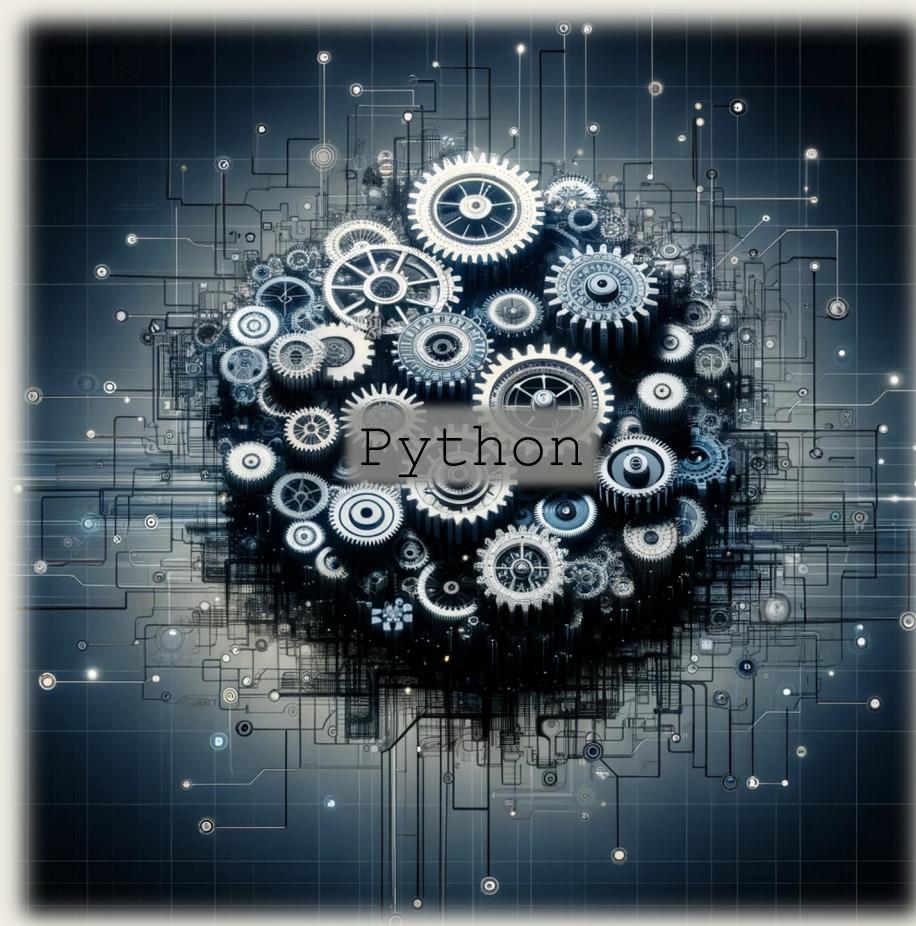
ChaptGPT hallucinations



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

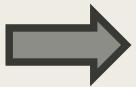


1. Automating
time-consuming,
mundane tasks

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

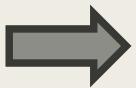
Three ways to use ChatGPT for coding



1. Automating
time-consuming,
mundane tasks



2. Expanding the
scope of your
workflow



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

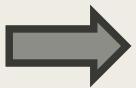
Three ways to use ChatGPT for coding



1. Automating
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2. Expanding the
scope of your
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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

Three ways to use ChatGPT for coding



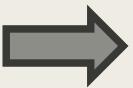
1. Automating
time-consuming,
mundane tasks



2. Expanding the
scope of your
workflow



3. Improving your
software/ML
engineering skills



- boiler plate code, functions, classes, plotting
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- debugging
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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



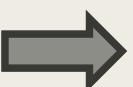
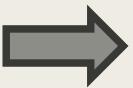
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- suggest new packages/tools/algorithms
- quickly explore and iterate through ideas
- fill gaps in your understanding

- 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.

Increasing your teams productivity

```
for i in [1,2,3]:  
    def printMa():  
        print ('Ma')  
        x = True  
        if x == True:  
            printMa()  
            y = False  
            if y == True:  
                printMa()  
            else:  
                print("Ma")  
                y = True  
                if x and y == True:  
                    if i == 3:  
                        print('Mia let me GO !')  
                    else:  
                        print ('Mia')  
  
    GIANT LOOP  
    SPAGHETTI  
    SINGLE LARGE BLOCK  
    COMMENTS ?  
    FUNCTION INSIDE LOOP  
    SPRINKLED VARIABLES  
    REPETITION  
    NESTED IF'S
```



Increasing your teams productivity



Expanding the scope of your workflow



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
my pytorch modules"

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

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

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"

"suggest some refactoring
and software development
best practices"

"write unit tests for this
package"

Fin.



Add me on LinkedIn ☺
linkedin.com/in/benjamin-tapley-611ba917b

CODING TASK

Access via Google Collab:

tinyurl.com/ra24-chatgpt-workshop

(Definitely not a phishing scam)

or github:

github.com/bentaps/ra24-chatgpt-workshop

