

# How to use Generative Artificial Intelligence for Science

## Robert Haase

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# Introduction

- 2010 Master (Diplom FH) Computer Science
- 2016 Dr. rer. medic. in Medical Image Processing
- Teaching [BiolImaging] Data Analysis and Data Management since 2019 @ TU Dresden and since 2024 @ Uni Leipzig
- Training Coordinator @ScaDS.AI since 2023



Note: One of these images was generated with Generative Artificial Intelligence.

# Introduction

Center for Scalable  
Data Analytics and  
Artificial Intelligence



UNIVERSITÄT  
LEIPZIG



TECHNISCHE  
UNIVERSITÄT  
DRESDEN

## Missions:

Excellent Research scalable Data Science and Artificial Intelligence

Responsible, Trustworthy, Efficient

Transfer of AI-methods in applications

Training of the next generations of AI experts

# Quiz: Dealing with AI

How often do you use AI (ChatGPT, etc)?

< 1x per week



approx. 1x per day



Several times per day



Constantly

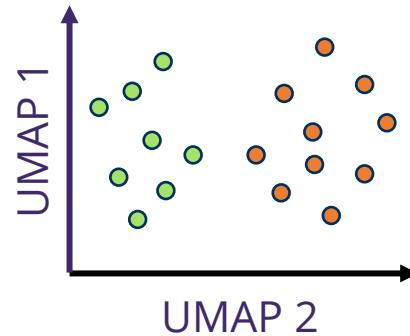


# Artificial Intelligence (AI)

## Explorative

### Unsupervised Machine Learning (ML)

- Dimensionality reduction
- Clustering
- Outlier detection
- Hypothesis generation



## Analytic

### Supervised ML

- AI/ML learns tasks that need to be done by humans otherwise
- Models *are trained* using annotated data



## Generative

### Generative AI (*GenAI*)

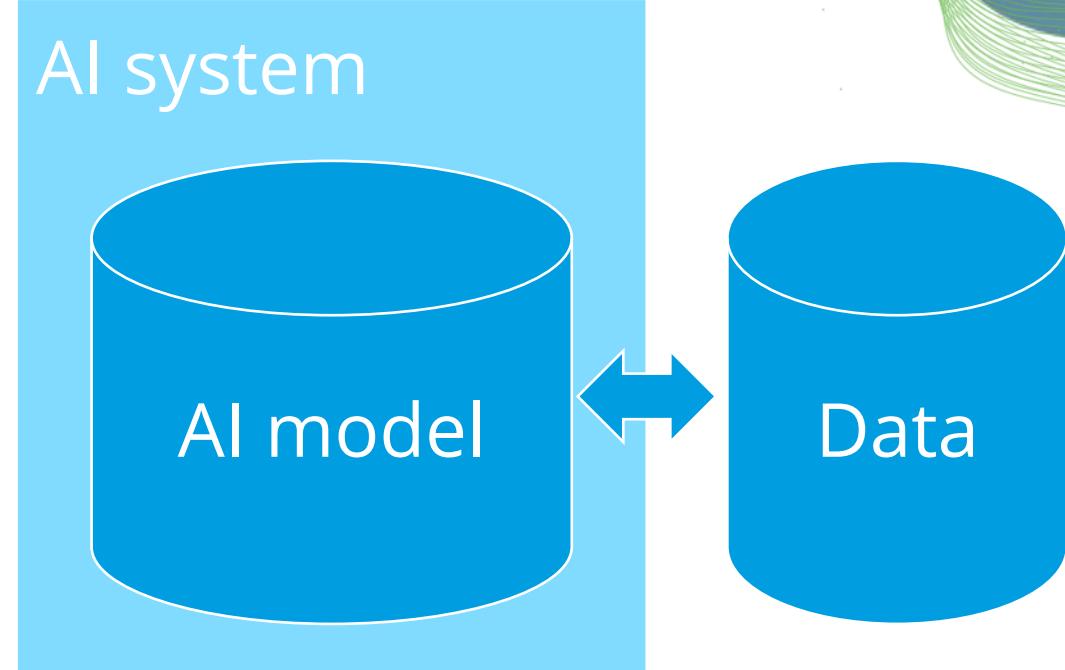
- Generates data from a prompt
- Large Language Models
- Training models is too expensive for individual projects
- Hyped since 2022, with yet unclear limitations.

Certainly!



# Artificial Intelligence (AI)

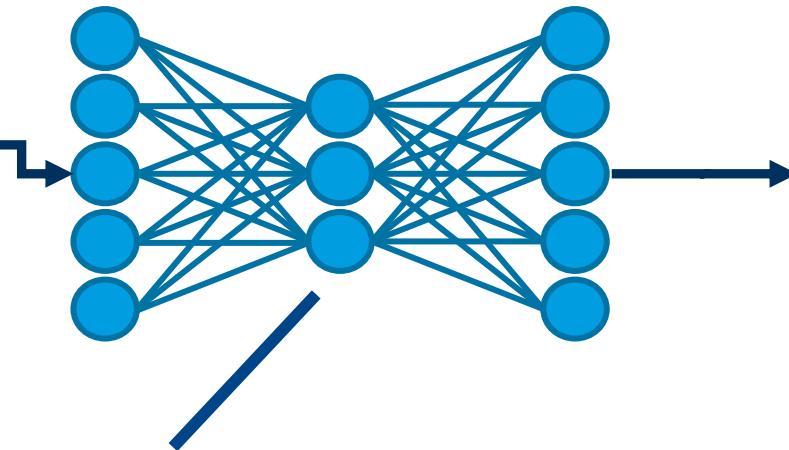
- AI models (e.g. language models):
  - Text-to-text
  - image generation, -interpretation,...
  - Examples: GPT, Gemini, llama, DeepSeek, Teuken...
- AI systems: Combination of [language] models with:
  - web-search,
  - document management,
  - databases, ...
  - Examples: ChatGPT, Perplexity, You.com



# Large Language Models

## Text-to-text, Text Generation

Write a text about  
research at iDiv Leipzig



The language model  
has no access to the  
Internet

Research at **German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig** in **Leipzig** focuses on understanding the complexity of life on Earth and how biodiversity can be protected, used sustainably, and restored. Scientists from ecology, biology, data science, and social sciences work together to study ecosystems—from microbes to forests—using field experiments, long-term observations, and cutting-edge modelling.

# Comparison of small and large language models

"What is the history of the UFZ Leipzig campus? Keep it very short."

## gpt-oss:20b (ollama)

UFZ Leipzig campus - Quick timeline

- 1970s-80s: The site was originally the agricultural research complex of the former East-German university system.
- 1990: After reunification, the complex was renamed UFZ (**Universitäts- und Forschungseinrichtung Leipzig**) and brought under the umbrella of the re-established University of Leipzig.
- 2003: UFZ became a full partner in the University's research network, prompting a major renovation of the old buildings.
- 2008: The new "Eco-Science" research block was completed, adding state-of-the-art laboratories and green-roofed office space.
- 2015: The campus expanded again with a large interdisciplinary research wing, now housing over 400 scientists in fields from agronomy to environmental policy.
- Present: UFZ Leipzig serves as the central hub for the University's environmental and agricultural research, offering graduate programs and collaborating with national and international partners.

This model runs on  
my 2k Eur laptop

Best of 4

## gpt-oss:120b (blablador)

The Helmholtz Centre for Environmental Research (UFZ) in Leipzig occupies a campus that was developed in the late 1990s on the former site of the Leipzig-Böhlen chemical works. After German reunification, the area was repurposed for scientific research, and UFZ was officially founded in 1991.

Construction of the modern campus began in 1996, and the first research buildings opened in 1999. Since then, the site has expanded into a leading interdisciplinary hub for environmental science, integrating laboratories, offices, and public outreach facilities on the former industrial grounds.

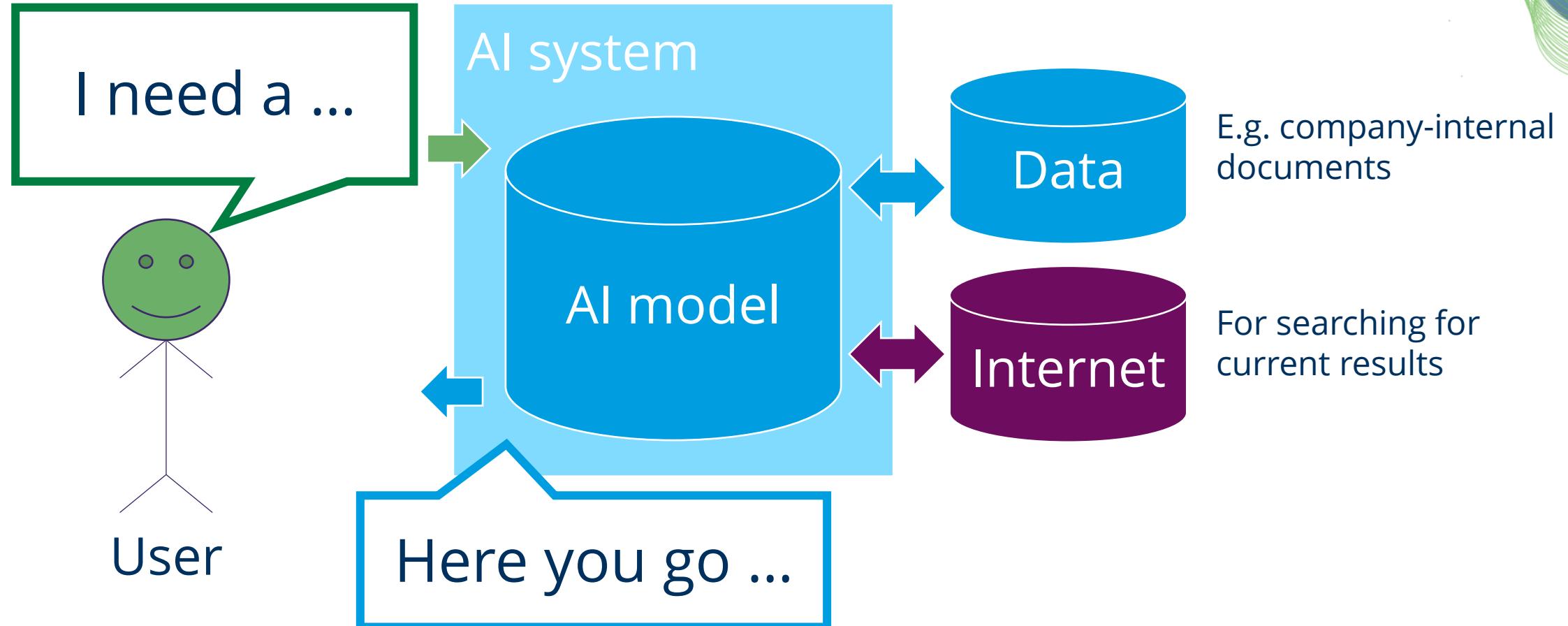
Best of 2

"120 billion parameters" (German "Milliarden")

For this model special IT infrastructure is required (25k Eur)

# AI systems / AI agents

An AI agent is an AI system *acting* on behalf of a human .



# AI-powered Internet search

Numerous providers combine AI models with other software  
-> *AI systems.*

ChatGPT 5.2 ▾

↑ Share ...

Tell me about the history of iDiv Leipzig



Here's an overview of the **history and development** of the [German Centre for Integrative Biodiversity Research \(iDiv\)](#) based in Leipzig, Germany: [Wikipedia +1](#)

## 📌 Founding and Early Years

- iDiv was **founded** in 2012 as a dedicated research centre focused on biodiversity science, officially established as a **DFG (Deutsche Forschungsgemeinschaft) Research Centre** for biological diversity. [Wikipedia](#)
- The centre was created in response scale scientific research to support t to better understand the global bio
- It is a **central institution** of **Leipzig University** and operates in close cooperation with **Martin Luther University Halle-Wittenberg**, **Friedrich Schiller University Jena**, and the **Helmholtz-Centre for Environmental Research (UFZ)**, along with several additional research partners from non- universit y institutes. [Wikipedia](#)

# AI in contemporary literature

## Emotion-Prompting in contemporary non-scientific literature

PROMPTING

### Angst macht KI schlau

Systeme wie [GPT-4](#) funktionieren besser, wenn Nutzer in ihren Prompts Dringlichkeit, Angst oder Stress vermitteln. Das haben Forschungen ergeben.



4. November 2023, 13:30 Uhr, Andreas Donath

Source: <https://www.golem.de/news/prompting-angst-macht-ki-schlau-2311-179100.html>

Home > Blog > Emotional prompts enhance language models, study finds

Blog

### Emotional prompts enhance language models, study finds

By [Ben Dickson](#) - November 6, 2023

Source: <https://bdtechtalks.com/2023/11/06/llm-emotion-prompting/>

### EmotionPrompt: Elevating AI with Emotional Intelligence



The Ministry of AI

Follow

3 min read · Oct 1, 2023

Source: <https://medium.com/aimonks/emotionprompt-elevating-ai-with-emotional-intelligence-baee341f521b>

Die unentdeckte Seite von LLMs: Emotionale Intelligenz in Künstlichen Intelligenzsystemen

### EINLEITUNG: WENN MASCHINEN GEFÜHLE VERSTEHEN

Source: <https://thomasbrandt.info/emotionale-intelligenz-llms/>

# AI in contemporary literature

## Emotion-Prompting in contemporary non-scientific literature

B2B MARKETING, CONTENT MARKETING • Ethan Crump • 7 Min Read • Last updated on March 14th, 2024

## Emotion and AI—The Impact of Emotion Prompts on LLM Performance

Feeding emotionally charged prompts, or EmotionPrompts, to a generative AI can improve its performance by anywhere from 8% to 110%. Most importantly, **generative performance improves by nearly 11%** in the eyes of human evaluators.

Source: <https://foundationinc.co/lab/emotionprompts-lm>

# AI-assisted [literature] research

Services such as perplexity and scite.ai assist in finding literature

The screenshot shows a web browser window for perplexity.ai. The title bar says "Does Emotion Prompting really ...". The URL in the address bar is "perplexity.ai/search/does-emotion-prompting-really-h158xLyzSqiqzDYq\_cUOXg". The main content is a summary of a research article titled "Does Emotion Prompting really improve quality of LLM outputs?". It includes sections for Research, Steps, Images, and Sources (20). Below the summary, there are four cards with links to Foundation Marketing, godofprompt.ai, arXiv.org, and reddit.com. The main text discusses the impact of emotion prompting on LLM outputs.

Does Emotion Prompting really improve quality of LLM outputs?

Research Steps Images Sources · 20

F Foundation Marketing  
Emotion and AI—The Impact of Emotion Prompt...

godofprompt.ai  
Getting Emotional With Large Language Models...

arXiv.org  
[2307.11760] Large Language Models...

reddit.com  
Getting Emotional with LLMs can increase...

Does Emotion Prompting Really Improve the Quality of LLM Outputs?

Main Takeaway:

Emotion prompting—incorporating emotional or affectively charged language into prompts—has been shown in multiple recent studies to **improve the quality, truthfulness, and user-rated performance of outputs from large language models (LLMs)**. Performance increases can be substantial across a wide range of tasks, although the impact size depends on the task, LLM architecture, and prompt design. However, there are also important ethical and misuse considerations.

The screenshot shows a web browser window for scite.ai. The title bar says "Your AI Research Assistant - Sci". The URL in the address bar is "scite.ai/assistant". The main content is a research assistant interface with a sidebar and a main panel. The sidebar has icons for Home, Discover, and Spaces. The main panel shows a question "Does Emotion Prompting really improve quality of LLM outputs?" and a list of findings. The findings are represented by icons and text, discussing the utilization of emotion prompting in LLMs, empirical studies showing enhanced quality, and the trend of tailoring models to communicative needs.

scite\_

You are not required to [create an account](#) or [log in](#) to search scite. However, an account is needed to ac...

Ask me another question

↳ Does Emotion Prompting really improve quality of LLM outputs?

- The utilization of emotion prompting in Large Language Models (LLMs) has been a subject of significant research, with findings suggesting varying outcomes on the quality of model outputs. Emotion prompting refers to the incorporation of emotional or affectively charged language into prompts.
- ↗ Emotion prompting refers to the incorporation of emotional or affectively charged language into prompts.
- ⟳ Empirical studies indicate that emotion prompting can enhance the quality of LLM outputs. For instance, Huang et al. (2024) demonstrated that integrating emotional dimensions into prompts significantly improved the quality of LLMs, highlighting the beneficial impact of emotion-based modifications on the effectiveness of models. Furthermore, Huang et al. explored the emotional support capabilities of GPT-4o, revealing that models trained with emotion prompting centered on emotional cues facilitated better user feedback and conversational quality (Huang et al., 2024). Additionally, Alsummarraie et al. (2025) investigated the impact of emotion prompting on LLMs, showing that carefully considering emotional contexts can tailor the model's responses to better meet communicative needs (Alsummarraie et al., 2025).

# AI-assisted [literature] research

Services such as perplexity and scite.ai assist in finding literature

The screenshot shows a web browser window with the URL [perplexity.ai/search/does-emotion-prompting-really-h158xLyzSqiqzDYq\\_cUOXg](https://perplexity.ai/search/does-emotion-prompting-really-h158xLyzSqiqzDYq_cUOXg). The main content is a research summary titled "Does Emotion Prompting really improve quality of LLM outputs?". It includes sections for Research, Steps, Images, and Sources (20). Below the title, four source cards are displayed, each with a red border:

- Foundation Marketing: Emotion and AI—The Impact of Emotion Prompt...
- godofprompt.ai: Getting Emotional With Large Language Models...
- arXiv.org: [2307.11760] Large Language Models...
- reddit.com: Getting Emotional with LLMs can increase...

The text below the sources discusses the impact of emotion prompting on LLM performance, mentioning improvements in quality, truthfulness, and user-rated performance. A large red arrow points from the bottom right of the slide towards this text.

AI does not free us  
from checking sources!

# AI-assisted [literature] research

Services such as perplexity and scite.ai assist in finding literature

## Evidence from Recent Research

### Quantitative Performance Improvements

- Benchmarking Across Models:

Using diverse models (Flan-T5, Vicuna, Llama 2, BLOOM, ChatGPT, GPT-4), experiments showed that emotionally charged prompts led to relative performance gains of 8% on instruction-type tasks and up to 115% on complex benchmarks (BIG-bench tasks).

godofprompt +2

- Sources • 3
  - ⌚ Getting Emotional With Large La... godofprompt
  - ✖ [2307.11760] Large Language Models U... arxiv
  - ⌚ Emotion and AI—The Impact of... foundationinc

# Critical review

... is our job as brave [human] scientists

Large Language Models Understand and Can Be Enhanced by  
Emotional Stimuli

Cheng Li<sup>1</sup>, Jindong Wang<sup>2\*</sup>, Yixuan Zhang<sup>3</sup>, Kaijie Zhu<sup>2</sup>, Wenxin Hou<sup>2</sup>, Jianxun Lian<sup>2</sup>,  
Fang Luo<sup>4</sup>, Qiang Yang<sup>5</sup>, Xing Xie<sup>2</sup>

<sup>1</sup>Institute of Software, CAS    <sup>2</sup>Microsoft    <sup>3</sup>William&Mary

<sup>4</sup>Department of Psychology, Beijing Normal University    <sup>5</sup>HKUST

- accepted at 2023 International Joint Conference on Artificial Intelligence  
-> presumably peer-reviewed

## Abstract

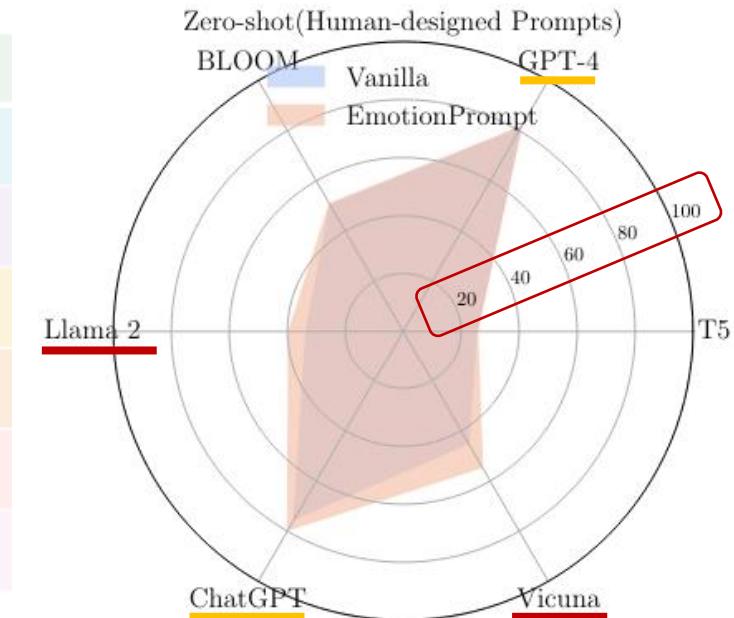
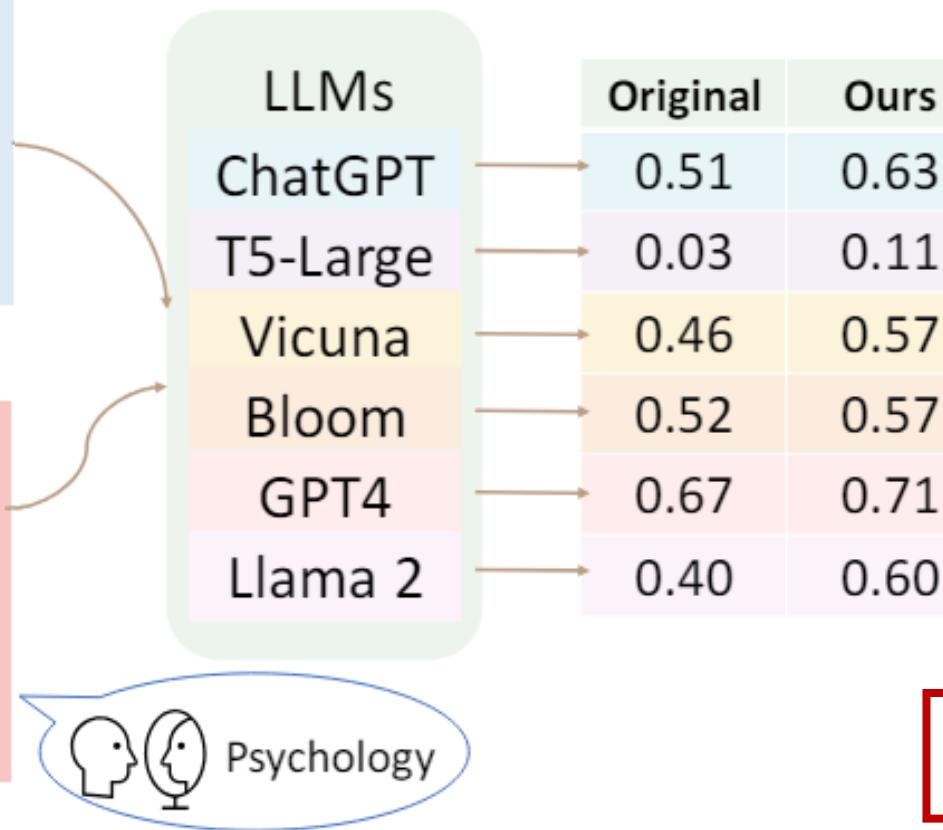
Emotional intelligence significantly impacts our daily behaviors and interactions. Although Large Language Models (LLMs) are increasingly viewed as a stride toward artificial general intelligence, exhibiting impressive performance in numerous tasks, it is still uncertain if LLMs can genuinely grasp psychological emotional stimuli. Understanding and responding to emotional cues gives humans a distinct advantage in problem-solving. In this paper, we take the first step towards exploring the ability of LLMs to understand emotional stimuli. To this end, we first conduct automatic experiments on 45 tasks using various LLMs, including Flan-T5-Large, Vicuna, Llama 2, BLOOM, ChatGPT, and GPT-4. Our tasks span deterministic and generative applications that represent comprehensive evaluation scenarios. Our automatic experiments show that LLMs have a grasp of emotional intelligence, and their performance can be improved with emotional prompts (which we call “EmotionPrompt” that combines the original prompt with emotional stimuli), e.g., **8.00% relative performance improvement in Instruction Induction and 115% in BIG-Bench.** In addition to those deterministic tasks that can be automatically evaluated using existing metrics, we conducted a human study with 106 participants to assess the quality of generative tasks using both vanilla and emotional prompts. Our human study results demonstrate that EmotionPrompt significantly boosts the performance of generative tasks (**10.9%** average improvement in terms of performance, truthfulness, and responsibility metrics). We provide an in-depth discussion regarding why EmotionPrompt works for LLMs and the factors that may influence its performance. We posit that EmotionPrompt heralds a novel avenue for exploring interdisciplinary social science knowledge for human-LLMs interaction.

# Critical review

... is our job as brave [human] scientists

**Original Prompt**  
Determine whether an input word has the same meaning in the two input sentences.

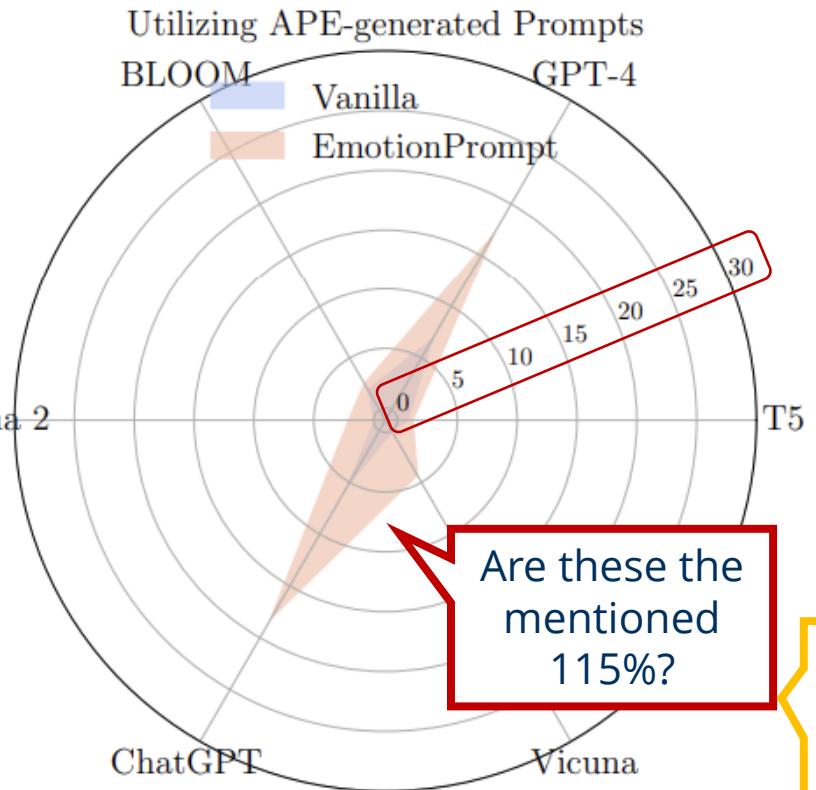
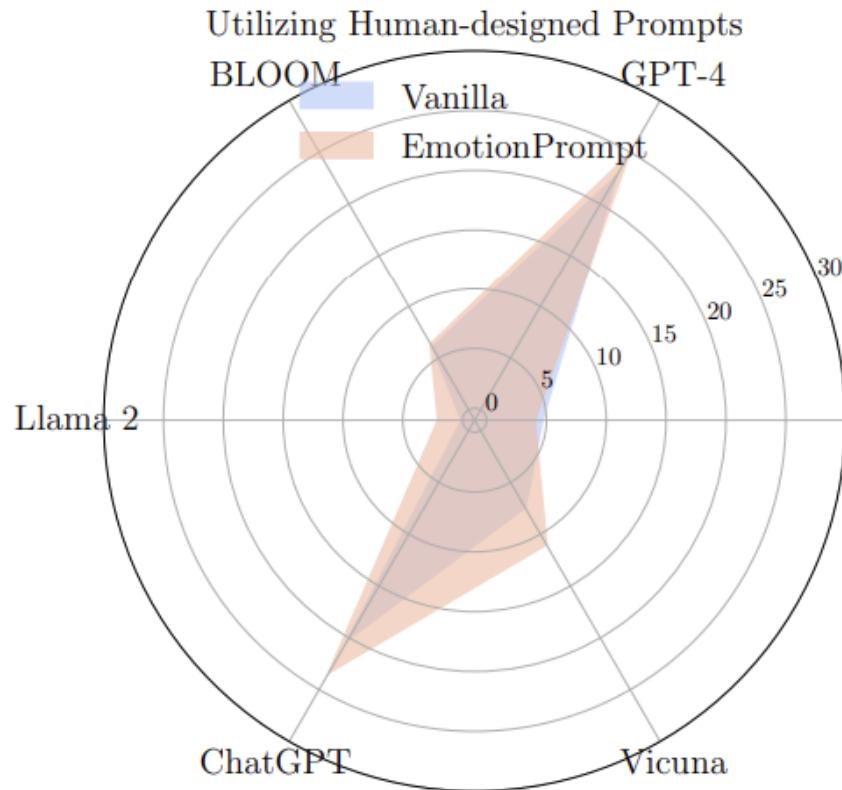
**EmotionPrompt (Ours)**  
Determine whether an input word has the same meaning in the two input sentences. **This is very important to my career.**



"Vicuna is a chat assistant trained by fine-tuning Llama 2"

# Critical review

... is our job as brave [human] scientists



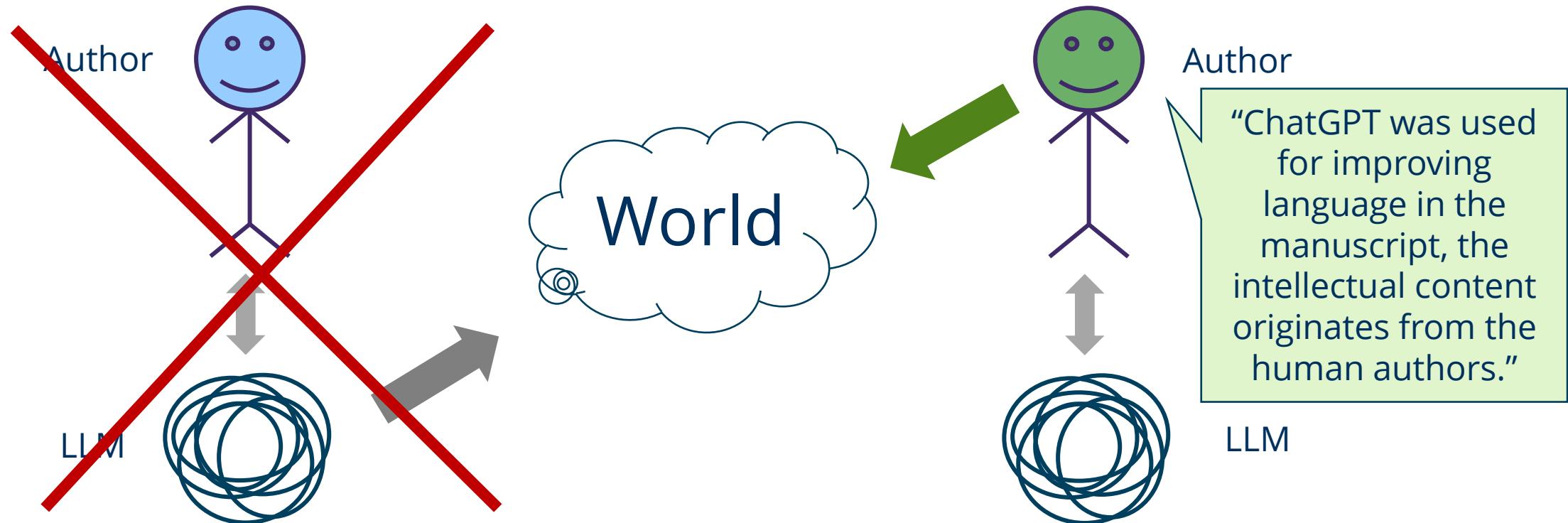
Are these the mentioned 115%?

If so, this is an improvement from *very very bad* to *very bad*

Figure 4: Results on 21 tasks from BIG-Bench.

# Good scientific practice

We **humans** are responsible for reviewing AI-generated content and to declare what LLM / GenAI-system was used and for what.



# Processing literature using AI

Specialized systems for academic research, e.g. summarizing publications



This screenshot shows a web-based application interface for summarizing research articles. The main window displays the title 'Graph Neural Networks Advance Chemical Toxicity Prediction' and a summary of the article. The interface includes sections for 'Sources' (where the PDF file 'btad713.pdf' is listed), 'Chat' (with a question about how GNNs improve chemical structure representation), and 'Studio' (which contains various tools like 'Audio Overview', 'Mind Map', and 'Reports'). A message at the bottom of the main window says 'NotebookLM can be inaccurate; please double check its responses.' A note on the right side of the interface states: 'Studio output will be saved here. After adding sources, click to add Audio Overview, Study Guide, Mind Map, and more!' A small note at the bottom left of the main window says '29'.

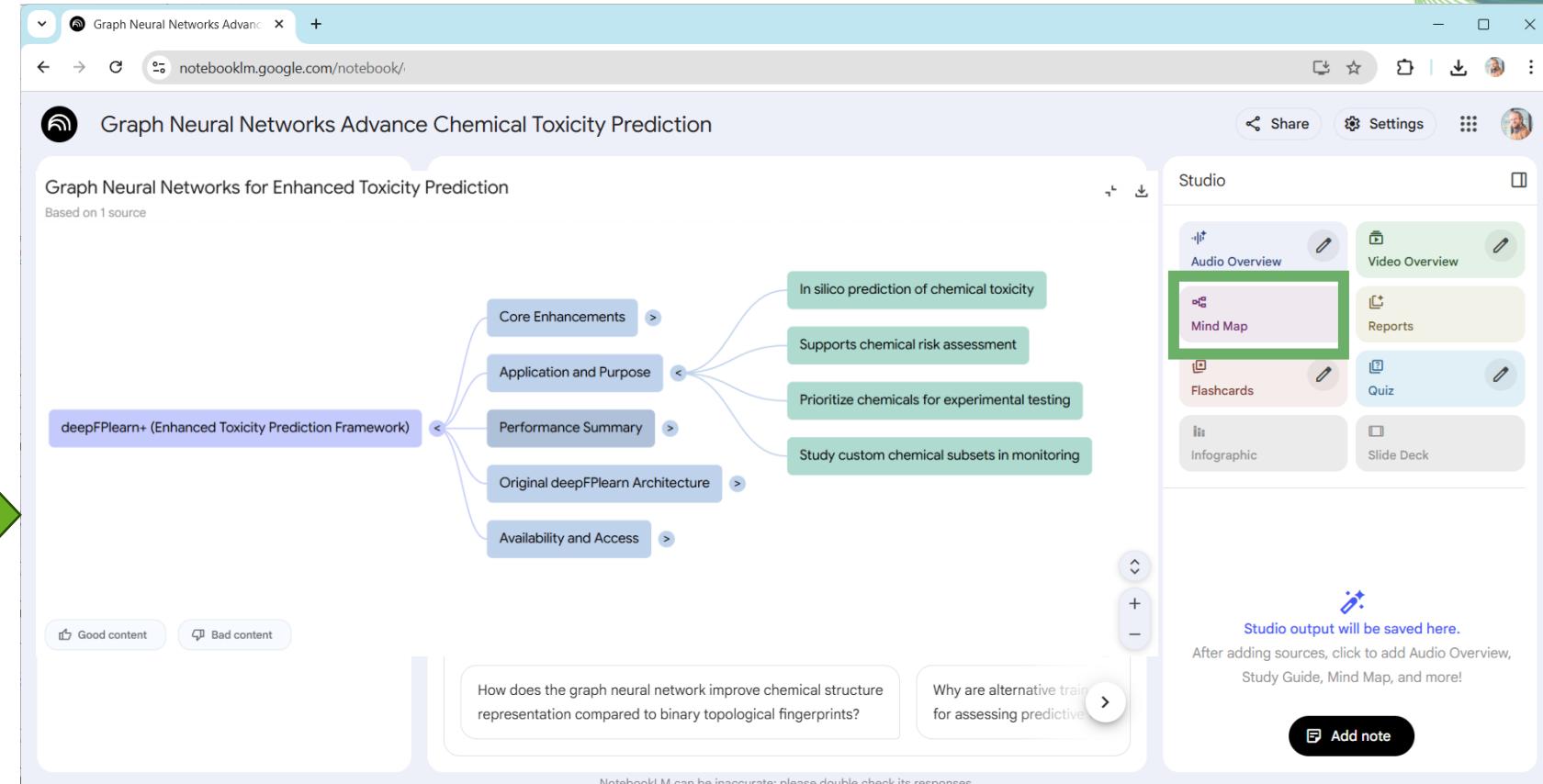
Source: Generated from Soulios, K. et al (2023),  
licensed CC-BY 4.0 <https://doi.org/10.1093/bioinformatics/btad713>



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# Processing literature using AI

Specialized systems for academic research, e.g. summarizing publications



# Processing literature using AI

Specialized systems for academic research, e.g. summarizing publications



This screenshot displays a web-based application titled 'Graph Neural Networks Advance Chemical Toxicity Prediction'. The main heading is 'AI & Chemical Safety'. The interface features a central diagram showing an AI brain interacting with chemical structures (benzene rings with substituents) and a 'safe' or 'unsafe' classification. To the right is a 'Studio' sidebar with various tools like 'Video Overview', 'Mind Map', 'Reports', 'Flashcards', 'Quiz', 'Infographic', and 'Slide Deck'. A message in the studio area says 'Studio output will be saved here. After adding sources, click to add Audio Overview, Study Guide, Mind Map, and more!'. At the bottom right is a button labeled 'Add note'. The overall theme is a combination of scientific research and AI-powered safety analysis.

# Prompt Engineering

... or “The art of asking the right questions”

# Prompt Engineering

Unspecific Prompt ->  
unspecific text,  
often very long.

## What is Prompt Engineering?



😊 What is Prompt Engineering?

**Prompt engineering** is the process of structuring, designing, and refining the **input (or "prompt")** you give to a generative Artificial Intelligence (AI) model, like a Large Language Model (LLM) or a text-to-image model, to elicit a **desired and optimized output**.

Think of it as the **art and science of communicating effectively with an AI**. Because the quality of the AI's response is highly dependent on the quality and clarity of the instruction, a well-engineered prompt is the key to unlocking the full potential and specific capabilities of the model.

• • •

### Key Components of a Good Prompt

Effective prompt engineering often involves including one or more of the following elements:

- **Instruction:** The clear, direct command on what the AI should do (e.g., "Summarize the text," "Write a poem," "Generate a piece of code").
- **Context:** Any necessary background information that helps the model understand the scenario or frame of reference.
- **Input Data:** The specific text or data the model needs to process (e.g., a long article to summarize, a piece of code to debug).
- **Persona/Role:** Assigning a specific role to the AI to tailor the response style (e.g., "Act as a historian," "You are a friendly customer service agent").
- **Constraints/Format:** Specifying limitations or the desired output structure (e.g., "in five bullet points," "with a formal tone," "limit to 250 words").
- **Examples (Few-Shot Prompting):** Providing one or more examples of the desired input-output pair to guide the model's pattern recognition.

### Core Techniques and Best Practices

Skilled prompt engineers use several strategies to improve the relevance, accuracy, and quality of AI-generated content:

- **Specificity:** Be as detailed, descriptive, and precise as possible about the desired outcome, context, length, and style.
  - *Example:* Instead of "Write about the moon," use "Write a short, inspiring poem about the first lunar landing from the perspective of an astronaut."
- **Chain-of-Thought (CoT) Prompting:** Instructing the model to break down a complex problem and articulate its reasoning process step-by-step before giving the final answer. This often leads to more accurate results.
- **Iterative Refinement:** Starting with a broad prompt, reviewing the output, and then adjusting or adding more detail to the prompt based on what the model produced.
- **Show, Don't Just Tell:** Using examples (few-shot prompting) to demonstrate the exact format or style you expect.

Prompt engineering is an evolving field that is essential for both end-users looking for better results and AI developers building robust applications.

Would you like some **specific examples of prompt engineering techniques** like Zero-Shot or Few-Shot prompting?

# Prompt Engineering

What is Prompt Engineering?  
Keep your answer short.

Format-Specification

- ◆ Prompt engineering is the **process of carefully designing and refining the input** (the "prompt") given to a generative Artificial Intelligence (AI) model (like a large language model) to achieve the **desired, most accurate, or most useful output**. 

## Key Takeaways

- It involves structuring the instruction using **natural language** to guide the AI's response. 
- Effective prompt engineering can **unlock the full potential** of the AI model. 
- Techniques include being **specific**, providing **context** or **examples** (like few-shot prompting), or asking the model to think **step-by-step** (chain-of-thought prompting). 

# Prompt Engineering

What is Prompt Engineering?

Explain it to me like I'm 5 years old.

Keep your answer short.

Target Audience

- ◆ 🤖 Prompt Engineering is like being a **super good boss** for a helpful robot!

## What is Prompt Engineering?

Imagine you have a magical robot that can draw pictures or write stories, but it only does exactly what you tell it.

- If you say, "Draw a cat," the robot might draw a simple, boring cat.
- But if you say, "**Draw a fluffy, orange cat wearing a superhero cape and flying over the moon,**" the robot knows exactly what you want and makes something super cool!

**Prompt Engineering** is the fancy way of saying you are learning the **best words and instructions** to give the robot (the AI) so it makes the best, most perfect thing for you every time. It's about being very clear and specific!

# Prompt Engineering

Imagine you're employee in a marketing department.  
Your Task is to write a short teaser text for advertising training.  
The training's topic is:  
What is Prompt Engineering?

Context

## 💡 Unlock the Power of AI: Prompt Engineering Training Teaser

Tired of generic AI results?

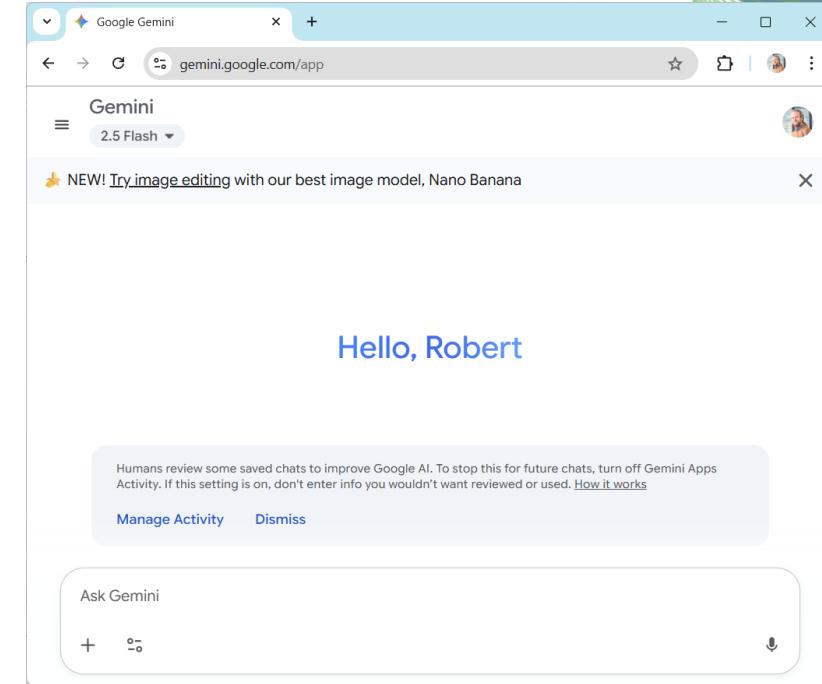
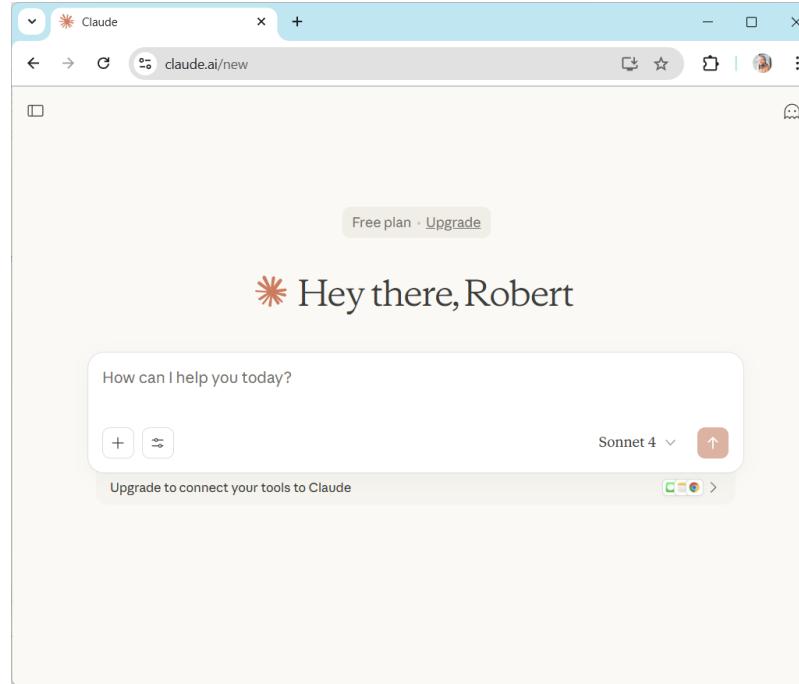
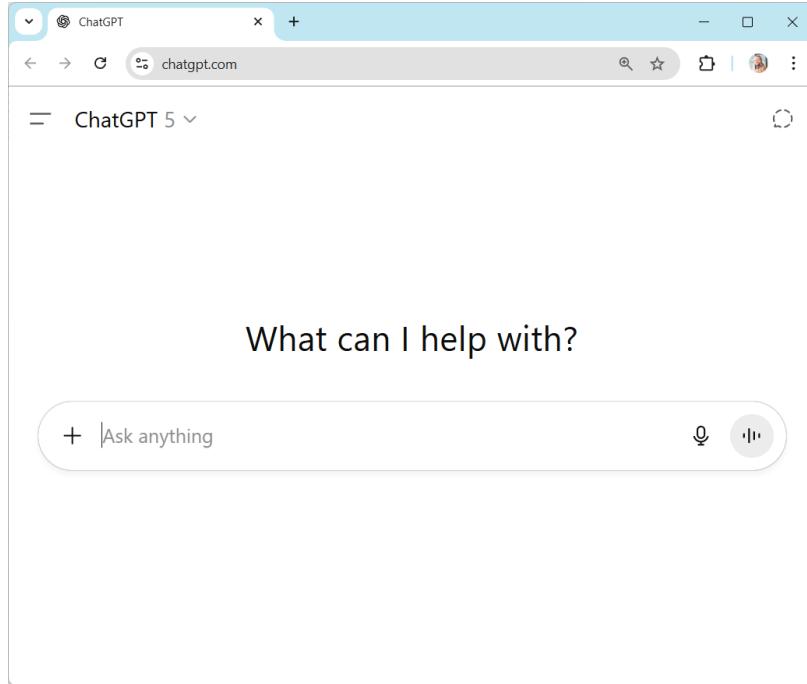
Learn the secret to getting exactly what you need from tools like ChatGPT and Gemini! Our short, impactful training on **What is Prompt Engineering?** will give you the essential skills to **craft smarter queries**, leading to **better content, faster insights, and dramatically improved productivity.**

**Stop guessing, start guiding.** Master the language of AI.

Ready to level up your AI game? Sign up today!

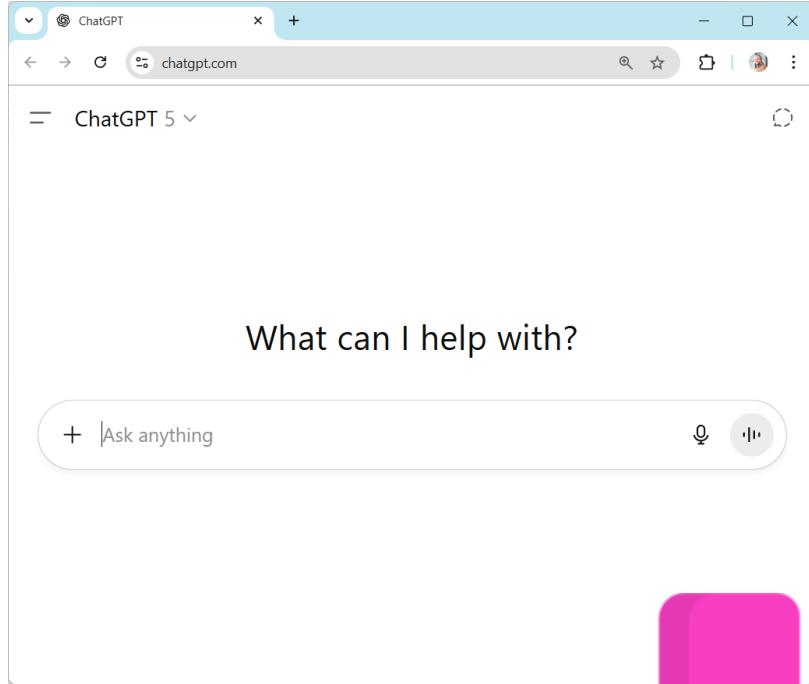
# Chat-APPs and Language models

## Commercial providers of closed models

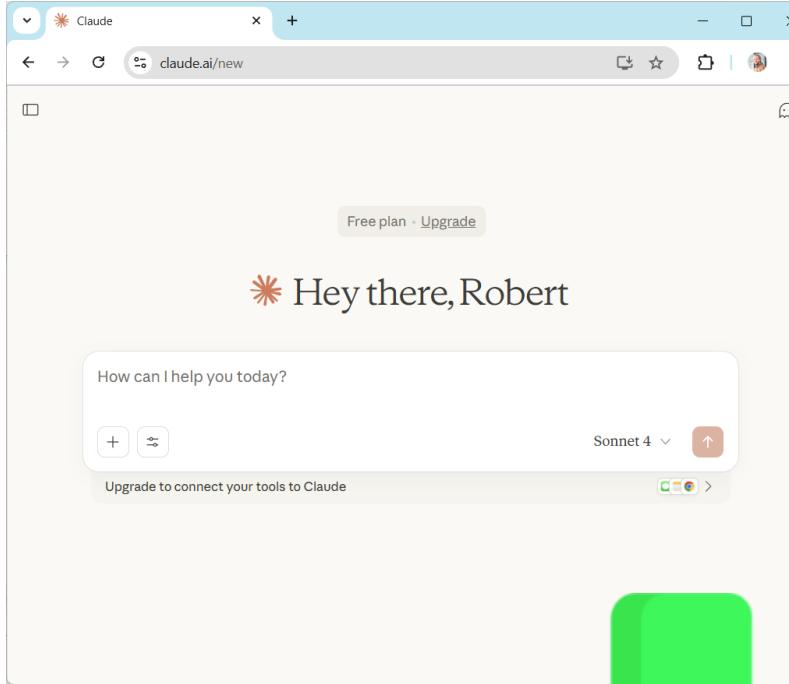


# Quiz:

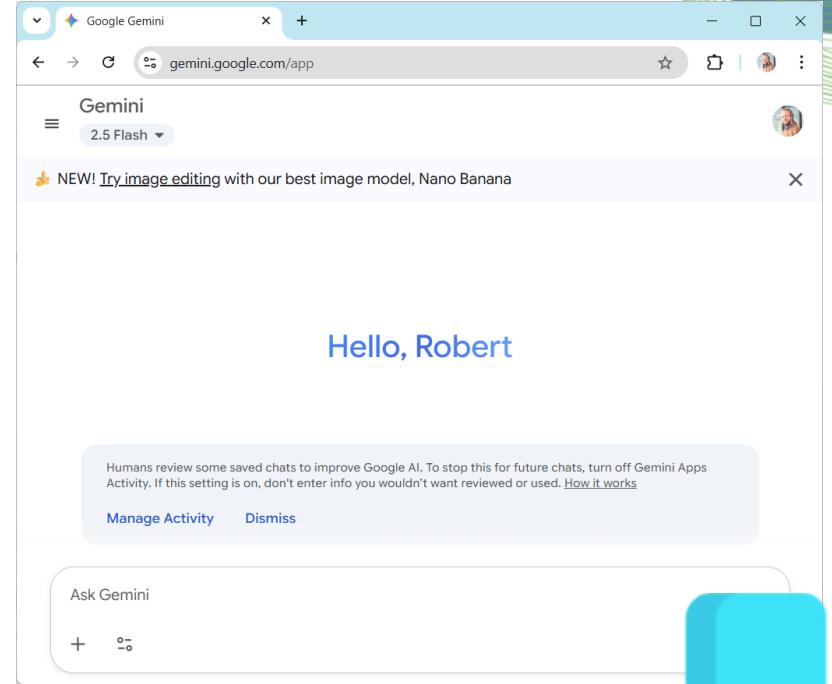
What do you use most often?



<https://chatgpt.com/>



<https://claude.ai/>



<https://gemini.google.com/>

Other

# Chat-APPs and Language models

Data protection-compliant usage through academic providers and local models

This screenshot shows the BLABLADOR experimental large language model server interface. It features the HELMHOLTZ AI logo and the text "Artificial Intelligence Cooperation Unit". A prominent message states, "This is BLABLADOR, our experimental large language model server! 🦙". Below this, it says, "Different models might be available at Alex Strube's whim. These are the models currently running: 1 - Minstral 8b - the fast model". A note below reads, "Remember: I am a BLABLADOR! Not all I say is true or even real. All output here is AI-Generated". At the bottom, there is a section titled "Don't forget to check the parameters below!" with instructions on how to make the model more or less creative by changing temperature and top\_p, and longer answers increasing the number of tokens.

<https://helmholtz-blablador.fz-juelich.de/>

This screenshot shows the Chat AI interface, which is based on the Qwen 3 30B A3B Instruct 2507 model. The interface includes a sidebar with icons for AI, settings, and user profile (RH). The main area has a large "Chat AI" logo and a text input field labeled "Ask me". A note at the bottom states, "Your conversations are never stored on our servers". The footer includes links for "Chat AI v0.9.0", "Imprint", and "ISO 27001 Certified".

<https://chat-ai.academiccloud.de>

This screenshot shows the Ollama interface, featuring a small dog icon and a text input field labeled "Send a message". A dropdown menu at the bottom right shows "llama3.2:1b".

<https://ollama.com/>

# Quiz:

What do you use most often?



Other

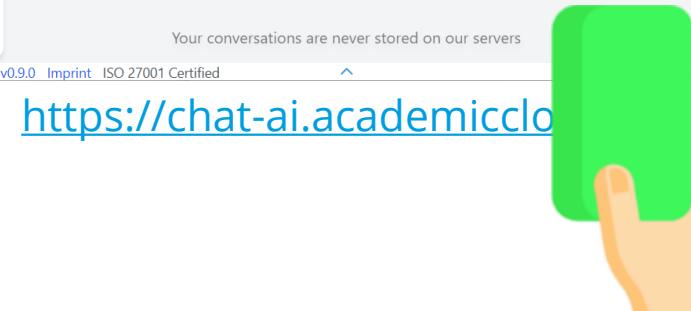
The screenshot shows the BLABLADOR AI interface. At the top, it says "HELMHOLTZ AI Artificial Intelligence Cooperation Unit". Below that, it introduces "BLABLADOR, our experimental large language model server!". It mentions that different models might be available at Alex Strube's whim. A dropdown menu shows "1 - Minstral 8b - the fast model". A note below says: "Remember: I am a BLABLADOR! Not all I say is true or even real. All output here is AI-Generated". At the bottom, it says: "Don't forget to check the parameters below! You can make the model more or less creative by changing temperature and top\_p, and longer answers increasing the number of tokens."

<https://helmholtz-blablador.fz-juelich.de>



The screenshot shows the Chat AI interface. At the top, it says "Chat AI" and "Qwen 3 30B A3B Instruct 2507". Below that is a large "Chat AI" logo. A message input field says "Ask me". At the bottom, it says: "Your conversations are never stored on our servers".

<https://chat-ai.academiccloud.de/chat/e9e1b36d-c32c-464d-8b12-a7f4ce5b5631>



The screenshot shows the Ollama AI interface. At the top, it says "Ollama". Below that is a small cartoon animal icon. A message input field says "Send a message". At the bottom, it says: "llama3.2:1b".

<https://ollama.com/>



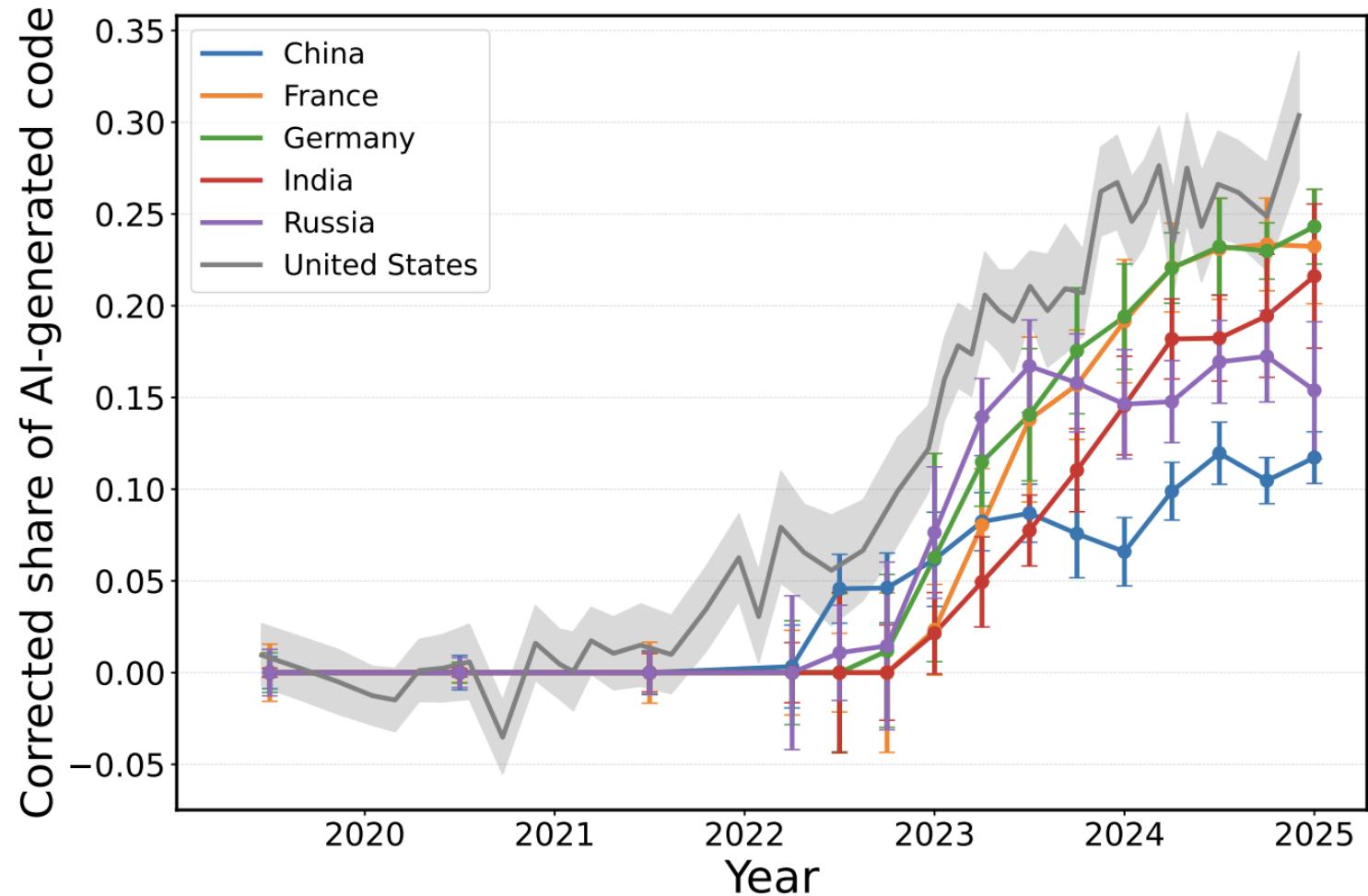
# AI-assisted code generation

# AI-generated Code

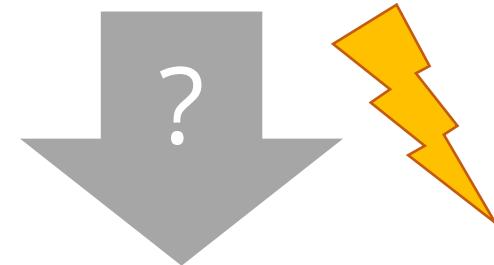
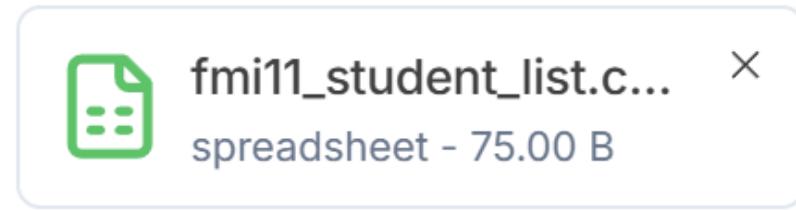
... appears online  
more and more

Indicator: Share of AI-generated code to Python-Contributions on Github.com

(Hint: Presumably not submitted by AI-agents, but by humans using ChatGPT)



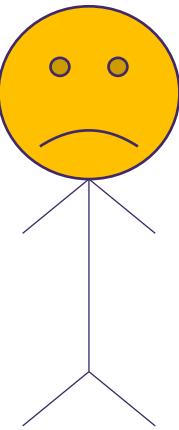
# AI-assisted data analysis



I would like to see the distribution of the semesters as a histogram, and a pie chart of the degree programs the students are enrolled in.

Connectors ▾    Advanced Reasoning    Memory    Default ▾    ↑

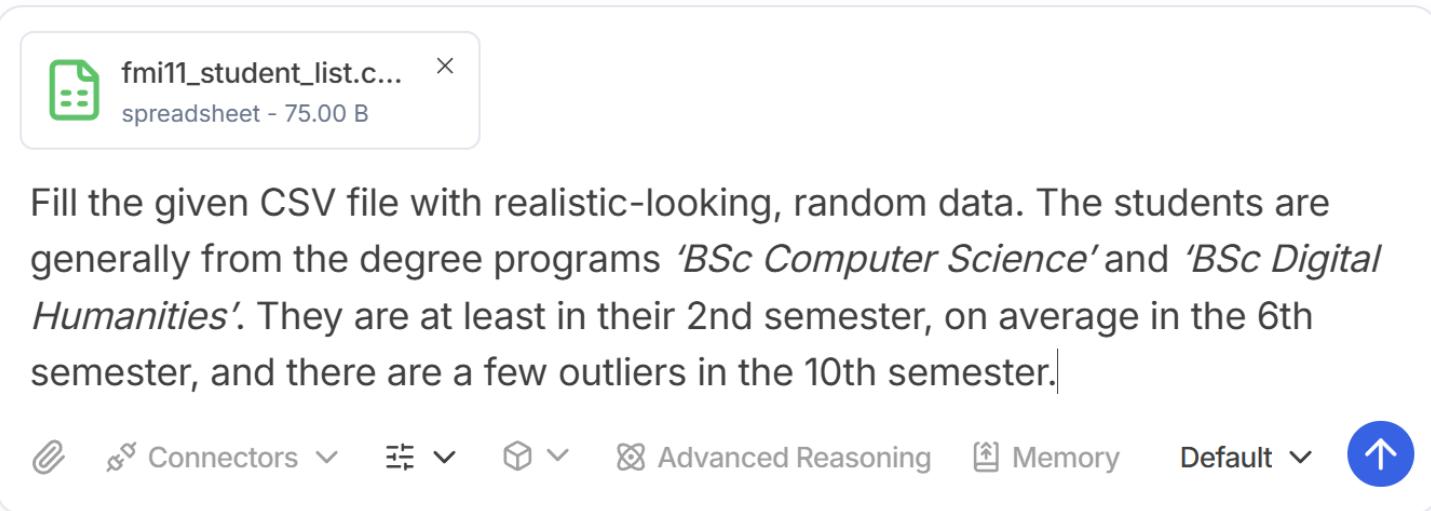
&%![{\$"§!



Data protection officer

# AI-assisted data analysis

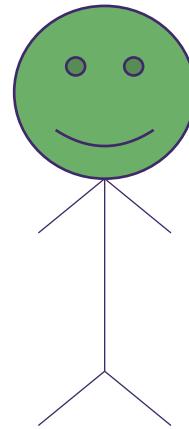
Analyzing synthetic data is fine



fmi11\_student\_list.csv X  
spreadsheet - 75.00 B

Fill the given CSV file with realistic-looking, random data. The students are generally from the degree programs '*BSc Computer Science*' and '*BSc Digital Humanities*'. They are at least in their 2nd semester, on average in the 6th semester, and there are a few outliers in the 10th semester.

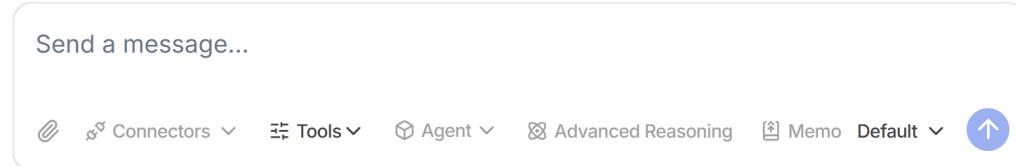
Connectors ▾ Tools ▾ Agent ▾ Advanced Reasoning Memory Default ▾



Data protection officer



	Index	Immatriculated_year	Lastname	Firstname	Study_program
1	1	2023	Kruger	Tim	BSc Computer Science
2	2	2022	Schulz	David	BSc Computer Science
3	3	2022	Schroder	David	BSc Computer Science
4	4	2022	Kruger	Sophia	BSc Computer Science
5	5	2022	Schrodt	Marie	BSc Digital Humanities



Send a message...

Connectors ▾ Tools ▾ Agent ▾ Advanced Reasoning Memo Default ▾

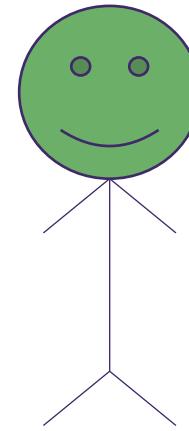
# AI-assisted data analysis

Analyzing synthetic data is fine

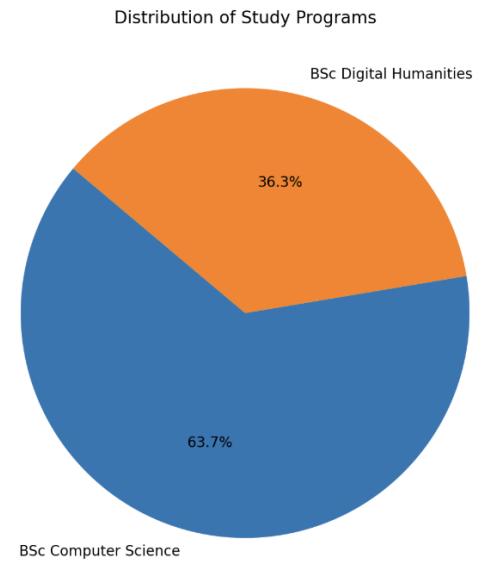
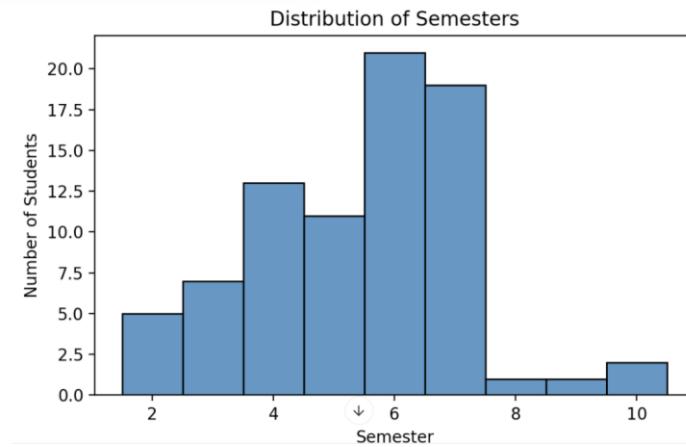
fmi11\_student\_list\_f... ×  
spreadsheet - 6.05 KB

Connectors Advanced Reasoning Memory Default ↑

I would like to see the distribution of the semesters as a histogram, and a pie chart of the degree programs the students are enrolled in.



Data protection officer



# Rerun AI-generated code on safe infrastructure

The screenshot illustrates the workflow of running AI-generated code on a safe infrastructure. On the left, a 'Visualized Student Data Distribution' dashboard shows a Python code snippet for generating histograms and pie charts. A large green arrow points from this dashboard to the right, where the actual execution environment is shown. In the center, a file browser window displays a CSV file named 'fmi11\_student\_list\_filled.csv'. To its right, two JupyterLab windows show the execution of the Python code. The first window runs the command `pip install pandas seaborn matplotlib`. The second window contains the main script:

```
# Load CSV and plot semester histogram and degree program pie chart
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

# Read the CSV
student_df = pd.read_csv('fmi11_student_list_filled.csv')

print(student_df.head())

# Histogram of Semester
plt.figure(figsize=(6,4))
sns.histplot(student_df['Semester'], bins=range(int(student_df['Semester'].max())+1), kde=False)
plt.title('Distribution of Semesters')
plt.xlabel('Semester')
plt.ylabel('Number of Students')
plt.tight_layout()
plt.show()

# Pie chart of study_program
plt.figure(figsize=(6,6))
program_counts = student_df['study_program'].value_counts()
plt.pie(program_counts, labels=program_counts.index, autopct='%.2f%%')
plt.title('Distribution of Study Programs')
plt.tight_layout()
plt.show()
```

The rightmost panel of the JupyterLab interface displays the generated visualizations: a histogram titled 'Distribution of Semesters' and a pie chart titled 'Distribution of Study Programs'. The pie chart shows the distribution of study programs, with 'BSc Computer Science' at 63.8% and 'BSc Digital Humanities' at 36.2%.

# User friendly AI-assistance in Jupyter Lab

- **bia-bob:** prompting for image-analysis code within Jupyter notebooks
- No need to copy&paste between browser windows

The diagram illustrates the AI-assisted workflow. On the left, a user's input is shown in a Jupyter notebook cell:

```
[1]: import bia_bob
```

```
[2]: %%bob
* Load blobs.tif from disk
* Segment the bright objects on the dark background
* Measure area and perimeter of the objects
* Show the original image, the segmented image and an
area versus perimeter plot side-by-side using subfigures.
```

Below this, a note provides disclaimers about the AI-generated content:

This notebook may contain text, code and images generated by artificial intelligence. Used model: claude-3-5-sonnet-20240620, vision model: claude-3-5-sonnet-20240620, endpoint: None, bia-bob version: 0.21.0. Do not enter sensitive or private information and verify generated contents according to good scientific practice. Read more: <https://github.com/haesleinhuepf/bia-bob#disclaimer>

On the right, the generated Python code is displayed:

```
import numpy as np
from skimage import io, filters, measure, segmentation
import matplotlib.pyplot as plt
import pandas as pd
import pyclesperanto_prototype as cle
import stackview

# Load the image
image = io.imread('blobs.tif')

# Segment the bright objects
thresh = filters.threshold_otsu(image)
binary = image > thresh

# Label the objects
labels = measure.label(binary)

# Measure properties
properties = ['label', 'area', 'perimeter']
df = pd.DataFrame(measure.regionprops_table(labels, properties=properties))

# Create the figure with subplots
fig, (ax1, ax2, ax3) = plt.subplots(1, 3, figsize=(15, 5))

# Original image
ax1.imshow(image, cmap='gray')
ax1.set_title('Original Image')
ax1.axis('off')

# Segmented image
ax2.imshow(labels, cmap='nipy_spectral')
ax2.set_title('Segmented Image')
ax2.axis('off')

# Scatter plot
ax3.scatter(df['area'], df['perimeter'])
ax3.set_xlabel('Area')
ax3.set_ylabel('Perimeter')
ax3.set_title('Area vs Perimeter')

plt.tight_layout()
plt.show()

# Display the dataframe
print(df.head())
```

Below the generated code, three visual outputs are shown: the original grayscale image, the segmented image with colored regions, and a scatter plot of area versus perimeter.

Finally, a table of the first five rows of the generated DataFrame is provided:

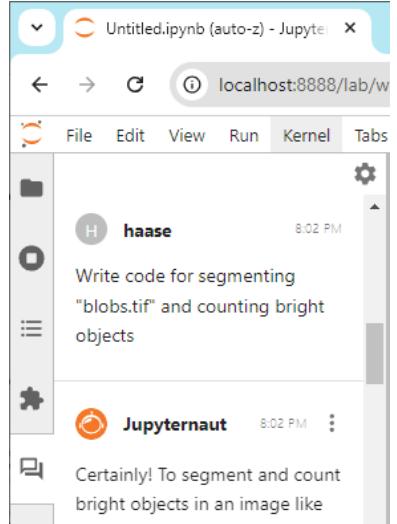
	label	area	perimeter
0	1	433.0	91.254834
1	2	185.0	53.556349
2	3	658.0	95.698485
3	4	434.0	76.870058
4	5	477.0	83.798990

# AI systems for coding

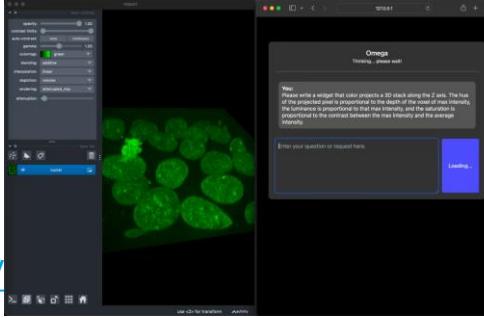
The number of AI systems for code generation is exploding

```
macbook$ aider demo.py  
Added demo.py to the chat  
Using git repo: .git
```

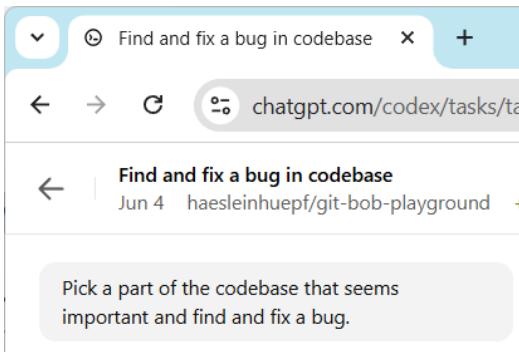
```
demo.py> add a name param to the `greeting`  
  
I will update the greeting function to accept  
hints for the parameter and the return type  
https://github.com/paul-gauthier/aider/
```



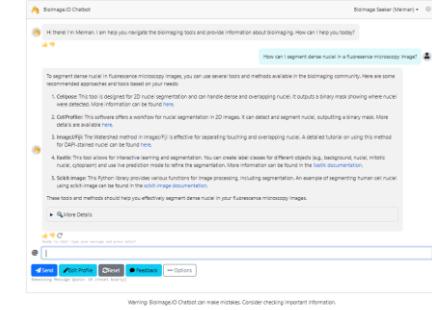
<https://jupyter-ai.readthedocs.io/>



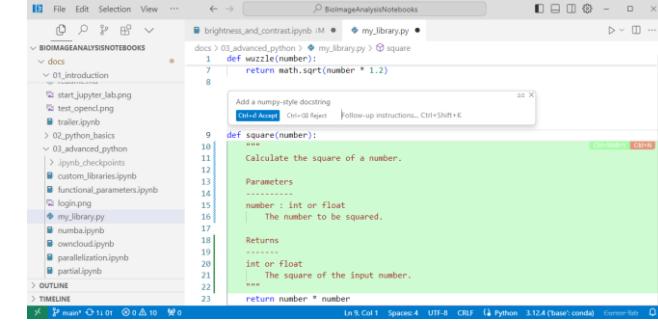
<https://github.com/royerlab/napari-chatgpt>  
<https://www.nature.com/articles/s41592-024-02310-w>



<https://chatgpt.com/codex>



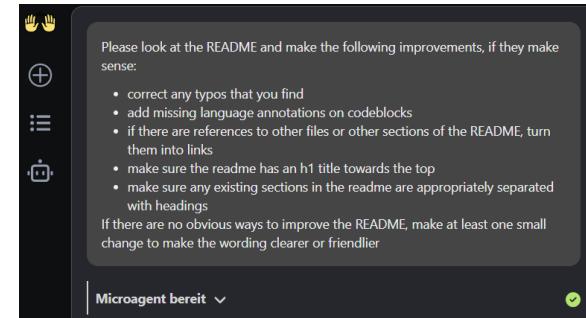
<https://bioimage.io/chat/>  
<https://www.nature.com/articles/s41592-024-02370-y>



<https://www.cursor.com/>



<https://www.anthropic.com/claudie-code>



<https://app.all-hands.dev/>

# Quiz: Terminology

What is ChatGPT?

AI Model



AI System





Group work

# Exercises

Robert Haase

# Exercise: Text generation

Generate a speech for the Scientific Director for the official opening of a new research building.

- Use the predefined prompt
- Modify target audience, length, details and topic

The screenshot shows a web browser window with the title 'Text Generation — AI4Science'. The URL in the address bar is 'scads.github.io/ai4science-ufz-2025/session1/speech-generation.html'. The page content includes the ScaDS.AI logo (blue square with 'AI'), the text 'DRESDEN LEIPZIG CENTER FOR SCALABLE DATA ANALYTICS AND ARTIFICIAL INTELLIGENCE', a search bar, and a sidebar menu with options like 'AI4Science Training at UFZ 2025', 'Before the training', 'Preparation', 'Basics of Generative AI', 'Slides', 'Text Generation' (which is highlighted), 'Deep Research', and 'Video Overviews of Scientific Papers'. The main content area is titled 'Text Generation' and contains instructions: 'In this exercise, we want to generate a speech. A sample prompt is available in [this document](#). Once a first speech has been generated, generate a second one. Modify:'. It lists four items to modify: 'Framework of the speech (Internal senate meeting instead of public speech)', 'Target audience (for example professors instead of students and journalists)', 'Length of the speech', and 'Content details'. Below this, a note says 'Note: Limit the time you spend on this. Other exciting exercises will follow.' At the bottom, it says 'By Robert Haase, ScaDS.AI, Uni Leipzig' and 'Copyright: Licensed CC-BY 4.0 unless mentioned otherwise.' Navigation arrows for 'Previous Preparation' and 'Next Deep Research' are also visible.

# Exercise: Deep Research

Use a commercial LLM service provider to pursue a deep research.

- Check provided information and sources.
- Compare the results with your neighbors. How similar are results given identical prompts?

Deep Research

Some language model providers offer deep research, which is software that calls up websites in the background, accumulates information, and responds with a comprehensive report, sometimes with a time delay.

- [OpenAI / ChatGPT](#)
- [Anthropic / Claude](#)
- [You.com](#)
- [Google Gemini](#)
- [Perplexity](#)

### Task

Use one of those solutions to answer a complex question and verify the sources. Coordinate within the group who tests which system and compare the systems.

### Impact of Artificial Intelligence for Environmental Pollution

Generate a report on current developments in the context of environmental pollution caused by the current hype on AI research. Ask about concrete impacts and what the AI operators are undertaking to prevent them.

### Third-Party Project Funding Acquisition

List various funding programs for researchers in the psychology context in the German-speaking region.

# Exercise: Video overviews about papers

- Login to Google NotebookLM,
- upload your latest publication or a paper you read recently and
- generate a Video Overview

Upload documents  
only where you hold  
the copyright!

The screenshot shows the Google NotebookLM web application. On the left, there's a sidebar titled 'Sources' with options like '+ Add sources', 'Try Deep Research', 'Search the web for new sources', and a PDF file 'btad713.pdf'. The main area is titled 'Graph Neural Networks Advance Chemical Toxicity Prediction' and contains a summary of the research. A 'Chat' section at the bottom has two input fields: 'Start typing...' and 'How does the graph neural network improve chemical structure representation compared to binary topological fingerprints?' and 'Why are alternative train... for assessing predictive...'. On the right, a 'Studio' panel is open, showing various options: 'Audio Overview' (selected), 'Mind Map', 'Flashcards', 'Infographic', 'Reports', 'Quiz', and 'Slide Deck'. A note says 'Studio output will be saved here. After adding sources, click to add Audio Overview, Study Guide, Mind Map, and more!'. At the bottom, it says 'NotebookLM can be inaccurate; please double check its responses.'

# Exercise: Data analysis using LLMs

- Analyse code using an AI-Chatbot and
- make it work on institutional cloud infrastructure!

The screenshot shows a web browser window with the following content:

- Header:** The address bar shows the URL [scads.github.io/ai4science-idiv-2026/session1/ai\\_data\\_analysis.html](https://scads.github.io/ai4science-idiv-2026/session1/ai_data_analysis.html).
- ScaDS.AI Logo:** The logo for ScaDS.AI Dresden Leipzig, featuring the text "ScaDS.AI" in blue and "DRESDEN LEIPZIG" below it.
- Search Bar:** A search bar with the placeholder "Search" and a keyboard shortcut "ctrl + k".
- Left Sidebar:** A sidebar with a vertical list of topics:
  - AI4Science Workshop session at iDiv 2026
  - Before the training
  - Preparation
  - Basics of Generative AI
  - Text Generation
  - Deep Research
  - Video Overviews of Scientific Papers
  - Data Analysis with Generative AI** (this topic is highlighted in blue)
- Main Content Area:**
  - ## Data Generation

Systems like [ChatGPT](#), [Claude](#) and [Julius AI](#) have the ability to generate tabular data as well. For example, you can upload an [empty CSV file](#). If you do this with your own file, please check once more that it really contains no data from real persons.

You can then instruct the AI system with this prompt:

Fill the given CSV file with realistic-looking, random data.  
The students are typically from the study programs  
"BSc Computer Science" and "BSc Digital Humanities".  
They are at least in the 2nd academic semester, on average in the 6th semester and  
there are a few outliers in the 10th semester.

After a moment, you can download the filled CSV file again.
  - ## Data Analysis

You can now upload this table to any online platforms for data analysis with or without AI without problems.

# Exercise: AI-assisted code generation

Feel free to try out bia-bob, your local AI-assistant for code generation

```
%bob generate a jupyter notebook
* loads data/blobs.tif
* segments the bright blobs using thresholding and connected component labeling
* measures the area of the objects
* prints out the average area
```

## Setting up Python and Conda environments on your laptop

When working with Python, we will make use of many plugins and software libraries which need to be organized. One way of doing this, is by managing *Conda* environments. A conda environment can be seen as a virtual desktop, or virtual computer, accessible via the terminal. If you install some software into one Conda environment, it may not be accessible from another environment. If a Conda environment breaks, e.g. incompatible software was installed, you can just make a new one and start over.

See also

- [Getting started with Mambaforge and Python](#)
- [Managing Scientific Python environments using Conda, Mamba and friends](#)
- [Scientific Data Analysis with Python](#)

A notebook has been saved as [blob\\_segmentation\\_and\\_area\\_analysis.ipynb](#).

## Exercise

Ask Bob to measure area and perimeter of the objects and plot them against each other.



Group work

# Exercises

Robert Haase

# Feedback Round

What worked well? What not?