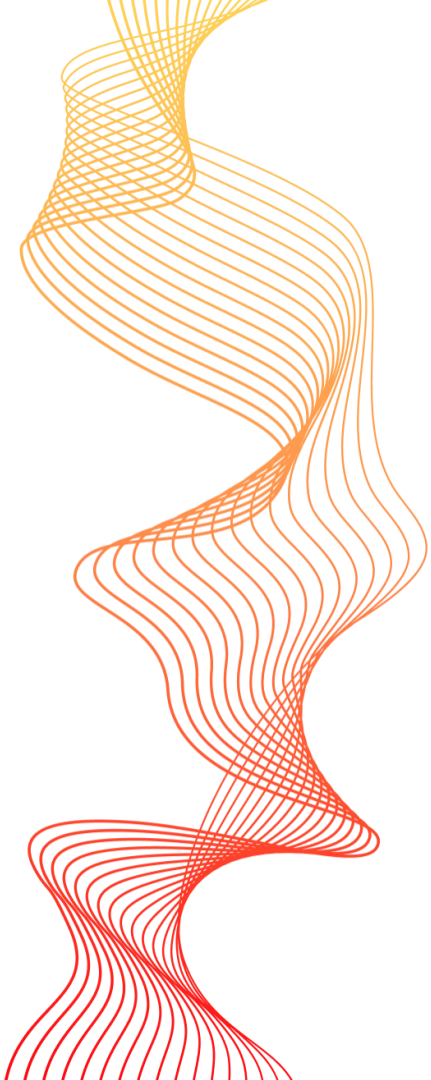
A roadmap for the responsible use of AI in research

Dr. Carolina Natel de Moura
carolina.natel@kit.edu

Trainer in Training (Digital Research Academy)
Researcher at Karlsruhe Institute of Technology

Helmholtz TEACH conference | December 7-8, 2023



House-keeping

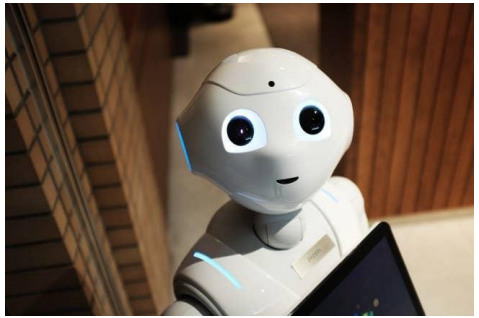
What this workshop is about...

Let‘s ...
- make a safe space for discussion
- be respectful of other people’s opinions
- be open-minded
- interact as much as possible

Questions and comments are very welcome!

Today's agenda...

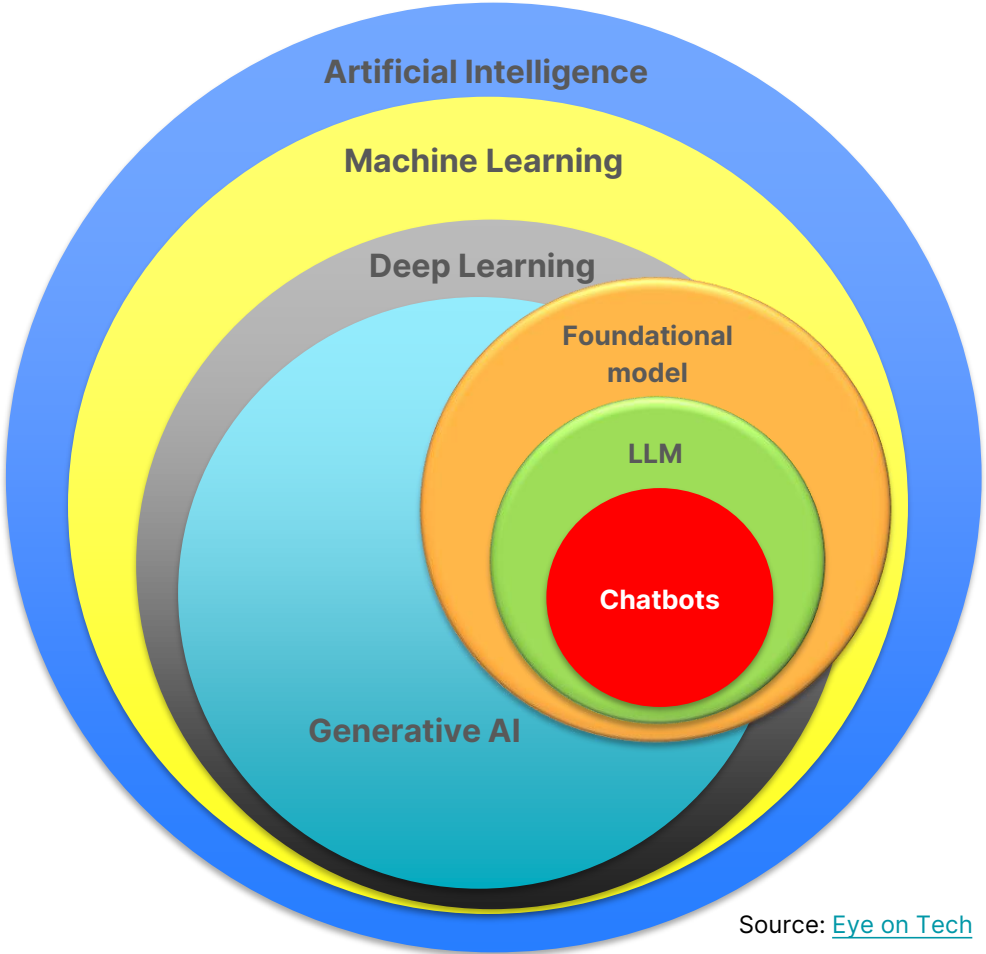
1. Basics of AI technology



2. Use cases of generative AI in research

3. AI ethics and responsible use of AI

AI is a set of tools



Source: Eye on Tech

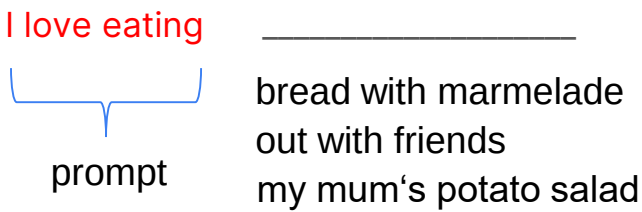
What is Generative AI?

Artificial Intelligence systems that can produce high quality content, specifically **text**, **images** and **audios**

Generating text with Large Language Models (LLM)

- LLMs are built on large amounts of text data to repeatedly predict the next word

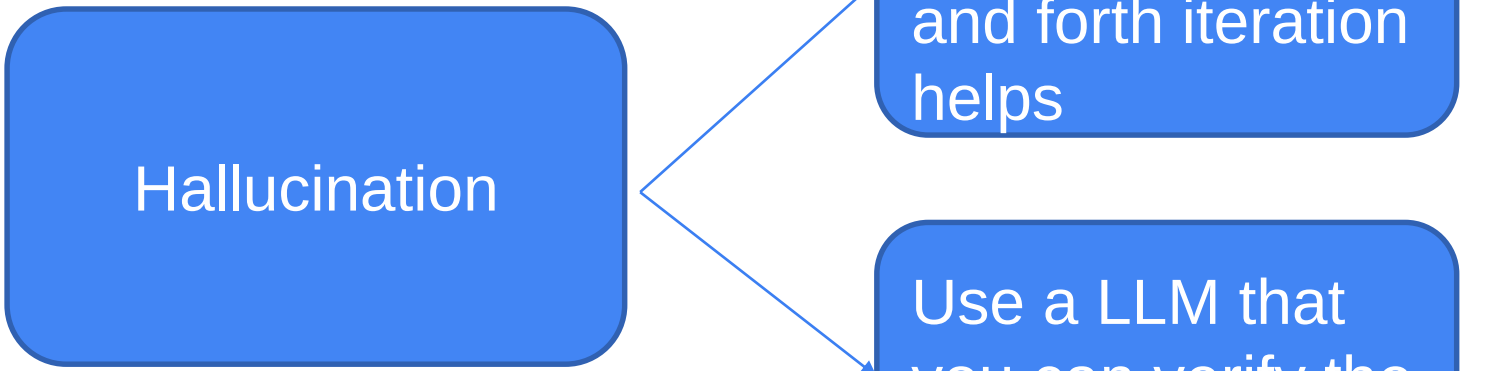
Text generation process



- When we train a very large AI system on a lot of data (hundreds of billions of words), we get a LLM like ChatGPT

Source: DeepLearning.AI

Don‘t mistake eloquence for truth or understanding



LLMs can sometimes make facts up

perplexity.ai will give you links to sources that you can easily verify

How can generative AI help with research tasks?

Text

- To summarize content
- To help write research manuscrips
- To help write grant applications
- To conduct literature reviews
- To help write coursework or exam questions
- To help fill-out work-related or administrative emails

Coding

- To help write code
- To document your code
- To debug code
- To learn how to code
- To understand other people‘s code

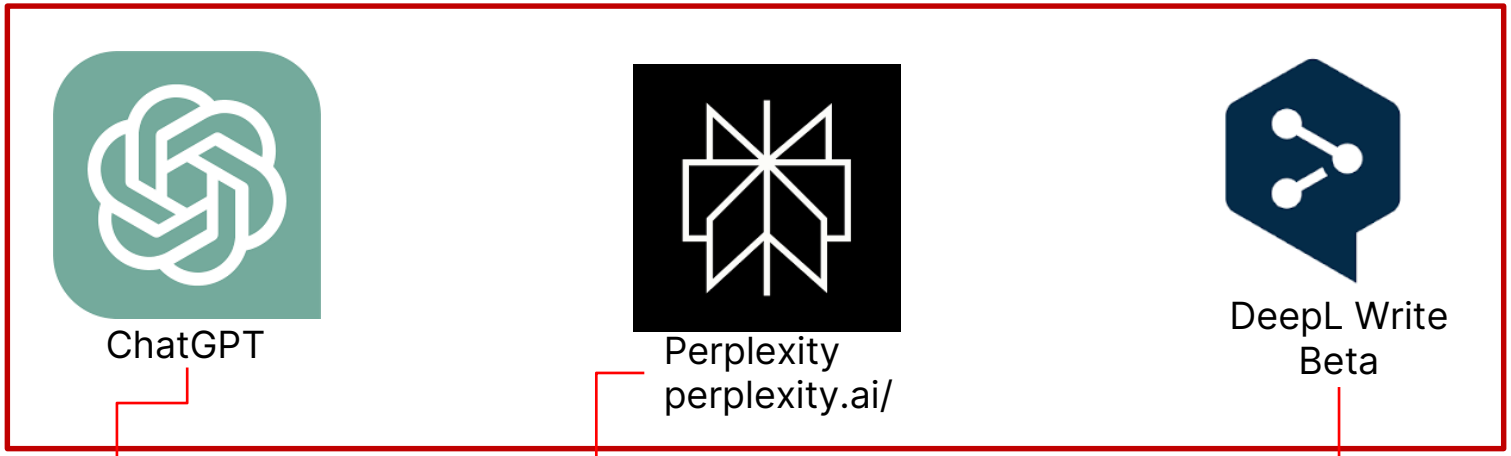
Brainstorming

- To help brainstorming new research ideas
- To design experiments
- To get advice on career development
- To help in decision-making

With the rapid technical development of generative AI, the possibilities are expanding rapidly.

AI and science: what 1,600 researchers think Nature, 2023

My selection of AI assistants for research



Coding, improving text, brainstorming

ChatGPT4: advanced data analysis, image generation…

„Factual“ or at least verifiable and up to date information

Grammar check, spelling, and paraphrasing

Less is more

Generative AI makes knowledge workers 25% faster and 40% better

Distribution of output quality across all the tasks. The blue group did not use AI, the green and red groups used AI, the red group got some additional training on how to use AI.

3 groups:

- Control: with no AI access
- GPT4 access
- GPT4 access with a prompt engineering overview

with AI support:

- 12.5% more of tasks were finished;
- Tasks were done 25.1% faster;
- Tasks had 40% higher quality

Read more here: OneUsefulThing and Dell'Acqua et al., 2023 (SSRN)

Prompt engineering

Explicit instruction

Prompt: Please summarize the contents of this [blog post] in a concise, bullet-point format

Example-Based

Prompt: Follow this journal guidelines: [insert guidelines here] to rate my introduction, and suggest points of improvement.

Chain of Thought

Prompt: Break down the process of gene editing using CRISPR-Cas9. Start by explaining what CRISPR-Cas9 is, then describe how it is used to edit genes, and finally discuss potential applications of this technology in human medicine.

Few-shot learning

Prompt: Given the following examples of how artificial intelligence is being used in climate change research, explain how AI could be applied in studying ocean acidification. Example 1: AI in modeling weather patterns. Example 2: AI in analyzing satellite imagery for deforestation.

Role, Task, Format

Prompt: Imagine you are a researcher with more than 10 years in the field of Genetics, make bullet points on the main limitations of the CRISPR technology

Hands-on activity

1) Go into breakout rooms;
2) Work individually, select and use an AI assistant to carry out a research task;
3) Analyse the AI generated output;
4) In group, share your experiences and insights from the activity (what was the task, how was your prompt, do you think the AI helped).

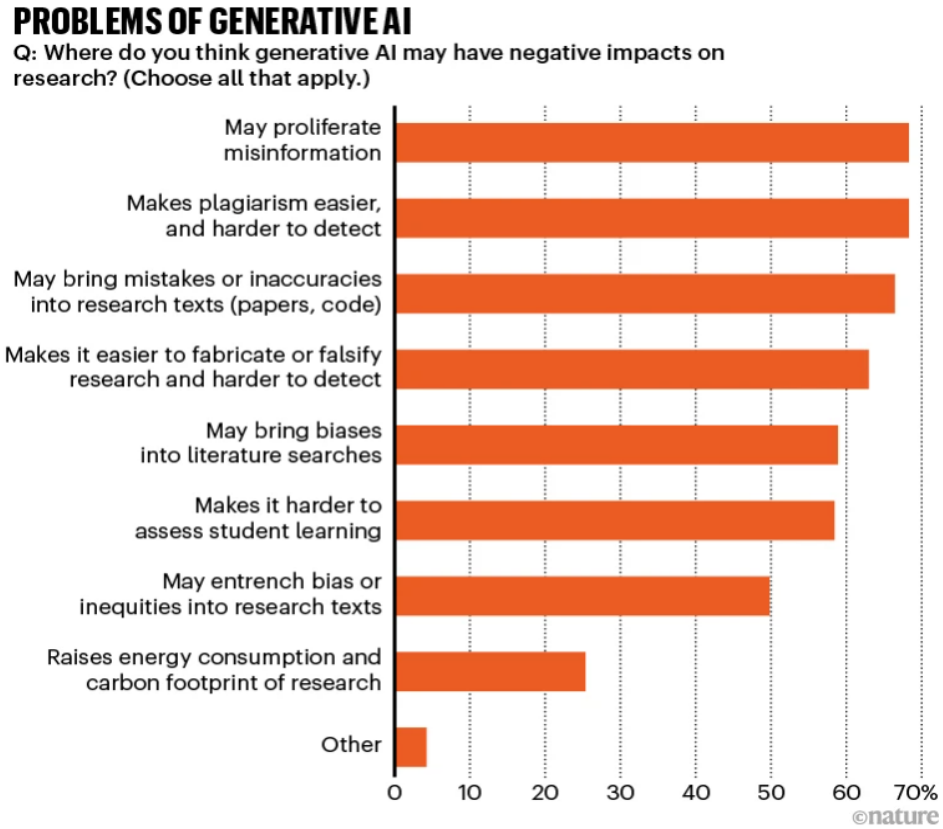
Tip:

- Remember that the AI output may contain plausible but potentially incorrect information, so interpret it carefully.
- Try using prompt engineering strategies.

Ethical issues and best practices

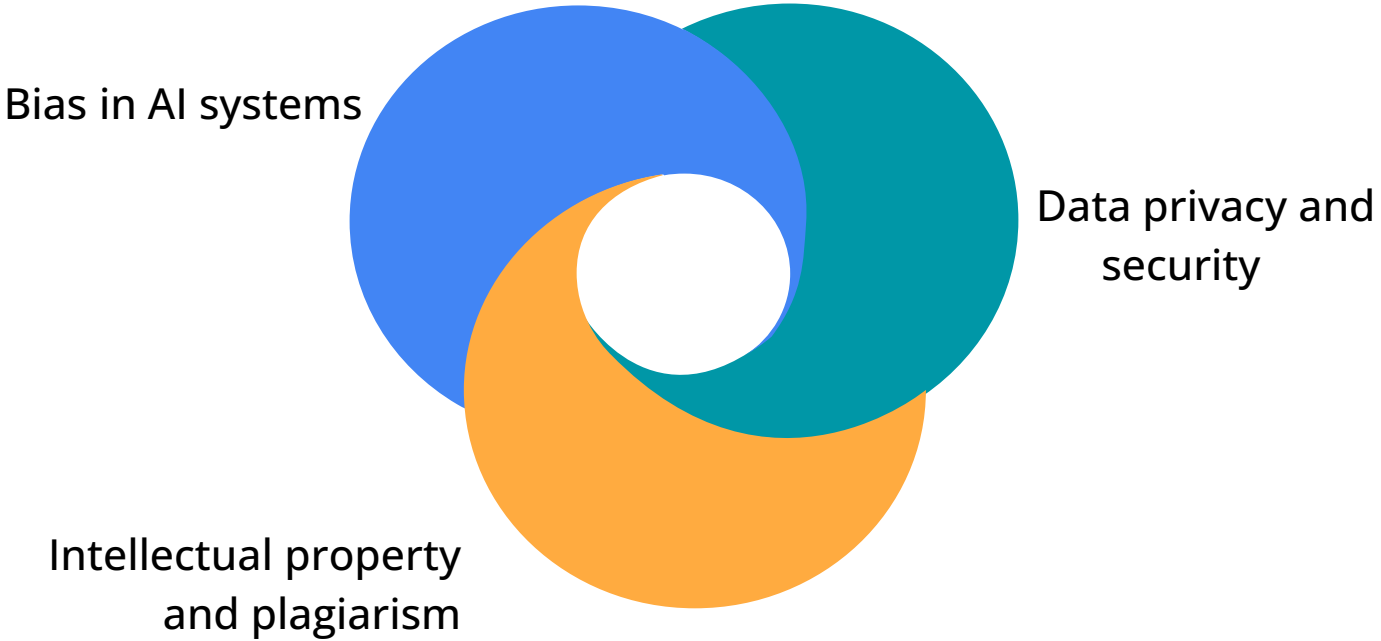
1. Current concerns

2. Best practices



AI and science: what 1,600 researchers think Nature, 2023

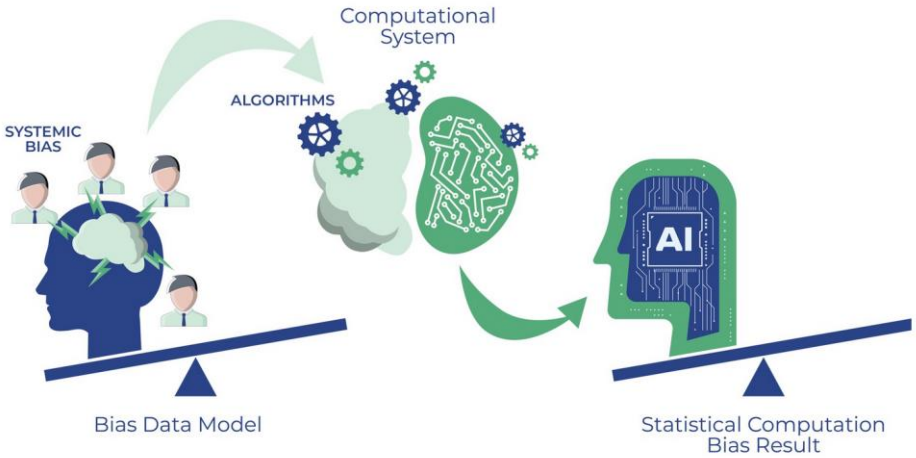
(Selected) ethical challenges in AI use



Bias in AI systems

- Biases in training data can lead to biased AI outputs

- Check the outputs carefully for any potential biases.
- More investment in AI alignment reseach



Source: Washington Technology

Data privacy and security

- Unauthorized incorporation of user data.
- Lack of privacy legislation that protects individuals from the use of personal information in AI.

- Remove any sensitive/personal data from your prompts.
- Use mock data for coding and data analysis.

Intellectual property and plagiarism

- Unintentional plagiarism
- Authorship of research papers

- Disclose the use of AI assistants in your scientific work.
- Verify everything.
- Check on plagiarism.
- Be transparent with colleagues when using AI assistants.

NEWS | 18 January 2023

ChatGPT listed as author on research papers: many scientists disapprove

At least four articles credit the AI tool as a co-author, as publishers scramble to regulate its use.

EDITORIAL | 24 January 2023

Tools such as ChatGPT threaten transparent science; here are our ground rules for their use

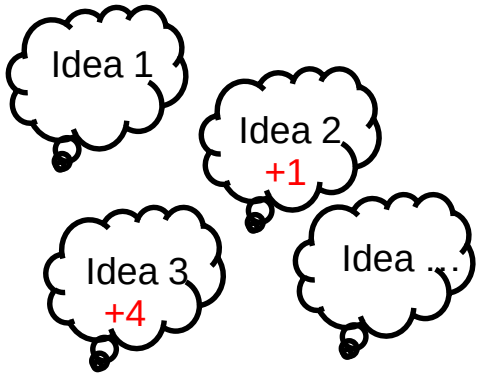
As researchers dive into the brave new world of advanced AI chatbots, publishers need to acknowledge their legitimate uses and lay down clear guidelines to avoid abuse.

Source: Nature, 2023 and Nature, 2023

Group activity: Note & Vote

Discuss ideas for handling ethical challenge(s) as a group.

1) Spend 5-7 minutes brainstorming individually and jotting down your ideas on the whiteboard;
2) When the 5-7 minutes are up, begin voting for the ideas that you find most relevant to the discussion (grouping similar ideas if necessary);
3) Next, discuss the most popular ideas with the group and summarise your discussion.



Use the white board in breakout rooms for this exercise!

Take-home message

01 Treat AI as a research assistant, not a supervisor!

02 Don’t over-rely on AI and always check the outputs!

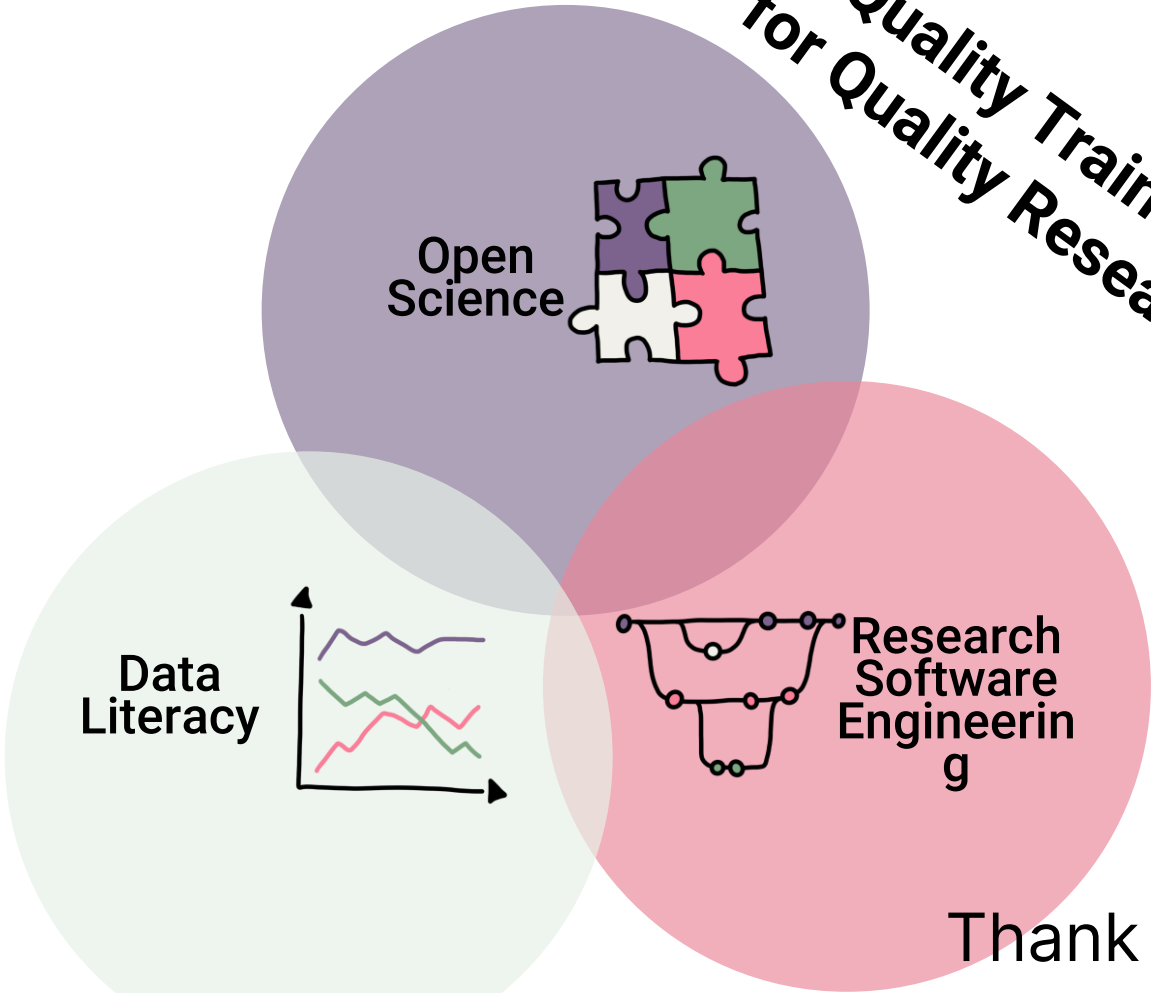
03 Join discussions on the subject, and keep up to date!

Questions?

DIGITAL RESEARCH ACADEMY

digital-research.academy

Quality Training for Quality Research



Thank you.