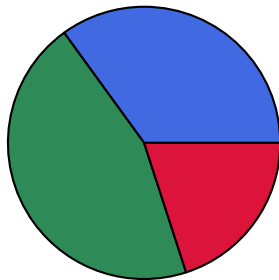# Using AI as a mathematician

Johannes Schmitt

ETH Zürich

14th of March 2025

A day in the life of a mathematician

Teaching

Class preparation, Exercise sheets, Instruction time, Advising of student theses

Research

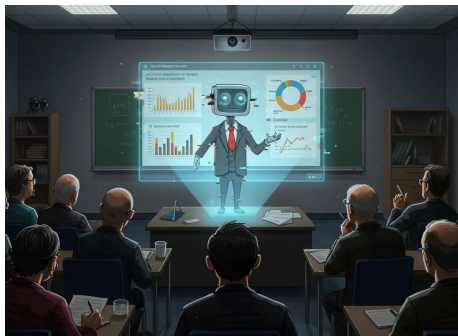Mathematical reasoning, Writing papers, Proofreading, Paper revisions, Research talks, E-Mails

Administrative

Refereeing papers, Committee work, Paperwork

Goal: Show how AI assistants like ChatGPT can help with some of these.

Example 1 - Meeting agenda & presentation

- **Goal:** Drafting an agenda and LaTeX beamer slides for an administrative meeting
- **Category:** Administrative task
- **Tags:** Non-Text Output, General Reasoning
- **System:** ChatGPT o1-pro (Brainstorming), Claude 3.7 (Creating slides)
- **Output:** Beamer slides

Anatomy of a Prompt

Hey, I am the group organizer of Group 1 at D-MATH of ETH Zurich. We are planning to have a meeting of the professors and permanent faculty tomorrow, to discuss organizational matters of the group. We have never done this before, and I think it's a bit fuzzy what the precise purpose of the meeting should be. I would like to discuss with you what possible agenda we could try to set.

The main focus should be on getting the most value per minute of meeting. I don't want any unnecessary bloat, no self-styled long speeches etc. The goal is to make this the most productive possible, and use the opportunity provided by having all stakeholders of the group there.

There will be about 5 professors and 3 senior lecturers present, as well as the pool secretary who knows about things like the budget. Traditionally, the topics of discussion include the incoming and outgoing personnel, as well as the budget (making sure that neither too little nor too much money is used). This semester we are also planning to have a group outing (pasting you some email conversation for context).

[AI proposes an agenda, creates beamer slides for a presentation]

Remove action items slide for now, insert dummy slides for Personnel changes (just blank slide with title, this can be a discussion which is a bit more free)

- ■ Context
- ■ Goal
- ■ Specifications
- ■ Input data
- ■ Feedback

Example 2 - Lecture scripts from recordings and notes

- **Goal:** Create LaTeX script for existing lecture
- **Category:** Teaching
- **Tags:** Multimodal input, Large context, One-shot prompting
- **System:** Whisper + Gemini
- **Input:**
  - Video recordings of previous lectures (transcribed via Whisper)
  - PDF of handwritten blackboard notes
  - Existing LaTeX code from a related lecture as style guide
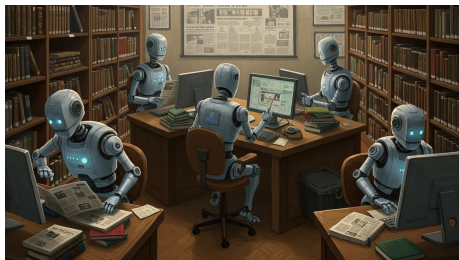- **Result:** 30 min work per 90 min lecture = 7 pages of script

Output:

- First draft
- Comparison with final version
- Example Gemini session

Example 3 - Research on academic career opportunities

- **Goal:** Summarize career opportunities in Zurich for junior researcher
- **Category:** Career Development
- **Tags:** Internet research, AI agent
- **System:** ChatGPT DeepResearch
- **Result:** Comprehensive list of options including grants, fellowships, and positions

Output:

- Full conversation and results

Example 4 - Subtle mistakes in mathematical reasoning

- **Goal:** For finite G-set E, does representation Perm(E) determine E?
- **Category:** Research
- **Tags:** Reasoning model, Hallucination
- **System:** ChatGPT o3-mini-high
- **AI response:** Yes...
- **Problem:** Contains hallucinated formula, claim is false
- **Silver lining:** Proof attempt put me on right path to correct classification.

Output:

- Conversation with o3-mini-high

Where to start?

ChatGPT

Free tier

- Quick searches
- Create pictures
- Reasoning (mid-level)
- Advanced Voice mode

Paid tier ($20/month)

- DeepResearch
- Reasoning (high-level)

Claude

Free tier

- Best writing model
- Creating artifacts (web-apps)
  Example artifact

Paid tier ($20/month)

- Best coding model (Extended Thinking)