LLMs and Beyond

Modern Topics in Reasoning and Agentic Systems

Peter Gehler, 17.4.25

Thanks for the interest!

ILIAS

Material

Key Publications

Code / Frameworks

Data & Metrics

Format

Single 30 min presentation	Team of 2 60 min presentation

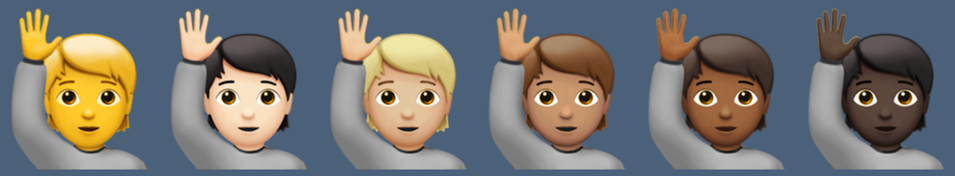
AND

2 page report OR AI agent with documentation	2x2 page report OR AI Agent with documentation

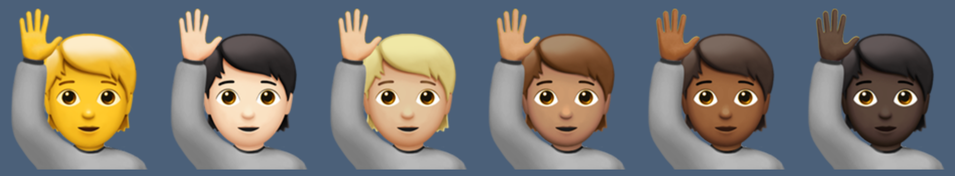
Schedule a 15 min before.
https://calendar.tuebingen.ai/petergehler/office-hours

Same Seminar — Different time

Wednesday 16-18 ?



Monday 16-18 ?



Timeline: Thursday 14-16, Sand A104 (30)

17.4.	Today	5.6.	
24.4	YouTube: GPT from scratch	12.6.	Pfingsten
1.5.	Tag der Arbeit	19.6.	Fronleichnam
8.5.	Tokenizer	26.6.	
15.5.	Basics	3.7.	
22.5.		10.7.	
29.5.		17.7.	[Agents presentation]
		24.7.	

10 meetings = 30 presentations

Timeline Wednesday 16 - 18, C118

17.4.	Today	4.6.	
23.4	YouTube: GPT from scratch	11.6.	Pfingsten
30.4.	Basics	18.6.	
7.5.	Tokenizer	25.6.	
14.5.		2.7.	
21.5.		9.7.	
28.5.		16.7.	[Agents presentation]
		23.7.	skip

11 meetings = 33 presentations

How to present?

- 30 min presentation (25+5, 27+3, you choose)
- 2x30 = 60 min presentation (prepare as team of 2)

Presenting a Publication

- What is the main contribution — “the nugget”?
- What is the main claim? How is it validated?
- Focus on the main message, details only where necessary
- Inspire to read further

- Training procedure and details (dataset,training time)?
- Model design? Evaluation?
- What are unanswered questions? Limitations?
- What is your opinion? Is this a paper you would like to have written? Do you like the style?

Presenting a Dataset

- What is the main contribution — “the nugget”?
- What specifically does this dataset cover?
- Are there ethical concerns? Are they addressed?
- What does “solving this dataset” require?
- How does it advance over previous ones?
- Effort involved to create this dataset
- Show examples. Then show more examples.
- What are the limitations?
- What is your opinion? Is this a dataset you would like to have created?

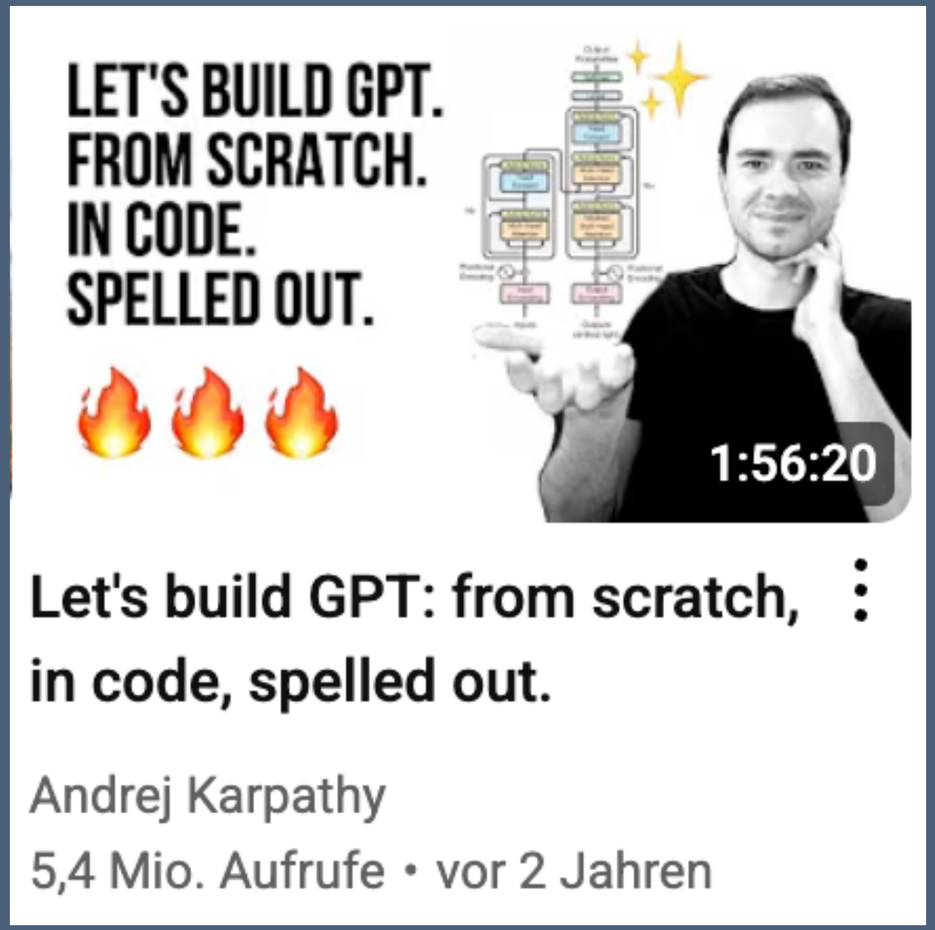
Presenting Code/Blog/ Frameworks

- What is the main contribution — “the nugget”?
- Screensharing is okay, preferred.
- What is the main design principles? What are the main components?
- Could you run the code locally? Is there an example?
- Ideal: walk-through example.
- Inspire to try yourself
- What are the known limitations?
- What is your opinion? Easy to use, what is your experience after trying? What was your expectation?

23./24.4. GPT from Scratch

No in-person seminar

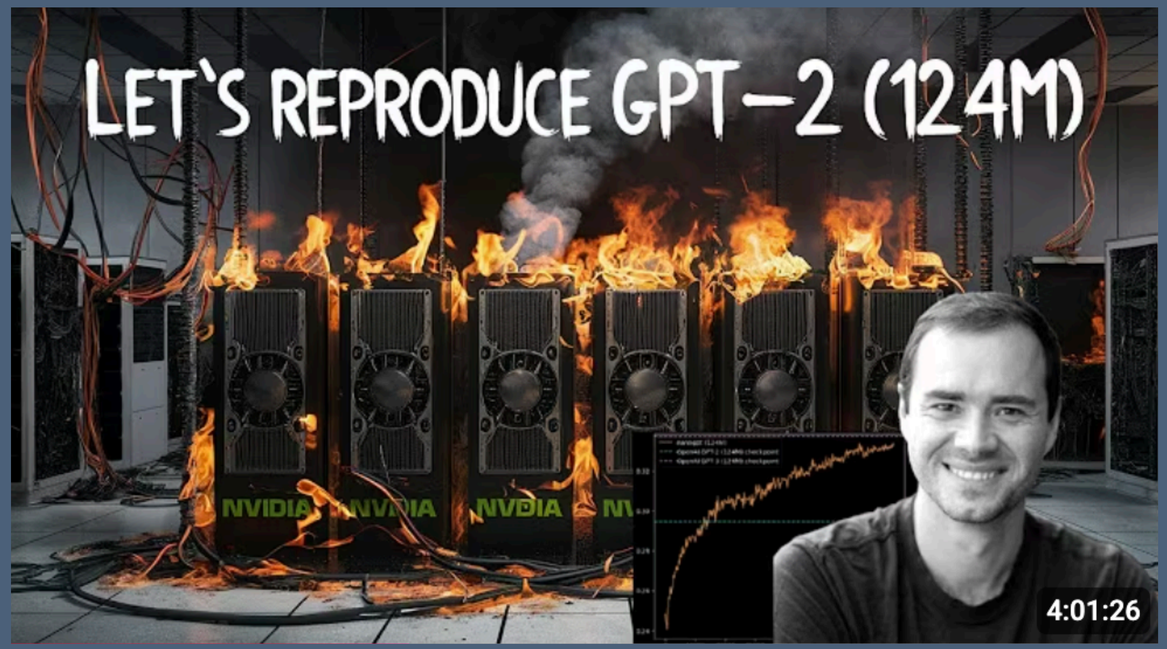
- No in-person seminar
- GPT from scratch
- Watch at your own pace
- Use the Discussion forum on ILIAS



23./24.4. Alternative: GPT-2

No in-person seminar

- No in-person seminar
- Reprodcuce GPT-2
- Watch at your own pace
- Use the Discussion forum on ILIAS



Key Publications

Basics

- [1x,🔑] The Natural Language Decathlon: Multitask Learning as Question Answering (review here) (8 pages)
- [1x,🔑] Attention is all you need, (another resource: YouTube 3Blue1Brown)
- [2x] Instruct-GPT (Training language models to follow instructions with human feedback) (20 pages, 2x30min)
- [1x] PEFT: Parameter Efficient Fine Tuning (just the basics and taxonomy please)
- [1x] LoRA: Low-Rank Adaptation of Large Language Models (12 pages)

Tokenizer

- [1x] Neural Machine Translation of Rare Words with Subword Units (9 pages)
- [1x] https://github.com/google/sentencepiece
- [1x] https://github.com/openai/tiktoken
- Extra Material: GPT - tokenization (YouTube Karpathy)

Models

- [1x,🔑] Language Models are Unsupervised Multitask Learners (GPT2) (9 pages)
- [1x] GPT-4 Technical Report (14 pages with pictures)
- [1x] Mixtral of Experts (8 pages)
- [1x,🔑] LLaMA (11 pages)
- [1x] Teuken-7B-Base & Teuken-7B-Base-Instruct: Towards European LLMs
- [2x,🔑] DeepSeek-R1
- [1x] DeepSeek v3 anyone ?
- [1x] Learning Transferable Visual Models From Natural Language Supervision (CLIP)
- [3x, 🔑] Gemini (3x30min, 40 pages)

Retrieval Augmented Generation

- [1x,🔑] Retrieval Augmented Generation for Knowledge-Intensive NLP Tasks (9 pages)
- [1x] Retrieval-Augmented Generation for Large Language Models: A Survey
- [1x, 🔑] From Local to Global: A GraphRAG Approach to Query-Focused Summarization (12 pages)
- Another resource: RAG From scratch YouTube series

Agents

- [1x, 🔑] ReAct: Synergizing Reasoning and acting in language models
- [1x, 🔑] Chain-of-Thought Prompting Elicits Reasoning in Large Language Models (9 pages)
- [1x, 🔑] Toolformer: Language Models Can Teach Themselves to Use Tools (10 pages)
- [1x] Building effective agents (Anthropic blog post)
- [2x, 🔑] Agent2Agent Protocol (A2A), protocol and example
- [1x,2,x,3x,... 🔑] A review of Market Analysis for AI Agents (bcg, gartner, a16z

Data and Metrics

Data & Metrics

- [1x] CommonCrawl
- [1x,🔑] HumanEval: Evaluating Large Language Models Trained on Code (14 pages)
- [1x] Humanity's Last Exam and https://agi.safe.ai/
- [1x] Training Verifiers to Solve Math Word Problems
- [2x,🔑] LAION-5B: An open large-scale dataset for training next generation image-text models (12pages, webpage) + CLIP?
- [2x, 🔑] Chatbot Arena (website, leaderboard)
- [1x] PaperBench: Evaluating AI's Ability to Replicate AI Research

Agent Frameworks

Agent Toolkits

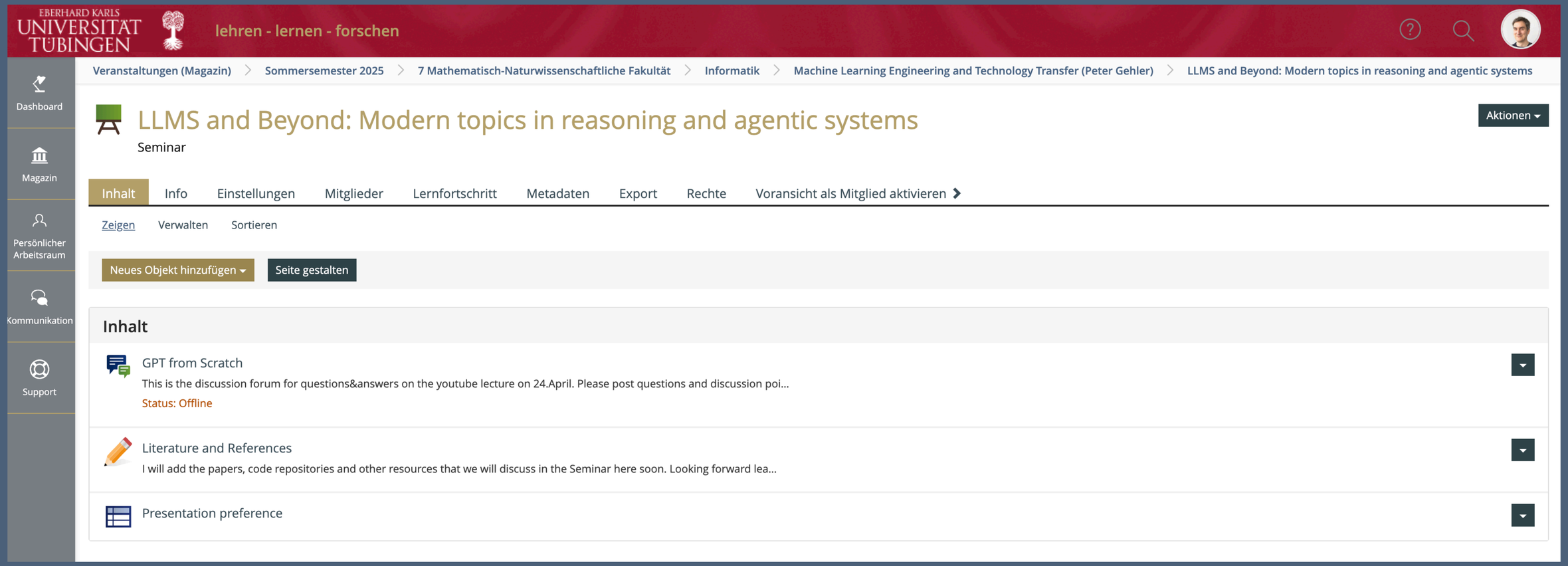
- [2x, 🔑] smolagents Huggingface
- [1x] Rivet
- [2x] OpenManus (blog, GitHub code)
- [2x] n8n
- [2x, 🔑] LangChain
- [2x, 🔑] LangGraph
- [1x] Lang Chain RAG Tutorial
- [2x, 🔑] Agent Development Kit (Google/Gemini)
- [2x] Nvidia Generative AI Examples (RAG, AgenticLlama3.1)

Propose your own topic

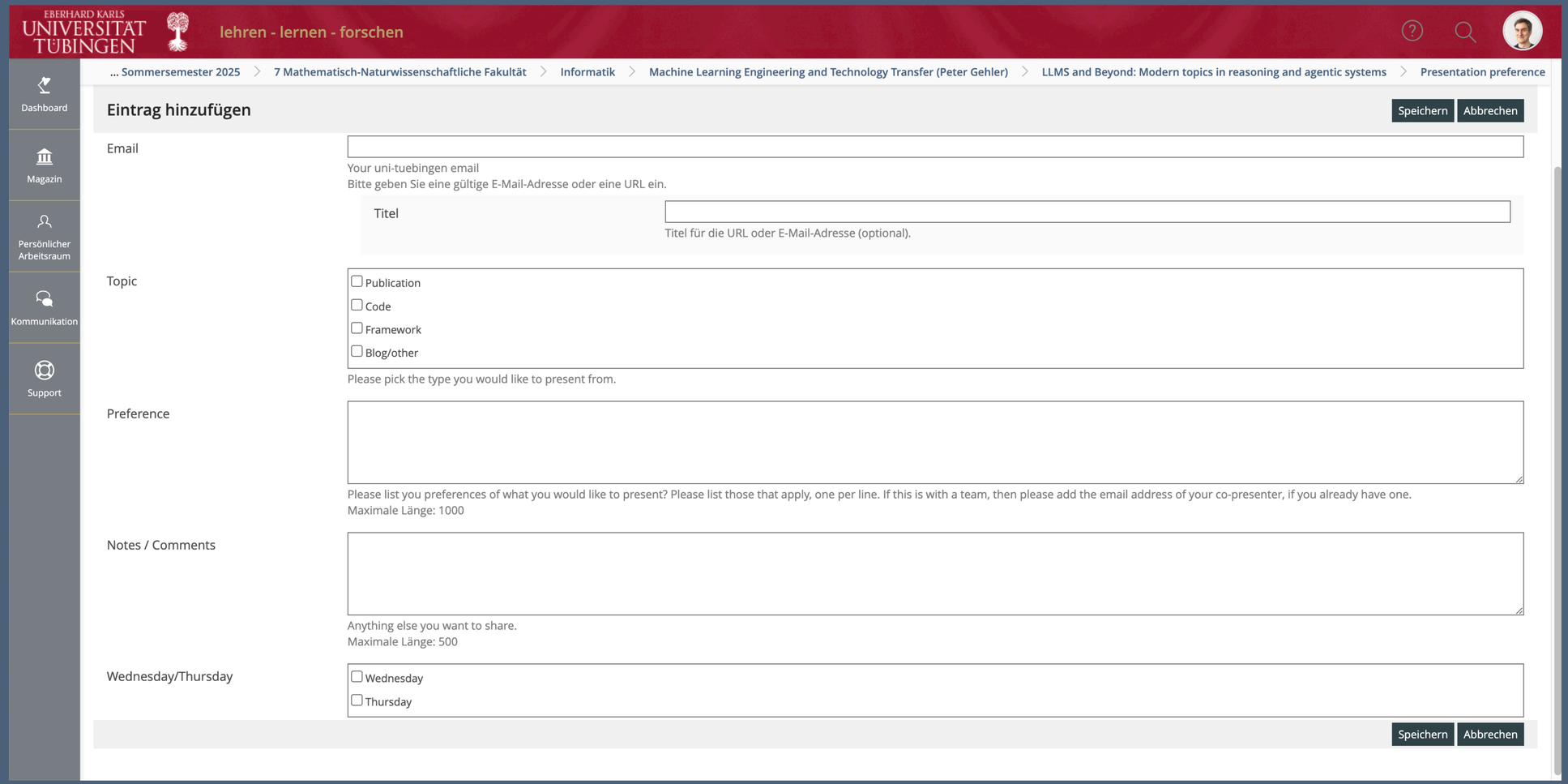
Other resources

- The 2025 AI Engineer Reading List
- The black spatula project

How to pick a topic



How to pick a topic



📣 Advertisement: Hiwi position

- High-Performance Computing (HPC)
- European Project Minvera on HPC access
- Task: Simplify access to Supercomputers
- Research into training times of popular projects (from papers, webpage, etc.) (maybe through an agent?)
- Prototype website to bring compute demand and access together