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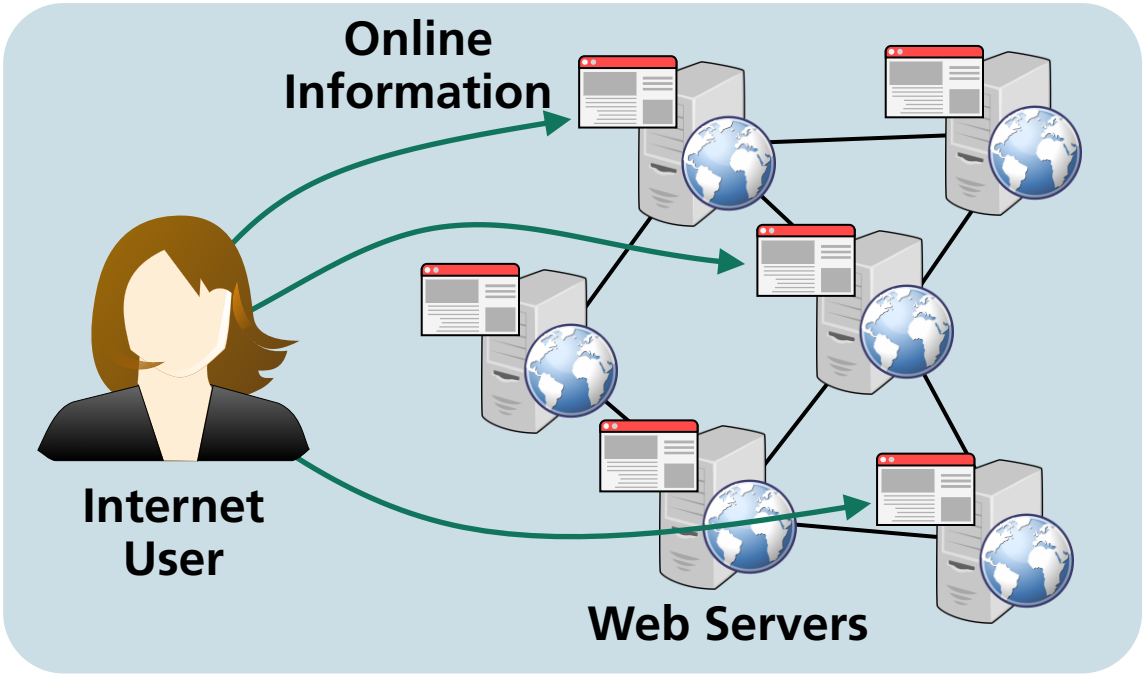
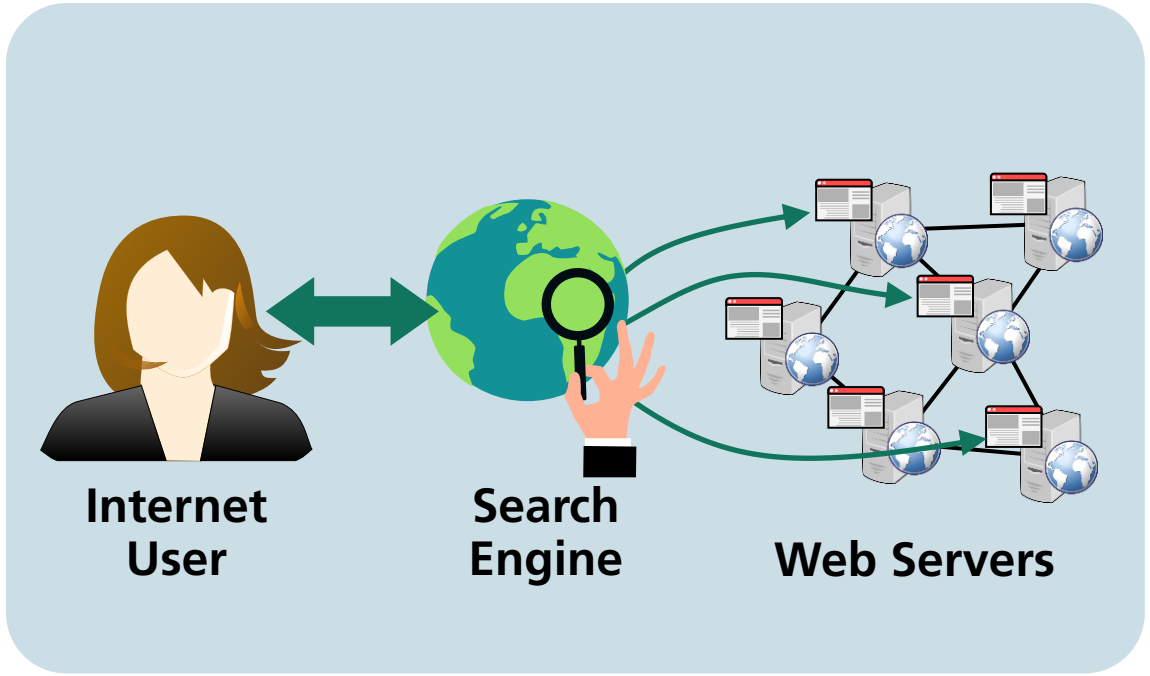
Roman Matzutt, Avikarsha Mandal

Towards a Reliable Web of Knowledge

Revolution of the Early Internet

From a User's Perspective





Early Internet

- Fragmented, direct access to information
- User has to know where to look

Search Engines

- Maintain central search index / interface
- User can query information

Recent Developments with LLMs

Why the Previous History Lesson?

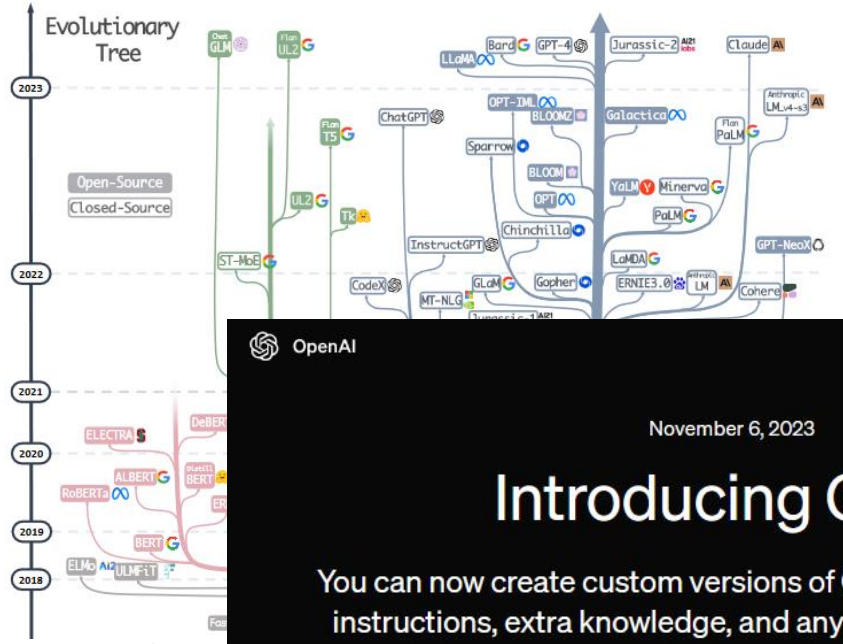
We already have a serverely fragmented LLM market!

- Both regarding the available models…
- …and services!

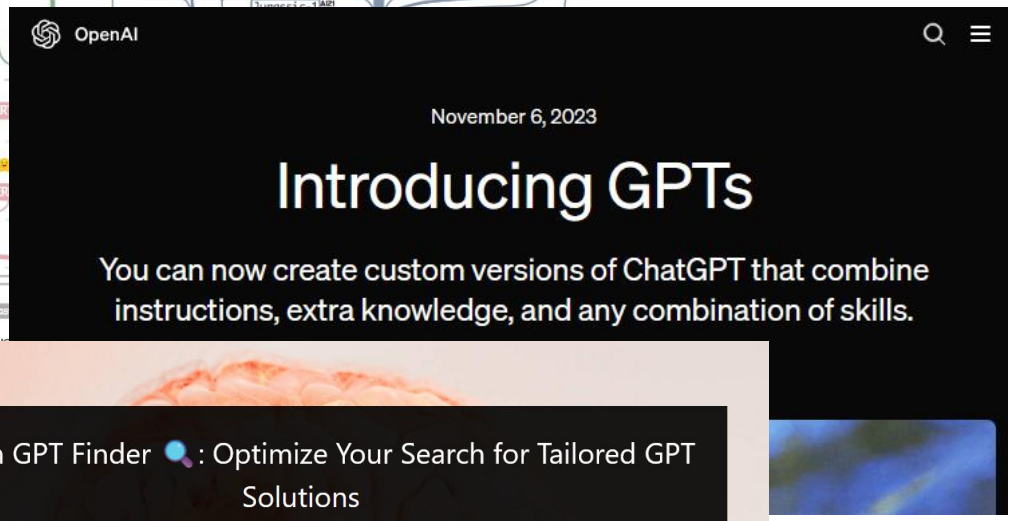
This leads to undesirable customer experience:

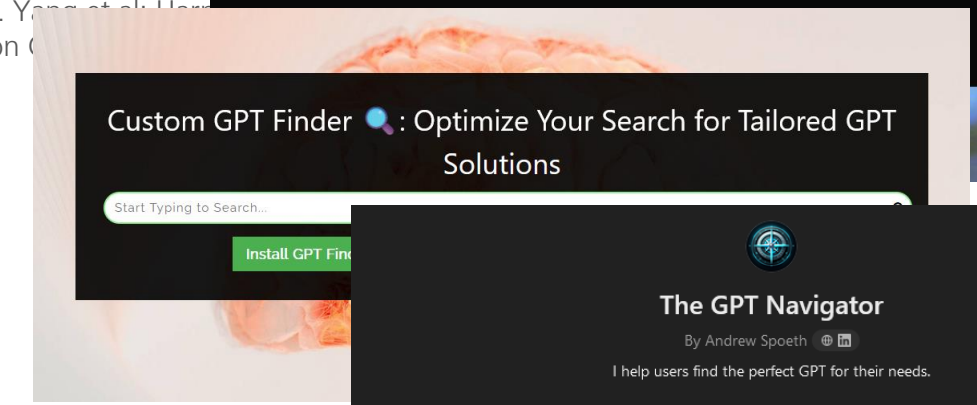
- It becomes increasingly hard to traverse the „LLM Jungle“
- Do users now have to know the best LLM for their use case again?

In the worst case, we may revert to Early Internet-style browsing

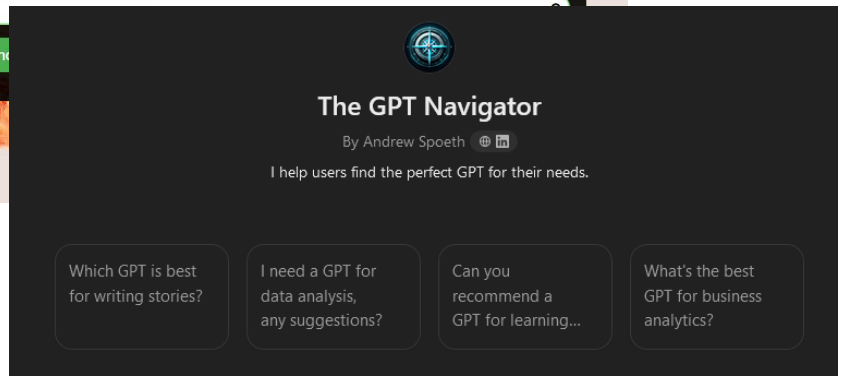


J. Yang et al. Harn… on …





https://gptfinder.co/



https://chatgpt.com/g/g-RizxV7UDv-the-gpt-navigator

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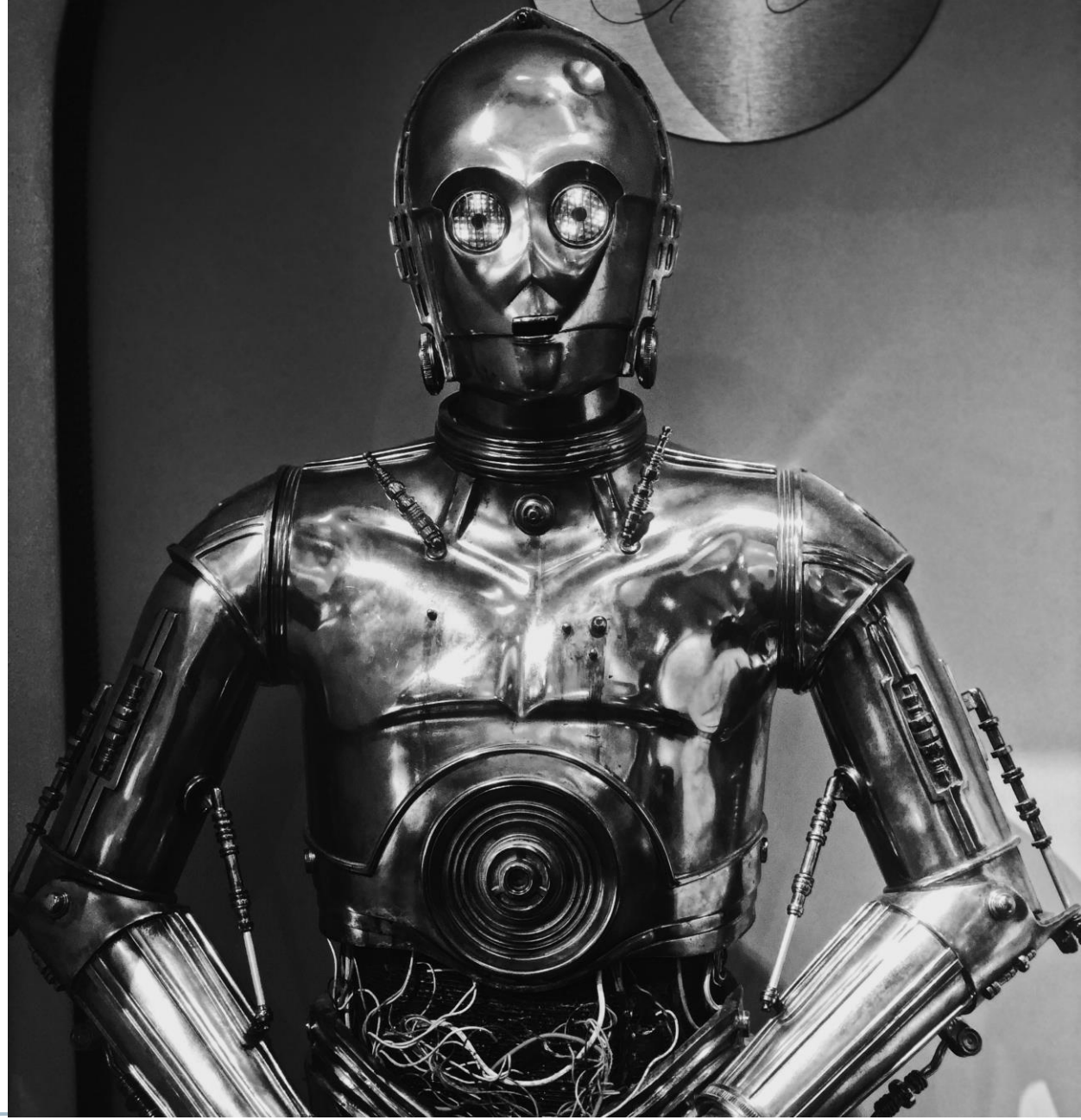
Toward a Web of Knowledge

Desirable User Experience

Instead, offer LLMs as integral part of the user interface for information retrieval

- Already offered by search engine / tech providers
  - Microsoft Copilot, Google Gemini, Apple Intelligence
- Also, development toward on-the-fly information retrieval
  - E.g., OpenAI ChatGPT-4o

But: Challenges of LLMs get aggravated in this scenario



Recap: Challenges of LLMs

Aggravated in Single-Point-of-Failure Deployment

Response Accuracy

- Statistical responses without reasoning
- Hallucination of “likely” information
- Identification of tasks that require calling external functionality (e.g., computations)

Data Availability

- Vast amounts of training data required
- Privacy and copyright issues
- Tendency cover knowledge in training data (fine tuning)

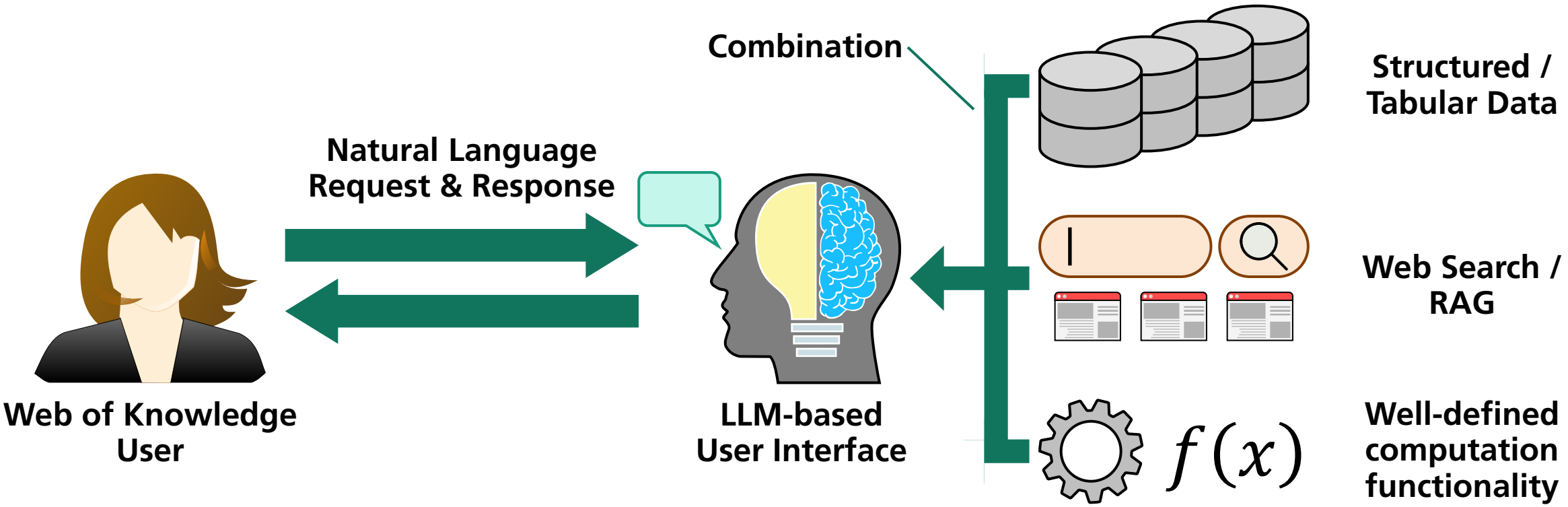
Why do LLMs have to encode knowledge?
→ Focus on the true strengths of LLMs!

Get inspired by RAG to rethink knowledge retrieval

LLMs in the Center of the Web of Knowledge

Return to Strengths

Main idea: Focus on what LLMs provide at the core: Natural-language user interfaces

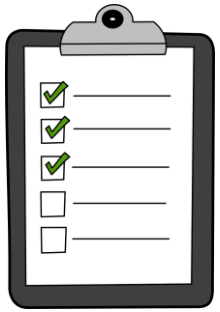


Challenges

Or: Research Opportunities

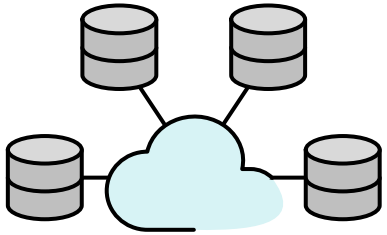
Standardization

- Requirement for APIs
- Data ontologies and derivation of structured data
- Access structures and permission management



Linking Data Sources

- Find and combine data from multiple sources
- Data heterogeneity
- Different data owners
- Example: “Should I go by car or train?”



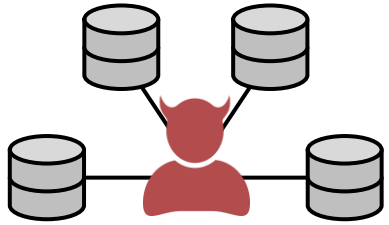
Data Provenance

- Provide means to validate received information
- Trade off: response simplicity and verifiability
- Enable dynamic investigation with optional auxiliary data (quick info vs. research)

[citation needed]

Over-Centralization

- Service providers not guaranteed to stay neutral
- May become person in the middle
- Withhold crucial information
- Alter retrieved data

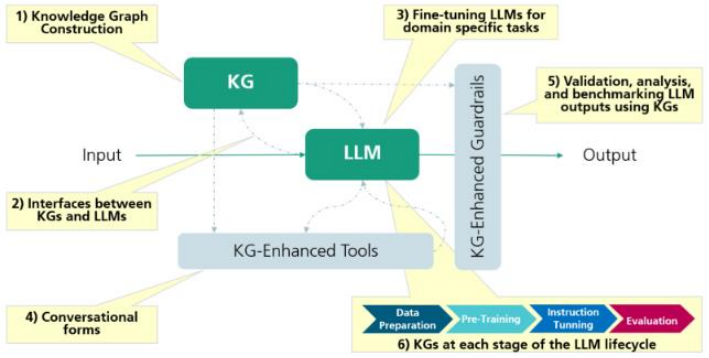


Next Steps

Related Activities at FIT

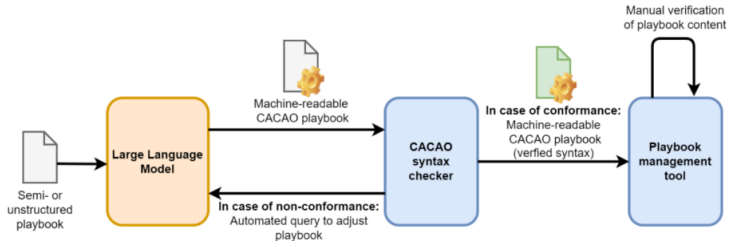
Knowledge-Enhanced LLMs

- Enhance reasoning of LLMs by introducing a structured knowledge store
- Realized by constructing knowledge graphs that is queried by the LLM
- Translate natural language queries via Text-to-SPARQL technology



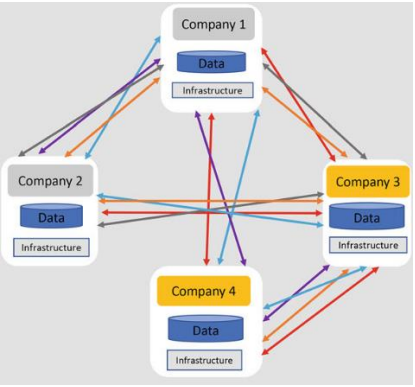
Structured Process Descriptions

- Translate natural-language descriptions of workflows into machine-readable, standardized form for LLM compatibility
- Current focus: Shareable cybersecurity playbooks: Bidirectional translation
- Envisioned application to general process descriptions



Data Spaces

- Federated architectures to facilitate self-sovereign data exchanges
- Provide infrastructure for sharing industrial data that is hosted at the respective origin companies
- Example initiatives: IDS and GAIA-X



H. Tardieu: Role of Gaia-X in the European Data Space Ecosystem

Conclusion

Summary

Web of Knowledge (WoK):

- Understand LLMs as excellent interfaces based on human natural language instead of knowledge encoders

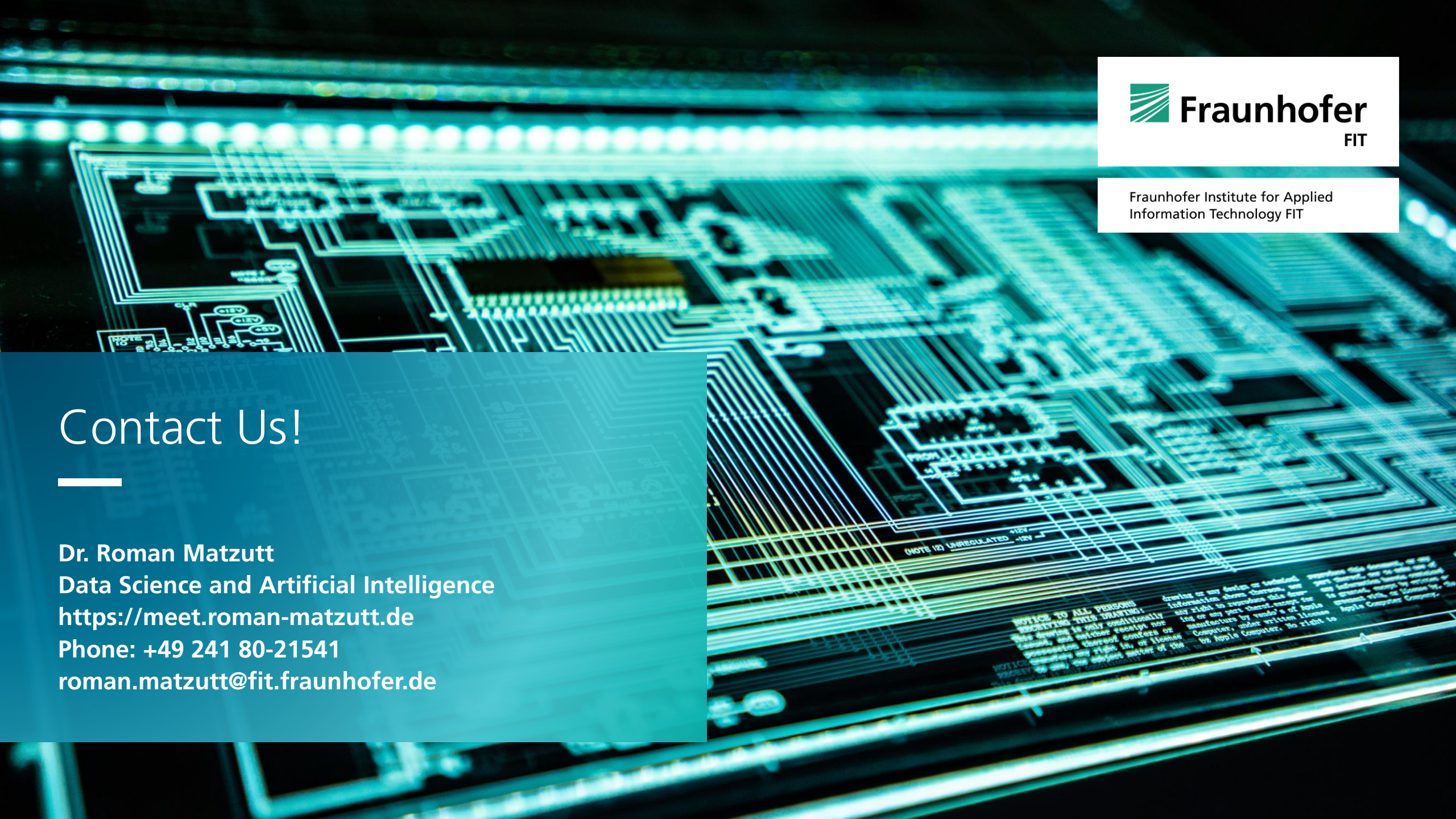
Exchange old for new challenges

- Potential to reduce hallucination, data ownership issues
- But: Challenges regarding standardization, linkability, verifiability

Ongoing initial efforts

- Connecting knowledge graphs and standardized processes to LLMs

Interested? Let's cook together!



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