Development of a Decommissioning Knowledge Management Tool at EPRI

IAEA Technical Meeting on Knowledge Management for Decommissioning

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ABOUT US

Founded in 1972, EPRI is the world's preeminent independent, non-profit energy research and development organization, with offices around the world. EPRI's trusted experts collaborate with more than 450 companies in 45 countries, driving innovation to ensure the public has clean, safe, reliable, affordable, and equitable access to electricity across the globe. Together, we are shaping the future of energy.

The Decommissioning Knowledge Management tool development at EPRI is being lead through a collaboration between two programs:

- Remediation and Decommissioning Technology Program
- Data-Driven Decision-Making Program

Motivation

- Building on more than **30 years of EPRI unstructured decommissioning information**, with the aim of providing guidance, plans, and strategies for executing an effective, efficient and safe NPP decommissioning program;
- **Strong international engagment**, at IAEA, OECD-NEA, European Commission and others, to structure and drive KM through **taxonomies** and **ontologies**, now supplemented with advance language processing capabilities.
- Synergizing and complementing EPRI developments in the area of **smart information retrieval systems** and **information processing through advanced machine learning modules**.

EPRI Connecticut Yankee Decommissioning Experience Report (1013511)

EPRI Remediation and Decommissioning Technology Program

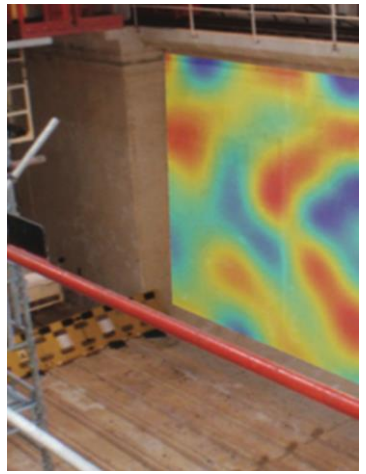
- Building on more than **30 years of documented experience**, EPRI's research provides structured and practical guidance, plans, and strategies for executing an effective decommissioning program

Connecticut Yankee Decommissioning Experience Report (1013511)

Facilitates technology transfer between nuclear plant owners and industry experts

Compiles best practices from past and ongoing decommissioning projects

Demonstrates technologies that offer efficiency or safety improvements



D:EEP Application and visualization output

Quick-Link to EPRI Decommissioning Sourcebook:

Data-Driven Decision Making (3DM)

Leverage data science for the Nuclear Power industry

Launch & support activities across the Nuclear Sector

General application areas

Insights: learning from the past

Prognostics: anticipating the future

Automation: increasing reliability

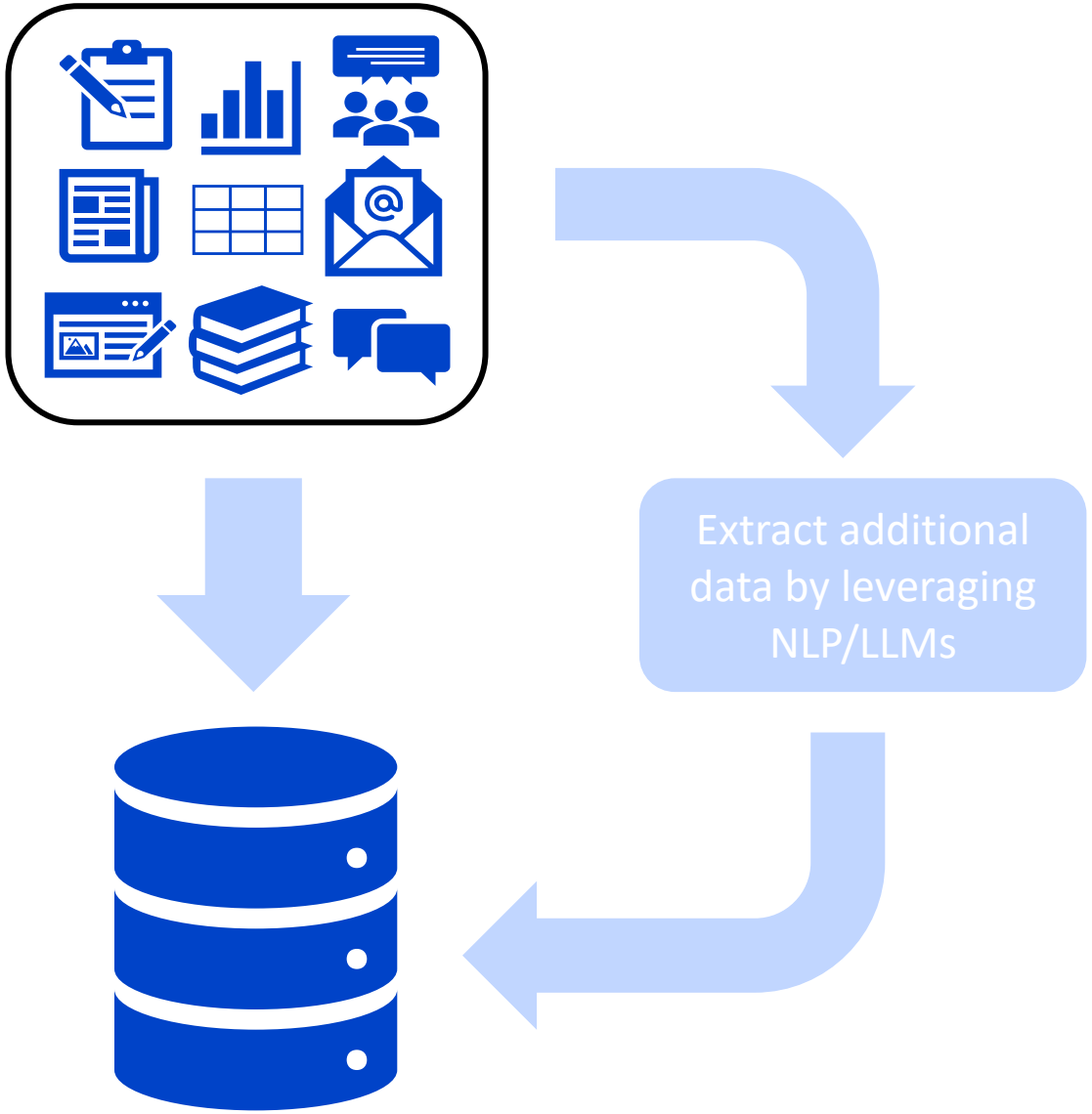
Optimization: increasing efficiency

More details on 3DM program page

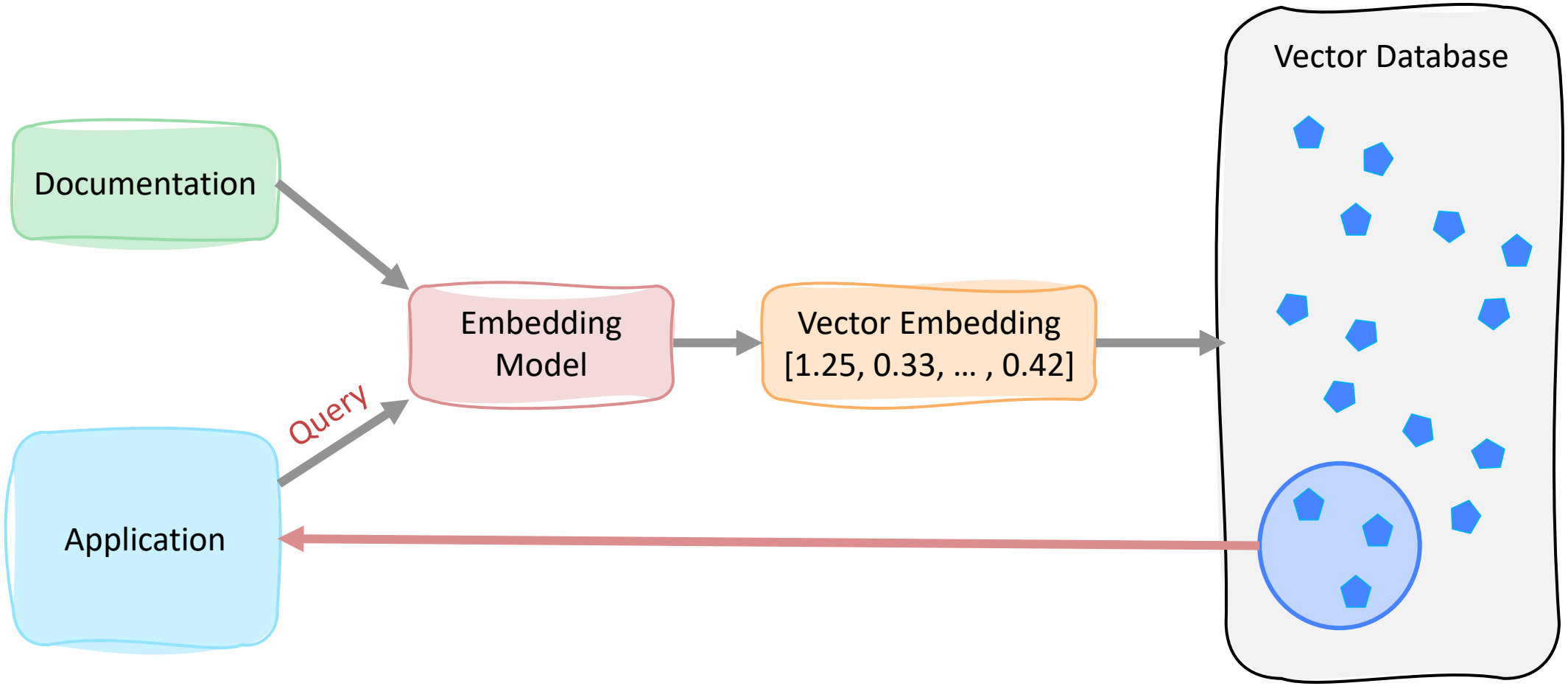
Applying Data Science in the Nuclear Power Industry

Decom KM

- The goal is to help subject matter experts in the Decommissioning program find relevant information fast
- Challenges:
  - Information spread over various formats
  - Evaluation of search results and optimization of database parameters
  - Working with the legal team to make sure we are in compliance and that our data are protected



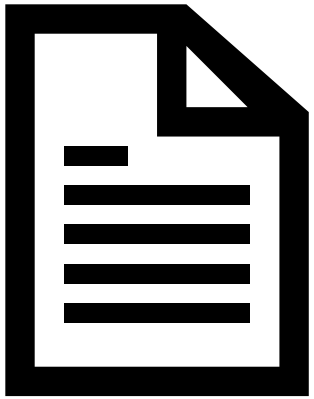
Approach



Standard Semantic Retrieval Approach

Synthesis of Queries

Also evaluate information retrieval based only on the text chunk and its source



Chunk of text

Ask LLM to generate a query based on the text

Synthesized Query	Relevant Text Chunk	Text Source

The corpus can then be used for:

- Evaluations of how well the information is retrieved based on different parameters (i.e. chunk size, embedding model used, different reranking algorithms). This uses the form of queries that are expected to be input by the user.
- Finetuning of the embedding model with domain-specific language
- However, does not consider multiple relevant documents

Evaluation of Synthesized Queries

- Synthesized queries need to be reviewed by the SME's
  - Hallucination concerns
- However, synthesis speeds up the whole process

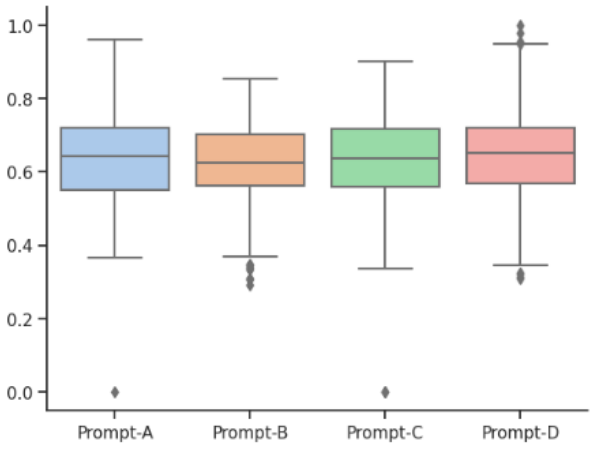


Figure 6: Score distribution across diffent prompts

← Evaluation of questions generated with Llama 70B [from Amyeen et al, 2023]

https://arxiv.org/abs/2310.18867
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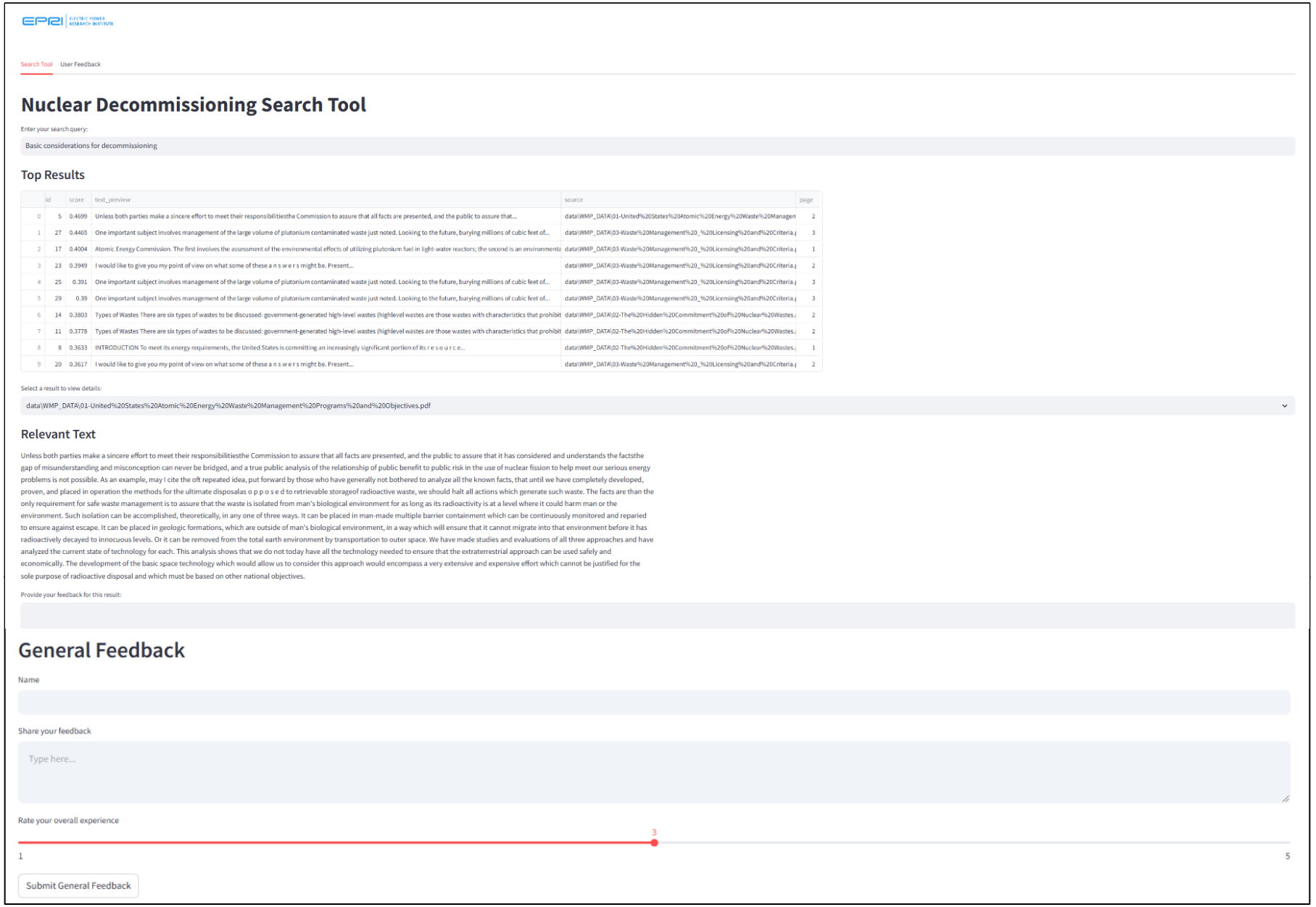
Streamlit User Interface (restricted access)



- Simple **Top Results** tabled to display relevant document matches with relevance score.
- **Preview** of source snippets prior to opening full file.
- **User Feedback** (work in progress) per respective document hit for model finetuning based on preliminary vectorstore.

Consideration for improvement…

- Filtering methods of the WM database
- Q&A evaluation dataset: best to use only SME input, but would like to improve the process of synthesis to increase the volume
- Document scraping and ingestion pipeline – quality checks, ingestion methods are evolving, metadata considerations
- Embedding model and vector DB choice, search methods, etc..
- On-prem vs. enterprise cloud tools

Collaboration with the Oral History Project

- New joint project between Nuclear and Generation sectors at EPRI
- The goal is to develop a scalable application that enables power plant workers to record their experiences and insights via voice, which are then transcribed, anonymized, and processed using large language models (LLMs). The processed content would then be stored in a searchable knowledge base, making it accessible to current and future employees for training, troubleshooting, and decision-making.

Focusing on capturing context and nuance

Acknowledgments

- **Crosscutting international exchanges** with SMEs at IAEA, EC-JRC, OECD-NEA, LANL and international research entities (UM, FIU, University of Rome)
- Strong **internal EPRI collaboration**:
  - Support and funding by **EPRI Technology Innovation Program**
  - Strong collaboration between **EPRI Fuels&Chemistry** and **EPRI Engineering Department** directorates:
    - EPRI Program 41.09.02: Remediation and Decommissioning Technology
    - EPRI Program 41.13.02: Data-Driven Decision Making



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