



# Fantasy or Philosophy?

The Philosopher's Spellbook



Hermine Kleiner, Sarah Anna Uffelmann, Sebastian Loftus  
03.07.2024



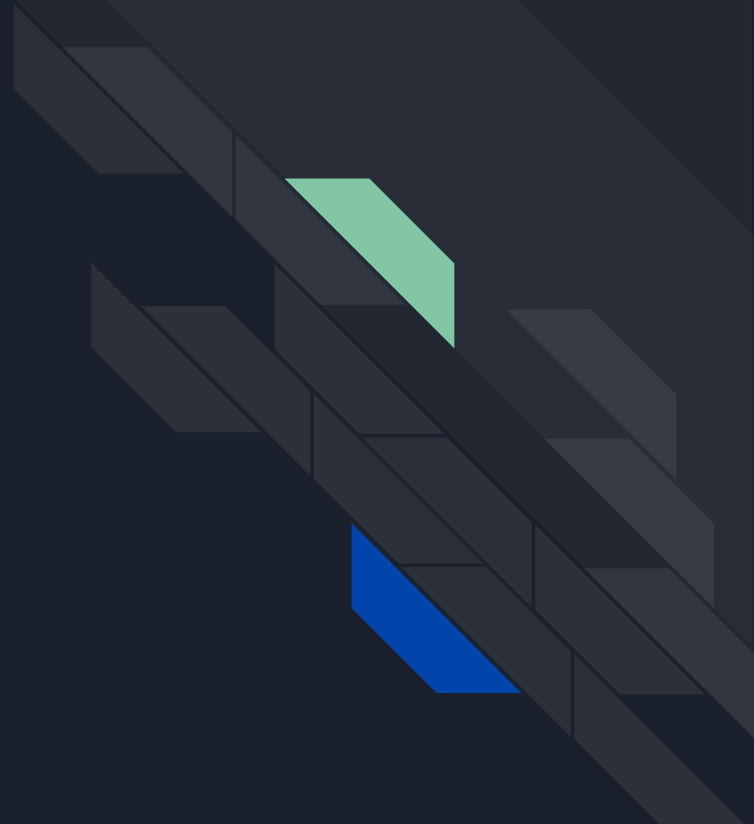
# Overview

- 1) Data
- 2) RAG-Pipeline and Architecture

— *Demonstration* —

- 3) Evaluation and Results
- 4) Challenges and Future Work

Data





# Data

## *Harry Potter*

- Seven books by J. K. Rowling, 1997-2007
- **PDF**-Downloads from the Internet (English Corpus))
- **Number of Pages: 3.407**
- + Harry Potter and the Cursed Child

## Ludwig Wittgenstein

- *Nachlass*
- Philosophical Works and Diaries, 1914-1951
- XML Downloads from the *Wittgenstein Archives*, transformed into **PDF**
- mostly German, some English
- **Number of Pages: >20.000**



# Pre-Processing

## *Harry Potter*

- Remove line breaks
- Remove Page Numbers
- Separate Chapter Number + Headlines
- Separate Chapter Headings from the first line of the text

## Ludwig Wittgenstein

- Remove links
- Remove editorial notes, footnotes and annotations
- Remove superfluous whitespaces

# RAG-Pipeline and Architecture

The background features a series of dark gray, three-dimensional rectangular planes that recede into the distance, creating a sense of depth. A light green parallelogram is positioned on one of the upper planes, and a blue parallelogram is on a lower plane, both adding a pop of color to the monochromatic scheme.



# Models

## LLM

- Mistral-7B (Ollama)
- 7.25 Billion Parameters
- Token Limit: 8192

## Embeddings

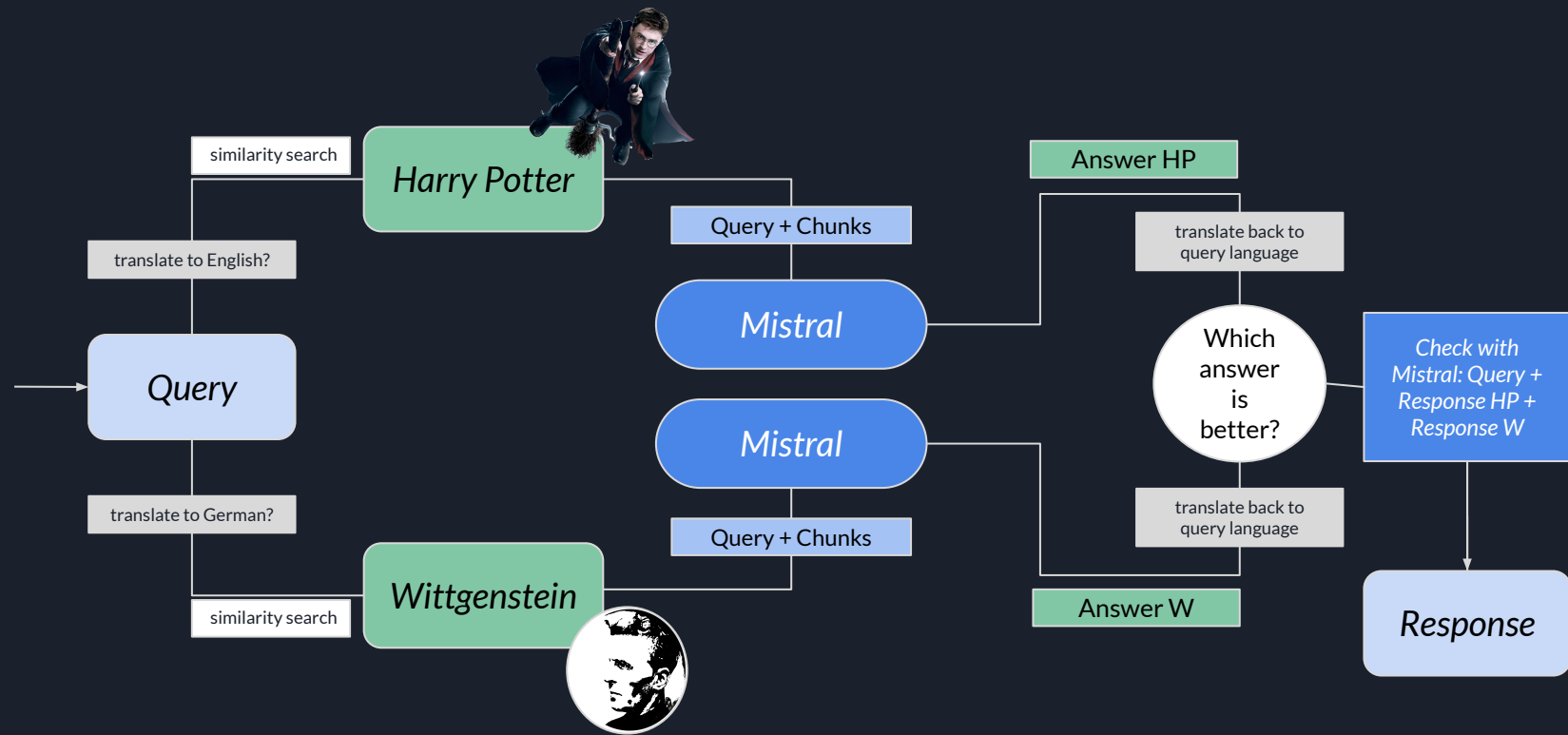
- Multilingual Embeddings
- Hugging Face:  
*sentence-transformers/stsb-xlm-r-multilingual*



# Libraries

- **RAG:** LangChain (Vector Store: DB Chroma)
- **Translation:** translate (Google)
- **Language Detection:** papluca/xlm-roberta-base-language-detection
- **PDF-Reader:** PyPDFD
- **Evaluation:** Evaluate
- **GUI:** Gradio





# RAG-Pipeline



# Prompts for Question-Answering

## System Prompt

*You are an AI language model assistant for {topic}. You must answer in {lang}. Your task is to answer a question ONLY based only on the following context: {context}*

*You will be punished if you use your own knowledge.*

**Topic:** Harry Potter OR Wittgenstein

**Language:**

if Harry Potter: English

if Wittgenstein: German

## Prompt

*Here is the question to answer: {question}*

*Keep in mind, you are only allowed to use the provided context!*

**Question:** Query entered by the User



# Prompts for Deciding Which Answer Is Better

## System Prompt

*Your task is to decide which of the two generated answer options is more suitable to answer the given question: {options}*  
*You are not allowed to use any information besides these two options. You will be punished if you use your own knowledge.*

**Context:** Answer for Harry Potter +  
Answer for Wittgenstein

## Prompt

*Here is the question to answer with the help of the provided options: {question}*  
*If you think the Harry Potter answer is better, return: "9 3/4". If you prefer the Wittgenstein answer, you return "227". If you like both, return "42". Don't give any reasoning. You will be punished if you answer more than stated.*

**Question:** Query entered by the User

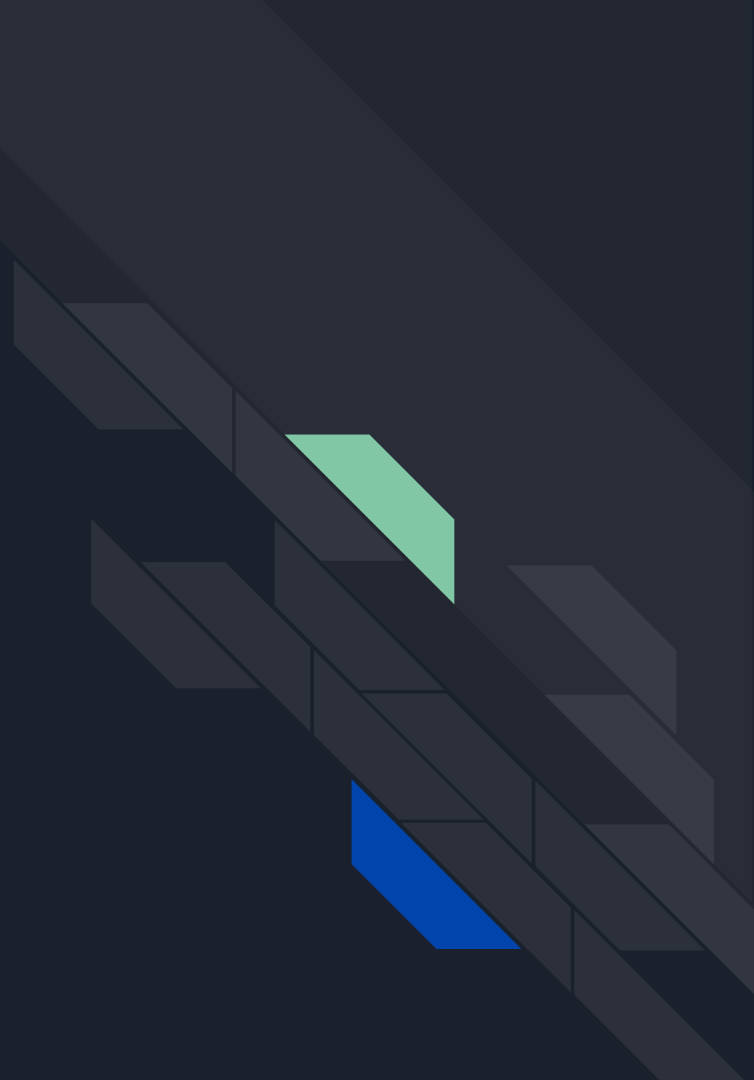
Try it yourself:

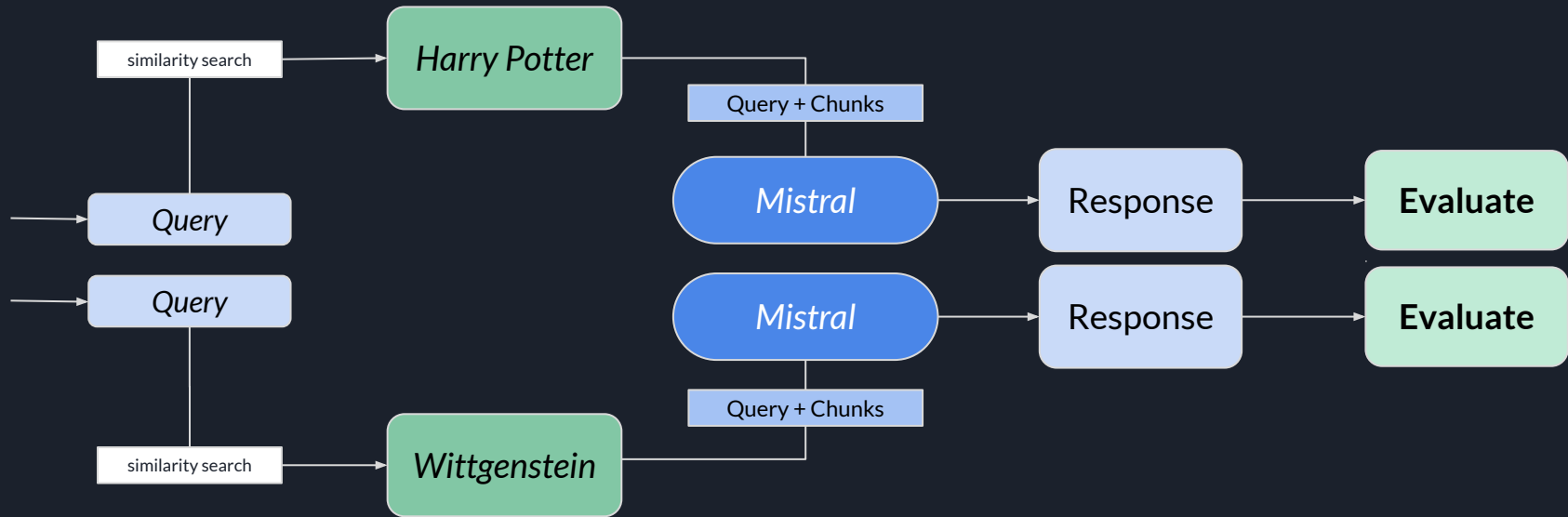
<https://645d7b37bb491fe84c.gradio.live>

(not active anymore)



# Evaluation and Results





## Pipelines for Evaluation



# Metrics

## Metrics

- Bleu - *Weighted geometric mean of modified n-gram precision with n=4 (default)*
- RougeN - *Based on recall of ngrams (with n=1 and n=2)*
- RougeL - *Based on recall of Longest Common Subsequence*
- Meteor - *Based on combination of unigram-precision, unigram-recall, and a measure of alignment*



# Parameters

## Chunk Size (tokens)

- 100
- 200
- 300

## # Chunks included in the Prompt (K)

- 20
- 15
- 10





# Gold Standard

- 40 question-answer pairs for each corpus
- Answers:
  - List of 4 correct answer variations
- Context:
  - List of as many text passages as contain the answer  
(in most cases just 1 text passage)



# Gold Standard Example

```
{  
  "question": "Who killed Bellatrix Lestrange?",  
  "answers": ["Bellatrix Lestrange was killed by Molly Weasley.",  
              "Molly Weasley killed Bellatrix Lestrange in the Battle of Hogwarts.",  
              "Bellatrix Lestrange was a death eater who was killed by Molly Weasley.",  
              "The evil witch Bellatrix Lestrange was killed by Molly Weasley."],  
  "context": ["Bellatrix was still fighting ..."]  
}
```

# Results

	chunk size	k	Bleu	Rouge1	Rouge2	RougeL	Meteor
HP gold	-	-	0.23	0.58	0.43	0.52	0.67
Wittg gold	-	-	0.23	0.54	0.38	0.50	0.61
Harry Potter	200	15	0.09	0.33	0.19	0.27	0.43
Wittgenstein	200	15	0.07	0.25	0.13	0.20	0.35
Harry Potter	100	20	0.09	0.35	0.22	0.31	0.48
Wittgenstein	100	20	0.04	0.22	0.10	0.18	0.32
Harry Potter	300	10	0.10	0.36	0.22	0.31	0.45
Wittgenstein	300	10	0.06	0.25	0.13	0.21	0.35

# Challenges and Future Work





# Technical Challenges

- Hardware Restrictions
- Finding an open-source LLM with good performance
- Retrieval didn't work well at first - better with multilingual embeddings



## Challenges Related to the Wittgenstein Corpus

For the Wittgenstein Corpus it was challenging to find suitable question-answer pairs for the evaluation. In most cases the context is rather short.



## Challenges Related to the *Harry Potter* Corpus

Implicit meaning is key in literature, yet RAG models struggle with retrieving answers to questions when the information is not explicitly stated in the text.



# Example

**Question:** Who left the sword of Gryffindor in the forest for Harry and Hermione to find?

**Context:** Now, Severus, the sword! Do not forget that it must be taken under conditions of need and valor — and he must not know that you give it! If Voldemort should read Harry's mind and see you acting for him —"  
"I know," said Snape curtly. He approached the portrait of Dumbledore and pulled at its side. It swung forward, revealing a hidden cavity behind it from which he took the sword of Gryffindor.

**Generated Answer:** Based on the provided context, it is not possible to definitively determine who left the sword of Gryffindor in the forest for Harry and Hermione to find. The sword was taken by Snape from behind a hidden cavity within the portrait of Dumbledore, but no information is given about its origin or the person who placed it there.





## Future Work

- Compare performance for different chunk sizes
- Increase number of chunks for generation
- Compare performance on a wider range of domains
- Include re-ranking in the retrieval pipeline



Let's conclude with GPT

*Thank you for exploring the magic and  
meaning with Harry Potter and Wittgenstein!*