

# Building Effective Search Systems HelpMateAI

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## 1. Background

This project demonstrate "Building Effective Search Systems HelpMateAI" with a long insurance policy document using RAG techniques.

## 2. Problem Statement

The goal of the project is to build a robust generative search system capable of effectively and accurately answering questions from a policy document.

We will be using a single long life insurance policy document for this project.

## 3. Document

1. The policy document can be found [here](#)

## 4. Approach

The project should implement all the three layers effectively. It will be key to try out various strategies and experiments in various layers in order to build an effective search system. Let's explore what we need to do in each of the layers.

1. **The Embedding Layer:** The PDF document needs to be effectively processed, cleaned, and chunked for the embeddings. Here, the choice of the chunking strategy will have a large impact on the final quality of the retrieved results. So, we need to make sure that we try out various strategies and compare their performances.

Another important aspect in the embedding layer is the choice of the embedding model. we can choose to embed the chunks using the OpenAI embedding model or any model from the SentenceTransformers library on HuggingFace.

2. **The Search Layer:** Here, we need to design at least 3 queries against which you will test your system. You need to understand and skim through the document, and accordingly come up with some queries, the answers to which can be found in the policy document.

Next, we need to embed the queries and search your ChromaDB vector database against each of these queries. Implementing a cache mechanism is also mandatory.

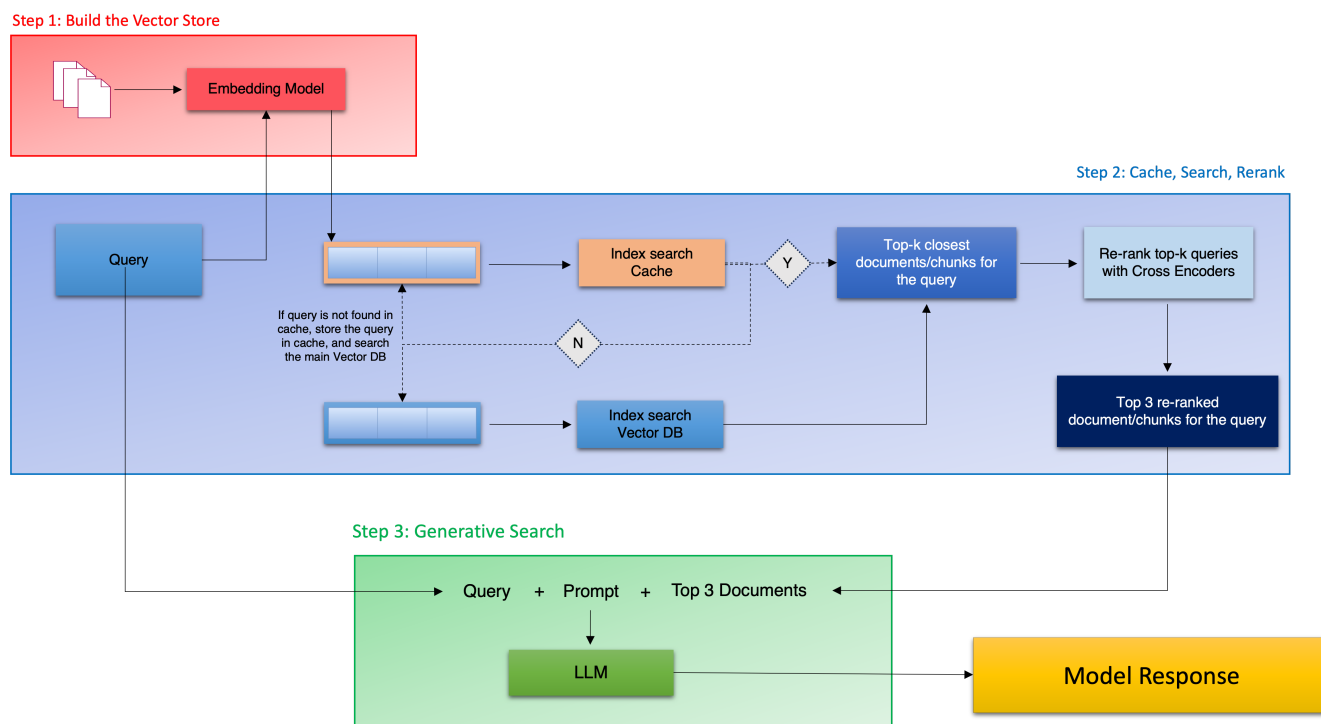
Finally, we need to implement the re-ranking block, and for this we can choose from a range of cross-encoding models on HuggingFace.

3. **The Generation Layer:** In the generation layer, the final prompt that we design is the major component. We need to make sure that the prompt is exhaustive in its instructions, and the relevant information is correctly passed to the prompt. We may also choose to provide some few-shot examples in an attempt to improve the LLM output.

## 5. System Layers

- **Reading & Processing PDF File:** We will be using [pdfplumber](#) to read and process the PDF files. [pdfplumber](#) allows for better parsing of the PDF file as it can read various elements of the PDF apart from the plain text, such as, tables, images, etc. It also offers wide functionalities and visual debugging features to help with advanced preprocessing as well.
- **Document Chunking:** The document contains several pages and contains huge text, before generating the embeddings, we need to generate the chunks. Let's start with a basic chunking technique, and chunking the text with fixed size.
- **Generating Embeddings:** Generates embedding with SentenceTransformer with all-MiniLM-L6-v2 model.
- **Store Embeddings In ChromaDB:** In this section we will store embedding in ChromaDB.
- **Semantic Search with Cache:** In this section we will introduce cache collection layer for embeddings.
- **Re-Ranking with a Cross Encoder:** Re-ranking the results obtained from the semantic search will sometime significantly improve the relevance of the retrieved results. This is often done by passing the query paired with each of the retrieved responses into a cross-encoder to score the relevance of the response w.r.t. the query.
- **Retrieval Augmented Generation:** Now we have the final top search results, we can pass it to an GPT 3.5 along with the user query and a well-engineered prompt, to generate a direct answer to the query along with citations.

## 6. System Architecture



## 7. Prerequisites

- Python 3.7+

- Please ensure that you add your OpenAI API key to the empty text file named "OpenAI\_API\_Key" in order to access the OpenAI API.

## 8. Query Screenshots

```
query = 'what is the life insurance coverage for disability'
df = search(query)
df = apply_cross_encoder(query, df)
df = get_topn(3, df)
response = generate_response(query, df)
print("\n".join(response))

The life insurance coverage for disability is not explicitly mentioned in the provided documents. I recommend looking specifically for sections related to disability coverage in the insurance policy documents to get detailed information on the coverage

**Citations:**
1. Policy Name: Member Life Insurance or Coverage During Disability
   - Page Number: Page 42
2. Policy Name: Dependent's Life Insurance
   - Page Number: Page 44

query = 'what is the Proof of ADL Disability or Total Disability'
df = search(query)
df = apply_cross_encoder(query, df)
df = get_topn(3, df)
response = generate_response(query, df)
print("\n".join(response))

The Proof of ADL Disability or Total Disability typically refers to the documentation required to validate a claim for benefits based on activities of daily living (ADL) disability or total disability. This proof may include medical records, physician :
Unfortunately, the specific details regarding the Proof of ADL Disability or Total Disability are not explicitly outlined in the provided insurance policy documents.

Citations:
1. Policy Name: Member Life Insurance or Coverage During Disability
   Page Number: Page 42
2. Policy Name: Payment of benefits
   Page Number: Page 49
3. Policy Name: Dependent's Life Insurance terminates
   Page Number: Page 44

query = 'what is condition of death while not wearing Seat Belt'
df = search(query)
df = apply_cross_encoder(query, df)
df = get_topn(3, df)
response = generate_response(query, df)
print("\n".join(response))

The policy documents provided do not contain specific information regarding the condition of death while not wearing a seat belt. It is advisable to refer to the insured individual's specific auto insurance policy or consult with the insurance provider

## Relevant Policy Names and Page Numbers:
- Policy Document 1: Page 49
- Policy Document 2: Page 42
- Policy Document 3: Page 44

While the specific details were not found in the mentioned documents, you may refer to sections related to coverage exclusions, claim procedures, or terms and conditions to find more information on this topic in the cited policy documents.
```