🤖 Mr.HelpMate AI: Insurance Policy Question-Answering System

📌 Introduction

In today's complex insurance landscape, policy documents are often lengthy, filled with technical jargon, and structured in ways that can be challenging for the average policyholder to navigate. When customers have questions about their coverage, benefits, or exclusions, they typically resort to one of several suboptimal solutions:

1. 📞 Calling customer service and enduring long wait times
2. 📄 Sifting through dense policy documents manually
3. 🔍 Using basic search functionality that returns entire sections rather than specific answers
4. 🤷 Relying on simplified FAQs that may not address their specific concern

This creates friction in the customer experience and increases operational costs for insurance providers who must maintain large customer service teams to handle repetitive queries.

Mr.HelpMate AI aims to solve this problem by creating an intelligent assistant that leverages recent advances in generative AI and retrieval-augmented generation (RAG) techniques. This system will enable policyholders to ask questions in natural language and receive accurate, contextually relevant answers extracted directly from their policy documents.

Unlike simple keyword search or traditional chatbots with predefined responses, **Mr.HelpMate AI** will understand the semantic meaning behind questions, retrieve the most relevant policy sections, and generate human-like responses that directly address the customer's query while maintaining factual accuracy by grounding all responses in the source documents.

🎯 Project Objectives

The primary goal of this project is to build a robust generative search system capable of effectively and accurately answering questions from insurance policy documents. Specifically, we aim to:

1. **Develop an efficient document processing pipeline** that can ingest, parse, and index insurance policy documents while preserving their semantic structure and relationships.
2. **Implement a retrieval system** that accurately identifies the most relevant sections of a policy document in response to user queries.

3. **Create a generative component** that produces clear, concise, and accurate answers based on the retrieved document sections.

4. **Ensure factual grounding** by developing techniques to verify that all generated answers are supported by the source document and contain no hallucinated information.

5. **Design an evaluation framework** to measure the system's performance in terms of answer relevance, factual accuracy, completeness, and clarity.

6. **Optimize the user experience** by creating a simple, intuitive interface that allows users to interact with the system through natural language questions.

7. **Implement safeguards** to identify questions that cannot be reliably answered based on the available policy documents and provide appropriate disclaimers.

This project will synthesize techniques from natural language processing, information retrieval, and generative AI to create a practical solution that improves customer satisfaction, reduces operational costs for insurers, and demonstrates the potential of RAG systems in specialized domains with strict accuracy requirements.

By successfully completing this project, we will not only create a valuable tool for insurance customers but also develop a framework that can be extended to other document-intensive domains such as legal contracts, financial agreements, and technical documentation.

Flowchart Overview: Building a Document-Based LLM Search System

The flowchart illustrates a three-layer architecture that powers a document-based search system using a Large Language Model (LLM). The system is modular and emphasizes experimentation across all layers to optimize relevance and response quality.

1. **Embedding Layer:**
   This is the foundational step where both the documents and user queries are converted into vector embeddings using pre-trained embedding models (e.g., OpenAI, Hugging Face). These embeddings capture semantic meaning, enabling effective similarity comparisons. Experimentation here could involve testing different embedding models, chunking strategies, or metadata augmentation.

2. **Search Layer:**
   Once embedded, the system performs a similarity search in the vector store (e.g., FAISS, Chroma) to retrieve the most relevant document chunks. This step ensures only contextually relevant content is passed to the LLM. Experimentation may include different distance metrics (cosine, dot product), hybrid search techniques (BM25 + vectors), and filtering using metadata.

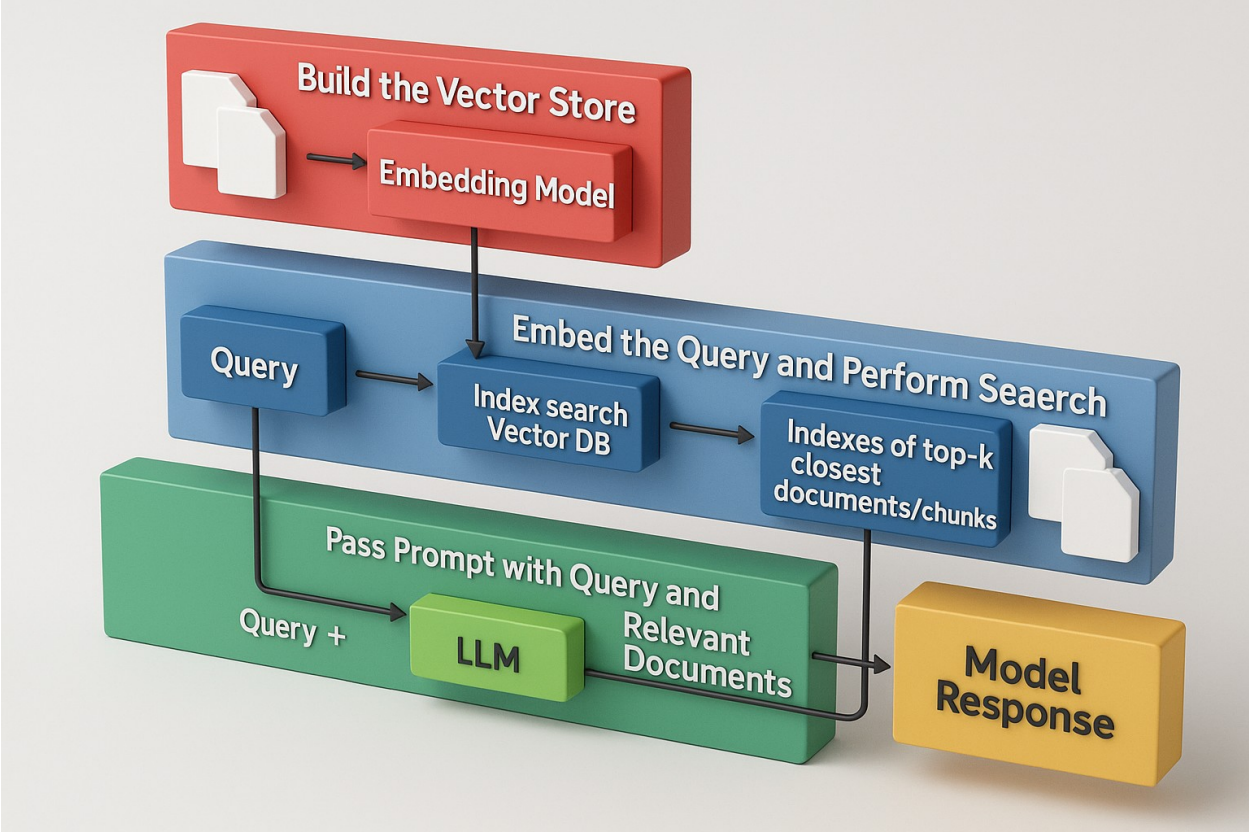
3. **Generation Layer:**
   The selected documents, along with the user's query, are passed to the LLM as part of a prompt. The model then generates a natural language response. This layer can

be enhanced by prompt engineering, using custom instructions, or incorporating tools like retrieval-augmented generation (RAG).

Together, these layers form a flexible and powerful semantic search pipeline.

```
from IPython.display import Image, display

image_path = "/kaggle/input/flowchart-diagram-demonstrates-helpmate-ai-project/
A_Flowchart_Digital_Diagram_Demonstrates_Building_HelpMate_AI_Project.png"
display(Image(image_path))
```



1 Install and Load Necessary Libraries

```
# Install all the required libraries
# !pip install google-generativeai pinecone-client pdfplumber openai sentence-transformers
!pip install pdfplumber tiktoken openai chromaDB sentence-transformers -q
```

```
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l) ... ERROR: pip's dependency resolver does not currently take into
account all the packages that are installed. This behaviour is the
source of the following dependency conflicts.
google-api-core 1.34.1 requires protobuf!=3.20.0,!=3.20.1,!=4.21.0,!
=4.21.1,!=4.21.2,!=4.21.3,!=4.21.4,!=4.21.5,<4.0.0dev,>=3.19.5, but
you have protobuf 5.29.4 which is incompatible.
google-cloud-translate 3.12.1 requires protobuf!=3.20.0,!=3.20.1,!
=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!=4.21.4,!
=4.21.5,<5.0.0dev,>=3.19.5, but you have protobuf 5.29.4 which is
incompatible.
cesium 0.12.4 requires numpy<3.0,>=2.0, but you have numpy 1.26.4
which is incompatible.
bigframes 1.42.0 requires rich<14,>=12.4.4, but you have rich 14.0.0
which is incompatible.
google-spark-connect 0.5.2 requires google-api-core>=2.19.1, but you
have google-api-core 1.34.1 which is incompatible.
google-cloud-bigtable 2.30.0 requires google-api-
core[grpc]<3.0.0,>=2.16.0, but you have google-api-core 1.34.1 which
is incompatible.
google-cloud-storage 2.19.0 requires google-api-
core<3.0.0dev,>=2.15.0, but you have google-api-core 1.34.1 which is
incompatible.
pandas-gbq 0.28.0 requires google-api-core<3.0.0dev,>=2.10.2, but you
have google-api-core 1.34.1 which is incompatible.
```

```python
# Import all the required Libraries
import pandas as pd
import pdfplumber
from pathlib import Path
from operator import itemgetter
import os
import json
import openai
import chromadb
from kaggle_secrets import UserSecretsClient
```

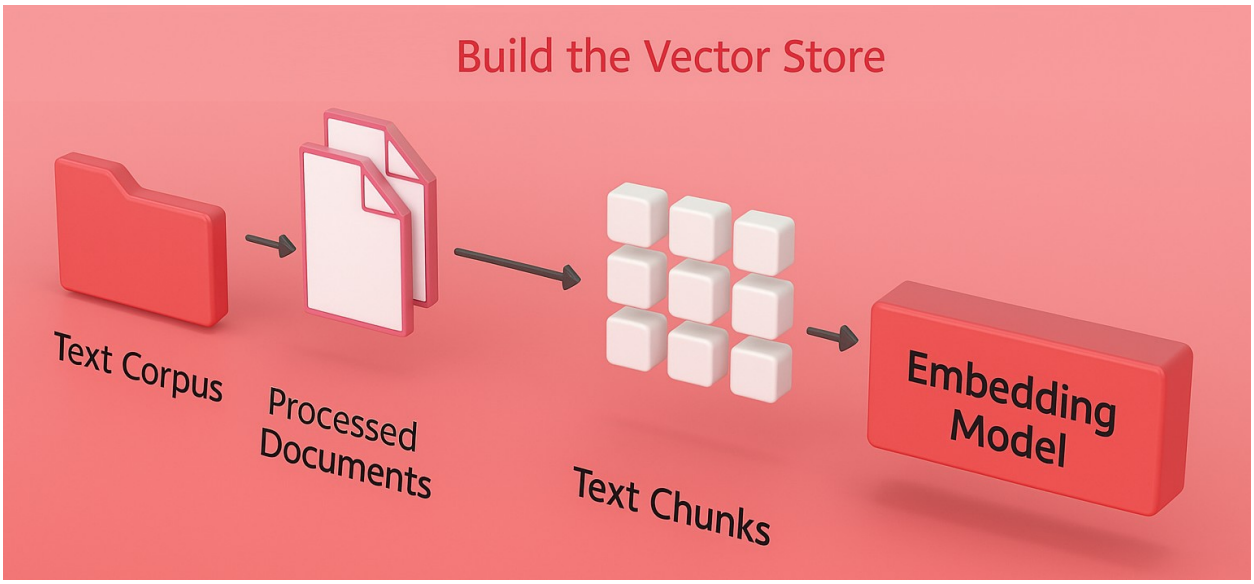
```
user_secrets = UserSecretsClient()
openai.api_key = user_secrets.get_secret("OPENAI_API_KEY")
```

Stage 1: Embedding Layer

The embedding layer transforms text into numerical vectors that capture semantic meaning. Using advanced transformer models, this stage converts documents into high-dimensional representations where similar concepts occupy nearby positions in vector space. Our system processes document chunks strategically, preserving contextual relationships while optimizing for retrieval efficiency.

These dense embeddings enable the system to understand conceptual similarities regardless of specific terminology, forming the foundation for semantic search and knowledge extraction capabilities. By mathematically encoding document meaning, the embedding layer creates a sophisticated representation that powers all subsequent processing stages in our document understanding pipeline.

```
image_path = "/kaggle/input/flowchart-diagram-demonstrates-helpmate-ai-project/Stage_1_Embedding Layer.png"
display(Image(image_path))
```



2 Read, Process, and Chunk the PDF Files

We'll use pdfplumber for PDF extraction and processing, which offers several advantages over simpler PDF libraries. pdfplumber provides robust capabilities for extracting structured content from PDFs, including:

Text extraction with positional data Table detection and extraction Form field identification Image extraction capabilities Visual debugging tools for development

This library allows us to handle complex document structures by preserving the spatial relationships between text elements, which is crucial for maintaining document context during chunking. It also provides methods to extract text while preserving formatting elements like paragraphs, headers, and lists. For optimal retrieval performance, we'll implement a strategic chunking approach that balances chunk size with semantic coherence, ensuring that related content stays together while creating chunks that are appropriately sized for our vector database.

```
# Use this path to fetch the dataset from the "helpmate ai" directory
pdf_path = '/kaggle/input/helpmate-ai/'
for dirname, _, filenames in os.walk(pdf_path):
    for filename in filenames:
        print("PDF Path 1: ", os.path.join(dirname, filename))


# Use this path to fetch the dataset from the "av ms helpmate ai
sample insurance policy pdf" directory
pdf_path_2 = '/kaggle/input/av-ms-helpmate-ai-sample-insurance-policy-
pdf/'
for dirname, _, filenames in os.walk(pdf_path_2):
    for filename in filenames:
        print("PDF Path 2: ", os.path.join(dirname, filename))

# # Use this path to fetch the dataset from the "Flowchart Diagram -
HelpMate AI Project" directory
# pdf_path_3 = '/kaggle/input/flowchart-diagram-demonstrates-helpmate-
ai-project/'
# for dirname, _, filenames in os.walk(pdf_path_3):
#     for filename in filenames:
#         print("PDF Path 3: ", os.path.join(dirname, filename))
```

```
PDF Path 1:  /kaggle/input/helpmate-ai/Principal-Sample-Life-
Insurance-Policy.pdf
PDF Path 2:  /kaggle/input/av-ms-helpmate-ai-sample-insurance-policy-
pdf/Principal-Sample-Life-Insurance-Policy.pdf
```

```
# Function to check whether a word is present in a table or not for
segregation of regular text and tables
def check_bboxes(word, table_bbox):
    # Check whether word is inside a table bbox.
    l = word['x0'], word['top'], word['x1'], word['bottom']
    r = table_bbox
    return l[0] > r[0] and l[1] > r[1] and l[2] < r[2] and l[3] < r[3]

# Function to extract text from a PDF file.
# 1. Declare a variable p to store the iteration of the loop that will
help us store page numbers alongside the text
# 2. Declare an empty list 'full_text' to store all the text files
# 3. Use pdfplumber to open the pdf pages one by one
# 4. Find the tables and their locations in the page
```

```
# 5. Extract the text from the tables in the variable 'tables'
# 6. Extract the regular words by calling the function check_bboxes()
and checking whether words are present in the table or not
# 7. Use the cluster_objects utility to cluster non-table and table
words together so that they retain the same chronology as in the
original PDF
# 8. Declare an empty list 'lines' to store the page text
# 9. If a text element in present in the cluster, append it to
'lines', else if a table element is present, append the table
# 10. Append the page number and all lines to full_text, and increment
'p'
# 11. When the function has iterated over all pages, return the
'full_text' list

def extract_text_from_pdf(pdf_path):
    p = 0
    full_text = []


    with pdfplumber.open(pdf_path) as pdf:
        for page in pdf.pages:
            page_no = f"Page {p+1}"
            text = page.extract_text()

            tables = page.find_tables()
            table_bboxes = [i.bbox for i in tables]
            tables = [{'table': i.extract(), 'top': i.bbox[1]} for i
in tables]
            non_table_words = [word for word in page.extract_words()
if not any(
                [check_bboxes(word, table_bbox) for table_bbox in
table_bboxes])]
            lines = []

            for cluster in
pdfplumber.utils.cluster_objects(non_table_words + tables,
itemgetter('top'), tolerance=5):

                if 'text' in cluster[0]:
                    try:
                        lines.append(' '.join([i['text'] for i in
cluster]))
                    except KeyError:
                        pass

                elif 'table' in cluster[0]:
                    lines.append(json.dumps(cluster[0]['table']))


            full_text.append([page_no, " ".join(lines)])
```

```
            p +=1

    return full_text
```

Now that we have defined the function for extracting the text and tables from a PDF, let's iterate and call this function for all the PDFs in our drive and store them in a list.

```
# Define the directory containing the PDF files
pdf_directory = Path(pdf_path)

# Initialize an empty list to store the extracted texts and document
names
data = []

# Loop through all files in the directory
for pdf_path in pdf_directory.glob("*.pdf"):

    # Process the PDF file
    print(f"...Processing {pdf_path.name}")

    # Call the function to extract the text from the PDF
    extracted_text = extract_text_from_pdf(pdf_path)

    # Convert the extracted list to a PDF, and add a column to store
document names
    extracted_text_df = pd.DataFrame(extracted_text, columns=['Page
No.', 'Page_Text'])
    extracted_text_df['Document Name'] = pdf_path.name

    # Append the extracted text and document name to the list
    data.append(extracted_text_df)

    # Print a message to indicate progress
    print(f"Finished processing {pdf_path.name}")

# Print a message to indicate all PDFs have been processed
print("All PDFs have been processed.")
```

```
...Processing Principal-Sample-Life-Insurance-Policy.pdf
Finished processing Principal-Sample-Life-Insurance-Policy.pdf
All PDFs have been processed.
```

```
# Concatenate all the DFs in the list 'data' together
insurance_pdfs_data = pd.concat(data, ignore_index=True)

print("Shape of the data is :: ", insurance_pdfs_data.shape, "\n")

insurance_pdfs_data.sample(2)
```

```
Shape of the data is ::  (64, 3)
```

```
   Page No.                                                Page_Text  \
48  Page 49  Payment of benefits will be subject to the Ben...
1    Page 2                This page left blank intentionally

                                    Document Name
48  Principal-Sample-Life-Insurance-Policy.pdf
1   Principal-Sample-Life-Insurance-Policy.pdf
```

```
# Let's also check the length of all the texts as there might be some
empty pages or pages with very few words that we can drop
insurance_pdfs_data['Text_Length'] =
insurance_pdfs_data['Page_Text'].apply(lambda x: len(x.split(' ')))

insurance_pdfs_data.sample(2)
```

```
   Page No.                                                Page_Text  \
46  Page 47  M ember's death, the Death Benefits Payable ma...
35  Page 36  A Member's insurance under this Group Policy f...

                                    Document Name  Text_Length
46  Principal-Sample-Life-Insurance-Policy.pdf          391
35  Principal-Sample-Life-Insurance-Policy.pdf          333
```

```
print("-"*50)
print("Maximum Text Length is :: ",
max(insurance_pdfs_data['Text_Length']))
print("-"*50)
print("Minimum Text Length is :: ",
min(insurance_pdfs_data['Text_Length']))
print("-"*50)
```

```
--------------------------------------------------
Maximum Text Length is ::  462
--------------------------------------------------
Minimum Text Length is ::  5
--------------------------------------------------
```

To skip pages that are essentially blank—either containing fewer than 10 words or consisting solely of a header or footer—we use the following code to filter them out during processing.

```
# Retain only the rows with a text length of at least 10
insurance_pdfs_data =
insurance_pdfs_data.loc[insurance_pdfs_data['Text_Length'] >= 10]

print("Shape of the data is :: ", insurance_pdfs_data.shape, "\n")

insurance_pdfs_data.head()
```

```
Shape of the data is ::  (60, 4)
```

```
  Page No.                                              Page_Text  \
0   Page 1  DOROTHEA GLAUSE S655 RHODE ISLAND JOHN DOE 01/...
2   Page 3  POLICY RIDER GROUP INSURANCE POLICY NO: S655 C...
4   Page 5  PRINCIPAL LIFE INSURANCE COMPANY (called The P...
5   Page 6  TABLE OF CONTENTS PART I - DEFINITIONS PART II...
6   Page 7  Section A – Eligibility Member Life Insurance ...

                                Document Name  Text_Length
0  Principal-Sample-Life-Insurance-Policy.pdf           30
2  Principal-Sample-Life-Insurance-Policy.pdf          230
4  Principal-Sample-Life-Insurance-Policy.pdf          110
5  Principal-Sample-Life-Insurance-Policy.pdf          153
6  Principal-Sample-Life-Insurance-Policy.pdf          176
```

```
# Store the metadata for each page in a separate column
insurance_pdfs_data['Metadata'] = insurance_pdfs_data.apply(lambda x:
{'Policy_Name': x['Document Name'][:-4], 'Page_No.': x['Page No.']},
axis=1)

print("Shape of the data is :: ", insurance_pdfs_data.shape, "\n")

insurance_pdfs_data.head()
```

```
Shape of the data is ::  (60, 5)
```

```
  Page No.                                              Page_Text  \
0   Page 1  DOROTHEA GLAUSE S655 RHODE ISLAND JOHN DOE 01/...
2   Page 3  POLICY RIDER GROUP INSURANCE POLICY NO: S655 C...
4   Page 5  PRINCIPAL LIFE INSURANCE COMPANY (called The P...
5   Page 6  TABLE OF CONTENTS PART I - DEFINITIONS PART II...
6   Page 7  Section A – Eligibility Member Life Insurance ...

                                Document Name  Text_Length  \
0  Principal-Sample-Life-Insurance-Policy.pdf           30
2  Principal-Sample-Life-Insurance-Policy.pdf          230
4  Principal-Sample-Life-Insurance-Policy.pdf          110
5  Principal-Sample-Life-Insurance-Policy.pdf          153
6  Principal-Sample-Life-Insurance-Policy.pdf          176

                                            Metadata
0  {'Policy_Name': 'Principal-Sample-Life-Insuran...
2  {'Policy_Name': 'Principal-Sample-Life-Insuran...
4  {'Policy_Name': 'Principal-Sample-Life-Insuran...
5  {'Policy_Name': 'Principal-Sample-Life-Insuran...
6  {'Policy_Name': 'Principal-Sample-Life-Insuran...
```

This wraps up the chunking process. As observed, most pages in the insurance documents contain a few hundred words, rarely exceeding 1000. Therefore, further chunking is unnecessary —we can perform embeddings at the page level. This approach is effective for two key reasons:

1. Insurance documents are typically well-structured, meaning the content within a page is usually coherent and contextually related.
2. Using larger chunks ensures we retain more contextual information, which is beneficial for the LLM during the generation stage.

Here are some **different approaches for chunking** documents, each suited for specific use cases depending on the structure of the content and the downstream tasks (like retrieval or generation):

---

1. **Fixed-Length Chunking**

- **Description**: Break text into chunks of a fixed number of tokens (e.g., 500 tokens per chunk).
- **Pros**: Simple to implement; consistent size for model input.
- **Cons**: May split sentences or lose semantic boundaries.

---

2. **Sliding Window Chunking**

- **Description**: Use overlapping chunks where each new chunk starts before the previous one ends (e.g., 500 tokens with a 100-token overlap).
- **Pros**: Maintains context across boundaries; reduces loss of continuity.
- **Cons**: Increases redundancy and storage.

---

3. **Semantic Chunking**

- **Description**: Use NLP techniques (e.g., sentence segmentation, topic modeling) to chunk by meaning or topic coherence.
- **Pros**: Preserves semantic integrity; ideal for LLM input.
- **Cons**: More complex; may result in variable chunk sizes.

---

4. **Header/Footer or Section-Based Chunking**

- **Description**: Split content based on document structure like headings, paragraphs, or predefined sections.
- **Pros**: Works well for structured documents (e.g., policies, legal).
- **Cons**: Depends on consistent formatting.

---

5. **Page-Level Chunking**

- **Description**: Treat each page as a separate chunk (used often in PDF/insurance documents).
- **Pros**: Easy to align with source documents; preserves visual context.
- **Cons**: May vary greatly in word count or relevance.

---

6. **Hybrid Chunking**

- **Description**: Combine two or more methods (e.g., semantic + sliding window) for optimal results.
- **Pros**: Flexible and adaptable to content.
- **Cons**: Requires more tuning and logic.

---

3 Generate and Store Embeddings using OpenAI and ChromaDB

This stage transforms our text chunks into numerical vector representations using OpenAI's `text-embedding-ada-002` model. Each document fragment is encoded into a high-dimensional embedding that captures its semantic essence.

We then persist these vectors in ChromaDB, a specialized vector database optimized for similarity search operations. This combination provides an efficient architecture for storing and retrieving documents based on meaning rather than keywords. The ChromaDB collection creates a searchable semantic index of our content, enabling natural language queries to find contextually relevant information even when exact terminology differs between query and documents.

```
# Import the OpenAI Embedding Function into chroma
from chromadb.utils.embedding_functions import OpenAIEmbeddingFunction
```

The `chromadb.PersistentClient` in **ChromaDB** is a client class used to manage a **persistent vector database**—meaning that your collections and embeddings are **saved to disk** and **not lost** after your script or notebook ends.

Meaning & Purpose:

`PersistentClient` enables **persistent storage** by writing the data to files (typically using **DuckDB and Parquet** under the hood). This is in contrast to the default in-memory client which loses all data when the program ends.

Typical Usage Example:

```
import chromadb

client = chromadb.PersistentClient(path="/path/to/chroma_db")

collection = client.get_or_create_collection(name="my_collection")

collection.add(
    documents=["This is a test document"],
    ids=["doc1"]
)
```

- `path` is where the data is stored (e.g., on disk in a directory).
- The next time you initialize a `PersistentClient` with the same path, your data will be loaded again.

Why Use `PersistentClient`?

- **Data survives kernel restarts**
- Ideal for large-scale or long-term applications
- Useful in notebooks (like Kaggle, Colab) if you want to **cache or re-use** computed embeddings without reprocessing

---

When **not** to use:

If you only need temporary data (e.g., during one-time experimentation), the default `chromadb.Client()` is simpler.

Let me know if you want help setting this up in a specific environment like Kaggle or Colab.

```
# Define the path where chroma collections will be stored
chroma_data_path = "/kaggle/working/chroma_db"

client = chromadb.PersistentClient(path=chroma_data_path)

# Set up the embedding function using the OpenAI embedding model
model = "text-embedding-3-small"
embedding_function = OpenAIEmbeddingFunction(api_key=openai.api_key,
model_name=model)

from chromadb.utils import embedding_functions

sentence_transformer_ef =
embedding_functions.SentenceTransformerEmbeddingFunction(model_name="a
ll-mpnet-base-v2")
```

```
2025-05-22 05:48:05.802136: E
external/local_xla/xla/stream_executor/cuda/cuda_fft.cc:477] Unable to
register cuFFT factory: Attempting to register factory for plugin
cuFFT when one has already been registered
WARNING: All log messages before absl::InitializeLog() is called are
written to STDERR
E0000 00:00:1747892886.072214      35 cuda_dnn.cc:8310] Unable to
register cuDNN factory: Attempting to register factory for plugin
cuDNN when one has already been registered
E0000 00:00:1747892886.151981      35 cuda_blas.cc:1418] Unable to
register cuBLAS factory: Attempting to register factory for plugin
cuBLAS when one has already been registered
```

{"model_id":"18a0c4e93e7c4a8e9a5fdf25f8e0c19c","version_major":2,"version_minor":0}

{"model_id":"c0160b57efc54411b6f40aba10660e45","version_major":2,"version_minor":0}

{"model_id":"b57ec17746374b08ac923c4f331e175d","version_major":2,"version_minor":0}

{"model_id":"3440424428d546bca51f37c24c8c858b","version_major":2,"version_minor":0}

{"model_id":"cff707605ebd4fe6a9a9a292a6176aa8","version_major":2,"version_minor":0}

{"model_id":"840f887ddb1b4db1ad37d7040ef43fbc","version_major":2,"version_minor":0}

{"model_id":"8d8f2a8df4064adc827ece0cc6704df1","version_major":2,"version_minor":0}

{"model_id":"fecad636316b41c4b98ab3af75cc5f97","version_major":2,"version_minor":0}

{"model_id":"c002967b1b6f4fddb6d302598c66e422","version_major":2,"version_minor":0}

{"model_id":"1b6aaeb012014277b153fa6cf705ea4a","version_major":2,"version_minor":0}

{"model_id":"8f97fbc2c84d4bf9a14067353196aa70","version_major":2,"version_minor":0}

```
# Convert the page text and metadata from your dataframe to lists to be able to pass it to chroma

documents_list = insurance_pdfs_data["Page_Text"].tolist()
metadata_list = insurance_pdfs_data['Metadata'].tolist()

# Initialise a collection in chroma and pass the embedding_function to it so that it used OpenAI embeddings to embed the documents

insurance_collection = client.get_or_create_collection(name='RAG_on_Insurance', embedding_function=embedding_function)

# Add the documents and metadata to the collection alongwith generic integer IDs. You can also feed the metadata information as IDs by combining the policy name and page no.

insurance_collection.add(
    documents= documents_list,
```

```
    ids = [str(i) for i in range(0, len(documents_list))],
    metadatas = metadata_list
)

# Let's take a look at the first few entries in the collection

insurance_collection.get(
    ids = ['0','1','2'],
    include = ['embeddings', 'documents', 'metadatas']
)
```

```
{'ids': ['0', '1', '2'],
 'embeddings': array([[ 0.02405244, -0.00258815,  0.05456119, ...,
0.00448833,
         -0.01202622, -0.01772842],
        [ 0.02750516,  0.02626047,  0.04568736, ...,  0.00913991,
         -0.00304155, -0.00285088],
        [ 0.02289954,  0.02201879,  0.05541594, ...,  0.0278984 ,
          0.01059282,  0.00306478]]),
 'documents': ['DOROTHEA GLAUSE S655 RHODE ISLAND JOHN DOE 01/01/2014
711 HIGH STREET GEORGE RI 02903 GROUP POLICY FOR: RHODE ISLAND JOHN
DOE ALL MEMBERS Group Member Life Insurance Print Date: 07/16/2014',
  'POLICY RIDER GROUP INSURANCE POLICY NO: S655 COVERAGE: Life
EMPLOYER: RHODE ISLAND JOHN DOE Effective on the later of the Date of
Issue of this Group Policy or March 1, 2005, the following will apply
to your Policy: From time to time The Principal may offer or provide
certain employer groups who apply for coverage with The Principal a
Financial Services Hotline and Grief Support Services or any other
value added service for the employees of that employer group. In
addition, The Principal may arrange for third party service providers
(i.e., optometrists, health clubs), to provide discounted goods and
services to those employer groups who apply for coverage with The
Principal or who become insureds/enrollees of The Principal. While The
Principal has arranged these goods, services and/or third party
provider discounts, the third party service providers are liable to
the applicants/insureds/enrollees for the provision of such goods
and/or services. The Principal is not responsible for the provision of
such goods and/or services nor is it liable for the failure of the
provision of the same. Further, The Principal is not liable to the
applicants/insureds/enrollees for the negligent provision of such
goods and/or services by the third party service providers. EXCEPT AS
SPECIFICALLY DESCRIBED IN THIS RIDER, ALL OTHER BENEFITS AND
PROVISIONS WILL BE AS DESCRIBED IN THE GROUP POLICY. PRINCIPAL LIFE
INSURANCE COMPANY DES MOINES, IOWA 50392-0001 GC 806 VAL',
  "PRINCIPAL LIFE INSURANCE COMPANY (called The Principal in this
Group Policy) Des Moines, Iowa 50392-0002 This group insurance policy
is issued to: RHODE ISLAND JOHN DOE (called the Policyholder in this
Group Policy) The Date of Issue is November 1, 2007. In return for the
Policyholder's application and payment of all premiums when due, The
Principal agrees to provide: MEMBER LIFE INSURANCE MEMBER ACCIDENTAL
```

```
DEATH AND DISMEMBERMENT INSURANCE DEPENDENT LIFE INSURANCE subject to
the terms and conditions described in this Group Policy. GROUP POLICY
NO. GL S655 RENEWABLE TERM - NON-PARTICIPATING CONTRACT STATE OF
ISSUE: RHODE ISLAND This policy has been updated effective January 1,
2014 GC 6000 TITLE PAGE"],
 'uris': None,
 'included': ['embeddings', 'documents', 'metadatas'],
 'data': None,
 'metadatas': [{'Page_No.': 'Page 1',
   'Policy_Name': 'Principal-Sample-Life-Insurance-Policy'},
  {'Page_No.': 'Page 3',
   'Policy_Name': 'Principal-Sample-Life-Insurance-Policy'},
  {'Page_No.': 'Page 5',
   'Policy_Name': 'Principal-Sample-Life-Insurance-Policy'}]}
```

```
cache_collection =
client.get_or_create_collection(name='Insurance_Cache',
embedding_function=embedding_function)

cache_collection.peek()
```

```
{'ids': [],
 'embeddings': array([], dtype=float64),
 'documents': [],
 'uris': None,
 'included': ['metadatas', 'documents', 'embeddings'],
 'data': None,
 'metadatas': []}
```

Once the text within the documents has been pre-processed and chunked, the next step is to convert it into vector representations using an appropriate text embedding model. Previously, we used the `sentence-transformers` library with the `all-mpnet-base-v2` model for this purpose. In this demonstration, we switch to **OpenAI's `text-embedding-3-small` model**, which transforms text into dense vector embeddings. These embeddings are generated using ChromaDB's utility functions that support OpenAI's models.

 For more details, refer to: https://docs.trychroma.com/embeddings

After generating the embeddings, we store them in a vector database—in this case, **ChromaDB**. As discussed earlier, ChromaDB requires collections to store data. The `get_or_create_collection` method is used to either fetch an existing collection or create a new one. Since we are using a custom embedding model (OpenAI) instead of Chroma's default, we must pass the embedding function explicitly when creating the collection.

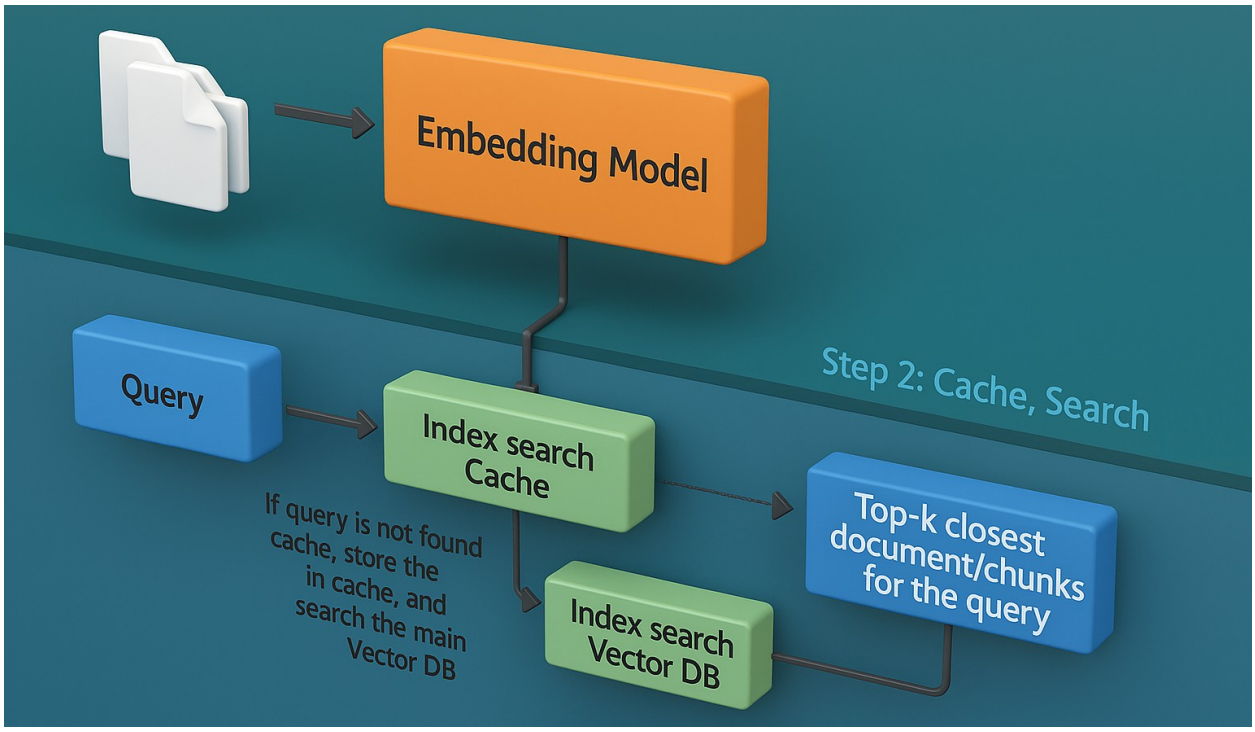
Once the collection is set up, we insert the documents along with their corresponding text and metadata. Additionally, we've also created a separate Chroma collection to serve as a **cache layer**, which will be covered in the next segment.

Stage 2: Semantic Search with Cache Layer

This section covers how semantic search is performed using a cache layer for improved efficiency. When a query is made, the system first searches the cache for top-k semantically similar documents or chunks. If found, results are returned instantly. If not, the query is processed using the main vector database.

The system then stores the new query and its results in the cache for faster future retrieval. This approach reduces latency for repeated or similar queries by avoiding redundant computation and enables quicker access to relevant documents through efficient indexing and retrieval from the vector store.

```
image_path = "/kaggle/input/flowchart-diagram-demonstrates-helpmate-ai-project/Stage_2_Search Layer.png"
display(Image(image_path))
```



QnA - Query 1

```
#
--------------------------------------------------------------------------------
# Question 1 : Can insurance coverage continue during an approved leave?
#
--------------------------------------------------------------------------------
```

```
# Read the user query
# query = input()
query = "Can insurance coverage continue during an approved leave?"

# Searh the Cache collection first
# Query the collection against the user query and return the top 20
results

cache_results = cache_collection.query(
    query_texts=query,
    n_results=1
)

cache_results
```

```
{'ids': [[]],
 'embeddings': None,
 'documents': [[]],
 'uris': None,
 'included': ['metadatas', 'documents', 'distances'],
 'data': None,
 'metadatas': [[]],
 'distances': [[]]}
```

```
results = insurance_collection.query(
    query_texts=query,
    n_results=10
)
results.items()
```

```
dict_items([('ids', [['37', '35', '38', '46', '25', '33', '29', '4',
'34', '30']]), ('embeddings', None), ('documents', [["Section E -
Reinstatement Article 1 - Reinstatement A Member's terminated
insurance will be reinstated if: a. insurance ceased because of layoff
or approved leave of absence; and b. the Member returns to Active Work
for the Policyholder within six months of the date insurance ceased.
The Member's reinstated insurance will be in force on the date of
return to work. However, the Actively at Work and Period of Limited
Activity provisions discussed in PART III, Section B, will apply.
Also, Proof of Good Health will be required to place in force any
Scheduled Benefit that would have been subject to Proof of Good Health
had the Member remained continuously insured. Only the period of time
during which a Member is actually insured will be included in
determining the length of his or her continuous coverage under this
Group Policy. For this purpose the period of time during which a
reinstated Member's insurance was not in force: a. will not be
considered an interruption of continuous coverage; and b. will not be
used to satisfy any provision of this Group Policy which pertains to a
period of continuous coverage. In addition, a longer reinstatement
period may be allowed for an approved leave of absence taken in
```

accordance with the provisions of the federal law regarding the Uniformed Services Employment and Reemployment Rights Act of 1994 (USERRA). Article 2 - Federal Required Family and Medical Leave Act (FMLA) A Member's terminated insurance may be reinstated in accordance with the provisions of the Federal Family and Medical Leave Act (FMLA), subject to the Actively at Work and Period of Limited Activity provision discussed in PART III, Section B. Article 3 - Reinstatement of Coverage for a Member or Dependent When Coverage Ends due to Living Outside of the United States This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6010 Section E - Reinstatement, Page 1", "Section D - Continuation Article 1 - Member Life Insurance a. Sickness or Injury (Other Than ADL Disability or Total Disability) If Active Work ends because a Member is sick or injured but not ADL Disabled or Totally Disabled, insurance for that Member may be continued until the earlier of: (1) the date insurance would otherwise cease as provided in PART III, Section C; or (2) the date the Member recovers. b. Layoff or Approved Leave of Absence If Active Work ends because a Member is on layoff or approved leave of absence, insurance for that Member may be continued until the earliest of: (1) the date insurance would otherwise cease as provided in PART III, Section C, Article 1 a. through g.; or (2) the date the layoff or approved leave of absence ends; or (3) the date the Member becomes eligible for any other group life coverage; or (4) the date one month after the date Active Work ends. c. Family and Medical Leave Act (FMLA) If a Member ceases Active Work due to an approved leave of absence under FMLA, the Policyholder may choose to continue the Member's insurance, subject to premium payment. A Member may qualify to have his or her insurance continued under one or more of the continuation provisions described in a., b., and c. above. If a Member qualifies for continuation under more than one provision, the longest period of continuation will be applied, and all periods of continuation will run concurrently. Article 2 - Dependent Insurance - Developmentally Disabled or Physically Handicapped Children a. Qualification Dependent Life Insurance for a child may be continued after the child reaches the maximum age for Dependent Children as defined in PART I of this Group Policy, provided that: This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6009 Section D - Continuation, Page 1", 'I f coverage for a Member or Dependent terminates because the person is outside of the United States as discussed in PART III, Section C, Article 5, the Member or Dependent may become eligible again for coverage under this Group Policy, but only if: a. the Member or Dependent return to the United States within six months of the date on which coverage terminated because the person is outside of the United States; and b. in the case of a Member, the Member returns to Active Work in the United States for the Policyholder for a period of at least 30 consecutive days. The Member will be eligible for coverage on the day immediately following completion of the 30 consecutive days of Active Work; and c. in the case of the Dependent, he or she remains in

the United States for 30 consecutive days. If the Dependent does so, he or she will be eligible for reinstatement of coverage on the day after completion of the 30 consecutive days of residence. The reinstated coverage will be on the same basis as that being provided on the date coverage is reinstated. However, any restrictions on this coverage that were in effect before reinstatement will continue to apply. If the Member or Dependent does not complete the 30 consecutive days of residence, the coverage for such person will not be reinstated. This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6010 Section E - Reinstatement, Page 2', "Payment of benefits will be subject to the Beneficiary and Facility of Payment provisions of this PART IV, Section A. Article 6 - Member Life Insurance - Coverage During Disability A Member may be eligible to continue his or her Member Life and Member Accidental Death and Dismemberment Insurance and Dependent Life Insurance coverage during the Member's ADL Disability or Total Disability. a. Coverage Qualification To be qualified for Coverage During Disability, a Member must: (1) become ADL Disabled or Totally Disabled while insured for Member Life Insurance; and (2) become ADL Disabled or Totally Disabled prior to the attainment of age 60; and (3) remain ADL Disabled or Totally Disabled continuously; and (4) be under the regular care and attendance of a Physician; and (5) send proof of ADL Disability or Total Disability to The Principal when required; and (6) submit to Medical Examinations or Evaluations when required; and (7) return to The Principal, without claim, any individual policy issued under his or her Individual Purchase Rights as described in PART III, Section F, Article 1. Upon return of such policy, The Principal will refund premiums paid, less dividends and less any outstanding policy loan balance. b. Proof of ADL Disability or Total Disability Written proof of ADL Disability or Total Disability must be sent to The Principal within one year of the date ADL Disability or Total Disability begins. Further proof that ADL Disability or Total Disability has not ended must be sent when The Principal requires. After ADL Disability or Total Disability has continued for two years from the date the first proof is received, The Principal may not ask for further proof more than once each year. If the Member dies while ADL Disabled or Totally Disabled, final proof that ADL Disability or Total Disability continued to the date of death must be sent to The Principal. If death occurs within one year of the start of ADL Disability or Total Disability, but before The Principal has received first proof, then final proof must be sent within one year of the date ADL Disability or Total Disability began. c. Medical Examinations and Evaluations This policy has been updated effective January 1, 2014 PART IV - BENEFITS GC 6013 Section A - Member Life Insurance, Page 4", "Section B - Effective Dates Article 1 - Member Life Insurance a. Actively at Work A Member's effective date for Member Life Insurance will be as explained in this article, if the Member is Actively at Work on that date. If the Member is not Actively at Work on the date insurance would otherwise be effective, such

insurance will not be in force until the day of return to Active Work. However, this Actively at Work requirement will be waived for Members who: (1) are absent from Active Work because of a regularly scheduled day off, holiday, or vacation day; and (2) were Actively at Work on their last scheduled work day before the date of their absence; and (3) were capable of Active Work on the day before the scheduled effective date of their insurance or change in their insurance, whichever is applicable. This Actively at Work requirement may also be waived as described below. When insurance under this Group Policy replaces coverage under a Prior Policy, the Active Work requirement may be waived for those Members who: (1) are eligible and enrolled under this Group Policy on its Date of Issue; and (2) were covered under the Prior Policy on the date of its termination. In no event will the Active Work requirement be waived for those Members who, on the date of termination of the Prior Policy, either: (1) had the option, under the terms of the Prior Policy, to convert their coverage under the Prior Policy to an individual policy; or (2) were eligible under the terms of the Prior Policy, to have their premiums waived due to ADL Disability or Total Disability. NOTE: When insurance under this Group Policy replaces coverage under a Prior Policy and the Active Work requirement is waived, any benefits payable will be the lesser of the Scheduled Benefit of this Group Policy or the amount that would have been paid by the Prior Policy had it remained in force. b. Effective Date for Initial Insurance When Proof of Good Health is Required This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6007 Section B - Effective Dates, Page 1", "A Member's insurance under this Group Policy for a Dependent will terminate on the earliest of: a. the date his or her Member Life Insurance ceases; or b. the date Dependent Life Insurance is removed from this Group Policy; or c. the date the last premium is paid for the Member's Dependent Life Insurance; or d. any date desired, if requested by the Member before that date; or e. the date the Member ceases to be in a class for which Dependent Life Insurance is provided; or f. for a Dependent spouse on the date that Dependent spouse ceases to be a Dependent as defined in PART I; or g. for each Dependent Child, on the date that Dependent Child ceases to be a Dependent as defined in PART I. Article 4 - Termination for Fraud The Principal may at any time terminate a Member's or Dependent's eligibility under the Group Policy: a. in Writing and with 31-day notice, if the individual submits any claim that contains false or fraudulent elements under state or federal law; or b. in Writing and with 31-day notice, upon finding in a civil or criminal case that a Member or Dependent has submitted claims that contain false or fraudulent elements under state or federal law; or c. in Writing and with 31-day notice, when a Member or Dependent has submitted a claim which, in good faith judgement and investigation, a Member or Dependent knew or should have known, contains false or fraudulent elements under state or federal law. Article 5 - Coverage While Outside of the United States If a Member or Dependent is temporarily

outside the United States, the Member or Dependent may choose to continue his or her insurance, subject to premium payment for a period of six months or less for one of the following reasons: a. travel; or This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6008 Section C - Individual Terminations, Page 2", "(1) marriage or establishment of a Civil Union partnership or divorce or termination of a Civil Union partnership; (2) death of a spouse or child; (3) birth or adoption of a child; (4) termination of employment by the Member's spouse or a change in the spouse's employment that causes loss of group coverage; (5) the Member's employment or the Member's spouse's employment changes from part- time to full-time or from full-time to part-time; (6) the Member or the Member's spouse takes an unpaid leave of absence. A change in the Scheduled Benefits because of a request by the Member when a change in family status has occurred for which Proof of Good Health is not required (see e. above) will normally be effective on the date of the request. However, if the Member is not Actively at Work on the date a Scheduled Benefit change would otherwise be effective, the Scheduled Benefit change will not be in force until the date the Member returns to Active Work. Any decrease in Scheduled Benefit amounts due to a request by the Member will be effective on the date of the change, whether or not the Member is Actively at Work. A change in the Scheduled Benefits because of a request by the Member when a change in family status has occurred for which Proof of Good Health is required (see e. above) will be effective on the later of: (1) the date the change would have been effective if Proof of Good Health had not been required; or (2) the date Proof of Good Health is approved by The Principal. Article 2 - Member Accidental Death and Dismemberment Insurance Member Accidental Death and Dismemberment Insurance will be effective under the same terms as set forth for Member Life Insurance in this Section B, Article 1. However, in no event will Member Accidental Death and Dismemberment Insurance be in force for a Member who is not insured for Member Life Insurance. Any change in a Member's Scheduled Benefit will be as stated in this Section B, Article 1. Article 3 - Dependent Life Insurance Dependent Life Insurance is available only with respect to Dependents of Members currently insured for Member Life Insurance. If a Member is eligible for Dependent Life Insurance, such insurance will be effective under the same terms as set forth for Member Life Insurance in this Section B, Article 1, except as described below. This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6007 Section B - Effective Dates, Page 5", 'Section A – Eligibility Member Life Insurance Article 1 Member Accidental Death and Dismemberment Insurance Article 2 Dependent Life Insurance Article 3 Section B - Effective Dates Member Life Insurance Article 1 Member Accidental Death and Dismemberment Insurance Article 2 Dependent Life Insurance Article 3 Section C - Individual Terminations Member Life Insurance Article 1 Member Accidental Death and Dismemberment Insurance Article 2 Dependent Life Insurance Article 3 Termination for Fraud Article 4

Coverage While Outside of the United States Article 5 Section D - Continuation Member Life Insurance Article 1 Dependent Insurance - Developmentally Disabled or Physically Handicapped Children Article 2 Section E - Reinstatement Reinstatement Article 1 Federal Required Family and Medical Leave Act (FMLA) Article 2 Reinstatement of Coverage for a Member or Dependent When Coverage Ends due to Living Outside of the United States Article 3 Section F - Individual Purchase Rights Member Life Insurance Article 1 Dependent Life Insurance Article 2 PART IV - BENEFITS This policy has been updated effective January 1, 2014 GC 6001 TABLE OF CONTENTS, PAGE 2', 'b. a business assignment; or c. full-time student status, provided the Member or Dependent is either: (1) enrolled and attending an accredited school in a foreign country; or (2) is participating in an academic program in a foreign country, for which the institution of higher learning at which the student is enrolled in the U.S. grants academic credit. The six-month period will not be reduced for any time covered under a Prior Policy. If a Member or Dependent is outside the United States for any other reason than those listed above, coverage for the person concerned will automatically terminate. This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6008 Section C - Individual Terminations, Page 3', "a . In no event will Dependent Life Insurance be in force for a Member who is not insured for Member Life Insurance. b. If a Dependent spouse is in a Period of Limited Activity on the date Dependent Life Insurance or an increase in Dependent Life Insurance Scheduled Benefit due to a change in the Member's Annual Compensation or insurance class would otherwise be effective, such insurance or increase will not be in force for that Dependent spouse until the Period of Limited Activity ends. However, this Period of Limited Activity requirement may be waived as described below. When insurance under this Group Policy replaces coverage under a Prior Policy, the Period of Limited Activity requirement may be waived for those Dependent spouses' who: (1) are eligible and enrolled under this Group Policy on its Date of Issue; and (2) were covered under the Prior Policy on the date of its termination. In no event will the Period of Limited Activity requirement be waived for those Dependent spouses' who, on the date of termination of the Prior Policy had the option, under the terms of the Prior Policy, to convert their coverage, under the Prior Policy, to an individual policy. NOTE: When insurance under this Group Policy replaces coverage under a Prior Policy and the Period of Limited Activity requirement is waived, any benefits payable will be the lesser of the Scheduled Benefit of this Group Policy or the amount that would have been paid by the Prior Policy had it remained in force. c. If insurance is requested under this Group Policy for a Dependent spouse that was eligible under the Prior Policy, but elected to waive coverage under the Prior Policy. d. If a Dependent is confined in a Hospital or Skilled Nursing Facility on the date an increase in the Dependent Life Insurance Scheduled Benefit would otherwise be effective, the Scheduled Benefit in force for the

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Dependent will continue to apply to the Dependent until such
confinement ends. When the Hospital or Skilled Nursing Facility
confinement ends, the Scheduled Benefit increase will then be in force
for the Dependent. e. Any required Proof of Good Health will be with
respect to the health of the Member's Dependents. f. If Dependent Life
Insurance is in force for a Dependent of the Member, a Member will be
insured with respect to a new Dependent (other than a newborn child)
on the date the new Dependent is acquired, provided the new Dependent
is not then confined in a Hospital or Skilled Nursing Facility.
Requests for insurance and Proof of Good Health are not required This
policy has been updated effective January 1, 2014 PART III -
INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6007 Section B - Effective
Dates, Page 6"]]), ('uris', None), ('included', ['metadatas',
'documents', 'distances']), ('data', None), ('metadatas',
[[{'Policy_Name': 'Principal-Sample-Life-Insurance-Policy',
'Page_No.': 'Page 40'}, {'Policy_Name': 'Principal-Sample-Life-
Insurance-Policy', 'Page_No.': 'Page 38'}, {'Page_No.': 'Page 41',
'Policy_Name': 'Principal-Sample-Life-Insurance-Policy'}, {'Page_No.':
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{'Policy_Name': 'Principal-Sample-Life-Insurance-Policy', 'Page_No.':
'Page 28'}, {'Page_No.': 'Page 36', 'Policy_Name': 'Principal-Sample-
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Insurance-Policy', 'Page_No.': 'Page 32'}, {'Policy_Name': 'Principal-
Sample-Life-Insurance-Policy', 'Page_No.': 'Page 7'}, {'Policy_Name':
'Principal-Sample-Life-Insurance-Policy', 'Page_No.': 'Page 37'},
{'Policy_Name': 'Principal-Sample-Life-Insurance-Policy', 'Page_No.':
'Page 33'}]]), ('distances', [[0.706852376461029, 0.7258145809173584,
0.8699490427970886, 0.9321367740631104, 0.9563360214233398,
0.9803516864776611, 1.0001188516616821, 1.0118558406829834,
1.0129334926605225, 1.0214715003967285]])])

# Implementing Cache in Semantic Search

# Set a threshold for cache searchA
threshold = 0.2

ids = []
documents = []
distances = []
metadatas = []
results_df = pd.DataFrame()


# If the distance is greater than the threshold, then return the
results from the main collection.

if cache_results['distances'][0] == [] or cache_results['distances']
[0][0] > threshold:
    # Query the collection against the user query and return the top
10 results
```

```
    results = insurance_collection.query(
    query_texts=query,
    n_results=10
    )

    # Store the query in cache_collection as document w.r.t to
ChromaDB so that it can be embedded and searched against later
    # Store retrieved text, ids, distances and metadatas in
cache_collection as metadatas, so that they can be fetched easily if a
query indeed matches to a query in cache
    Keys = []
    Values = []

    for key, val in results.items():
        # print(f"Key: {key}, Type of val: {type(val)}, Length of val:
{len(val) if val else 0}")
        if val is None:
           continue
        if key != 'embeddings':
           # Ensure val[0] exists and is a list-like object
           if len(val) > 0 and isinstance(val[0], (list, tuple)):
                for i in range(min(10, len(val[0]))):  # Avoid
IndexError
                     Keys.append(str(key) + str(i))
                     Values.append(str(val[0][i]))
           else:
                # Optional: log or handle unexpected structure
                print(f"Skipping key: {key}, unexpected structure:
{type(val[0]) if val else 'empty'}")

    cache_collection.add(
      documents= [query],
      ids = [query],  # Or if you want to assign integers as IDs
0,1,2,.., then you can use "len(cache_results['documents'])" as will
return the no. of queries currently in the cache and assign the next
digit to the new query."
      metadatas = dict(zip(Keys, Values))
    )

    print("Not found in cache. Found in main collection.")

    result_dict = {'Metadatas': results['metadatas'][0], 'Documents':
results['documents'][0], 'Distances': results['distances'][0],
"IDs":results["ids"][0]}
    results_df = pd.DataFrame.from_dict(result_dict)
    results_df

elif cache_results['distances'][0][0] <= threshold:
    cache_result_dict = cache_results['metadatas'][0][0]
```

```
    # Loop through each inner list and then through the dictionary
    for key, value in cache_result_dict.items():
        if 'ids' in key:
            ids.append(value)
        elif 'documents' in key:
            documents.append(value)
        elif 'distances' in key:
            distances.append(value)
        elif 'metadatas' in key:
            metadatas.append(value)

    print("Found in cache!")

    # Create a DataFrame
    results_df = pd.DataFrame({
        'IDs': ids,
        'Documents': documents,
        'Distances': distances,
        'Metadatas': metadatas
    })
```

```
Skipping key: included, unexpected structure: <class 'str'>
Not found in cache. Found in main collection.
```

```
results_df
```

	Metadatas
0	{'Policy_Name': 'Principal-Sample-Life-Insuran...
1	{'Policy_Name': 'Principal-Sample-Life-Insuran...
2	{'Policy_Name': 'Principal-Sample-Life-Insuran...
3	{'Page_No.': 'Page 49', 'Policy_Name': 'Princi...
4	{'Policy_Name': 'Principal-Sample-Life-Insuran...
5	{'Policy_Name': 'Principal-Sample-Life-Insuran...
6	{'Policy_Name': 'Principal-Sample-Life-Insuran...
7	{'Page_No.': 'Page 7', 'Policy_Name': 'Princip...
8	{'Page_No.': 'Page 37', 'Policy_Name': 'Princi...
9	{'Page_No.': 'Page 33', 'Policy_Name': 'Princi...

	Documents	Distances	IDs
0	Section E - Reinstatement Article 1 - Reinstat...	0.706852	37
1	Section D - Continuation Article 1 - Member Li...	0.725815	35
2	I f coverage for a Member or Dependent termina...	0.869949	38
3	Payment of benefits will be subject to the Ben...	0.932137	46
4	Section B - Effective Dates Article 1 - Member...	0.956336	25
5	A Member's insurance under this Group Policy f...	0.980352	33
6	(1) marriage or establishment of a Civil Union...	1.000119	29
7	Section A – Eligibility Member Life Insurance ...	1.011856	4
8	b. a business assignment; or c. full-time stud...	1.012933	34
9	a . In no event will Dependent Life Insurance ...	1.021472	30

QnA - Query 2

```
#
--------------------------------------------------------------------------------
# Question 2 : Are there age-based reductions in benefit amounts?
#
--------------------------------------------------------------------------------

# Read the user query
# query2 = input()
query2 = "Are there age-based reductions in benefit amounts?"

# Search the Cache collection first
# Query the collection against the user query and return the top 20 results

cache_results2 = cache_collection.query(
    query_texts=query2,
    n_results=1
)

cache_results2
```


```
{'ids': [['Can insurance coverage continue during an approved leave?']],
 'embeddings': None,
 'documents': [['Can insurance coverage continue during an approved leave?']],
 'uris': None,
 'included': ['metadatas', 'documents', 'distances'],
 'data': None,
 'metadatas': [[{'documents1': "Section D - Continuation Article 1 - Member Life Insurance a. Sickness or Injury (Other Than ADL Disability or Total Disability) If Active Work ends because a Member is sick or injured but not ADL Disabled or Totally Disabled, insurance for that Member may be continued until the earlier of: (1) the date insurance would otherwise cease as provided in PART III, Section C; or (2) the date the Member recovers. b. Layoff or Approved Leave of Absence If Active Work ends because a Member is on layoff or approved leave of absence, insurance for that Member may be continued until the earliest of: (1) the date insurance would otherwise cease as provided in PART III, Section C, Article 1 a. through g.; or (2) the date the layoff or approved leave of absence ends; or (3) the date the Member becomes eligible for any other group life coverage; or (4) the date one month after the date Active Work ends. c. Family and Medical Leave Act (FMLA) If a Member ceases Active Work due to an approved leave of absence under FMLA, the Policyholder may choose to continue the Member's insurance, subject to premium payment. A Member may qualify to have his or her insurance continued under one or more of the
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continuation provisions described in a., b., and c. above. If a Member qualifies for continuation under more than one provision, the longest period of continuation will be applied, and all periods of continuation will run concurrently. Article 2 - Dependent Insurance - Developmentally Disabled or Physically Handicapped Children a. Qualification Dependent Life Insurance for a child may be continued after the child reaches the maximum age for Dependent Children as defined in PART I of this Group Policy, provided that: This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6009 Section D - Continuation, Page 1",
    'ids7': '4',
    'documents6': "(1) marriage or establishment of a Civil Union partnership or divorce or termination of a Civil Union partnership; (2) death of a spouse or child; (3) birth or adoption of a child; (4) termination of employment by the Member's spouse or a change in the spouse's employment that causes loss of group coverage; (5) the Member's employment or the Member's spouse's employment changes from part- time to full-time or from full-time to part-time; (6) the Member or the Member's spouse takes an unpaid leave of absence. A change in the Scheduled Benefits because of a request by the Member when a change in family status has occurred for which Proof of Good Health is not required (see e. above) will normally be effective on the date of the request. However, if the Member is not Actively at Work on the date a Scheduled Benefit change would otherwise be effective, the Scheduled Benefit change will not be in force until the date the Member returns to Active Work. Any decrease in Scheduled Benefit amounts due to a request by the Member will be effective on the date of the change, whether or not the Member is Actively at Work. A change in the Scheduled Benefits because of a request by the Member when a change in family status has occurred for which Proof of Good Health is required (see e. above) will be effective on the later of: (1) the date the change would have been effective if Proof of Good Health had not been required; or (2) the date Proof of Good Health is approved by The Principal. Article 2 - Member Accidental Death and Dismemberment Insurance Member Accidental Death and Dismemberment Insurance will be effective under the same terms as set forth for Member Life Insurance in this Section B, Article 1. However, in no event will Member Accidental Death and Dismemberment Insurance be in force for a Member who is not insured for Member Life Insurance. Any change in a Member's Scheduled Benefit will be as stated in this Section B, Article 1. Article 3 - Dependent Life Insurance Dependent Life Insurance is available only with respect to Dependents of Members currently insured for Member Life Insurance. If a Member is eligible for Dependent Life Insurance, such insurance will be effective under the same terms as set forth for Member Life Insurance in this Section B, Article 1, except as described below. This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6007 Section B - Effective Dates, Page 5",
    'documents9': "a . In no event will Dependent Life Insurance be in

force for a Member who is not insured for Member Life Insurance. b. If a Dependent spouse is in a Period of Limited Activity on the date Dependent Life Insurance or an increase in Dependent Life Insurance Scheduled Benefit due to a change in the Member's Annual Compensation or insurance class would otherwise be effective, such insurance or increase will not be in force for that Dependent spouse until the Period of Limited Activity ends. However, this Period of Limited Activity requirement may be waived as described below. When insurance under this Group Policy replaces coverage under a Prior Policy, the Period of Limited Activity requirement may be waived for those Dependent spouses' who: (1) are eligible and enrolled under this Group Policy on its Date of Issue; and (2) were covered under the Prior Policy on the date of its termination. In no event will the Period of Limited Activity requirement be waived for those Dependent spouses' who, on the date of termination of the Prior Policy had the option, under the terms of the Prior Policy, to convert their coverage, under the Prior Policy, to an individual policy. NOTE: When insurance under this Group Policy replaces coverage under a Prior Policy and the Period of Limited Activity requirement is waived, any benefits payable will be the lesser of the Scheduled Benefit of this Group Policy or the amount that would have been paid by the Prior Policy had it remained in force. c. If insurance is requested under this Group Policy for a Dependent spouse that was eligible under the Prior Policy, but elected to waive coverage under the Prior Policy. d. If a Dependent is confined in a Hospital or Skilled Nursing Facility on the date an increase in the Dependent Life Insurance Scheduled Benefit would otherwise be effective, the Scheduled Benefit in force for the Dependent will continue to apply to the Dependent until such confinement ends. When the Hospital or Skilled Nursing Facility confinement ends, the Scheduled Benefit increase will then be in force for the Dependent. e. Any required Proof of Good Health will be with respect to the health of the Member's Dependents. f. If Dependent Life Insurance is in force for a Dependent of the Member, a Member will be insured with respect to a new Dependent (other than a newborn child) on the date the new Dependent is acquired, provided the new Dependent is not then confined in a Hospital or Skilled Nursing Facility. Requests for insurance and Proof of Good Health are not required This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6007 Section B - Effective Dates, Page 6",

    'documents3': "Payment of benefits will be subject to the Beneficiary and Facility of Payment provisions of this PART IV, Section A. Article 6 - Member Life Insurance - Coverage During Disability A Member may be eligible to continue his or her Member Life and Member Accidental Death and Dismemberment Insurance and Dependent Life Insurance coverage during the Member's ADL Disability or Total Disability. a. Coverage Qualification To be qualified for Coverage During Disability, a Member must: (1) become ADL Disabled or Totally Disabled while insured for Member Life Insurance; and (2) become ADL

Disabled or Totally Disabled prior to the attainment of age 60; and (3) remain ADL Disabled or Totally Disabled continuously; and (4) be under the regular care and attendance of a Physician; and (5) send proof of ADL Disability or Total Disability to The Principal when required; and (6) submit to Medical Examinations or Evaluations when required; and (7) return to The Principal, without claim, any individual policy issued under his or her Individual Purchase Rights as described in PART III, Section F, Article 1. Upon return of such policy, The Principal will refund premiums paid, less dividends and less any outstanding policy loan balance. b. Proof of ADL Disability or Total Disability Written proof of ADL Disability or Total Disability must be sent to The Principal within one year of the date ADL Disability or Total Disability begins. Further proof that ADL Disability or Total Disability has not ended must be sent when The Principal requires. After ADL Disability or Total Disability has continued for two years from the date the first proof is received, The Principal may not ask for further proof more than once each year. If the Member dies while ADL Disabled or Totally Disabled, final proof that ADL Disability or Total Disability continued to the date of death must be sent to The Principal. If death occurs within one year of the start of ADL Disability or Total Disability, but before The Principal has received first proof, then final proof must be sent within one year of the date ADL Disability or Total Disability began. c. Medical Examinations and Evaluations This policy has been updated effective January 1, 2014 PART IV - BENEFITS GC 6013 Section A - Member Life Insurance, Page 4",
    'metadatas7': "{'Page_No.': 'Page 7', 'Policy_Name': 'Principal-Sample-Life-Insurance-Policy'}",
    'distances5': '0.9803516864776611',
    'ids6': '29',
    'documents4': "Section B - Effective Dates Article 1 - Member Life Insurance a. Actively at Work A Member's effective date for Member Life Insurance will be as explained in this article, if the Member is Actively at Work on that date. If the Member is not Actively at Work on the date insurance would otherwise be effective, such insurance will not be in force until the day of return to Active Work. However, this Actively at Work requirement will be waived for Members who: (1) are absent from Active Work because of a regularly scheduled day off, holiday, or vacation day; and (2) were Actively at Work on their last scheduled work day before the date of their absence; and (3) were capable of Active Work on the day before the scheduled effective date of their insurance or change in their insurance, whichever is applicable. This Actively at Work requirement may also be waived as described below. When insurance under this Group Policy replaces coverage under a Prior Policy, the Active Work requirement may be waived for those Members who: (1) are eligible and enrolled under this Group Policy on its Date of Issue; and (2) were covered under the Prior Policy on the date of its termination. In no event will the Active Work requirement be waived for those Members who, on the date

of termination of the Prior Policy, either: (1) had the option, under the terms of the Prior Policy, to convert their coverage under the Prior Policy to an individual policy; or (2) were eligible under the terms of the Prior Policy, to have their premiums waived due to ADL Disability or Total Disability. NOTE: When insurance under this Group Policy replaces coverage under a Prior Policy and the Active Work requirement is waived, any benefits payable will be the lesser of the Scheduled Benefit of this Group Policy or the amount that would have been paid by the Prior Policy had it remained in force. b. Effective Date for Initial Insurance When Proof of Good Health is Required This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6007 Section B - Effective Dates, Page 1",
    'metadatas0': "{'Policy_Name': 'Principal-Sample-Life-Insurance-Policy', 'Page_No.': 'Page 40'}",
    'documents8': 'b. a business assignment; or c. full-time student status, provided the Member or Dependent is either: (1) enrolled and attending an accredited school in a foreign country; or (2) is participating in an academic program in a foreign country, for which the institution of higher learning at which the student is enrolled in the U.S. grants academic credit. The six-month period will not be reduced for any time covered under a Prior Policy. If a Member or Dependent is outside the United States for any other reason than those listed above, coverage for the person concerned will automatically terminate. This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6008 Section C - Individual Terminations, Page 3',
    'metadatas8': "{'Page_No.': 'Page 37', 'Policy_Name': 'Principal-Sample-Life-Insurance-Policy'}",
    'documents7': 'Section A – Eligibility Member Life Insurance Article 1 Member Accidental Death and Dismemberment Insurance Article 2 Dependent Life Insurance Article 3 Section B - Effective Dates Member Life Insurance Article 1 Member Accidental Death and Dismemberment Insurance Article 2 Dependent Life Insurance Article 3 Section C - Individual Terminations Member Life Insurance Article 1 Member Accidental Death and Dismemberment Insurance Article 2 Dependent Life Insurance Article 3 Termination for Fraud Article 4 Coverage While Outside of the United States Article 5 Section D - Continuation Member Life Insurance Article 1 Dependent Insurance - Developmentally Disabled or Physically Handicapped Children Article 2 Section E - Reinstatement Reinstatement Article 1 Federal Required Family and Medical Leave Act (FMLA) Article 2 Reinstatement of Coverage for a Member or Dependent When Coverage Ends due to Living Outside of the United States Article 3 Section F - Individual Purchase Rights Member Life Insurance Article 1 Dependent Life Insurance Article 2 PART IV - BENEFITS This policy has been updated effective January 1, 2014 GC 6001 TABLE OF CONTENTS, PAGE 2',
    'metadatas3': "{'Page_No.': 'Page 49', 'Policy_Name': 'Principal-Sample-Life-Insurance-Policy'}",

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    'ids1': '35',
    'metadatas9': "{'Page_No.': 'Page 33', 'Policy_Name': 'Principal-
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    'ids0': '37',
    'ids9': '30',
    'ids8': '34',
    'metadatas5': "{'Policy_Name': 'Principal-Sample-Life-Insurance-
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    'distances9': '1.0214715003967285',
    'ids2': '38',
    'distances3': '0.9321367740631104',
    'ids4': '25',
    'metadatas1': "{'Policy_Name': 'Principal-Sample-Life-Insurance-
Policy', 'Page_No.': 'Page 38'}",
    'distances6': '1.0001188516616821',
    'ids3': '46',
    'metadatas2': "{'Policy_Name': 'Principal-Sample-Life-Insurance-
Policy', 'Page_No.': 'Page 41'}",
    'documents5': "A Member's insurance under this Group Policy for a
Dependent will terminate on the earliest of: a. the date his or her
Member Life Insurance ceases; or b. the date Dependent Life Insurance
is removed from this Group Policy; or c. the date the last premium is
paid for the Member's Dependent Life Insurance; or d. any date
desired, if requested by the Member before that date; or e. the date
the Member ceases to be in a class for which Dependent Life Insurance
is provided; or f. for a Dependent spouse on the date that Dependent
spouse ceases to be a Dependent as defined in PART I; or g. for each
Dependent Child, on the date that Dependent Child ceases to be a
Dependent as defined in PART I. Article 4 - Termination for Fraud The
Principal may at any time terminate a Member's or Dependent's
eligibility under the Group Policy: a. in Writing and with 31-day
notice, if the individual submits any claim that contains false or
fraudulent elements under state or federal law; or b. in Writing and
with 31-day notice, upon finding in a civil or criminal case that a
Member or Dependent has submitted claims that contain false or
fraudulent elements under state or federal law; or c. in Writing and
with 31-day notice, when a Member or Dependent has submitted a claim
which, in good faith judgement and investigation, a Member or
Dependent knew or should have known, contains false or fraudulent
elements under state or federal law. Article 5 - Coverage While
Outside of the United States If a Member or Dependent is temporarily
outside the United States, the Member or Dependent may choose to
continue his or her insurance, subject to premium payment for a period
of six months or less for one of the following reasons: a. travel; or
This policy has been updated effective January 1, 2014 PART III -
INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6008 Section C - Individual
Terminations, Page 2",
```

'distances7': '1.0118558406829834',
'distances2': '0.8699490427970886',
'metadatas4': "{'Policy_Name': 'Principal-Sample-Life-Insurance-Policy', 'Page_No.': 'Page 28'}",
'distances4': '0.9563360214233398',
'documents0': "Section E - Reinstatement Article 1 - Reinstatement A Member's terminated insurance will be reinstated if: a. insurance ceased because of layoff or approved leave of absence; and b. the Member returns to Active Work for the Policyholder within six months of the date insurance ceased. The Member's reinstated insurance will be in force on the date of return to work. However, the Actively at Work and Period of Limited Activity provisions discussed in PART III, Section B, will apply. Also, Proof of Good Health will be required to place in force any Scheduled Benefit that would have been subject to Proof of Good Health had the Member remained continuously insured. Only the period of time during which a Member is actually insured will be included in determining the length of his or her continuous coverage under this Group Policy. For this purpose the period of time during which a reinstated Member's insurance was not in force: a. will not be considered an interruption of continuous coverage; and b. will not be used to satisfy any provision of this Group Policy which pertains to a period of continuous coverage. In addition, a longer reinstatement period may be allowed for an approved leave of absence taken in accordance with the provisions of the federal law regarding the Uniformed Services Employment and Reemployment Rights Act of 1994 (USERRA). Article 2 - Federal Required Family and Medical Leave Act (FMLA) A Member's terminated insurance may be reinstated in accordance with the provisions of the Federal Family and Medical Leave Act (FMLA), subject to the Actively at Work and Period of Limited Activity provision discussed in PART III, Section B. Article 3 - Reinstatement of Coverage for a Member or Dependent When Coverage Ends due to Living Outside of the United States This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6010 Section E - Reinstatement, Page 1",
'distances1': '0.7258145809173584',
'ids5': '33',
'documents2': 'I f coverage for a Member or Dependent terminates because the person is outside of the United States as discussed in PART III, Section C, Article 5, the Member or Dependent may become eligible again for coverage under this Group Policy, but only if: a. the Member or Dependent return to the United States within six months of the date on which coverage terminated because the person is outside of the United States; and b. in the case of a Member, the Member returns to Active Work in the United States for the Policyholder for a period of at least 30 consecutive days. The Member will be eligible for coverage on the day immediately following completion of the 30 consecutive days of Active Work; and c. in the case of the Dependent, he or she remains in the United States for 30 consecutive days. If the Dependent does so, he or she will be eligible for reinstatement of

```
coverage on the day after completion of the 30 consecutive days of residence. The reinstated coverage will be on the same basis as that being provided on the date coverage is reinstated. However, any restrictions on this coverage that were in effect before reinstatement will continue to apply. If the Member or Dependent does not complete the 30 consecutive days of residence, the coverage for such person will not be reinstated. This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6010 Section E - Reinstatement, Page 2',
    'metadatas6': "{'Policy_Name': 'Principal-Sample-Life-Insurance-Policy', 'Page_No.': 'Page 32'}"}]],
 'distances': [[1.3787976503372192]]}

# Implementing Cache in Semantic Search

# Set a threshold for cache search
threshold = 0.2

# Initialize lists and dataframe
ids2 = []
documents2 = []
distances2 = []
metadatas2 = []
results_df2 = pd.DataFrame()

# Check if cache is empty or not useful
if not cache_results2['distances'][0] or cache_results2['distances'][0][0] > threshold:
    # Query the main collection
    results = insurance_collection.query(
        query_texts=query2,
        n_results=10
    )

    # Prepare metadata for caching
    Keys2 = []
    Values2 = []

    for key, val in results.items():
        if val is None or key == 'embeddings':
            continue
        if len(val) > 0 and isinstance(val[0], (list, tuple)):
            for i in range(min(10, len(val[0]))):
                Keys2.append(f"{key}{i}")
                Values2.append(str(val[0][i]))
        else:
            print(f"Skipping key '{key}' due to unexpected structure or empty list.")

    # Add to cache
```

```
    cache_collection.add(
        documents=[query2],
        ids=[query2],
        metadatas=dict(zip(Keys2, Values2))
    )

    print("Not found in cache. Found in main collection.")

    # Prepare result DataFrame
    result_dict2 = {
        'Metadatas': results['metadatas'][0],
        'Documents': results['documents'][0],
        'Distances': results['distances'][0],
        'IDs': results['ids'][0]
    }
    results_df2 = pd.DataFrame.from_dict(result_dict2)

# Use cached results
elif cache_results2['distances'][0][0] <= threshold:
    cache_result_dict2 = cache_results2['metadatas'][0][0]

    for key, value in cache_result_dict2.items():
        if 'ids' in key:
            ids2.append(value)
        elif 'documents' in key:
            documents2.append(value)
        elif 'distances' in key:
            distances2.append(value)
        elif 'metadatas' in key:
            metadatas2.append(value)

    print("Found in cache!")

    results_df2 = pd.DataFrame({
        'IDs': ids2,
        'Documents': documents2,
        'Distances': distances2,
        'Metadatas': metadatas2
    })
```

```
Skipping key 'included' due to unexpected structure or empty list.
Not found in cache. Found in main collection.
```

```
results_df2
```

```
                                           Metadatas  \
0  {'Policy_Name': 'Principal-Sample-Life-Insuran...
1  {'Policy_Name': 'Principal-Sample-Life-Insuran...
2  {'Page_No.': 'Page 32', 'Policy_Name': 'Princi...
3  {'Page_No.': 'Page 46', 'Policy_Name': 'Princi...
4  {'Policy_Name': 'Principal-Sample-Life-Insuran...
```

```
5  {'Policy_Name': 'Principal-Sample-Life-Insuran...
6  {'Policy_Name': 'Principal-Sample-Life-Insuran...
7  {'Policy_Name': 'Principal-Sample-Life-Insuran...
8  {'Page_No.': 'Page 33', 'Policy_Name': 'Princi...
9  {'Policy_Name': 'Principal-Sample-Life-Insuran...
```

	Documents	Distances	IDs
0	(6) If, on the date a Member becomes eligible ...	0.927741	27
1	Scheduled Benefit in force for the Member befo...	0.991921	28
2	(1) marriage or establishment of a Civil Union...	1.054535	29
3	PART IV - BENEFITS Section A - Member Life Ins...	1.094952	43
4	(1) If termination is as described in b. (1) a...	1.101119	42
5	Coverage During Disability will cease on the e...	1.105354	48
6	Section C - Dependent Life Insurance Article 1...	1.116788	56
7	(1) the child is incapable of self-support as ...	1.140166	36
8	a . In no event will Dependent Life Insurance ...	1.146286	30
9	(1) only one Accelerated Benefit payment will ...	1.152514	49

QnA - Query 3

```
#
--------------------------------------------------------------------------------
# Question 3 : What are the exclusions under Accidental Death?
#
--------------------------------------------------------------------------------

# Read the user query
# query3 = input()
query3 = "What are the exclusions under Accidental Death?"

# Search the Cache collection first
# Query the collection against the user query and return the top 20 results

cache_results3 = cache_collection.query(
    query_texts=query3,
    n_results=1
)

cache_results3
```

```
{'ids': [['Can insurance coverage continue during an approved leave?']],
 'embeddings': None,
 'documents': [['Can insurance coverage continue during an approved leave?']],
 'uris': None,
 'included': ['metadatas', 'documents', 'distances'],
```

```
 'data': None,
 'metadatas': [[{'metadatas7': "{'Page_No.': 'Page 7', 'Policy_Name':
'Principal-Sample-Life-Insurance-Policy'}",
    'metadatas6': "{'Policy_Name': 'Principal-Sample-Life-Insurance-
Policy', 'Page_No.': 'Page 32'}",
    'distances4': '0.9563360214233398',
    'distances6': '1.0001188516616821',
    'documents4': "Section B - Effective Dates Article 1 - Member Life
Insurance a. Actively at Work A Member's effective date for Member
Life Insurance will be as explained in this article, if the Member is
Actively at Work on that date. If the Member is not Actively at Work
on the date insurance would otherwise be effective, such insurance
will not be in force until the day of return to Active Work. However,
this Actively at Work requirement will be waived for Members who: (1)
are absent from Active Work because of a regularly scheduled day off,
holiday, or vacation day; and (2) were Actively at Work on their last
scheduled work day before the date of their absence; and (3) were
capable of Active Work on the day before the scheduled effective date
of their insurance or change in their insurance, whichever is
applicable. This Actively at Work requirement may also be waived as
described below. When insurance under this Group Policy replaces
coverage under a Prior Policy, the Active Work requirement may be
waived for those Members who: (1) are eligible and enrolled under this
Group Policy on its Date of Issue; and (2) were covered under the
Prior Policy on the date of its termination. In no event will the
Active Work requirement be waived for those Members who, on the date
of termination of the Prior Policy, either: (1) had the option, under
the terms of the Prior Policy, to convert their coverage under the
Prior Policy to an individual policy; or (2) were eligible under the
terms of the Prior Policy, to have their premiums waived due to ADL
Disability or Total Disability. NOTE: When insurance under this Group
Policy replaces coverage under a Prior Policy and the Active Work
requirement is waived, any benefits payable will be the lesser of the
Scheduled Benefit of this Group Policy or the amount that would have
been paid by the Prior Policy had it remained in force. b. Effective
Date for Initial Insurance When Proof of Good Health is Required This
policy has been updated effective January 1, 2014 PART III -
INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6007 Section B - Effective
Dates, Page 1",
    'distances1': '0.7258145809173584',
    'distances0': '0.706852376461029',
    'distances9': '1.0214715003967285',
    'documents0': "Section E - Reinstatement Article 1 - Reinstatement
A Member's terminated insurance will be reinstated if: a. insurance
ceased because of layoff or approved leave of absence; and b. the
Member returns to Active Work for the Policyholder within six months
of the date insurance ceased. The Member's reinstated insurance will
be in force on the date of return to work. However, the Actively at
Work and Period of Limited Activity provisions discussed in PART III,
```

Section B, will apply. Also, Proof of Good Health will be required to place in force any Scheduled Benefit that would have been subject to Proof of Good Health had the Member remained continuously insured. Only the period of time during which a Member is actually insured will be included in determining the length of his or her continuous coverage under this Group Policy. For this purpose the period of time during which a reinstated Member's insurance was not in force: a. will not be considered an interruption of continuous coverage; and b. will not be used to satisfy any provision of this Group Policy which pertains to a period of continuous coverage. In addition, a longer reinstatement period may be allowed for an approved leave of absence taken in accordance with the provisions of the federal law regarding the Uniformed Services Employment and Reemployment Rights Act of 1994 (USERRA). Article 2 - Federal Required Family and Medical Leave Act (FMLA) A Member's terminated insurance may be reinstated in accordance with the provisions of the Federal Family and Medical Leave Act (FMLA), subject to the Actively at Work and Period of Limited Activity provision discussed in PART III, Section B. Article 3 - Reinstatement of Coverage for a Member or Dependent When Coverage Ends due to Living Outside of the United States This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6010 Section E - Reinstatement, Page 1",
    'distances5': '0.9803516864776611',
    'ids7': '4',
    'metadatas2': "{'Policy_Name': 'Principal-Sample-Life-Insurance-Policy', 'Page_No.': 'Page 41'}",
    'ids5': '33',
    'metadatas3': "{'Page_No.': 'Page 49', 'Policy_Name': 'Principal-Sample-Life-Insurance-Policy'}",
    'ids3': '46',
    'documents6': "(1) marriage or establishment of a Civil Union partnership or divorce or termination of a Civil Union partnership; (2) death of a spouse or child; (3) birth or adoption of a child; (4) termination of employment by the Member's spouse or a change in the spouse's employment that causes loss of group coverage; (5) the Member's employment or the Member's spouse's employment changes from part- time to full-time or from full-time to part-time; (6) the Member or the Member's spouse takes an unpaid leave of absence. A change in the Scheduled Benefits because of a request by the Member when a change in family status has occurred for which Proof of Good Health is not required (see e. above) will normally be effective on the date of the request. However, if the Member is not Actively at Work on the date a Scheduled Benefit change would otherwise be effective, the Scheduled Benefit change will not be in force until the date the Member returns to Active Work. Any decrease in Scheduled Benefit amounts due to a request by the Member will be effective on the date of the change, whether or not the Member is Actively at Work. A change in the Scheduled Benefits because of a request by the Member when a change in family status has occurred for which Proof of Good Health is

required (see e. above) will be effective on the later of: (1) the date the change would have been effective if Proof of Good Health had not been required; or (2) the date Proof of Good Health is approved by The Principal. Article 2 - Member Accidental Death and Dismemberment Insurance Member Accidental Death and Dismemberment Insurance will be effective under the same terms as set forth for Member Life Insurance in this Section B, Article 1. However, in no event will Member Accidental Death and Dismemberment Insurance be in force for a Member who is not insured for Member Life Insurance. Any change in a Member's Scheduled Benefit will be as stated in this Section B, Article 1. Article 3 - Dependent Life Insurance Dependent Life Insurance is available only with respect to Dependents of Members currently insured for Member Life Insurance. If a Member is eligible for Dependent Life Insurance, such insurance will be effective under the same terms as set forth for Member Life Insurance in this Section B, Article 1, except as described below. This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6007 Section B - Effective Dates, Page 5",
    'documents7': 'Section A – Eligibility Member Life Insurance Article 1 Member Accidental Death and Dismemberment Insurance Article 2 Dependent Life Insurance Article 3 Section B - Effective Dates Member Life Insurance Article 1 Member Accidental Death and Dismemberment Insurance Article 2 Dependent Life Insurance Article 3 Section C - Individual Terminations Member Life Insurance Article 1 Member Accidental Death and Dismemberment Insurance Article 2 Dependent Life Insurance Article 3 Termination for Fraud Article 4 Coverage While Outside of the United States Article 5 Section D - Continuation Member Life Insurance Article 1 Dependent Insurance - Developmentally Disabled or Physically Handicapped Children Article 2 Section E - Reinstatement Reinstatement Article 1 Federal Required Family and Medical Leave Act (FMLA) Article 2 Reinstatement of Coverage for a Member or Dependent When Coverage Ends due to Living Outside of the United States Article 3 Section F - Individual Purchase Rights Member Life Insurance Article 1 Dependent Life Insurance Article 2 PART IV - BENEFITS This policy has been updated effective January 1, 2014 GC 6001 TABLE OF CONTENTS, PAGE 2',
    'metadatas0': "{'Policy_Name': 'Principal-Sample-Life-Insurance-Policy', 'Page_No.': 'Page 40'}",
    'documents8': 'b. a business assignment; or c. full-time student status, provided the Member or Dependent is either: (1) enrolled and attending an accredited school in a foreign country; or (2) is participating in an academic program in a foreign country, for which the institution of higher learning at which the student is enrolled in the U.S. grants academic credit. The six-month period will not be reduced for any time covered under a Prior Policy. If a Member or Dependent is outside the United States for any other reason than those listed above, coverage for the person concerned will automatically terminate. This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6008 Section C -

Individual Terminations, Page 3',
    'documents9': "a . In no event will Dependent Life Insurance be in force for a Member who is not insured for Member Life Insurance. b. If a Dependent spouse is in a Period of Limited Activity on the date Dependent Life Insurance or an increase in Dependent Life Insurance Scheduled Benefit due to a change in the Member's Annual Compensation or insurance class would otherwise be effective, such insurance or increase will not be in force for that Dependent spouse until the Period of Limited Activity ends. However, this Period of Limited Activity requirement may be waived as described below. When insurance under this Group Policy replaces coverage under a Prior Policy, the Period of Limited Activity requirement may be waived for those Dependent spouses' who: (1) are eligible and enrolled under this Group Policy on its Date of Issue; and (2) were covered under the Prior Policy on the date of its termination. In no event will the Period of Limited Activity requirement be waived for those Dependent spouses' who, on the date of termination of the Prior Policy had the option, under the terms of the Prior Policy, to convert their coverage, under the Prior Policy, to an individual policy. NOTE: When insurance under this Group Policy replaces coverage under a Prior Policy and the Period of Limited Activity requirement is waived, any benefits payable will be the lesser of the Scheduled Benefit of this Group Policy or the amount that would have been paid by the Prior Policy had it remained in force. c. If insurance is requested under this Group Policy for a Dependent spouse that was eligible under the Prior Policy, but elected to waive coverage under the Prior Policy. d. If a Dependent is confined in a Hospital or Skilled Nursing Facility on the date an increase in the Dependent Life Insurance Scheduled Benefit would otherwise be effective, the Scheduled Benefit in force for the Dependent will continue to apply to the Dependent until such confinement ends. When the Hospital or Skilled Nursing Facility confinement ends, the Scheduled Benefit increase will then be in force for the Dependent. e. Any required Proof of Good Health will be with respect to the health of the Member's Dependents. f. If Dependent Life Insurance is in force for a Dependent of the Member, a Member will be insured with respect to a new Dependent (other than a newborn child) on the date the new Dependent is acquired, provided the new Dependent is not then confined in a Hospital or Skilled Nursing Facility. Requests for insurance and Proof of Good Health are not required This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6007 Section B - Effective Dates, Page 6",
    'ids1': '35',
    'metadatas9': "{'Page_No.': 'Page 33', 'Policy_Name': 'Principal-Sample-Life-Insurance-Policy'}",
    'ids8': '34',
    'distances2': '0.8699490427970886',
    'ids6': '29',
    'metadatas4': "{'Policy_Name': 'Principal-Sample-Life-Insurance-

Policy', 'Page_No.': 'Page 28'}",
    'ids2': '38',
    'metadatas5': "{'Policy_Name': 'Principal-Sample-Life-Insurance-Policy', 'Page_No.': 'Page 36'}",
    'distances3': '0.9321367740631104',
    'distances8': '1.0129334926605225',
    'documents2': 'I f coverage for a Member or Dependent terminates because the person is outside of the United States as discussed in PART III, Section C, Article 5, the Member or Dependent may become eligible again for coverage under this Group Policy, but only if: a. the Member or Dependent return to the United States within six months of the date on which coverage terminated because the person is outside of the United States; and b. in the case of a Member, the Member returns to Active Work in the United States for the Policyholder for a period of at least 30 consecutive days. The Member will be eligible for coverage on the day immediately following completion of the 30 consecutive days of Active Work; and c. in the case of the Dependent, he or she remains in the United States for 30 consecutive days. If the Dependent does so, he or she will be eligible for reinstatement of coverage on the day after completion of the 30 consecutive days of residence. The reinstated coverage will be on the same basis as that being provided on the date coverage is reinstated. However, any restrictions on this coverage that were in effect before reinstatement will continue to apply. If the Member or Dependent does not complete the 30 consecutive days of residence, the coverage for such person will not be reinstated. This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6010 Section E - Reinstatement, Page 2',
    'ids4': '25',
    'documents3': "Payment of benefits will be subject to the Beneficiary and Facility of Payment provisions of this PART IV, Section A. Article 6 - Member Life Insurance - Coverage During Disability A Member may be eligible to continue his or her Member Life and Member Accidental Death and Dismemberment Insurance and Dependent Life Insurance coverage during the Member's ADL Disability or Total Disability. a. Coverage Qualification To be qualified for Coverage During Disability, a Member must: (1) become ADL Disabled or Totally Disabled while insured for Member Life Insurance; and (2) become ADL Disabled or Totally Disabled prior to the attainment of age 60; and (3) remain ADL Disabled or Totally Disabled continuously; and (4) be under the regular care and attendance of a Physician; and (5) send proof of ADL Disability or Total Disability to The Principal when required; and (6) submit to Medical Examinations or Evaluations when required; and (7) return to The Principal, without claim, any individual policy issued under his or her Individual Purchase Rights as described in PART III, Section F, Article 1. Upon return of such policy, The Principal will refund premiums paid, less dividends and less any outstanding policy loan balance. b. Proof of ADL Disability or Total Disability Written proof of ADL Disability or Total

Disability must be sent to The Principal within one year of the date ADL Disability or Total Disability begins. Further proof that ADL Disability or Total Disability has not ended must be sent when The Principal requires. After ADL Disability or Total Disability has continued for two years from the date the first proof is received, The Principal may not ask for further proof more than once each year. If the Member dies while ADL Disabled or Totally Disabled, final proof that ADL Disability or Total Disability continued to the date of death must be sent to The Principal. If death occurs within one year of the start of ADL Disability or Total Disability, but before The Principal has received first proof, then final proof must be sent within one year of the date ADL Disability or Total Disability began. c. Medical Examinations and Evaluations This policy has been updated effective January 1, 2014 PART IV - BENEFITS GC 6013 Section A - Member Life Insurance, Page 4",
    'metadatas1': "{'Policy_Name': 'Principal-Sample-Life-Insurance-Policy', 'Page_No.': 'Page 38'}",
    'metadatas8': "{'Page_No.': 'Page 37', 'Policy_Name': 'Principal-Sample-Life-Insurance-Policy'}",
    'ids0': '37',
    'documents1': "Section D - Continuation Article 1 - Member Life Insurance a. Sickness or Injury (Other Than ADL Disability or Total Disability) If Active Work ends because a Member is sick or injured but not ADL Disabled or Totally Disabled, insurance for that Member may be continued until the earlier of: (1) the date insurance would otherwise cease as provided in PART III, Section C; or (2) the date the Member recovers. b. Layoff or Approved Leave of Absence If Active Work ends because a Member is on layoff or approved leave of absence, insurance for that Member may be continued until the earliest of: (1) the date insurance would otherwise cease as provided in PART III, Section C, Article 1 a. through g.; or (2) the date the layoff or approved leave of absence ends; or (3) the date the Member becomes eligible for any other group life coverage; or (4) the date one month after the date Active Work ends. c. Family and Medical Leave Act (FMLA) If a Member ceases Active Work due to an approved leave of absence under FMLA, the Policyholder may choose to continue the Member's insurance, subject to premium payment. A Member may qualify to have his or her insurance continued under one or more of the continuation provisions described in a., b., and c. above. If a Member qualifies for continuation under more than one provision, the longest period of continuation will be applied, and all periods of continuation will run concurrently. Article 2 - Dependent Insurance - Developmentally Disabled or Physically Handicapped Children a. Qualification Dependent Life Insurance for a child may be continued after the child reaches the maximum age for Dependent Children as defined in PART I of this Group Policy, provided that: This policy has been updated effective January 1, 2014 PART III - INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6009 Section D - Continuation, Page 1",
    'ids9': '30',

```
    'documents5': "A Member's insurance under this Group Policy for a
Dependent will terminate on the earliest of: a. the date his or her
Member Life Insurance ceases; or b. the date Dependent Life Insurance
is removed from this Group Policy; or c. the date the last premium is
paid for the Member's Dependent Life Insurance; or d. any date
desired, if requested by the Member before that date; or e. the date
the Member ceases to be in a class for which Dependent Life Insurance
is provided; or f. for a Dependent spouse on the date that Dependent
spouse ceases to be a Dependent as defined in PART I; or g. for each
Dependent Child, on the date that Dependent Child ceases to be a
Dependent as defined in PART I. Article 4 - Termination for Fraud The
Principal may at any time terminate a Member's or Dependent's
eligibility under the Group Policy: a. in Writing and with 31-day
notice, if the individual submits any claim that contains false or
fraudulent elements under state or federal law; or b. in Writing and
with 31-day notice, upon finding in a civil or criminal case that a
Member or Dependent has submitted claims that contain false or
fraudulent elements under state or federal law; or c. in Writing and
with 31-day notice, when a Member or Dependent has submitted a claim
which, in good faith judgement and investigation, a Member or
Dependent knew or should have known, contains false or fraudulent
elements under state or federal law. Article 5 - Coverage While
Outside of the United States If a Member or Dependent is temporarily
outside the United States, the Member or Dependent may choose to
continue his or her insurance, subject to premium payment for a period
of six months or less for one of the following reasons: a. travel; or
This policy has been updated effective January 1, 2014 PART III -
INDIVIDUAL REQUIREMENTS AND RIGHTS GC 6008 Section C - Individual
Terminations, Page 2",
    'distances7': '1.0118558406829834'}]],
 'distances': [[1.2619664669036865]]}
```

```python
def semantic_cache_search(query, cache_results, collection,
cache_collection, threshold=0.2, top_n=10):
    """
    Performs a semantic search with caching mechanism.

    Parameters:
        query (str): The input query string.
        cache_results (dict): The results from the cache collection.
        collection (object): The main ChromaDB collection to query if
cache misses.
        cache_collection (object): The cache ChromaDB collection to
store/retrieve results.
        threshold (float): The similarity threshold to decide cache
hit/miss.
        top_n (int): Number of top results to retrieve.

    Returns:
        pd.DataFrame: DataFrame containing search results.
```

```
    """
    ids, documents, distances, metadatas = [], [], [], []
    results_df = pd.DataFrame()

    # Check cache miss or low relevance
    if not cache_results['distances'][0] or cache_results['distances']
[0][0] > threshold:
        results = collection.query(query_texts=query, n_results=top_n)

        keys, values = [], []

        for key, val in results.items():
            if val is None or key == 'embeddings':
                continue

            if isinstance(val, list) and len(val) > 0 and
isinstance(val[0], (list, tuple)):
                for i in range(min(top_n, len(val[0]))):
                    keys.append(f"{key}{i}")
                    values.append(str(val[0][i]))
            else:
                print(f"Skipping key '{key}' due to unexpected
structure.")

        cache_collection.add(
            documents=[query],
            ids=[query],
            metadatas=dict(zip(keys, values))
        )

        print("Not found in cache. Found in main collection.")

        result_dict = {
            'Metadatas': results['metadatas'][0],
            'Documents': results['documents'][0],
            'Distances': results['distances'][0],
            'IDs': results['ids'][0]
        }
        results_df = pd.DataFrame.from_dict(result_dict)

    # Cache hit
    elif cache_results['distances'][0][0] <= threshold:
        cache_result_dict = cache_results['metadatas'][0][0]

        for key, value in cache_result_dict.items():
            if 'ids' in key:
                ids.append(value)
            elif 'documents' in key:
                documents.append(value)
            elif 'distances' in key:
```

```
                distances.append(value)
            elif 'metadatas' in key:
                metadatas.append(value)

        print("Found in cache!")

        results_df = pd.DataFrame({
            'IDs': ids,
            'Documents': documents,
            'Distances': distances,
            'Metadatas': metadatas
        })

    return results_df

results_df3 = semantic_cache_search(
    query=query3,
    cache_results=cache_results3,
    collection=insurance_collection,
    cache_collection=cache_collection,
    threshold=0.2,
    top_n=10
)
```

```
Skipping key 'included' due to unexpected structure.
Not found in cache. Found in main collection.
```

```
results_df3
```

	Metadatas	Documents	Distances	IDs
0	{'Policy_Name': 'Principal-Sample-Life-Insuran...	Exposure Exposure to the elements will be pres...	0.825728	52
1	{'Policy_Name': 'Principal-Sample-Life-Insuran...	f . claim requirements listed in PART IV, Sect...	0.866000	51
2	{'Page_No.': 'Page 58', 'Policy_Name': 'Princi...	a. willful self-injury or self-destruction, wh...	0.878712	55
3	{'Page_No.': 'Page 51', 'Policy_Name': 'Princi...	Coverage During Disability will cease on the e...	0.920861	48
4	{'Policy_Name': 'Principal-Sample-Life-Insuran...	Section B - Member Accidental Death and Dismem...	0.922414	50
5	{'Page_No.': 'Page 57', 'Policy_Name': 'Princi...	% of Scheduled Covered Loss Benefit Loss of Sp...	0.956724	54
6	{'Page_No.': 'Page 8', 'Policy_Name': 'Princip...	Section A - Member Life Insurance Schedule of ...	0.957127	5
7	{'Policy_Name': 'Principal-Sample-Life-Insuran...	If a Member sustains an injury, and as a resul...	0.973451	53
8	{'Page_No.': 'Page 49', 'Policy_Name': 'Princi...			
9	{'Policy_Name': 'Principal-Sample-Life-Insuran...			

```
8  Payment of benefits will be subject to the Ben...   0.976638  46
9  Section A – Eligibility Member Life Insurance ...   0.982840   4
```

⚡ What is a Semantic Cache?

A **semantic cache** stores the **meaning** (semantic representation) of a query or request — not just the raw data — along with the corresponding responses.

This smart caching mechanism significantly reduces the number of database queries by **recalling previously processed queries and their results**.

How It Works

1. When a **new query** is passed to the application:
   - Its **vector representation** is generated.
   - The system first **searches this vector in the cache collection**.
2. **If the query is found** in the cache:
   - The system **bypasses the semantic search layer** (which is typically the performance bottleneck)
   - It **retrieves the result instantly** from the cache. ⚡
3. **If the query is not found** in the cache:
   - The system queries the **main collection**.
   - It retrieves the **top *k* closest documents** or chunks.
   - These results are returned to the user **and simultaneously stored in the cache** for future use.

Benefits

- ⚡ **Faster response times**
- **Reduced load on the main database**
- **Customizable and monitorable** for optimal performance
- 😄 **Improved user experience** through quick result retrieval

By intelligently remembering previous queries and their results, a semantic cache can dramatically enhance the efficiency and responsiveness of your application.

QnA - Query 3.1 - Checking if found in Cache

```
query3 = "What exclusions apply to Accidental Death coverage?"

# Query the collection against the user query and return the top 20 results
```

```
cache_results3 = cache_collection.query(
    query_texts=query3,
    n_results=1
)

distances = cache_results3['distances'][0][0]
print("Threshold Distance :: ", distances)

results_df3 = semantic_cache_search(
    query=query3,
    cache_results=cache_results3,
    collection=insurance_collection,
    cache_collection=cache_collection,
    threshold=0.2,
    top_n=10
)
```

```
Threshold Distance ::  0.16220323741436005
Found in cache!
```

QnA - Query 3.2 - Checking if found in Cache for Another Similar Question

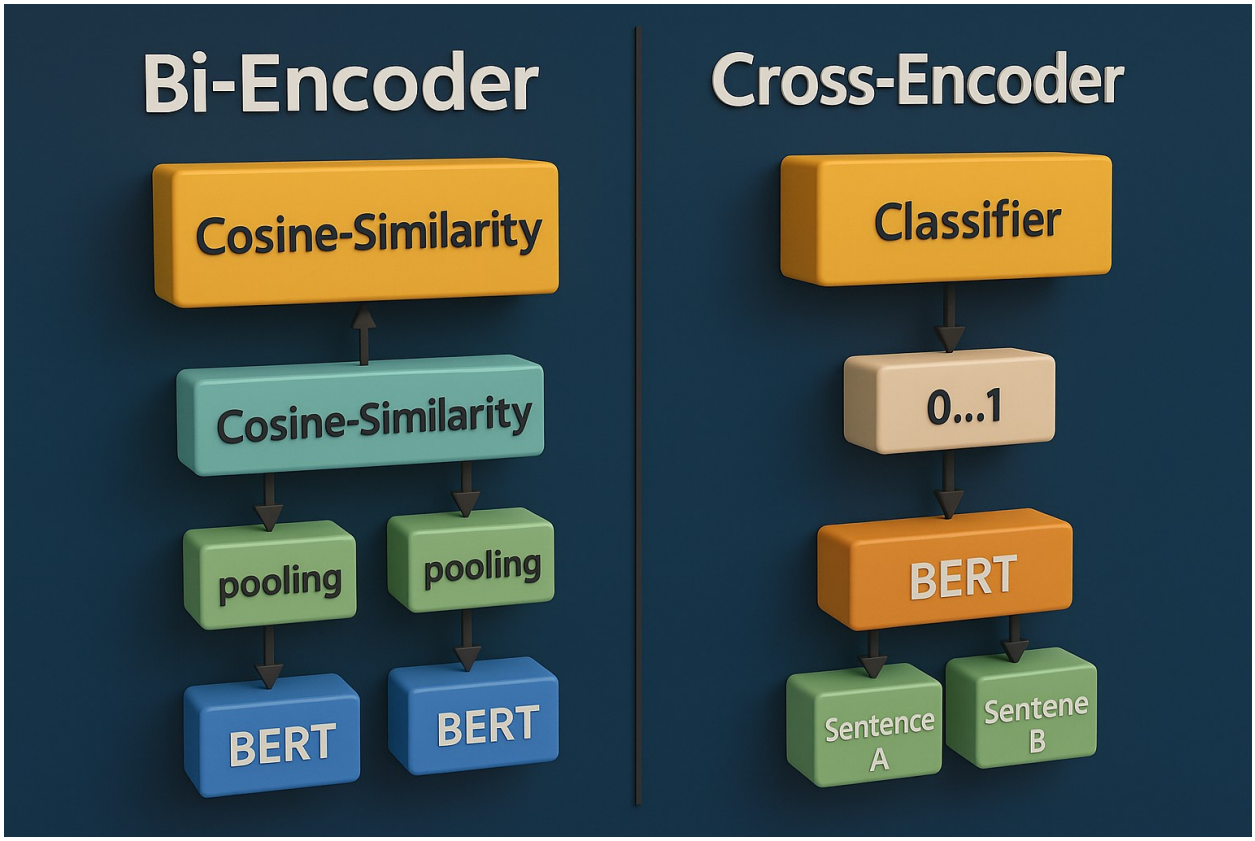
```
query3 = "What are the policy exclusions under Accidental Death
insurance?"

# Query the collection against the user query and return the top 20
results
cache_results3 = cache_collection.query(
    query_texts=query3,
    n_results=1
)

distances = cache_results3['distances'][0][0]
print("Threshold Distance :: ", distances)

results_df3 = semantic_cache_search(
    query=query3,
    cache_results=cache_results3,
    collection=insurance_collection,
    cache_collection=cache_collection,
    threshold=0.2,
    top_n=10
)
```

```
Threshold Distance ::  0.19314394891262054
Found in cache!
```

4 Re-Ranking with a Cross Encoder

Enhance semantic search results by re-ranking with a cross-encoder. This process significantly improves retrieval relevance by evaluating query-response pairs. The cross-encoder calculates relevance scores between the original query and each retrieved result, allowing for more accurate prioritization of truly relevant content. Unlike initial retrieval methods that may miss nuanced relationships, cross-encoder re-ranking provides refined assessment of how well each candidate response addresses the query's specific information needs.

```
image_path = "/kaggle/input/flowchart-diagram-demonstrates-helpmate-ai-project/Stage_2_Encoder.png"
display(Image(image_path))
```



Re-Ranking in Semantic Search

The re-ranking stage is the next step in building a powerful semantic search pipeline. So far, our system returns the top K documents that seem relevant to a user's query . However, these results may not always be accurate or truly relevant. That's where re-ranking comes in!

The re-ranking layer reviews the top K results, verifies their relevance , and reorders them based on how well they match the query . It assigns importance scores to improve result quality.

Benefits of Re-Ranking:

- More accurate and relevant answers
- Fewer irrelevant or incorrect results
- More personalized, meaningful responses
- Task/domain-specific search tailoring

Traditionally, methods like Reciprocal Rank Fusion (RRF), hybrid search , and cross-encoder models have been used. For this project, we'll focus on using **cross-encoders** for re-ranking.

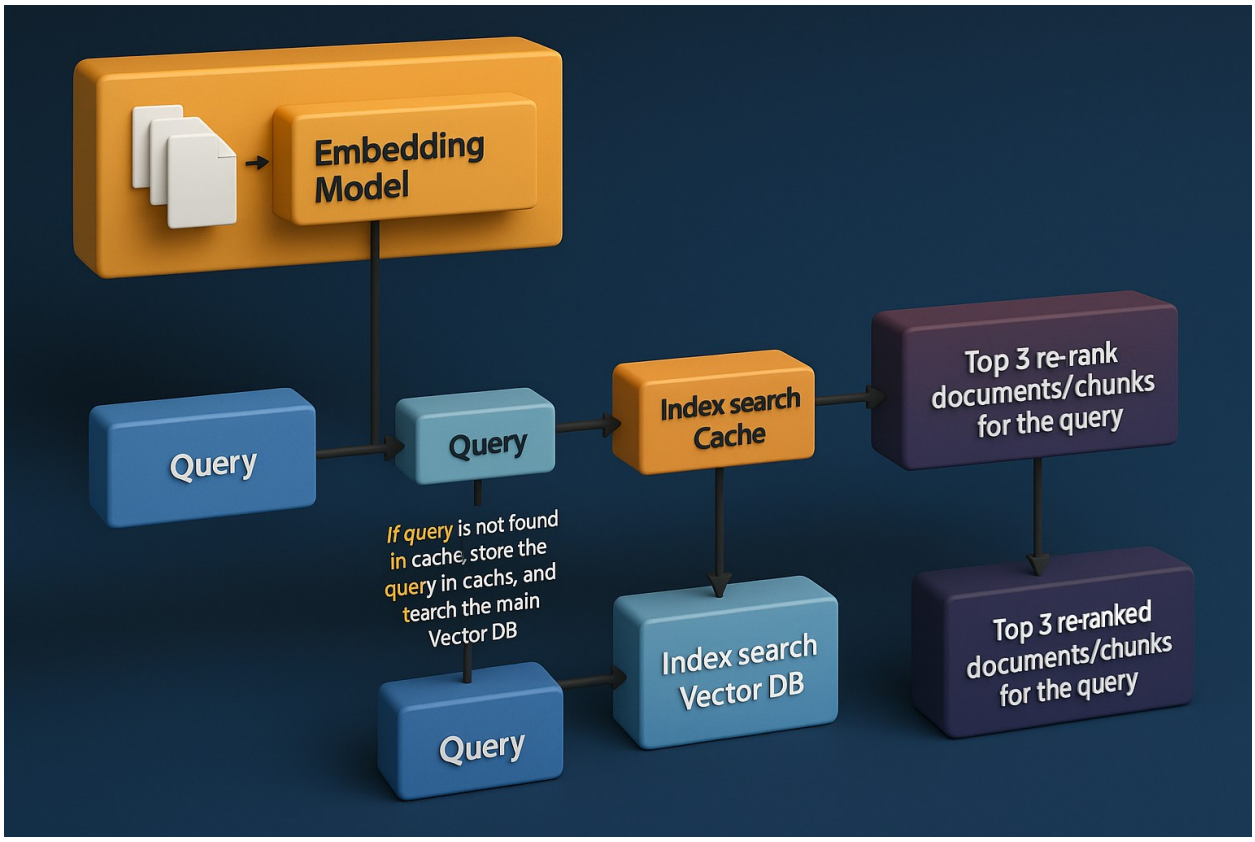
The image below shows how re-ranking fits into the semantic search process.

5 Search - with Cross Encoders System Design

In this design, we enhance the semantic search pipeline by integrating **cross-encoders** to improve the ranking of retrieved results. After the initial retrieval using embeddings (bi-encoders) , the top-K documents are passed through a **cross-encoder** model, which evaluates each document alongside the query to compute a relevance score .

Unlike bi-encoders that embed queries and documents independently, cross-encoders consider both inputs together, leading to **more precise scoring** and **better re-ranking** . This architecture ensures that the most relevant and contextually accurate information is prioritized for response generation .

```
image_path = "/kaggle/input/flowchart-diagram-demonstrates-helpmate-ai-project/Stage_2_Search Layer with Cross Encoders System Design.png"
display(Image(image_path))
```




```
results_df
```

```
                                           Metadatas  \
0  {'Policy_Name': 'Principal-Sample-Life-Insuran...
1  {'Policy_Name': 'Principal-Sample-Life-Insuran...
2  {'Policy_Name': 'Principal-Sample-Life-Insuran...
3  {'Page_No.': 'Page 49', 'Policy_Name': 'Princi...
4  {'Policy_Name': 'Principal-Sample-Life-Insuran...
5  {'Policy_Name': 'Principal-Sample-Life-Insuran...
6  {'Policy_Name': 'Principal-Sample-Life-Insuran...
7  {'Page_No.': 'Page 7', 'Policy_Name': 'Princip...
8  {'Page_No.': 'Page 37', 'Policy_Name': 'Princi...
9  {'Page_No.': 'Page 33', 'Policy_Name': 'Princi...

                                           Documents  Distances IDs
0  Section E - Reinstatement Article 1 - Reinstat...   0.706852  37
1  Section D - Continuation Article 1 - Member Li...   0.725815  35
2  I f coverage for a Member or Dependent termina...   0.869949  38
3  Payment of benefits will be subject to the Ben...   0.932137  46
4  Section B - Effective Dates Article 1 - Member...   0.956336  25
5  A Member's insurance under this Group Policy f...   0.980352  33
6  (1) marriage or establishment of a Civil Union...   1.000119  29
7  Section A – Eligibility Member Life Insurance ...   1.011856   4
8  b. a business assignment; or c. full-time stud...   1.012933  34
9  a . In no event will Dependent Life Insurance ...   1.021472  30
```

```
# Import the CrossEncoder library from sentence_transformers
from sentence_transformers import CrossEncoder, util

# Initialise the cross encoder model
cross_encoder = CrossEncoder('cross-encoder/ms-marco-MiniLM-L-12-v2')
```


```
{"model_id":"5f090e1ba4d9472a818b978f8e75eb68","version_major":2,"vers
ion_minor":0}

{"model_id":"9d0a5af530be45c9adb19069e773c351","version_major":2,"vers
ion_minor":0}

{"model_id":"dd01e127fc624765a5ac3178f7cfc96f","version_major":2,"vers
ion_minor":0}

{"model_id":"dd23518a7fce45ddb41c83749c83a24b","version_major":2,"vers
ion_minor":0}

{"model_id":"66e55e50fb114bde8549dd1f37b76b55","version_major":2,"vers
ion_minor":0}

{"model_id":"eb909ee3efaa444fa3d852eb9aa20c6f","version_major":2,"vers
ion_minor":0}
```


```
# Test the cross encoder model

scores = cross_encoder.predict([['Does the insurance cover diabetic
patients?', 'The insurance policy covers some pre-existing conditions
including diabetes, heart diseases, etc. The policy does not howev'],
                                ['Does the insurance cover diabetic
patients?', 'The premium rates for various age groups are given as
follows. Age group (<18 years): Premium rate']])
```


```
{"model_id":"dac96cde9ebf435b95919a0a0a3424fa","version_major":2,"vers
ion_minor":0}
```


```
scores
```

```
array([  4.460839, -11.19713 ], dtype=float32)
```

Cross-Encoders: Scoring Explaination

In earlier versions of **cross-encoders**, the prediction scores typically ranged between **0 and 1**, where **higher values meant stronger similarity**.

Now, things have evolved! The scores can range from **positive to negative values**:

- **Positive scores** → Indicate **high similarity** between the input pair
- **Negative scores** → Suggest **low or no similarity (dissimilarity)**

Input Format Reminder: Cross-encoders expect input as a **list of lists**, where each inner list contains a **[query, candidate]** pair.

```
# Example
[
  ["What is AI?", "Artificial intelligence is the simulation of human
intelligence by machines."],
  ["What is AI?", "The capital of France is Paris."]
]
```

This format allows the model to evaluate how relevant or similar the two texts are.

Re-rank with Cross Encoder for Query-1

```
# Input (query, response) pairs for each of the top 20 responses
received from the semantic search to the cross encoder
# Generate the cross_encoder scores for these pairs

cross_inputs = [[query, response] for response in
results_df['Documents']]
cross_rerank_scores = cross_encoder.predict(cross_inputs)
cross_rerank_scores
```


```
{"model_id":"59010323135a412faae3c54827570136","version_major":2,"vers
ion_minor":0}
```


```
array([ 4.2650566,  4.492276 , -1.8442681,  1.4256065, -4.858922 ,
       -2.2509098, -3.0892649, -4.3488407, -8.65608  , -1.5593936],
      dtype=float32)
```

```
# Store the rerank_scores in results_df
results_df['Reranked_scores'] = cross_rerank_scores

print("First Query :: ", query , "\n")

results_df
```

```
First Query ::  Can insurance coverage continue during an approved
leave?


                                              Metadatas  \
0  {'Policy_Name': 'Principal-Sample-Life-Insuran...
1  {'Policy_Name': 'Principal-Sample-Life-Insuran...
2  {'Policy_Name': 'Principal-Sample-Life-Insuran...
3  {'Page_No.': 'Page 49', 'Policy_Name': 'Princi...
4  {'Policy_Name': 'Principal-Sample-Life-Insuran...
5  {'Policy_Name': 'Principal-Sample-Life-Insuran...
6  {'Policy_Name': 'Principal-Sample-Life-Insuran...
7  {'Page_No.': 'Page 7', 'Policy_Name': 'Princip...
8  {'Page_No.': 'Page 37', 'Policy_Name': 'Princi...
9  {'Page_No.': 'Page 33', 'Policy_Name': 'Princi...

                                              Documents  Distances IDs  \
```

```
0  Section E - Reinstatement Article 1 - Reinstat...   0.706852  37
1  Section D - Continuation Article 1 - Member Li...   0.725815  35
2  I f coverage for a Member or Dependent termina...   0.869949  38
3  Payment of benefits will be subject to the Ben...   0.932137  46
4  Section B - Effective Dates Article 1 - Member...   0.956336  25
5  A Member's insurance under this Group Policy f...   0.980352  33
6  (1) marriage or establishment of a Civil Union...   1.000119  29
7  Section A – Eligibility Member Life Insurance ...   1.011856   4
8  b. a business assignment; or c. full-time stud...   1.012933  34
9  a . In no event will Dependent Life Insurance ...   1.021472  30

   Reranked_scores
0         4.265057
1         4.492276
2        -1.844268
3         1.425606
4        -4.858922
5        -2.250910
6        -3.089265
7        -4.348841
8        -8.656080
9        -1.559394
```

```
# Return the top 3 results from semantic search
top_3_semantic = results_df.sort_values(by='Distances')
top_3_semantic[:3]
```

```
                                            Metadatas  \
0  {'Policy_Name': 'Principal-Sample-Life-Insuran...
1  {'Policy_Name': 'Principal-Sample-Life-Insuran...
2  {'Policy_Name': 'Principal-Sample-Life-Insuran...

                                           Documents  Distances IDs  \
0  Section E - Reinstatement Article 1 - Reinstat...   0.706852  37
1  Section D - Continuation Article 1 - Member Li...   0.725815  35
2  I f coverage for a Member or Dependent termina...   0.869949  38

   Reranked_scores
0         4.265057
1         4.492276
2        -1.844268
```

```
# Return the top 3 results after reranking
top_3_rerank = results_df.sort_values(by='Reranked_scores',
ascending=False)
top_3_rerank[:3]
```

```
                                            Metadatas  \
1  {'Policy_Name': 'Principal-Sample-Life-Insuran...
0  {'Policy_Name': 'Principal-Sample-Life-Insuran...
```

```
3  {'Page_No.': 'Page 49', 'Policy_Name': 'Princi...

                                            Documents  Distances IDs  \
1  Section D - Continuation Article 1 - Member Li...   0.725815  35
0  Section E - Reinstatement Article 1 - Reinstat...   0.706852  37
3  Payment of benefits will be subject to the Ben...   0.932137  46

   Reranked_scores
1         4.492276
0         4.265057
3         1.425606

top_3_RAG_query1 = top_3_rerank[["Documents", "Metadatas"]][:3]

top_3_RAG_query1

                                            Documents  \
1  Section D - Continuation Article 1 - Member Li...
0  Section E - Reinstatement Article 1 - Reinstat...
3  Payment of benefits will be subject to the Ben...

                                            Metadatas
1  {'Policy_Name': 'Principal-Sample-Life-Insuran...
0  {'Policy_Name': 'Principal-Sample-Life-Insuran...
3  {'Page_No.': 'Page 49', 'Policy_Name': 'Princi...
```

Re-rank with Cross Encoder for Query-2

```
results_df2

                                            Metadatas  \
0  {'Policy_Name': 'Principal-Sample-Life-Insuran...
1  {'Policy_Name': 'Principal-Sample-Life-Insuran...
2  {'Page_No.': 'Page 32', 'Policy_Name': 'Princi...
3  {'Page_No.': 'Page 46', 'Policy_Name': 'Princi...
4  {'Policy_Name': 'Principal-Sample-Life-Insuran...
5  {'Policy_Name': 'Principal-Sample-Life-Insuran...
6  {'Policy_Name': 'Principal-Sample-Life-Insuran...
7  {'Policy_Name': 'Principal-Sample-Life-Insuran...
8  {'Page_No.': 'Page 33', 'Policy_Name': 'Princi...
9  {'Policy_Name': 'Principal-Sample-Life-Insuran...

                                            Documents  Distances IDs
0  (6) If, on the date a Member becomes eligible ...   0.927741  27
1  Scheduled Benefit in force for the Member befo...   0.991921  28
2  (1) marriage or establishment of a Civil Union...   1.054535  29
3  PART IV - BENEFITS Section A - Member Life Ins...   1.094952  43
4  (1) If termination is as described in b. (1) a...   1.101119  42
5  Coverage During Disability will cease on the e...   1.105354  48
6  Section C - Dependent Life Insurance Article 1...   1.116788  56
```

```
7  (1) the child is incapable of self-support as ...   1.140166  36
8  a . In no event will Dependent Life Insurance ...   1.146286  30
9  (1) only one Accelerated Benefit payment will ...   1.152514  49
```

```
# Input (query, response) pairs for each of the top 20 responses
received from the semantic search to the cross encoder
# Generate the cross_encoder scores for these pairs

cross_inputs2 = [[query2, response] for response in
results_df2['Documents']]
cross_rerank_scores2 = cross_encoder.predict(cross_inputs2)
cross_rerank_scores2
```


```
{"model_id":"75aa495327744815b6e2c2cfbf021994","version_major":2,"vers
ion_minor":0}
```


```
array([  2.2361574,  -1.4793499,  -6.5178785,  -0.9980295,  -
7.9971633,
        -5.5509777,  -4.174706 , -10.825476 ,  -5.99903  ,  -
3.67735  ],
      dtype=float32)
```

```
# Store the rerank_scores in results_df
results_df2['Reranked_scores'] = cross_rerank_scores2

print("Second Query :: ", query2 , "\n")

results_df2
```

```
Second Query ::  Are there age-based reductions in benefit amounts?


                                              Metadatas  \
0  {'Policy_Name': 'Principal-Sample-Life-Insuran...
1  {'Policy_Name': 'Principal-Sample-Life-Insuran...
2  {'Page_No.': 'Page 32', 'Policy_Name': 'Princi...
3  {'Page_No.': 'Page 46', 'Policy_Name': 'Princi...
4  {'Policy_Name': 'Principal-Sample-Life-Insuran...
5  {'Policy_Name': 'Principal-Sample-Life-Insuran...
6  {'Policy_Name': 'Principal-Sample-Life-Insuran...
7  {'Policy_Name': 'Principal-Sample-Life-Insuran...
8  {'Page_No.': 'Page 33', 'Policy_Name': 'Princi...
9  {'Policy_Name': 'Principal-Sample-Life-Insuran...

                                             Documents  Distances IDs  \
0  (6) If, on the date a Member becomes eligible ...   0.927741  27
1  Scheduled Benefit in force for the Member befo...   0.991921  28
2  (1) marriage or establishment of a Civil Union...   1.054535  29
3  PART IV - BENEFITS Section A - Member Life Ins...   1.094952  43
4  (1) If termination is as described in b. (1) a...   1.101119  42
5  Coverage During Disability will cease on the e...   1.105354  48
```

```
6  Section C - Dependent Life Insurance Article 1...   1.116788  56
7  (1) the child is incapable of self-support as ...   1.140166  36
8  a . In no event will Dependent Life Insurance ...   1.146286  30
9  (1) only one Accelerated Benefit payment will ...   1.152514  49

   Reranked_scores
0         2.236157
1        -1.479350
2        -6.517879
3        -0.998029
4        -7.997163
5        -5.550978
6        -4.174706
7       -10.825476
8        -5.999030
9        -3.677350
```

```
# Return the top 3 results from semantic search
top_3_semantic2_query2 = results_df2.sort_values(by='Distances')
top_3_semantic2_query2[:3]
```

```
                                            Metadatas  \
0  {'Policy_Name': 'Principal-Sample-Life-Insuran...
1  {'Policy_Name': 'Principal-Sample-Life-Insuran...
2  {'Page_No.': 'Page 32', 'Policy_Name': 'Princi...

                                            Documents  Distances IDs  \
0  (6) If, on the date a Member becomes eligible ...   0.927741  27
1  Scheduled Benefit in force for the Member befo...   0.991921  28
2  (1) marriage or establishment of a Civil Union...   1.054535  29

   Reranked_scores
0         2.236157
1        -1.479350
2        -6.517879
```

```
# Return the top 3 results after reranking
top_3_rerank_query2 = results_df2.sort_values(by='Reranked_scores',
ascending=False)
top_3_rerank_query2[:3]
```

```
                                            Metadatas  \
0  {'Policy_Name': 'Principal-Sample-Life-Insuran...
3  {'Page_No.': 'Page 46', 'Policy_Name': 'Princi...
1  {'Policy_Name': 'Principal-Sample-Life-Insuran...

                                            Documents  Distances IDs  \
0  (6) If, on the date a Member becomes eligible ...   0.927741  27
3  PART IV - BENEFITS Section A - Member Life Ins...   1.094952  43
1  Scheduled Benefit in force for the Member befo...   0.991921  28
```

```
   Reranked_scores
0         2.236157
3        -0.998029
1        -1.479350
```

```
top_3_RAG_query2 = top_3_rerank_query2[["Documents", "Metadatas"]][:3]

top_3_RAG_query2
```

```
                                            Documents  \
0  (6) If, on the date a Member becomes eligible ...
3  PART IV - BENEFITS Section A - Member Life Ins...
1  Scheduled Benefit in force for the Member befo...

                                            Metadatas
0  {'Policy_Name': 'Principal-Sample-Life-Insuran...
3  {'Page_No.': 'Page 46', 'Policy_Name': 'Princi...
1  {'Policy_Name': 'Principal-Sample-Life-Insuran...
```

Re-rank with Cross Encoder for Query-3

```
results_df3
```

```
  IDs                                           Documents
Distances  \
0   5  f . claim requirements listed in PART IV, Sect...
0.9224141836166382
1  48  Coverage During Disability will cease on the e...
0.9766375422477722
2  52  Section A – Eligibility Member Life Insurance ...
0.8257278203964233
3  46  Section B - Member Accidental Death and Dismem...
0.9571272730827332
4  54  Payment of benefits will be subject to the Ben...
0.9208610653877258
5   4  % of Scheduled Covered Loss Benefit Loss of Sp...
0.9734508991241455
6  51  a. willful self-injury or self-destruction, wh...
0.9567238688468933
7  50  If a Member sustains an injury, and as a resul...
0.8660002946853638
8  53  Exposure Exposure to the elements will be pres...
0.982839822769165
9  55  Section A - Member Life Insurance Schedule of ...
0.8787118792533875

                                            Metadatas
0  {'Policy_Name': 'Principal-Sample-Life-Insuran...
1  {'Page_No.': 'Page 8', 'Policy_Name': 'Princip...
2  {'Policy_Name': 'Principal-Sample-Life-Insuran...
```

```
3  {'Page_No.': 'Page 58', 'Policy_Name': 'Princi...
4  {'Policy_Name': 'Principal-Sample-Life-Insuran...
5  {'Page_No.': 'Page 49', 'Policy_Name': 'Princi...
6  {'Page_No.': 'Page 51', 'Policy_Name': 'Princi...
7  {'Policy_Name': 'Principal-Sample-Life-Insuran...
8  {'Policy_Name': 'Principal-Sample-Life-Insuran...
9  {'Page_No.': 'Page 57', 'Policy_Name': 'Princi...
```

```
# Input (query, response) pairs for each of the top 20 responses
received from the semantic search to the cross encoder
# Generate the cross_encoder scores for these pairs
cross_inputs3 = [[query3, response] for response in
results_df3['Documents']]
cross_rerank_scores3 = cross_encoder.predict(cross_inputs3)
cross_rerank_scores3
```


```
{"model_id":"6fc4769c331944d6bedd21f1fd77d6d3","version_major":2,"vers
ion_minor":0}
```


```
array([ -3.4060597 , -10.266796  ,  -1.2106388 ,   0.40420592,
         0.2372373 ,  -3.5169964 ,  -2.756032  ,  -1.6128452 ,
         0.03237037,  -1.6799722 ], dtype=float32)
```

```
# Store the rerank_scores in results_df
results_df3['Reranked_scores'] = cross_rerank_scores3

print("Third Query :: ", query3 , "\n")

results_df3
```

```
Third Query ::  What are the policy exclusions under Accidental Death
insurance?


  IDs                                              Documents
Distances  \
0   5  f . claim requirements listed in PART IV, Sect...
0.9224141836166382
1  48  Coverage During Disability will cease on the e...
0.9766375422477722
2  52  Section A – Eligibility Member Life Insurance ...
0.8257278203964233
3  46  Section B - Member Accidental Death and Dismem...
0.9571272730827332
4  54  Payment of benefits will be subject to the Ben...
0.9208610653877258
5   4  % of Scheduled Covered Loss Benefit Loss of Sp...
0.9734508991241455
6  51  a. willful self-injury or self-destruction, wh...
0.9567238688468933
7  50  If a Member sustains an injury, and as a resul...
```

```
0.8660002946853638
8  53  Exposure Exposure to the elements will be pres...
0.982839822769165
9  55  Section A - Member Life Insurance Schedule of ...
0.8787118792533875

                                                Metadatas  Reranked_scores

0  {'Policy_Name': 'Principal-Sample-Life-Insuran...         -3.406060

1  {'Page_No.': 'Page 8', 'Policy_Name': 'Princip...        -10.266796

2  {'Policy_Name': 'Principal-Sample-Life-Insuran...         -1.210639

3  {'Page_No.': 'Page 58', 'Policy_Name': 'Princi...          0.404206

4  {'Policy_Name': 'Principal-Sample-Life-Insuran...          0.237237

5  {'Page_No.': 'Page 49', 'Policy_Name': 'Princi...         -3.516996

6  {'Page_No.': 'Page 51', 'Policy_Name': 'Princi...         -2.756032

7  {'Policy_Name': 'Principal-Sample-Life-Insuran...         -1.612845

8  {'Policy_Name': 'Principal-Sample-Life-Insuran...          0.032370

9  {'Page_No.': 'Page 57', 'Policy_Name': 'Princi...         -1.679972
```

```
# Return the top 3 results from semantic search
top_3_semantic_query3 = results_df3.sort_values(by='Distances')
top_3_semantic_query3[:3]
```

```
  IDs                                             Documents
Distances  \
2  52  Section A – Eligibility Member Life Insurance ...
0.8257278203964233
7  50  If a Member sustains an injury, and as a resul...
0.8660002946853638
9  55  Section A - Member Life Insurance Schedule of ...
0.8787118792533875

                                                Metadatas  Reranked_scores

2  {'Policy_Name': 'Principal-Sample-Life-Insuran...         -1.210639

7  {'Policy_Name': 'Principal-Sample-Life-Insuran...         -1.612845

9  {'Page_No.': 'Page 57', 'Policy_Name': 'Princi...         -1.679972
```

```
# Return the top 3 results after reranking
top_3_rerank_query3 = results_df3.sort_values(by='Reranked_scores',
```

```
ascending=False)
top_3_rerank_query3[:3]
```

```
  IDs                                                Documents
Distances  \
3  46  Section B - Member Accidental Death and Dismem...
0.9571272730827332
4  54  Payment of benefits will be subject to the Ben...
0.9208610653877258
8  53  Exposure Exposure to the elements will be pres...
0.982839822769165

                                                Metadatas  Reranked_scores

3  {'Page_No.': 'Page 58', 'Policy_Name': 'Princi...          0.404206

4  {'Policy_Name': 'Principal-Sample-Life-Insuran...          0.237237

8  {'Policy_Name': 'Principal-Sample-Life-Insuran...          0.032370
```

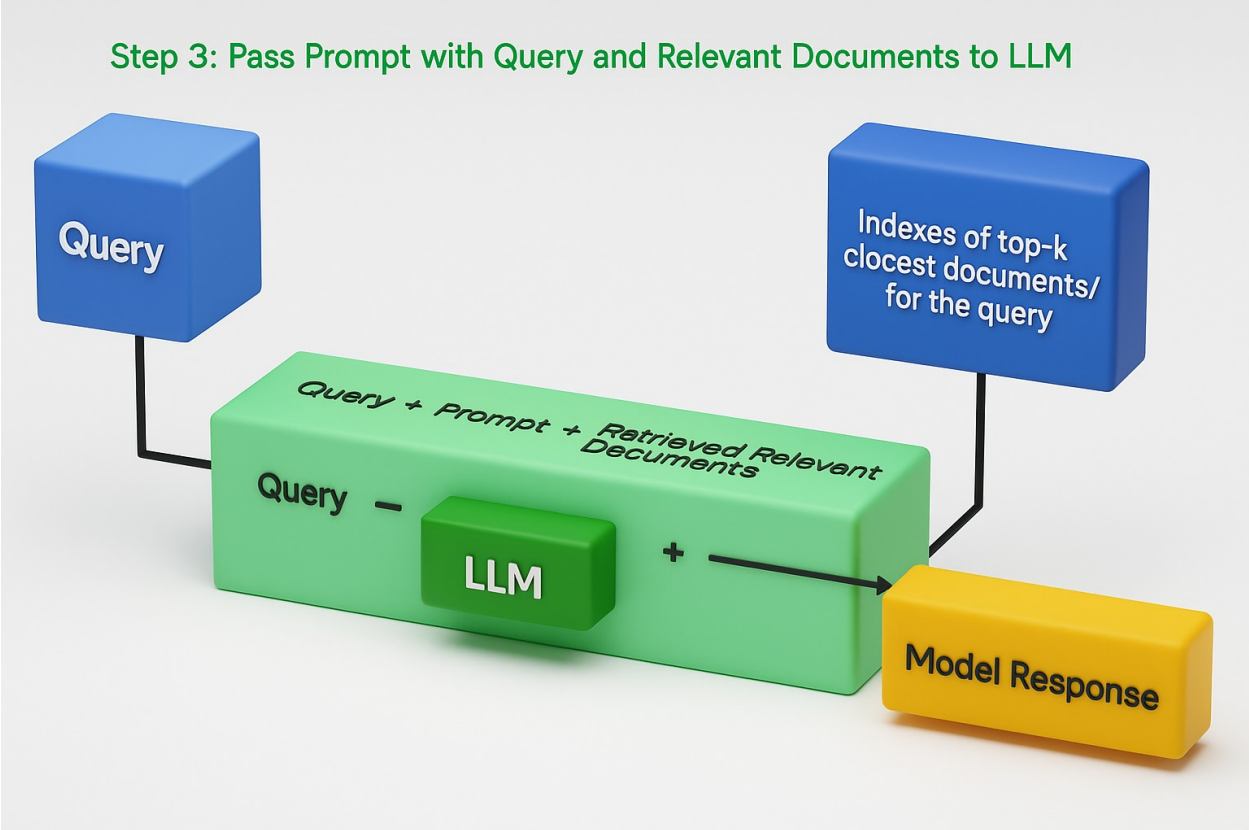
```
top_3_RAG_query3 = top_3_rerank_query3[["Documents", "Metadatas"]][:3]

top_3_RAG_query3
```

```
                                                Documents  \
3  Section B - Member Accidental Death and Dismem...
4  Payment of benefits will be subject to the Ben...
8  Exposure Exposure to the elements will be pres...

                                                Metadatas
3  {'Page_No.': 'Page 58', 'Policy_Name': 'Princi...
4  {'Policy_Name': 'Principal-Sample-Life-Insuran...
8  {'Policy_Name': 'Principal-Sample-Life-Insuran...
```

□ Stage 3 – Generation Layer □

In this stage, the top search results □ and the user's query □ are sent to a Large Language Model (LLM) 🧠 like GPT-4o. The model uses a well-crafted prompt ✍️ to generate a natural, accurate response □. Instead of returning full pages or chunks □, it delivers concise answers with citations . This layer benefits greatly from prompt engineering □, custom instructions □, and techniques like Retrieval-Augmented Generation (RAG) □□□. The goal is to provide smart, direct, and context-aware replies □, making the user experience faster, clearer, and more helpful □.

```
image_path = "/kaggle/input/flowchart-diagram-demonstrates-helpmate-ai-project/Stage_3_Generation Layer.png"
display(Image(image_path))
```



Generation Layer

❖ **Role**	You are a helpful assistant in the insurance domain who can effectively answer user queries about insurance policies and documents.
❖ **Context**	You have a question asked by the user in '{query}' and you have some search results from a corpus of insurance documents in the dataframe '{top_3_RAG}'. These search results are essentially one page of an insurance document that may be relevant to the user query. The column 'documents' inside this dataframe contains the actual text from the policy document and the column 'metadata' contains the policy name and source page. The text inside the document may also contain tables in the format of a list of lists where each of the nested lists indicates a row.
❖ **Task**	Use the documents in '{top_3_RAG}' to answer the query '{query}'. Frame an informative answer and also, use the dataframe to return the relevant policy names and page numbers as citations.
❖ **Guidelines**	Follow the guidelines below when performing the task. 1. Try to provide relevant/accurate numbers if available. 2. You don't have to necessarily use all the information in the dataframe. Only choose information that is relevant. 3. If the document text has tables with relevant information, please reformat the table and return the final information in a tabular in format. 4. Use the Metadatas columns in the dataframe to retrieve and cite the policy name(s) and page numbers(s) as citation. 5. If you can't provide the complete answer, please also provide any information that will help the user to search specific sections in the relevant cited documents. 6. You are a customer facing assistant, so do not provide any information on internal workings, just answer the query directly.
❖ **Output Format**	The generated response should answer the query directly addressing the user and avoiding additional information. If you think that the query is not relevant to the domain, reply that the query is irrelevant. Provide the final response as a well-formatted and easily readable text along with the citation. Provide your complete response first with all information, and then provide the citations.

```
# # Define the function to generate the response. Provide a comprehensive prompt that passes the user query and the top 3 results to the model
```

```
# def generate_response(query, top_3_RAG):
#     """
#     Generate a response using GPT-3.5's ChatCompletion based on the
user query and retrieved information.
#     """
#     messages = [
#                 {"role": "system", "content":  "You are a helpful
assistant in the insurance domain who can effectively answer user
queries about insurance policies and documents."},
#                 {"role": "user", "content": f"""You are a helpful
assistant in the insurance domain who can effectively answer user
queries about insurance policies and documents.
#                                                 You have a question
asked by the user in '{query}' and you have some search results from a
corpus of insurance documents in the dataframe '{top_3_RAG}'. These
search results are essentially one page of an insurance document that
may be relevant to the user query.

#                                                 The column
'documents' inside this dataframe contains the actual text from the
policy document and the column 'metadata' contains the policy name and
source page. The text inside the document may also contain tables in
the format of a list of lists where each of the nested lists indicates
a row.

#                                                 Use the documents in
'{top_3_RAG}' to answer the query '{query}'. Frame an informative
answer and also, use the dataframe to return the relevant policy names
and page numbers as citations.

#                                                 Follow the
guidelines below when performing the task.
#                                                 1. Try to provide
relevant/accurate numbers if available.
#                                                 2. You don’t have to
necessarily use all the information in the dataframe. Only choose
information that is relevant.
#                                                 3. If the document
text has tables with relevant information, please reformat the table
and return the final information in a tabular in format.
#                                                 3. Use the Metadatas
columns in the dataframe to retrieve and cite the policy name(s) and
page numbers(s) as citation.
#                                                 4. If you can't
provide the complete answer, please also provide any information that
will help the user to search specific sections in the relevant cited
documents.
#                                                 5. You are a
customer facing assistant, so do not provide any information on
internal workings, just answer the query directly.
```

```
#                                                   The generated
response should answer the query directly addressing the user and
avoiding additional information. If you think that the query is not
relevant to the document, reply that the query is irrelevant. Provide
the final response as a well-formatted and easily readable text along
with the citation. Provide your complete response first with all
information, and then provide the citations.
#                                                   """},
#               ]

#     response = openai.chat.completions.create(
#         model="gpt-4o-mini",
#         messages=messages
#     )

#     return response.choices[0].message.content.split('\n')

def generate_response(query, top_3_RAG):
    """
    Generate a response using GPT-4o-mini's ChatCompletion based on
the user query and top 3 retrieved insurance document chunks.
    """
    # Convert the DataFrame into a readable text block with each entry
clearly marked
    document_text = ""
    for idx, row in top_3_RAG.iterrows():
        document_text += (
            f"\n---\nDocument #{idx+1}\n"
            f"Policy Name & Page: {row['Metadatas']}\n"  #  Corrected
here
            f"Content:\n{row['Documents']}\n"
        )

    messages = [
        {
            "role": "system",
            "content": (
                "You are an expert assistant in the insurance domain.
You accurately answer user questions using provided excerpts "
                "from insurance policy documents. Always try to be
helpful, clear, and provide relevant citations."
            )
        },
        {
            "role": "user",
            "content": f"""
You are helping answer a customer question: **{query}**

Below are 3 potentially relevant insurance document excerpts. Each
```

```
document contains the policy text and its metadata (policy name and
page number). Use only the information relevant to the query.

{document_text}

Instructions:
1. Review all 3 documents to find information that helps answer the
query.
2. If useful information is inside a table (formatted as a list of
lists), convert it into a readable table.
3. Answer the question clearly and concisely using relevant content
only.
4. At the end of your response, list all cited policies and their page
numbers in a "Citations" section.
5. If no documents are useful, say: “None of the provided documents
contain relevant details to answer your query.”
6. Do not include any technical, implementation, or system details —
only answer the query.

Respond only with the final answer and citations. Do not explain your
reasoning or repeat instructions.
"""
        }
    ]

    response = openai.chat.completions.create(
        model="gpt-4o-mini",
        messages=messages
    )

    return response.choices[0].message.content.split('\n')

# Generate the response - For Query 1
response = generate_response(query, top_3_RAG_query1)
print("-"*80,"\n","-"*78)
print("Query 1: ",query)
print("-"*80,"\n","-"*78,"\n")

# Print the response
print("\n".join(response))
```

```
--------------------------------------------------------------------------------
```

```
--------------------------------------------------------------------------------
--------
Query 1:  Can insurance coverage continue during an approved leave?
--------------------------------------------------------------------------------
```

```
--------------------------------------------------------------------------------

Yes, insurance coverage can continue during an approved leave of absence. According to the policy excerpt, if active work ends because a member is on layoff or an approved leave of absence, their insurance may be continued until the earliest of:

1. The date insurance would otherwise cease.
2. The date the leave of absence ends.
3. The date the member becomes eligible for any other group life coverage.
4. One month after the date active work ends.

Additionally, if a member's leave of absence is due to the Family and Medical Leave Act (FMLA), the policyholder may choose to continue the member's insurance, provided that premiums are paid.

Citations:
- Principal-Sample-Life-Insurance-Policy, Page 38
```

```python
# Generate the response - For Query 2
response2 = generate_response(query2, top_3_RAG_query2)
print("-"*80,"\n","-"*78)
print("Query 2: ",query2)
print("-"*80,"\n","-"*78,"\n")

# Print the response
print("\n".join(response2))
```

```
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------
Query 2:  Are there age-based reductions in benefit amounts?
--------------------------------------------------------------------------------

--------------------------------------------------------------------------------

Yes, there are age-based reductions in benefit amounts. According to the policy, the amount of a Member's insurance will be reduced based on their age as follows:

| Age Range                    | % of Scheduled Benefit |
|------------------------------|------------------------|
| Age 70 but less than age 75 | 65%                     |
| Age 75 and over              | 45%                    |
```

```
Citations:
- Principal-Sample-Life-Insurance-Policy, Page 46

# Generate the response - For Query 3
response3 = generate_response(query3, top_3_RAG_query3)
print("-"*80,"\n","-"*78)
print("Query 3: ",query3)
print("-"*80,"\n","-"*78,"\n")

# Print the response
print("\n".join(response3))
```

```
--------------------------------------------------------------------------------
```

```
--------------------------------------------------------------------------------
Query 3:  What are the policy exclusions under Accidental Death insurance?
--------------------------------------------------------------------------------
```

```
--------------------------------------------------------------------------------

The policy exclusions under Accidental Death insurance specified in the excerpts include the following key requirements for benefit qualification:

1. The injury must be through external, violent, and accidental means.
2. The injury must be the direct and sole cause of a loss listed in the insurance policy.
3. The loss must occur within 365 days of the injury.
4. Limitations listed in the policy must not apply.

Specific exclusions that are typically outlined in other sections of an insurance policy may not be directly mentioned in the provided documents, but ensure that all conditions are met for a claim to be valid.

Citations:
- Principal-Sample-Life-Insurance-Policy, Page 58
- Principal-Sample-Life-Insurance-Policy, Page 56
```

Conclusion

Mr.HelpMate AI represents a transformative step forward in how policyholders interact with complex insurance documents . By combining the power of semantic search , retrieval-augmented generation (RAG) , and large language models , the system empowers users to get

fast, accurate, and easy-to-understand answers to their specific questions —without the frustration of navigating through dense paperwork or enduring long customer service waits .

This intelligent assistant not only enhances customer satisfaction 😊 but also significantly reduces operational overhead for insurance providers . Its modular architecture—spanning document processing, retrieval, and generative response layers—ensures scalability, adaptability, and precision .

Moreover, the learnings and architecture of **Mr.HelpMate AI** pave the way for applications in other domains such as legal tech ⚖, finance , and enterprise knowledge management . With a focus on factual accuracy, personalized interactions, and seamless user experience, this solution demonstrates the practical value of AI in solving real-world, document-heavy challenges .

Mr.HelpMate AI isn't just a tool—it's a step toward smarter, more human-centric digital experiences .