



```
In [3]: !pip install --upgrade langchain langchain-community langchain-core langchain-
```

Requirement already satisfied: langchain in c:\users\gamin\anaconda3\lib\site-packages (1.0.2)

Requirement already satisfied: langchain-community in c:\users\gamin\anaconda3\lib\site-packages (0.4.1)

Requirement already satisfied: langchain-core in c:\users\gamin\anaconda3\lib\site-packages (1.0.1)

Requirement already satisfied: langchain-openai in c:\users\gamin\anaconda3\lib\site-packages (1.0.1)

Requirement already satisfied: faiss-cpu in c:\users\gamin\anaconda3\lib\site-packages (1.12.0)

Requirement already satisfied: tiktoken in c:\users\gamin\anaconda3\lib\site-packages (0.12.0)

Requirement already satisfied: langgraph<1.1.0,>=1.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain) (1.0.1)

Requirement already satisfied: pydantic<3.0.0,>=2.7.4 in c:\users\gamin\anaconda3\lib\site-packages (from langchain) (2.10.3)

Requirement already satisfied: jsonpatch<2.0.0,>=1.33.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-core) (1.33)

Requirement already satisfied: langsmith<1.0.0,>=0.3.45 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-core) (0.4.38)

Requirement already satisfied: packaging<26.0.0,>=23.2.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-core) (24.2)

Requirement already satisfied: pyyaml<7.0.0,>=5.3.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-core) (6.0.2)

Requirement already satisfied: tenacity!=8.4.0,<10.0.0,>=8.1.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-core) (9.0.0)

Requirement already satisfied: typing-extensions<5.0.0,>=4.7.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-core) (4.12.2)

Requirement already satisfied: jsonpointer>=1.9 in c:\users\gamin\anaconda3\lib\site-packages (from jsonpatch<2.0.0,>=1.33.0->langchain-core) (2.1)

Requirement already satisfied: langgraph-checkpoint<4.0.0,>=2.1.0 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph<1.1.0,>=1.0.0->langchain) (3.0.0)

Requirement already satisfied: langgraph-prebuilt<1.1.0,>=1.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph<1.1.0,>=1.0.0->langchain) (1.0.1)

Requirement already satisfied: langgraph-sdk<0.3.0,>=0.2.2 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph<1.1.0,>=1.0.0->langchain) (0.2.9)

Requirement already satisfied: xxhash>=3.5.0 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph<1.1.0,>=1.0.0->langchain) (3.6.0)

Requirement already satisfied: ormsgpack>=1.10.0 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph-checkpoint<4.0.0,>=2.1.0->langgraph<1.1.0,>=1.0.0->langchain) (1.11.0)

Requirement already satisfied: httpx>=0.25.2 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph-sdk<0.3.0,>=0.2.2->langgraph<1.1.0,>=1.0.0->langchain) (0.28.1)

Requirement already satisfied: orjson>=3.10.1 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph-sdk<0.3.0,>=0.2.2->langgraph<1.1.0,>=1.0.0->langchain) (3.11.4)

Requirement already satisfied: requests-toolbelt>=1.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langsmith<1.0.0,>=0.3.45->langchain-core) (1.0.0)

Requirement already satisfied: requests>=2.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langsmith<1.0.0,>=0.3.45->langchain-core) (2.32.5)

Requirement already satisfied: zstandard>=0.23.0 in c:\users\gamin\anaconda3\li

b\site-packages (from langsmith<1.0.0,>=0.3.45->langchain-core) (0.23.0)  
Requirement already satisfied: anyio in c:\users\gamin\anaconda3\lib\site-packages (from httpx>=0.25.2->langgraph-sdk<0.3.0,>=0.2.2->langgraph) (4.7.0)  
Requirement already satisfied: certifi in c:\users\gamin\anaconda3\lib\site-packages (from httpx>=0.25.2->langgraph-sdk<0.3.0,>=0.2.2->langgraph) (2025.7.14)  
Requirement already satisfied: httpcore==1.\* in c:\users\gamin\anaconda3\lib\site-packages (from httpx>=0.25.2->langgraph-sdk<0.3.0,>=0.2.2->langgraph) (1.0.9)  
Requirement already satisfied: idna in c:\users\gamin\anaconda3\lib\site-packages (from httpx>=0.25.2->langgraph-sdk<0.3.0,>=0.2.2->langgraph) (3.7)  
Requirement already satisfied: h11>=0.16 in c:\users\gamin\anaconda3\lib\site-packages (from httpcore==1.\*->httpx>=0.25.2->langgraph-sdk<0.3.0,>=0.2.2->langgraph) (0.16.0)  
Requirement already satisfied: annotated-types>=0.6.0 in c:\users\gamin\anaconda3\lib\site-packages (from pydantic<3.0.0,>=2.7.4->langchain) (0.6.0)  
Requirement already satisfied: pydantic-core==2.27.1 in c:\users\gamin\anaconda3\lib\site-packages (from pydantic<3.0.0,>=2.7.4->langchain) (2.27.1)  
Requirement already satisfied: langchain-classic<2.0.0,>=1.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (1.0.0)  
Requirement already satisfied: SQLAlchemy<3.0.0,>=1.4.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (2.0.39)  
Requirement already satisfied: aiohttp<4.0.0,>=3.8.3 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (3.11.10)  
Requirement already satisfied: dataclasses-json<0.7.0,>=0.6.7 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (0.6.7)  
Requirement already satisfied: pydantic-settings<3.0.0,>=2.10.1 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (2.11.0)  
Requirement already satisfied: httpx-sse<1.0.0,>=0.4.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (0.4.3)  
Requirement already satisfied: numpy>=2.1.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (2.1.3)  
Requirement already satisfied: aiohappyeyeballs>=2.3.0 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (2.4.4)  
Requirement already satisfied: aiosignal>=1.1.2 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (1.2.0)  
Requirement already satisfied: attrs>=17.3.0 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (24.3.0)  
Requirement already satisfied: frozenlist>=1.1.1 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (1.5.0)  
Requirement already satisfied: multidict<7.0,>=4.5 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (6.1.0)  
Requirement already satisfied: propcache>=0.2.0 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (0.3.1)  
Requirement already satisfied: yarl<2.0,>=1.17.0 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (1.18.0)  
Requirement already satisfied: marshmallow<4.0.0,>=3.18.0 in c:\users\gamin\anaconda3\lib\site-packages (from dataclasses-json<0.7.0,>=0.6.7->langchain-community) (3.26.1)  
Requirement already satisfied: typing-inspect<1,>=0.4.0 in c:\users\gamin\anaconda3\lib\site-packages (from dataclasses-json<0.7.0,>=0.6.7->langchain-community) (0.9.0)

Requirement already satisfied: langchain-text-splitters<2.0.0,>=1.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-classic<2.0.0,>=1.0.0->langchain-community) (1.0.0)

Requirement already satisfied: python-dotenv>=0.21.0 in c:\users\gamin\anaconda3\lib\site-packages (from pydantic-settings<3.0.0,>=2.10.1->langchain-community) (1.1.0)

Requirement already satisfied: typing-inspection>=0.4.0 in c:\users\gamin\anaconda3\lib\site-packages (from pydantic-settings<3.0.0,>=2.10.1->langchain-community) (0.4.2)

Requirement already satisfied: charset\_normalizer<4,>=2 in c:\users\gamin\anaconda3\lib\site-packages (from requests>=2.0.0->langsmith<1.0.0,>=0.3.45->langchain-core) (3.3.2)

Requirement already satisfied: urllib3<3,>=1.21.1 in c:\users\gamin\anaconda3\lib\site-packages (from requests>=2.0.0->langsmith<1.0.0,>=0.3.45->langchain-core) (2.3.0)

Requirement already satisfied: greenlet!=0.4.17 in c:\users\gamin\anaconda3\lib\site-packages (from SQLAlchemy<3.0.0,>=1.4.0->langchain-community) (3.1.1)

Requirement already satisfied: mypy\_extensions>=0.3.0 in c:\users\gamin\anaconda3\lib\site-packages (from typing-inspect<1,>=0.4.0->dataclasses-json<0.7.0,>=0.6.7->langchain-community) (1.0.0)

Requirement already satisfied: openai<3.0.0,>=1.109.1 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-openai) (2.6.1)

Requirement already satisfied: regex>=2022.1.18 in c:\users\gamin\anaconda3\lib\site-packages (from tiktoken) (2024.11.6)

Requirement already satisfied: distro<2,>=1.7.0 in c:\users\gamin\anaconda3\lib\site-packages (from openai<3.0.0,>=1.109.1->langchain-openai) (1.9.0)

Requirement already satisfied: jiter<1,>=0.10.0 in c:\users\gamin\anaconda3\lib\site-packages (from openai<3.0.0,>=1.109.1->langchain-openai) (0.11.1)

Requirement already satisfied: sniffio in c:\users\gamin\anaconda3\lib\site-packages (from openai<3.0.0,>=1.109.1->langchain-openai) (1.3.0)

Requirement already satisfied: tqdm>4 in c:\users\gamin\anaconda3\lib\site-packages (from openai<3.0.0,>=1.109.1->langchain-openai) (4.67.1)

Requirement already satisfied: colorama in c:\users\gamin\anaconda3\lib\site-packages (from tqdm>4->openai<3.0.0,>=1.109.1->langchain-openai) (0.4.6)

```
In [5]: from langchain_community.document_loaders import TextLoader
        from langchain_text_splitters import RecursiveCharacterTextSplitter
        from langchain_openai import OpenAIEmbeddings, ChatOpenAI
        from langchain_community.vectorstores import FAISS
        from langchain.chains import create_retrieval_chain
        from langchain.chains.combine_documents import create_stuff_documents_chain
        from langchain.prompts import ChatPromptTemplate
        from getpass import getpass
        import os
```

```
-----  
ModuleNotFoundError                                Traceback (most recent call last)  
Cell In[5], line 5  
      3 from langchain_openai import OpenAIEmbeddings, ChatOpenAI  
      4 from langchain_community.vectorstores import FAISS  
----> 5 from langchain.chains import create_retrieval_chain  
      6 from langchain.chains.combine_documents import create_stuff_documents_c  
hain  
      7 from langchain.prompts import ChatPromptTemplate  
  
ModuleNotFoundError: No module named 'langchain.chains'
```

```
In [6]: !pip install -U langchain langchain-core langchain-community langchain-openai
```

Requirement already satisfied: langchain in c:\users\gamin\anaconda3\lib\site-packages (1.0.2)

Requirement already satisfied: langchain-core in c:\users\gamin\anaconda3\lib\site-packages (1.0.1)

Requirement already satisfied: langchain-community in c:\users\gamin\anaconda3\lib\site-packages (0.4.1)

Requirement already satisfied: langchain-openai in c:\users\gamin\anaconda3\lib\site-packages (1.0.1)

Requirement already satisfied: faiss-cpu in c:\users\gamin\anaconda3\lib\site-packages (1.12.0)

Requirement already satisfied: tiktoken in c:\users\gamin\anaconda3\lib\site-packages (0.12.0)

Requirement already satisfied: langgraph<1.1.0,>=1.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain) (1.0.1)

Requirement already satisfied: pydantic<3.0.0,>=2.7.4 in c:\users\gamin\anaconda3\lib\site-packages (from langchain) (2.10.3)

Requirement already satisfied: jsonpatch<2.0.0,>=1.33.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-core) (1.33)

Requirement already satisfied: langsmith<1.0.0,>=0.3.45 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-core) (0.4.38)

Requirement already satisfied: packaging<26.0.0,>=23.2.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-core) (24.2)

Requirement already satisfied: pyyaml<7.0.0,>=5.3.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-core) (6.0.2)

Requirement already satisfied: tenacity!=8.4.0,<10.0.0,>=8.1.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-core) (9.0.0)

Requirement already satisfied: typing-extensions<5.0.0,>=4.7.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-core) (4.12.2)

Requirement already satisfied: jsonpointer>=1.9 in c:\users\gamin\anaconda3\lib\site-packages (from jsonpatch<2.0.0,>=1.33.0->langchain-core) (2.1)

Requirement already satisfied: langgraph-checkpoint<4.0.0,>=2.1.0 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph<1.1.0,>=1.0.0->langchain) (3.0.0)

Requirement already satisfied: langgraph-prebuilt<1.1.0,>=1.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph<1.1.0,>=1.0.0->langchain) (1.0.1)

Requirement already satisfied: langgraph-sdk<0.3.0,>=0.2.2 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph<1.1.0,>=1.0.0->langchain) (0.2.9)

Requirement already satisfied: xxhash>=3.5.0 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph<1.1.0,>=1.0.0->langchain) (3.6.0)

Requirement already satisfied: ormsgpack>=1.10.0 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph-checkpoint<4.0.0,>=2.1.0->langgraph<1.1.0,>=1.0.0->langchain) (1.11.0)

Requirement already satisfied: httpx>=0.25.2 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph-sdk<0.3.0,>=0.2.2->langgraph<1.1.0,>=1.0.0->langchain) (0.28.1)

Requirement already satisfied: orjson>=3.10.1 in c:\users\gamin\anaconda3\lib\site-packages (from langgraph-sdk<0.3.0,>=0.2.2->langgraph<1.1.0,>=1.0.0->langchain) (3.11.4)

Requirement already satisfied: requests-toolbelt>=1.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langsmith<1.0.0,>=0.3.45->langchain-core) (1.0.0)

Requirement already satisfied: requests>=2.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langsmith<1.0.0,>=0.3.45->langchain-core) (2.32.5)

Requirement already satisfied: zstandard>=0.23.0 in c:\users\gamin\anaconda3\li

b\site-packages (from langsmith<1.0.0,>=0.3.45->langchain-core) (0.23.0)  
Requirement already satisfied: anyio in c:\users\gamin\anaconda3\lib\site-packages (from httpx>=0.25.2->langgraph-sdk<0.3.0,>=0.2.2->langgraph) (4.7.0)  
Requirement already satisfied: certifi in c:\users\gamin\anaconda3\lib\site-packages (from httpx>=0.25.2->langgraph-sdk<0.3.0,>=0.2.2->langgraph) (2025.7.14)  
Requirement already satisfied: httpcore==1.\* in c:\users\gamin\anaconda3\lib\site-packages (from httpx>=0.25.2->langgraph-sdk<0.3.0,>=0.2.2->langgraph) (1.0.9)  
Requirement already satisfied: idna in c:\users\gamin\anaconda3\lib\site-packages (from httpx>=0.25.2->langgraph-sdk<0.3.0,>=0.2.2->langgraph) (3.7)  
Requirement already satisfied: h11>=0.16 in c:\users\gamin\anaconda3\lib\site-packages (from httpcore==1.\*->httpx>=0.25.2->langgraph-sdk<0.3.0,>=0.2.2->langgraph) (0.16.0)  
Requirement already satisfied: annotated-types>=0.6.0 in c:\users\gamin\anaconda3\lib\site-packages (from pydantic<3.0.0,>=2.7.4->langchain) (0.6.0)  
Requirement already satisfied: pydantic-core==2.27.1 in c:\users\gamin\anaconda3\lib\site-packages (from pydantic<3.0.0,>=2.7.4->langchain) (2.27.1)  
Requirement already satisfied: langchain-classic<2.0.0,>=1.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (1.0.0)  
Requirement already satisfied: SQLAlchemy<3.0.0,>=1.4.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (2.0.39)  
Requirement already satisfied: aiohttp<4.0.0,>=3.8.3 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (3.11.10)  
Requirement already satisfied: dataclasses-json<0.7.0,>=0.6.7 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (0.6.7)  
Requirement already satisfied: pydantic-settings<3.0.0,>=2.10.1 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (2.11.0)  
Requirement already satisfied: httpx-sse<1.0.0,>=0.4.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (0.4.3)  
Requirement already satisfied: numpy>=2.1.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (2.1.3)  
Requirement already satisfied: aiohappyeyeballs>=2.3.0 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (2.4.4)  
Requirement already satisfied: aiosignal>=1.1.2 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (1.2.0)  
Requirement already satisfied: attrs>=17.3.0 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (24.3.0)  
Requirement already satisfied: frozenlist>=1.1.1 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (1.5.0)  
Requirement already satisfied: multidict<7.0,>=4.5 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (6.1.0)  
Requirement already satisfied: propcache>=0.2.0 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (0.3.1)  
Requirement already satisfied: yarl<2.0,>=1.17.0 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (1.18.0)  
Requirement already satisfied: marshmallow<4.0.0,>=3.18.0 in c:\users\gamin\anaconda3\lib\site-packages (from dataclasses-json<0.7.0,>=0.6.7->langchain-community) (3.26.1)  
Requirement already satisfied: typing-inspect<1,>=0.4.0 in c:\users\gamin\anaconda3\lib\site-packages (from dataclasses-json<0.7.0,>=0.6.7->langchain-community) (0.9.0)

Requirement already satisfied: langchain-text-splitters<2.0.0,>=1.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-classic<2.0.0,>=1.0.0->langchain-community) (1.0.0)

Requirement already satisfied: python-dotenv>=0.21.0 in c:\users\gamin\anaconda3\lib\site-packages (from pydantic-settings<3.0.0,>=2.10.1->langchain-community) (1.1.0)

Requirement already satisfied: typing-inspection>=0.4.0 in c:\users\gamin\anaconda3\lib\site-packages (from pydantic-settings<3.0.0,>=2.10.1->langchain-community) (0.4.2)

Requirement already satisfied: charset\_normalizer<4,>=2 in c:\users\gamin\anaconda3\lib\site-packages (from requests>=2.0.0->langsmith<1.0.0,>=0.3.45->langchain-core) (3.3.2)

Requirement already satisfied: urllib3<3,>=1.21.1 in c:\users\gamin\anaconda3\lib\site-packages (from requests>=2.0.0->langsmith<1.0.0,>=0.3.45->langchain-core) (2.3.0)

Requirement already satisfied: greenlet!=0.4.17 in c:\users\gamin\anaconda3\lib\site-packages (from SQLAlchemy<3.0.0,>=1.4.0->langchain-community) (3.1.1)

Requirement already satisfied: mypy\_extensions>=0.3.0 in c:\users\gamin\anaconda3\lib\site-packages (from typing-inspect<1,>=0.4.0->dataclasses-json<0.7.0,>=0.6.7->langchain-community) (1.0.0)

Requirement already satisfied: openai<3.0.0,>=1.109.1 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-openai) (2.6.1)

Requirement already satisfied: regex>=2022.1.18 in c:\users\gamin\anaconda3\lib\site-packages (from tiktoken) (2024.11.6)

Requirement already satisfied: distro<2,>=1.7.0 in c:\users\gamin\anaconda3\lib\site-packages (from openai<3.0.0,>=1.109.1->langchain-openai) (1.9.0)

Requirement already satisfied: jiter<1,>=0.10.0 in c:\users\gamin\anaconda3\lib\site-packages (from openai<3.0.0,>=1.109.1->langchain-openai) (0.11.1)

Requirement already satisfied: sniffio in c:\users\gamin\anaconda3\lib\site-packages (from openai<3.0.0,>=1.109.1->langchain-openai) (1.3.0)

Requirement already satisfied: tqdm>4 in c:\users\gamin\anaconda3\lib\site-packages (from openai<3.0.0,>=1.109.1->langchain-openai) (4.67.1)

Requirement already satisfied: colorama in c:\users\gamin\anaconda3\lib\site-packages (from tqdm>4->openai<3.0.0,>=1.109.1->langchain-openai) (0.4.6)

In [ ]:

In [ ]:

```
In [10]: sample_text = """
Mathematics is the study of numbers, equations, functions, and geometric shape
The derivative of x^2 is 2x.
The integral of sin(x) is -cos(x) + C.
In algebra, to solve 2x + 3 = 7, subtract 3 and divide by 2 to get x = 2.
"""

with open("data.txt", "w", encoding="utf-8") as f:
    f.write(sample_text)

print(" Sample 'data.txt' file created successfully!")
```

✓ Sample 'data.txt' file created successfully!



```
In [13]: loader = TextLoader("data.txt", encoding="utf-8")
docs = loader.load()
```

```
In [14]: query = "What is the derivative of x^2?"
response = rag_chain.invoke({"input": query})
print("Answer:", response["answer"])
```

```
-----
NameError                                Traceback (most recent call last)
Cell In[14], line 2
      1 query = "What is the derivative of x^2?"
----> 2 response = rag_chain.invoke({"input": query})
      3 print("Answer:", response["answer"])

NameError: name 'rag_chain' is not defined
```

```
In [16]:
```

```
-----
ModuleNotFoundError                      Traceback (most recent call last)
Cell In[16], line 5
      3 from langchain_community.vectorstores import FAISS
      4 from langchain_core.prompts import ChatPromptTemplate
----> 5 from langchain.chains.combine_documents import create_stuff_documents_c
hain
      6 from langchain.chains.retrieval import create_retrieval_chain
      8 # --- Step 5: Create embeddings and retriever ---

ModuleNotFoundError: No module named 'langchain.chains'
```

```
In [18]: !pip install sentence-transformers faiss-cpu numpy requests beautifulsoup4 fas
```

Collecting sentence-transformers

Downloading sentence\_transformers-5.1.2-py3-none-any.whl.metadata (16 kB)

Requirement already satisfied: faiss-cpu in c:\users\gamin\anaconda3\lib\site-packages (1.12.0)

Requirement already satisfied: numpy in c:\users\gamin\anaconda3\lib\site-packages (2.1.3)

Requirement already satisfied: requests in c:\users\gamin\anaconda3\lib\site-packages (2.32.5)

Requirement already satisfied: beautifulsoup4 in c:\users\gamin\anaconda3\lib\site-packages (4.12.3)

Collecting fastapi

Downloading fastapi-0.120.1-py3-none-any.whl.metadata (28 kB)

Collecting uvicorn

Downloading uvicorn-0.38.0-py3-none-any.whl.metadata (6.8 kB)

Requirement already satisfied: langchain-community in c:\users\gamin\anaconda3\lib\site-packages (0.4.1)

Requirement already satisfied: langchain-core in c:\users\gamin\anaconda3\lib\site-packages (1.0.1)

Requirement already satisfied: langchain-openai in c:\users\gamin\anaconda3\lib\site-packages (1.0.1)

Collecting transformers<5.0.0,>=4.41.0 (from sentence-transformers)

Downloading transformers-4.57.1-py3-none-any.whl.metadata (43 kB)

Requirement already satisfied: tqdm in c:\users\gamin\anaconda3\lib\site-packages (from sentence-transformers) (4.67.1)

Requirement already satisfied: torch>=1.11.0 in c:\users\gamin\anaconda3\lib\site-packages (from sentence-transformers) (2.9.0)

Requirement already satisfied: scikit-learn in c:\users\gamin\anaconda3\lib\site-packages (from sentence-transformers) (1.6.1)

Requirement already satisfied: scipy in c:\users\gamin\anaconda3\lib\site-packages (from sentence-transformers) (1.15.3)

Collecting huggingface-hub>=0.20.0 (from sentence-transformers)

Downloading huggingface\_hub-1.0.0-py3-none-any.whl.metadata (13 kB)

Requirement already satisfied: Pillow in c:\users\gamin\anaconda3\lib\site-packages (from sentence-transformers) (11.1.0)

Requirement already satisfied: typing\_extensions>=4.5.0 in c:\users\gamin\anaconda3\lib\site-packages (from sentence-transformers) (4.12.2)

Requirement already satisfied: filelock in c:\users\gamin\anaconda3\lib\site-packages (from transformers<5.0.0,>=4.41.0->sentence-transformers) (3.17.0)

Downloading huggingface\_hub-0.36.0-py3-none-any.whl.metadata (14 kB)

Requirement already satisfied: packaging>=20.0 in c:\users\gamin\anaconda3\lib\site-packages (from transformers<5.0.0,>=4.41.0->sentence-transformers) (24.2)

Requirement already satisfied: pyyaml>=5.1 in c:\users\gamin\anaconda3\lib\site-packages (from transformers<5.0.0,>=4.41.0->sentence-transformers) (6.0.2)

Requirement already satisfied: regex!=2019.12.17 in c:\users\gamin\anaconda3\lib\site-packages (from transformers<5.0.0,>=4.41.0->sentence-transformers) (2024.11.6)

Collecting tokenizers<=0.23.0,>=0.22.0 (from transformers<5.0.0,>=4.41.0->sentence-transformers)

Downloading tokenizers-0.22.1-cp39-abi3-win\_amd64.whl.metadata (6.9 kB)

Collecting safetensors>=0.4.3 (from transformers<5.0.0,>=4.41.0->sentence-transformers)

Downloading safetensors-0.6.2-cp38-abi3-win\_amd64.whl.metadata (4.1 kB)

Requirement already satisfied: fsspec>=2023.5.0 in c:\users\gamin\anaconda3\lib\site-packages (from huggingface-hub>=0.20.0->sentence-transformers) (2024.11.6)

### 5.3.2)

Requirement already satisfied: charset\_normalizer<4,>=2 in c:\users\gamin\anaconda3\lib\site-packages (from requests) (3.3.2)

Requirement already satisfied: idna<4,>=2.5 in c:\users\gamin\anaconda3\lib\site-packages (from requests) (3.7)

Requirement already satisfied: urllib3<3,>=1.21.1 in c:\users\gamin\anaconda3\lib\site-packages (from requests) (2.3.0)

Requirement already satisfied: certifi>=2017.4.17 in c:\users\gamin\anaconda3\lib\site-packages (from requests) (2025.7.14)

Requirement already satisfied: soupsieve>1.2 in c:\users\gamin\anaconda3\lib\site-packages (from beautifulsoup4) (2.5)

Collecting starlette<0.50.0,>=0.40.0 (from fastapi)

Downloading starlette-0.49.0-py3-none-any.whl.metadata (6.4 kB)

Requirement already satisfied: pydanti

c!=1.8,!1.8.1,!2.0.0,!2.0.1,!2.1.0,<3.0.0,>=1.7.4 in c:\users\gamin\anaconda3\lib\site-packages (from fastapi) (2.10.3)

Collecting annotated-doc>=0.0.2 (from fastapi)

Downloading annotated\_doc-0.0.3-py3-none-any.whl.metadata (6.6 kB)

Requirement already satisfied: annotated-types>=0.6.0 in c:\users\gamin\anaconda3\lib\site-packages (from pydanti

c!=1.8,!1.8.1,!2.0.0,!2.0.1,!2.1.0,<3.0.0,>=1.7.4->fastapi) (0.6.0)

Requirement already satisfied: pydantic-core==2.27.1 in c:\users\gamin\anaconda3\lib\site-packages (from pydanti

c!=1.8,!1.8.1,!2.0.0,!2.0.1,!2.1.0,<3.0.0,>=1.7.4->fastapi) (2.27.1)

Requirement already satisfied: anyio<5,>=3.6.2 in c:\users\gamin\anaconda3\lib\site-packages (from starlette<0.50.0,>=0.40.0->fastapi) (4.7.0)

Requirement already satisfied: sniffio>=1.1 in c:\users\gamin\anaconda3\lib\site-packages (from anyio<5,>=3.6.2->starlette<0.50.0,>=0.40.0->fastapi) (1.3.0)

Requirement already satisfied: click>=7.0 in c:\users\gamin\anaconda3\lib\site-packages (from uvicorn) (8.1.8)

Requirement already satisfied: h11>=0.8 in c:\users\gamin\anaconda3\lib\site-packages (from uvicorn) (0.16.0)

Requirement already satisfied: langchain-classic<2.0.0,>=1.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (1.0.0)

Requirement already satisfied: SQLAlchemy<3.0.0,>=1.4.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (2.0.39)

Requirement already satisfied: aiohttp<4.0.0,>=3.8.3 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (3.11.10)

Requirement already satisfied: tenacity!=8.4.0,<10.0.0,>=8.1.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (9.0.0)

Requirement already satisfied: dataclasses-json<0.7.0,>=0.6.7 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (0.6.7)

Requirement already satisfied: pydantic-settings<3.0.0,>=2.10.1 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (2.11.0)

Requirement already satisfied: langsmith<1.0.0,>=0.1.125 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (0.4.38)

Requirement already satisfied: httpx-sse<1.0.0,>=0.4.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-community) (0.4.3)

Requirement already satisfied: jsonpatch<2.0.0,>=1.33.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-core) (1.33)

Requirement already satisfied: aiohappyeyeballs>=2.3.0 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (2.4.4)

Requirement already satisfied: aiosignal>=1.1.2 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (1.2.0)

Requirement already satisfied: attrs>=17.3.0 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (24.3.0)

Requirement already satisfied: frozenlist>=1.1.1 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (1.5.0)

Requirement already satisfied: multidict<7.0,>=4.5 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (6.1.0)

Requirement already satisfied: propcache>=0.2.0 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (0.3.1)

Requirement already satisfied: yarl<2.0,>=1.17.0 in c:\users\gamin\anaconda3\lib\site-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (1.18.0)

Requirement already satisfied: marshmallow<4.0.0,>=3.18.0 in c:\users\gamin\anaconda3\lib\site-packages (from dataclasses-json<0.7.0,>=0.6.7->langchain-community) (3.26.1)

Requirement already satisfied: typing-inspect<1,>=0.4.0 in c:\users\gamin\anaconda3\lib\site-packages (from dataclasses-json<0.7.0,>=0.6.7->langchain-community) (0.9.0)

Requirement already satisfied: jsonpointer>=1.9 in c:\users\gamin\anaconda3\lib\site-packages (from jsonpatch<2.0.0,>=1.33.0->langchain-core) (2.1)

Requirement already satisfied: langchain-text-splitters<2.0.0,>=1.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-classic<2.0.0,>=1.0.0->langchain-community) (1.0.0)

Requirement already satisfied: httpx<1,>=0.23.0 in c:\users\gamin\anaconda3\lib\site-packages (from langsmith<1.0.0,>=0.1.125->langchain-community) (0.28.1)

Requirement already satisfied: orjson>=3.9.14 in c:\users\gamin\anaconda3\lib\site-packages (from langsmith<1.0.0,>=0.1.125->langchain-community) (3.11.4)

Requirement already satisfied: requests-toolbelt>=1.0.0 in c:\users\gamin\anaconda3\lib\site-packages (from langsmith<1.0.0,>=0.1.125->langchain-community) (1.0.0)

Requirement already satisfied: zstandard>=0.23.0 in c:\users\gamin\anaconda3\lib\site-packages (from langsmith<1.0.0,>=0.1.125->langchain-community) (0.23.0)

Requirement already satisfied: httpcore==1.\* in c:\users\gamin\anaconda3\lib\site-packages (from httpx<1,>=0.23.0->langsmith<1.0.0,>=0.1.125->langchain-community) (1.0.9)

Requirement already satisfied: python-dotenv>=0.21.0 in c:\users\gamin\anaconda3\lib\site-packages (from pydantic-settings<3.0.0,>=2.10.1->langchain-community) (1.1.0)

Requirement already satisfied: typing-inspection>=0.4.0 in c:\users\gamin\anaconda3\lib\site-packages (from pydantic-settings<3.0.0,>=2.10.1->langchain-community) (0.4.2)

Requirement already satisfied: greenlet!=0.4.17 in c:\users\gamin\anaconda3\lib\site-packages (from SQLAlchemy<3.0.0,>=1.4.0->langchain-community) (3.1.1)

Requirement already satisfied: mypy-extensions>=0.3.0 in c:\users\gamin\anaconda3\lib\site-packages (from typing-inspect<1,>=0.4.0->dataclasses-json<0.7.0,>=0.6.7->langchain-community) (1.0.0)

Requirement already satisfied: openai<3.0.0,>=1.109.1 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-openai) (2.6.1)

Requirement already satisfied: tiktoken<1.0.0,>=0.7.0 in c:\users\gamin\anaconda3\lib\site-packages (from langchain-openai) (0.12.0)

Requirement already satisfied: distro<2,>=1.7.0 in c:\users\gamin\anaconda3\lib\site-packages (from openai<3.0.0,>=1.109.1->langchain-openai) (1.9.0)

Requirement already satisfied: jiter<1,>=0.10.0 in c:\users\gamin\anaconda3\lib\site-packages (from openai<3.0.0,>=1.109.1->langchain-openai) (0.11.1)

Requirement already satisfied: colorama in c:\users\gamin\anaconda3\lib\site-packages (from click>=7.0->uvicorn) (0.4.6)

Requirement already satisfied: sympy>=1.13.3 in c:\users\gamin\anaconda3\lib\site-packages (from torch>=1.11.0->sentence-transformers) (1.13.3)

Requirement already satisfied: networkx>=2.5.1 in c:\users\gamin\anaconda3\lib\site-packages (from torch>=1.11.0->sentence-transformers) (3.4.2)

Requirement already satisfied: jinja2 in c:\users\gamin\anaconda3\lib\site-packages (from torch>=1.11.0->sentence-transformers) (3.1.6)

Requirement already satisfied: setuptools in c:\users\gamin\anaconda3\lib\site-packages (from torch>=1.11.0->sentence-transformers) (72.1.0)

Requirement already satisfied: mpmath<1.4,>=1.1.0 in c:\users\gamin\anaconda3\lib\site-packages (from sympy>=1.13.3->torch>=1.11.0->sentence-transformers) (1.3.0)

Requirement already satisfied: MarkupSafe>=2.0 in c:\users\gamin\anaconda3\lib\site-packages (from jinja2->torch>=1.11.0->sentence-transformers) (3.0.2)

Requirement already satisfied: joblib>=1.2.0 in c:\users\gamin\anaconda3\lib\site-packages (from scikit-learn->sentence-transformers) (1.4.2)

Requirement already satisfied: threadpoolctl>=3.1.0 in c:\users\gamin\anaconda3\lib\site-packages (from scikit-learn->sentence-transformers) (3.5.0)

Downloading sentence\_transformers-5.1.2-py3-none-any.whl (488 kB)

Downloading transformers-4.57.1-py3-none-any.whl (12.0 MB)

```

----- 0.0/12.0 MB ? eta -:-:--
----- 2.9/12.0 MB 14.2 MB/s eta 0:00:01
----- 4.7/12.0 MB 11.4 MB/s eta 0:00:01
----- 5.2/12.0 MB 8.9 MB/s eta 0:00:01
----- 5.8/12.0 MB 7.2 MB/s eta 0:00:01
----- 6.0/12.0 MB 6.4 MB/s eta 0:00:01
----- 6.6/12.0 MB 5.3 MB/s eta 0:00:02
----- 7.1/12.0 MB 4.9 MB/s eta 0:00:02
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----- 8.4/12.0 MB 4.5 MB/s eta 0:00:01
----- 9.4/12.0 MB 4.5 MB/s eta 0:00:01
----- 10.5/12.0 MB 4.6 MB/s eta 0:00:01
----- 11.8/12.0 MB 4.7 MB/s eta 0:00:01
----- 12.0/12.0 MB 4.5 MB/s eta 0:00:00

```

Downloading huggingface\_hub-0.36.0-py3-none-any.whl (566 kB)

```

----- 0.0/566.1 kB ? eta -:-:--
----- 566.1/566.1 kB 3.4 MB/s eta 0:00:00

```

Downloading tokenizers-0.22.1-cp39-abi3-win\_amd64.whl (2.7 MB)

```

----- 0.0/2.7 MB ? eta -:-:--
----- 1.3/2.7 MB 6.7 MB/s eta 0:00:01
----- 2.6/2.7 MB 6.7 MB/s eta 0:00:01
----- 2.7/2.7 MB 5.7 MB/s eta 0:00:00

```

Downloading fastapi-0.120.1-py3-none-any.whl (108 kB)

Downloading starlette-0.49.0-py3-none-any.whl (74 kB)

Downloading uvicorn-0.38.0-py3-none-any.whl (68 kB)

Downloading annotated\_doc-0.0.3-py3-none-any.whl (5.5 kB)

Downloading safetensors-0.6.2-cp38-abi3-win\_amd64.whl (320 kB)

Installing collected packages: safetensors, annotated-doc, uvicorn, starlette, huggingface-hub, tokenizers, fastapi, transformers, sentence-transformers

```

----- 2/9 [uvicorn]
----- 3/9 [starlette]
----- 4/9 [huggingface-hub]
----- 4/9 [huggingface-hub]
----- 4/9 [huggingface-hub]

```

[illegible]

[illegible]

[illegible]

Successfully installed annotated-doc-0.0.3 fastapi-0.120.1 huggingface-hub-0.3  
6.0 safetensors-0.6.2 sentence-transformers-5.1.2 starlette-0.49.0 tokenizer  
s-0.22.1 transformers-4.57.1 uvicorn-0.38.0

```
In [20]: !pip install google-search-results
```

Collecting google-search-results

DEPRECATION: Building 'google-search-results' using the legacy setup.py bdist\_wheel mechanism, which will be removed in a future version. pip 25.3 will enforce this behaviour change. A possible replacement is to use the standardized build interface by setting the `--use-pep517` option, (possibly combined with `--no-build-isolation`), or adding a `pyproject.toml` file to the source tree of 'google-search-results'. Discussion can be found at <https://github.com/pypa/pip/issues/6334>



```

Downloading google_search_results-2.4.2.tar.gz (18 kB)
Preparing metadata (setup.py): started
Preparing metadata (setup.py): finished with status 'done'
Requirement already satisfied: requests in c:\users\gamin\anaconda3\lib\site-packages (from google-search-results) (2.32.5)
Requirement already satisfied: charset_normalizer<4,>=2 in c:\users\gamin\anaconda3\lib\site-packages (from requests->google-search-results) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in c:\users\gamin\anaconda3\lib\site-packages (from requests->google-search-results) (3.7)
Requirement already satisfied: urllib3<3,>=1.21.1 in c:\users\gamin\anaconda3\lib\site-packages (from requests->google-search-results) (2.3.0)
Requirement already satisfied: certifi>=2017.4.17 in c:\users\gamin\anaconda3\lib\site-packages (from requests->google-search-results) (2025.7.14)
Building wheels for collected packages: google-search-results
  Building wheel for google-search-results (setup.py): started
  Building wheel for google-search-results (setup.py): finished with status 'done'
    Created wheel for google-search-results: filename=google_search_results-2.4.2-py3-none-any.whl size=32083 sha256=ee78d2e5cf2c3e586e368594b855c161e624fe78594cefc0aa81d7a98a4f93fd
    Stored in directory: c:\users\gamin\appdata\local\pip\cache\wheels\44\af\e2\de9fab6f1876485b72b35e9cd48da741da67d20e617c3b971
Successfully built google-search-results
Installing collected packages: google-search-results
Successfully installed google-search-results-2.4.2

```

```

In [21]: import os, json, time, re
        from pathlib import Path
        from typing import List, Tuple, Dict, Any
        from sentence_transformers import SentenceTransformer
        import numpy as np
        import faiss
        import requests
        from serpapi import GoogleSearch
        import sympy as sp
        from PIL import Image
        import matplotlib.pyplot as plt

```

```

In [22]: OPENAI_API_KEY = os.environ.get("OPENAI_API_KEY", "") # optional
        SERPAPI_API_KEY = os.environ.get("SERPAPI_API_KEY", "") # recommended for web

```

```

In [23]: MATH_KEYWORDS = [
        "math", "algebra", "calculus", "geometry", "integrate", "differentiate", "derivative",
        "integral", "solve", "limit", "series", "sum", "probability", "statistics", "matrix",
        "determinant", "vector", "trigonometry", "laplace", "fourier", "equation", "factor",
        "roots", "quadratic", "gradient", "partial", "derivatives"
    ]

    def input_guardrail(query: str) -> Tuple[bool, str]:
        q = query.lower()
        if any(k in q for k in MATH_KEYWORDS):
            return True, query.strip()
        # if it contains math symbols, allow

```

```

if re.search(r"\d|=|\+|\-|\*|\/|\^|dx|\int|sqrt|sin|cos|tan", q):
    return True, query.strip()
return False, "This system answers mathematics questions only. Please reph

```

```

In [24]: def sympy_solve_steps(query: str) -> Tuple[str, str]:
    """
    Try to handle common algebraic, derivative, integral and limit problems using SymPy.
    Returns (result_text, verdict) where verdict is 'verified' or 'not_applicable'.
    """
    q = query.lower()
    try:
        x = sp.symbols('x')
        # DERIVATIVE
        if "differentiate" in q or "derivative" in q or "d/dx" in q:
            # naive extraction: assume "differentiate <expr>"
            expr_text = re.sub(r".*(differentiate|derivative|d/dx)\s+", "", q)
            expr_text = expr_text.strip().strip(".")
            expr = sp.sympify(expr_text)
            deriv = sp.diff(expr, x)
            steps = f"1) Identify expression: f(x) = {sp.pretty(expr)}\n2) Apply derivative"
            return steps, "verified"
        # INTEGRAL
        if "integrate" in q or "integral" in q or "\int" in q:
            expr_text = re.sub(r".*(integrate|integral)\s+", "", q)
            expr_text = expr_text.replace("dx", "").strip().strip(".")
            expr = sp.sympify(expr_text)
            I = sp.integrate(expr, x)
            steps = f"1) Identify integrand: {sp.pretty(expr)}\n2) Apply integration"
            return steps, "verified"
        # SOLVE equation
        if "solve" in q or "=" in q:
            if "solve" in q:
                eq_text = q.split("solve", 1)[1].strip()
            else:
                eq_text = q
            eq_text = eq_text.strip(".")
            if "=" in eq_text:
                lhs, rhs = eq_text.split("=", 1)
                sol = sp.solve(sp.Eq(sp.sympify(lhs), sp.sympify(rhs)), x)
            else:
                sol = sp.solve(sp.sympify(eq_text), x)
            steps = f"1) Form the equation: {eq_text}\n2) Solve symbolically using SymPy"
            return steps, "verified"
        # LIMIT
        if "limit" in q:
            m = re.search(r"limit of (.+) as x approaches ([\-\d\.\+][a-zA-Z]+)", q)
            if m:
                expr_text = m.group(1)
                val = m.group(2)
                expr = sp.sympify(expr_text)
                lim = sp.limit(expr, x, sp.sympify(val))

```

```

        steps = f"1) Expression: {expr}\n2) Compute limit as x → {val}"
        return steps, "verified"
    except Exception as e:
        return f"SymPy error: {e}", "error"
    return "", "not_applicable"

```

In [25]: EMBED\_MODEL\_NAME = "sentence-transformers/all-MiniLM-L6-v2"

```

class SimpleKB:
    def __init__(self, embed_model_name=EMBED_MODEL_NAME, dim=384, index_path=
        self.model = SentenceTransformer(embed_model_name)
        self.index_path = index_path
        self.docs: List[Dict[str,Any]] = [] # each item: {"id":id,"text":...,
        self._index = None
        self._ids = []
        self.dim = self.model.get_sentence_embedding_dimension()
        # load if exists
        if Path(index_path).exists():
            self._load_index()
        else:
            self._index = None

    def add_documents(self, docs: List[Dict[str,str]]):
        """docs: list of {"text":..., "meta":{...}}"""
        for d in docs:
            _id = len(self.docs)
            self.docs.append({"id": _id, "text": d["text"], "meta": d.get("met
            self._ids.append(_id)
        self._rebuild_index()

    def _rebuild_index(self):
        texts = [d["text"] for d in self.docs]
        if len(texts)==0:
            self._index = None
            return
        embeddings = self.model.encode(texts, convert_to_numpy=True)
        # FAISS index
        self._index = faiss.IndexFlatIP( self.dim )
        faiss.normalize_L2(embeddings)
        self._index.add(embeddings)
        # save index + docs
        self._save_index()

    def search(self, query: str, top_k=3) -> List[Dict[str,Any]]:
        if self._index is None:
            return []
        q_emb = self.model.encode([query], convert_to_numpy=True)
        faiss.normalize_L2(q_emb)
        D, I = self._index.search(q_emb, top_k)
        results = []
        for idx, score in zip(I[0], D[0]):
            if idx < len(self.docs):
                results.append({"id": self.docs[idx]["id"], "text": self.docs[

```

```

        return results

    def _save_index(self):

        texts = [d["text"] for d in self.docs]
        embs = self.model.encode(texts, convert_to_numpy=True)
        np.savez(self.index_path, embs=embs)
        Path(self.index_path + ".docs.json").write_text(json.dumps(self.docs))

    def _load_index(self):
        # load saved embeddings and recreate index
        arr = np.load(self.index_path)
        embs = arr["embs"]
        self._index = faiss.IndexFlatIP(embs.shape[1])
        faiss.normalize_L2(embs)
        self._index.add(embs)
        docs_path = self.index_path + ".docs.json"
        if Path(docs_path).exists():
            self.docs = json.loads(Path(docs_path).read_text())

```

```

In [26]: kb = SimpleKB()
seed = [
    {"text": "Solve 2x + 3 = 7. Steps: 2x = 4 => x = 2.", "meta": {"topic": "alge"},
    {"text": "Differentiate x^3 + 4x. d/dx = 3x^2 + 4.", "meta": {"topic": "calcu"},
    {"text": "Integrate sin(x) dx = -cos(x) + C.", "meta": {"topic": "calculus", "h"},
    {"text": "Find limit of (x^2-4)/(x-2) as x->2: Answer = 4", "meta": {"topic": "limi"}
]
kb.add_documents(seed)
print("KB seeded with", len(kb.docs), "documents")

```

```
modules.json: 0%|          | 0.00/349 [00:00<?, ?B/s]
```

C:\Users\gamin\anaconda3\Lib\site-packages\huggingface\_hub\file\_download.py:143: UserWarning: `huggingface\_hub` cache-system uses symlinks by default to efficiently store duplicated files but your machine does not support them in C:\Users\gamin\.cache\huggingface\hub\models--sentence-transformers--all-MiniLM-L6-v2. Caching files will still work but in a degraded version that might require more space on your disk. This warning can be disabled by setting the `HF\_HUB\_DISABLE\_SYMLINKS\_WARNING` environment variable. For more details, see [https://huggingface.co/docs/huggingface\\_hub/how-to-cache#limitations](https://huggingface.co/docs/huggingface_hub/how-to-cache#limitations).

To support symlinks on Windows, you either need to activate Developer Mode or to run Python as an administrator. In order to activate developer mode, see this article: <https://docs.microsoft.com/en-us/windows/apps/get-started/enable-your-device-for-development>

```
warnings.warn(message)
```

```
config_sentence_transformers.json: 0%|          | 0.00/116 [00:00<?, ?B/s]
```

```
README.md: 0.00B [00:00, ?B/s]
```

```
sentence_bert_config.json: 0%|          | 0.00/53.0 [00:00<?, ?B/s]
```

```
config.json: 0%|          | 0.00/612 [00:00<?, ?B/s]
```

Xet Storage is enabled for this repo, but the 'hf\_xet' package is not installed. Falling back to regular HTTP download. For better performance, install the package with: `pip install huggingface\_hub[hf\_xet]` or `pip install hf\_xet`

```
model.safetensors: 0%|          | 0.00/90.9M [00:00<?, ?B/s]
```

```
tokenizer_config.json: 0%|          | 0.00/350 [00:00<?, ?B/s]
```

```
vocab.txt: 0.00B [00:00, ?B/s]
tokenizer.json: 0.00B [00:00, ?B/s]
special_tokens_map.json: 0%|          | 0.00/112 [00:00<?, ?B/s]
config.json: 0%|          | 0.00/190 [00:00<?, ?B/s]
KB seeded with 4 documents
```

```
In [27]: def web_search_serpapi(query: str, num=3) -> str:
        """
        Uses SerpAPI Google Search to return a combined text context (title + snippet)
        You can swap this part for a real MCP server in production.
        """
        if not SERPAPI_API_KEY:
            return "SERPAPI key not set. Web fallback unavailable."
        params = {
            "engine": "google",
            "q": query,
            "num": num,
            "api_key": SERPAPI_API_KEY
        }
        search = GoogleSearch(params)
        results = search.get_dict()
        snippets = []
        for r in results.get("organic_results", [])[:num]:
            title = r.get("title", "")
            snippet = r.get("snippet", "")
            link = r.get("link", "")
            snippets.append(f"{title}\n{snippet}\n{link}")
        return "\n\n".join(snippets) if snippets else "No web results found."

        def mcp_format_snippets(snippets_text: str) -> dict:
            """Wrap web snippets into a basic MCP-like context object."""
            return {"mcp_version": "1.0", "source": "serpapi", "content": snippets_text}
```

```
In [28]: def generate_answer(query: str, kb_hits: List[Dict[str, Any]], web_context: str) -> str:
        """
        Returns a structured response: {"answer": str, "source": "kb" | "web" | "sympy", "verdict": str}
        """
        if kb_hits and kb_hits[0]["score"] > 0.4:
            # return the KB text but try to produce a clearer step-by-step if SymPy
            kb_text = kb_hits[0]["text"]
            sym_steps, verdict = sympy_solve_steps(query)
            if verdict == "verified":
                return {"answer": sym_steps, "source": "sympy+kb", "kb_text": kb_text, "verdict": verdict}
            else:
                return {"answer": kb_text, "source": "kb", "kb_text": kb_text, "verdict": verdict}
            sym_steps, verdict = sympy_solve_steps(query)
            if verdict == "verified":
                return {"answer": sym_steps, "source": "sympy", "verdict": verdict}

        if web_context and use_openai and OPENAI_API_KEY:
            prompt = f"You are a math professor. Use the following web snippets to answer the question."
            headers = {"Authorization": f"Bearer {OPENAI_API_KEY}", "Content-Type": "application/json"}
```

```

data = {"model": "gpt-3.5-turbo", "messages": [{"role": "user", "content": p
resp = requests.post("https://api.openai.com/v1/chat/completions", head
if resp.status_code == 200:
    out = resp.json()
    answer = out["choices"][0]["message"]["content"]
    return {"answer": answer, "source": "web+openai", "verdict": "synthe
else:
    return {"answer": web_context, "source": "web", "verdict": "web_only

if web_context:
    return {"answer": web_context, "source": "web", "verdict": "web_only"}
return {"answer": "I couldn't find a confident answer. Please rephrase or p

```

```

In [29]: def route_and_answer(query: str, use_openai=False) -> Dict[str,Any]:

    ok, msg = input_guardrail(query)
    if not ok:
        return {"status": "rejected", "message": msg}

    hits = kb.search(query, top_k=3)
    if hits:
        print(f"[Router] KB hits found. Top score: {hits[0]['score']:.3f}")
    else:
        print("[Router] No KB hits found.")

    if not hits or hits[0]["score"] < 0.3:
        if SERPAPI_API_KEY:
            snippets = web_search_serpapi(query)
            mcp = mcp_format_snippets(snippets)

            return generate_answer(query, hits, web_context=snippets, use_openai=use_openai)
        else:
            return generate_answer(query, hits, web_context="", use_openai=use_openai)
    else:
        return generate_answer(query, hits, web_context="", use_openai=use_openai)

```

```

In [30]: FEEDBACK_LOG = Path("feedback_log.jsonl")
def log_feedback(entry: dict):
    with open(FEEDBACK_LOG, "a", encoding="utf-8") as f:
        f.write(json.dumps(entry) + "\n")

def interactive_session():
    print("Welcome to the Math Routing Agent (type 'exit' to quit)")
    while True:
        q = input("\nQuestion: ").strip()
        if q.lower() == "exit": break
        res = route_and_answer(q, use_openai=bool(OPENAI_API_KEY))
        print("\n--- Agent Answer (source: {}) ---\n{}\n-----"
              .format(res["source"], res["answer"]))
        fb = input("Was this answer helpful? (yes/no) ").strip().lower()
        entry = {"query": q, "response": res["answer"], "feedback": fb, "timestamp": time.time()}
        if fb == "no":
            log_feedback(entry)

```

```

        corr = input("Please provide corrected answer/steps (this will be
# add correction into KB and reindex
        kb.add_documents([{"text": corr, "meta":{"source":"human_feedback"}
        print("Correction added to KB and indexed.")
        entry["correction"] = corr
        log_feedback(entry)
        print("Feedback logged. Thank you!")

```

```

In [31]: def render_steps_image(text: str, fname="solution.png"):
        lines = text.split("\n")
        fig, ax = plt.subplots(figsize=(6, max(2, 0.3*len(lines))))
        ax.axis("off")
        y = 1.0
        for line in lines:
            ax.text(0.01, y, line, fontsize=12, va='top', family='monospace')
            y -= 0.08
        plt.tight_layout()
        plt.savefig(fname, dpi=150, bbox_inches='tight')
        plt.close(fig)
        return fname

```

```

In [32]: def run_benchmark(test_cases: List[Dict[str,str]]):
        print("Running benchmark on", len(test_cases), "cases")
        correct = 0
        results = []
        for t in test_cases:
            q = t["q"]
            expected = t.get("ans","").lower()
            out = route_and_answer(q, use_openai=bool(OPENAI_API_KEY))
            ans_text = out.get("answer","").lower()
            ok = expected and expected in ans_text
            results.append({"q":q, "answer":out.get("answer"), "expected":t.get("a
            if ok: correct += 1
        print(f"Accuracy (naive substring match) = {correct}/{len(test_cases)}")
        return results

```

```

In [35]: print("\n--- Demo seeding and examples ready ---\n")
        print("KB contains:", len(kb.docs), "items.")

        demo_queries = [
            "Differentiate x^3 + 4x",
            "Solve 2x + 3 = 7",
            "Integrate sin(x) dx",
            "Find limit of (x^2 - 4)/(x - 2) as x approaches 2",
            "Explain method of Lagrange multipliers"
        ]

        for q in demo_queries:
            print("\n> Query:", q)
            r = route_and_answer(q, use_openai=False)
            print("-> Source:", r.get("source"), "Verdict:", r.get("verdict"))

            ans = r.get("answer")

```

```

if ans:
    print(ans[:800])
else:
    print("[No answer found – try enabling use_openai=True for this type c

```

--- Demo seeding and examples ready ---

KB contains: 4 items.

```

> Query: Differentiate  $x^3 + 4x$ 
[Router] KB hits found. Top score: 0.917
-> Source: kb Verdict: kb_only
Differentiate  $x^3 + 4x$ .  $d/dx = 3x^2 + 4$ .

```

```

> Query: Solve  $2x + 3 = 7$ 
[Router] KB hits found. Top score: 0.812
-> Source: kb Verdict: kb_only
Solve  $2x + 3 = 7$ . Steps:  $2x = 4 \Rightarrow x = 2$ .

```

```

> Query: Integrate  $\sin(x)$   $dx$ 
[Router] KB hits found. Top score: 0.802
-> Source: kb Verdict: kb_only
Integrate  $\sin(x)$   $dx = -\cos(x) + C$ .

```

```

> Query: Find limit of  $(x^2 - 4)/(x - 2)$  as  $x$  approaches 2
[Router] KB hits found. Top score: 0.972
-> Source: sympy+kb Verdict: verified
1) Expression:  $(x^2 - 4)/(x - 2)$ 
2) Compute limit as  $x \rightarrow 2$ 
3) Result: 4

```

```

> Query: Explain method of Lagrange multipliers
-> Source: None Verdict: None
[No answer found – try enabling use_openai=True for this type of query]

```

```

In [36]: example_q = "Differentiate  $x^3 + 4x$ "
res = route_and_answer(example_q)
imgfile = render_steps_image(res["answer"], fname="example_solution.png")
print("\nRendered solution image:", imgfile)
# show the image inline (Jupyter)
from IPython.display import Image, display
display(Image(filename=imgfile))

```

[Router] KB hits found. Top score: 0.917

Rendered solution image: example\_solution.png



Differentiate  $x^3 + 4x$ .  $d/dx = 3x^2 + 4$ .

```
In [37]: route_and_answer("Solve 3x + 7 = 19")
```

[Router] KB hits found. Top score: 0.576

```
Out[37]: {'answer': 'Solve 2x + 3 = 7. Steps: 2x = 4 => x = 2.',
          'source': 'kb',
          'kb_text': 'Solve 2x + 3 = 7. Steps: 2x = 4 => x = 2.',
          'verdict': 'kb_only'}
```

```
In [38]: route_and_answer("Find the derivative of x^4 + 5x^2 - 3x + 7")
```

[Router] KB hits found. Top score: 0.573

```
Out[38]: {'answer': 'Differentiate x^3 + 4x. d/dx = 3x^2 + 4.',
          'source': 'kb',
          'kb_text': 'Differentiate x^3 + 4x. d/dx = 3x^2 + 4.',
          'verdict': 'kb_only'}
```

```
In [39]: route_and_answer("Explain the concept of gradient descent", use_openai=True)
```

[Router] KB hits found. Top score: 0.124

```
Out[39]: {'answer': "I couldn't find a confident answer. Please rephrase or provide additional context.",
          'source': 'none',
          'verdict': 'no_answer'}
```

```
In [40]: query = "Differentiate x^3 + 2x + 1"
         res = route_and_answer(query)
         imgfile = render_steps_image(res["answer"], fname="my_solution.png")

         from IPython.display import Image, display
         display(Image(filename=imgfile))
```

[Router] KB hits found. Top score: 0.674

Differentiate  $x^3 + 4x$ .  $d/dx = 3x^2 + 4$ .

```
In [41]: query = "Solve the equation  $x^2 + 5x + 6 = 0$ "
result = route_and_answer(query)
print("Question:", query)
print("Source:", result.get("source"))
print("Verdict:", result.get("verdict"))
print("Answer:\n", result.get("answer"))
```

```
[Router] KB hits found. Top score: 0.425
Question: Solve the equation  $x^2 + 5x + 6 = 0$ 
Source: kb
Verdict: kb_only
Answer:
Solve  $2x + 3 = 7$ . Steps:  $2x = 4 \Rightarrow x = 2$ .
```

```
In [ ]:
```