

ChatBot

May 8, 2024

1 Incorporating RAG with Version Control

2 Required libraries:

```
[ ]: !pip install PyPDF2==3.0.1
!pip install PyMuPDF
!pip install -qU langchain pypdf llama-cpp-python huggingface_hub
!pip install -qU sentence_transformers
!pip install -q chromadb
!pip install rank_bm25
!pip install -q ragas
!pip install langchain-community
!pip install langchain
!pip install transformers torch numpy scikit-learn sentencepiece tqdm requests
↳typing regex dataclasses tokenizers typing-extensions
!pip install langchain-openai
```

Requirement already satisfied: PyPDF2==3.0.1 in /usr/local/lib/python3.10/dist-packages (3.0.1)

Exception in thread Thread-5 (attachment_entry):

Traceback (most recent call last):

File "/usr/local/lib/python3.10/dist-packages/debugpy/server/api.py", line 237, in listen

sock, _ = endpoints_listener.accept()

File "/usr/lib/python3.10/socket.py", line 293, in accept

fd, addr = self._accept()

TimeoutError: timed out

During handling of the above exception, another exception occurred:

Traceback (most recent call last):

File "/usr/lib/python3.10/threading.py", line 1016, in _bootstrap_inner
self.run()

File "/usr/lib/python3.10/threading.py", line 953, in run

self._target(*self._args, **self._kwargs)

File "/usr/local/lib/python3.10/dist-packages/google/colab/_debugpy.py", line 52, in attachment_entry

```

    debugpy.listen(_dap_port)
File "/usr/local/lib/python3.10/dist-packages/debugpy/public_api.py", line 31,
in wrapper
    return wrapped(*args, **kwargs)
File "/usr/local/lib/python3.10/dist-packages/debugpy/server/api.py", line
143, in debug
    log.reraise_exception("{0}() failed:", func.__name__, level="info")
File "/usr/local/lib/python3.10/dist-packages/debugpy/server/api.py", line
141, in debug
    return func(address, settrace_kwargs, **kwargs)
File "/usr/local/lib/python3.10/dist-packages/debugpy/server/api.py", line
251, in listen
    raise RuntimeError("timed out waiting for adapter to connect")
RuntimeError: timed out waiting for adapter to connect

Requirement already satisfied: PyMuPDF in /usr/local/lib/python3.10/dist-
packages (1.24.2)
Requirement already satisfied: PyMuPDFb==1.24.1 in
/usr/local/lib/python3.10/dist-packages (from PyMuPDF) (1.24.1)
Requirement already satisfied: rank_bm25 in /usr/local/lib/python3.10/dist-
packages (0.2.2)
Requirement already satisfied: numpy in /usr/local/lib/python3.10/dist-packages
(from rank_bm25) (1.25.2)
Requirement already satisfied: langchain-community in
/usr/local/lib/python3.10/dist-packages (0.0.36)
Requirement already satisfied: PyYAML>=5.3 in /usr/local/lib/python3.10/dist-
packages (from langchain-community) (6.0.1)
Requirement already satisfied: SQLAlchemy<3,>=1.4 in
/usr/local/lib/python3.10/dist-packages (from langchain-community) (2.0.29)
Requirement already satisfied: aiohttp<4.0.0,>=3.8.3 in
/usr/local/lib/python3.10/dist-packages (from langchain-community) (3.9.5)
Requirement already satisfied: dataclasses-json<0.7,>=0.5.7 in
/usr/local/lib/python3.10/dist-packages (from langchain-community) (0.6.5)
Requirement already satisfied: langchain-core<0.2.0,>=0.1.48 in
/usr/local/lib/python3.10/dist-packages (from langchain-community) (0.1.48)
Requirement already satisfied: langsmith<0.2.0,>=0.1.0 in
/usr/local/lib/python3.10/dist-packages (from langchain-community) (0.1.52)
Requirement already satisfied: numpy<2,>=1 in /usr/local/lib/python3.10/dist-
packages (from langchain-community) (1.25.2)
Requirement already satisfied: requests<3,>=2 in /usr/local/lib/python3.10/dist-
packages (from langchain-community) (2.31.0)
Requirement already satisfied: tenacity<9.0.0,>=8.1.0 in
/usr/local/lib/python3.10/dist-packages (from langchain-community) (8.2.3)
Requirement already satisfied: aiosignal>=1.1.2 in
/usr/local/lib/python3.10/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain-
community) (1.3.1)
Requirement already satisfied: attrs>=17.3.0 in /usr/local/lib/python3.10/dist-
packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (23.2.0)

```

Requirement already satisfied: frozenlist>=1.1.1 in /usr/local/lib/python3.10/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (1.4.1)

Requirement already satisfied: multidict<7.0,>=4.5 in /usr/local/lib/python3.10/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (6.0.5)

Requirement already satisfied: yarl<2.0,>=1.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (1.9.4)

Requirement already satisfied: async-timeout<5.0,>=4.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (4.0.3)

Requirement already satisfied: marshmallow<4.0.0,>=3.18.0 in /usr/local/lib/python3.10/dist-packages (from dataclasses-json<0.7,>=0.5.7->langchain-community) (3.21.2)

Requirement already satisfied: typing-inspect<1,>=0.4.0 in /usr/local/lib/python3.10/dist-packages (from dataclasses-json<0.7,>=0.5.7->langchain-community) (0.9.0)

Requirement already satisfied: jsonpatch<2.0,>=1.33 in /usr/local/lib/python3.10/dist-packages (from langchain-core<0.2.0,>=0.1.48->langchain-community) (1.33)

Requirement already satisfied: packaging<24.0,>=23.2 in /usr/local/lib/python3.10/dist-packages (from langchain-core<0.2.0,>=0.1.48->langchain-community) (23.2)

Requirement already satisfied: pydantic<3,>=1 in /usr/local/lib/python3.10/dist-packages (from langchain-core<0.2.0,>=0.1.48->langchain-community) (2.7.1)

Requirement already satisfied: orjson<4.0.0,>=3.9.14 in /usr/local/lib/python3.10/dist-packages (from langsmith<0.2.0,>=0.1.0->langchain-community) (3.10.2)

Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2->langchain-community) (3.3.2)

Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2->langchain-community) (3.7)

Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2->langchain-community) (2.0.7)

Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2->langchain-community) (2024.2.2)

Requirement already satisfied: typing-extensions>=4.6.0 in /usr/local/lib/python3.10/dist-packages (from SQLAlchemy<3,>=1.4->langchain-community) (4.11.0)

Requirement already satisfied: greenlet!=0.4.17 in /usr/local/lib/python3.10/dist-packages (from SQLAlchemy<3,>=1.4->langchain-community) (3.0.3)

Requirement already satisfied: jsonpointer>=1.9 in /usr/local/lib/python3.10/dist-packages (from jsonpatch<2.0,>=1.33->langchain-core<0.2.0,>=0.1.48->langchain-community) (2.4)

Requirement already satisfied: annotated-types>=0.4.0 in /usr/local/lib/python3.10/dist-packages (from pydantic<3,>=1->langchain-core<0.2.0,>=0.1.48->langchain-community) (0.6.0)

Requirement already satisfied: pydantic-core==2.18.2 in /usr/local/lib/python3.10/dist-packages (from pydantic<3,>=1->langchain-core<0.2.0,>=0.1.48->langchain-community) (2.18.2)

Requirement already satisfied: mpyy-extensions>=0.3.0 in /usr/local/lib/python3.10/dist-packages (from typing-inspect<1,>=0.4.0->dataclasses-json<0.7,>=0.5.7->langchain-community) (1.0.0)

Requirement already satisfied: langchain in /usr/local/lib/python3.10/dist-packages (0.1.17)

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Requirement already satisfied: langchain-text-splitters<0.1,>=0.0.1 in /usr/local/lib/python3.10/dist-packages (from langchain) (0.0.1)

Requirement already satisfied: langsmith<0.2.0,>=0.1.17 in /usr/local/lib/python3.10/dist-packages (from langchain) (0.1.52)

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 (2.4)
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 Requirement already satisfied: annotated-types>=0.4.0 in
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 (3.0.3)
 Requirement already satisfied: mypy-extensions>=0.3.0 in
 /usr/local/lib/python3.10/dist-packages (from typing-
 inspect<1,>=0.4.0->dataclasses-json<0.7,>=0.5.7->langchain) (1.0.0)
 Requirement already satisfied: transformers in /usr/local/lib/python3.10/dist-
 packages (4.40.1)
 Requirement already satisfied: torch in /usr/local/lib/python3.10/dist-packages
 (2.2.1+cu121)
 Requirement already satisfied: numpy in /usr/local/lib/python3.10/dist-packages
 (1.25.2)

Requirement already satisfied: scikit-learn in /usr/local/lib/python3.10/dist-packages (1.2.2)

Requirement already satisfied: sentencepiece in /usr/local/lib/python3.10/dist-packages (0.1.99)

Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packages (4.66.2)

Requirement already satisfied: requests in /usr/local/lib/python3.10/dist-packages (2.31.0)

Requirement already satisfied: typing in /usr/local/lib/python3.10/dist-packages (3.7.4.3)

Requirement already satisfied: regex in /usr/local/lib/python3.10/dist-packages (2023.12.25)

Requirement already satisfied: dataclasses in /usr/local/lib/python3.10/dist-packages (0.6)

Requirement already satisfied: tokenizers in /usr/local/lib/python3.10/dist-packages (0.19.1)

Requirement already satisfied: typing-extensions in /usr/local/lib/python3.10/dist-packages (4.11.0)

Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-packages (from transformers) (3.13.4)

Requirement already satisfied: huggingface-hub<1.0,>=0.19.3 in /usr/local/lib/python3.10/dist-packages (from transformers) (0.23.0)

Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from transformers) (23.2)

Requirement already satisfied: pyyaml>=5.1 in /usr/local/lib/python3.10/dist-packages (from transformers) (6.0.1)

Requirement already satisfied: safetensors>=0.4.1 in /usr/local/lib/python3.10/dist-packages (from transformers) (0.4.3)

Requirement already satisfied: sympy in /usr/local/lib/python3.10/dist-packages (from torch) (1.12)

Requirement already satisfied: networkx in /usr/local/lib/python3.10/dist-packages (from torch) (3.3)

Requirement already satisfied: jinja2 in /usr/local/lib/python3.10/dist-packages (from torch) (3.1.3)

Requirement already satisfied: fsspec in /usr/local/lib/python3.10/dist-packages (from torch) (2023.6.0)

Requirement already satisfied: nvidia-cuda-nvrtc-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch) (12.1.105)

Requirement already satisfied: nvidia-cuda-runtime-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch) (12.1.105)

Requirement already satisfied: nvidia-cuda-cupti-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch) (12.1.105)

Requirement already satisfied: nvidia-cudnn-cu12==8.9.2.26 in /usr/local/lib/python3.10/dist-packages (from torch) (8.9.2.26)

Requirement already satisfied: nvidia-cublas-cu12==12.1.3.1 in /usr/local/lib/python3.10/dist-packages (from torch) (12.1.3.1)

Requirement already satisfied: nvidia-cufft-cu12==11.0.2.54 in /usr/local/lib/python3.10/dist-packages (from torch) (11.0.2.54)

Requirement already satisfied: nvidia-curand-cu12==10.3.2.106 in /usr/local/lib/python3.10/dist-packages (from torch) (10.3.2.106)

Requirement already satisfied: nvidia-cusolver-cu12==11.4.5.107 in /usr/local/lib/python3.10/dist-packages (from torch) (11.4.5.107)

Requirement already satisfied: nvidia-cusparse-cu12==12.1.0.106 in /usr/local/lib/python3.10/dist-packages (from torch) (12.1.0.106)

Requirement already satisfied: nvidia-nccl-cu12==2.19.3 in /usr/local/lib/python3.10/dist-packages (from torch) (2.19.3)

Requirement already satisfied: nvidia-nvtx-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch) (12.1.105)

Requirement already satisfied: triton==2.2.0 in /usr/local/lib/python3.10/dist-packages (from torch) (2.2.0)

Requirement already satisfied: nvidia-nvjitlink-cu12 in /usr/local/lib/python3.10/dist-packages (from nvidia-cusolver-cu12==11.4.5.107->torch) (12.4.127)

Requirement already satisfied: scipy>=1.3.2 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (1.11.4)

Requirement already satisfied: joblib>=1.1.1 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (1.4.0)

Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (3.4.0)

Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests) (3.3.2)

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Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests) (2024.2.2)

Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/dist-packages (from jinja2->torch) (2.1.5)

Requirement already satisfied: mpmath>=0.19 in /usr/local/lib/python3.10/dist-packages (from sympy->torch) (1.3.0)

Requirement already satisfied: langchain-openai in /usr/local/lib/python3.10/dist-packages (0.1.5)

Requirement already satisfied: langchain-core<0.2.0,>=0.1.46 in /usr/local/lib/python3.10/dist-packages (from langchain-openai) (0.1.48)

Requirement already satisfied: openai<2.0.0,>=1.10.0 in /usr/local/lib/python3.10/dist-packages (from langchain-openai) (1.25.0)

Requirement already satisfied: tiktoken<1,>=0.5.2 in /usr/local/lib/python3.10/dist-packages (from langchain-openai) (0.6.0)

Requirement already satisfied: PyYAML>=5.3 in /usr/local/lib/python3.10/dist-packages (from langchain-core<0.2.0,>=0.1.46->langchain-openai) (6.0.1)

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Requirement already satisfied: langsmith<0.2.0,>=0.1.0 in /usr/local/lib/python3.10/dist-packages (from langchain-

core<0.2.0,>=0.1.46->langchain-openai) (0.1.52)

Requirement already satisfied: packaging<24.0,>=23.2 in /usr/local/lib/python3.10/dist-packages (from langchain-core<0.2.0,>=0.1.46->langchain-openai) (23.2)

Requirement already satisfied: pydantic<3,>=1 in /usr/local/lib/python3.10/dist-packages (from langchain-core<0.2.0,>=0.1.46->langchain-openai) (2.7.1)

Requirement already satisfied: tenacity<9.0.0,>=8.1.0 in /usr/local/lib/python3.10/dist-packages (from langchain-core<0.2.0,>=0.1.46->langchain-openai) (8.2.3)

Requirement already satisfied: anyio<5,>=3.5.0 in /usr/local/lib/python3.10/dist-packages (from openai<2.0.0,>=1.10.0->langchain-openai) (3.7.1)

Requirement already satisfied: distro<2,>=1.7.0 in /usr/lib/python3/dist-packages (from openai<2.0.0,>=1.10.0->langchain-openai) (1.7.0)

Requirement already satisfied: httpx<1,>=0.23.0 in /usr/local/lib/python3.10/dist-packages (from openai<2.0.0,>=1.10.0->langchain-openai) (0.27.0)

Requirement already satisfied: sniffio in /usr/local/lib/python3.10/dist-packages (from openai<2.0.0,>=1.10.0->langchain-openai) (1.3.1)

Requirement already satisfied: tqdm>4 in /usr/local/lib/python3.10/dist-packages (from openai<2.0.0,>=1.10.0->langchain-openai) (4.66.2)

Requirement already satisfied: typing-extensions<5,>=4.7 in /usr/local/lib/python3.10/dist-packages (from openai<2.0.0,>=1.10.0->langchain-openai) (4.11.0)

Requirement already satisfied: regex>=2022.1.18 in /usr/local/lib/python3.10/dist-packages (from tiktoken<1,>=0.5.2->langchain-openai) (2023.12.25)

Requirement already satisfied: requests>=2.26.0 in /usr/local/lib/python3.10/dist-packages (from tiktoken<1,>=0.5.2->langchain-openai) (2.31.0)

Requirement already satisfied: idna>=2.8 in /usr/local/lib/python3.10/dist-packages (from anyio<5,>=3.5.0->openai<2.0.0,>=1.10.0->langchain-openai) (3.7)

Requirement already satisfied: exceptiongroup in /usr/local/lib/python3.10/dist-packages (from anyio<5,>=3.5.0->openai<2.0.0,>=1.10.0->langchain-openai) (1.2.1)

Requirement already satisfied: certifi in /usr/local/lib/python3.10/dist-packages (from httpx<1,>=0.23.0->openai<2.0.0,>=1.10.0->langchain-openai) (2024.2.2)

Requirement already satisfied: httpcore==1.* in /usr/local/lib/python3.10/dist-packages (from httpx<1,>=0.23.0->openai<2.0.0,>=1.10.0->langchain-openai) (1.0.5)

Requirement already satisfied: h11<0.15,>=0.13 in /usr/local/lib/python3.10/dist-packages (from httpcore==1.*->httpx<1,>=0.23.0->openai<2.0.0,>=1.10.0->langchain-openai) (0.14.0)

Requirement already satisfied: jsonpointer>=1.9 in /usr/local/lib/python3.10/dist-packages (from jsonpatch<2.0,>=1.33->langchain-core<0.2.0,>=0.1.46->langchain-openai) (2.4)

Requirement already satisfied: orjson<4.0.0,>=3.9.14 in


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/usr/local/lib/python3.10/dist-packages (from
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(3.10.2)
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Requirement already satisfied: pydantic-core==2.18.2 in
/usr/local/lib/python3.10/dist-packages (from pydantic<3,>=1->langchain-
core<0.2.0,>=0.1.46->langchain-openai) (2.18.2)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.10/dist-packages (from
requests>=2.26.0->tiktoken<1,>=0.5.2->langchain-openai) (3.3.2)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.10/dist-packages (from
requests>=2.26.0->tiktoken<1,>=0.5.2->langchain-openai) (2.0.7)

```

```
[ ]: !pip install -U langchain-openai
```

```

Requirement already satisfied: langchain-openai in
/usr/local/lib/python3.10/dist-packages (0.1.5)
Requirement already satisfied: langchain-core<0.2.0,>=0.1.46 in
/usr/local/lib/python3.10/dist-packages (from langchain-openai) (0.1.48)
Requirement already satisfied: openai<2.0.0,>=1.10.0 in
/usr/local/lib/python3.10/dist-packages (from langchain-openai) (1.25.0)
Requirement already satisfied: tiktoken<1,>=0.5.2 in
/usr/local/lib/python3.10/dist-packages (from langchain-openai) (0.6.0)
Requirement already satisfied: PyYAML>=5.3 in /usr/local/lib/python3.10/dist-
packages (from langchain-core<0.2.0,>=0.1.46->langchain-openai) (6.0.1)
Requirement already satisfied: jsonpatch<2.0,>=1.33 in
/usr/local/lib/python3.10/dist-packages (from langchain-
core<0.2.0,>=0.1.46->langchain-openai) (1.33)
Requirement already satisfied: langsmith<0.2.0,>=0.1.0 in
/usr/local/lib/python3.10/dist-packages (from langchain-
core<0.2.0,>=0.1.46->langchain-openai) (0.1.52)
Requirement already satisfied: packaging<24.0,>=23.2 in
/usr/local/lib/python3.10/dist-packages (from langchain-
core<0.2.0,>=0.1.46->langchain-openai) (23.2)
Requirement already satisfied: pydantic<3,>=1 in /usr/local/lib/python3.10/dist-
packages (from langchain-core<0.2.0,>=0.1.46->langchain-openai) (2.7.1)
Requirement already satisfied: tenacity<9.0.0,>=8.1.0 in
/usr/local/lib/python3.10/dist-packages (from langchain-
core<0.2.0,>=0.1.46->langchain-openai) (8.2.3)
Requirement already satisfied: anyio<5,>=3.5.0 in
/usr/local/lib/python3.10/dist-packages (from openai<2.0.0,>=1.10.0->langchain-
openai) (3.7.1)
Requirement already satisfied: distro<2,>=1.7.0 in /usr/lib/python3/dist-
packages (from openai<2.0.0,>=1.10.0->langchain-openai) (1.7.0)
Requirement already satisfied: httpx<1,>=0.23.0 in

```

/usr/local/lib/python3.10/dist-packages (from openai<2.0.0,>=1.10.0->langchain-openai) (0.27.0)

Requirement already satisfied: sniffio in /usr/local/lib/python3.10/dist-packages (from openai<2.0.0,>=1.10.0->langchain-openai) (1.3.1)

Requirement already satisfied: tqdm>4 in /usr/local/lib/python3.10/dist-packages (from openai<2.0.0,>=1.10.0->langchain-openai) (4.66.2)

Requirement already satisfied: typing-extensions<5,>=4.7 in /usr/local/lib/python3.10/dist-packages (from openai<2.0.0,>=1.10.0->langchain-openai) (4.11.0)

Requirement already satisfied: regex>=2022.1.18 in /usr/local/lib/python3.10/dist-packages (from tiktoken<1,>=0.5.2->langchain-openai) (2023.12.25)

Requirement already satisfied: requests>=2.26.0 in /usr/local/lib/python3.10/dist-packages (from tiktoken<1,>=0.5.2->langchain-openai) (2.31.0)

Requirement already satisfied: idna>=2.8 in /usr/local/lib/python3.10/dist-packages (from anyio<5,>=3.5.0->openai<2.0.0,>=1.10.0->langchain-openai) (3.7)

Requirement already satisfied: exceptiongroup in /usr/local/lib/python3.10/dist-packages (from anyio<5,>=3.5.0->openai<2.0.0,>=1.10.0->langchain-openai) (1.2.1)

Requirement already satisfied: certifi in /usr/local/lib/python3.10/dist-packages (from httpx<1,>=0.23.0->openai<2.0.0,>=1.10.0->langchain-openai) (2024.2.2)

Requirement already satisfied: httpcore==1.* in /usr/local/lib/python3.10/dist-packages (from httpx<1,>=0.23.0->openai<2.0.0,>=1.10.0->langchain-openai) (1.0.5)

Requirement already satisfied: h11<0.15,>=0.13 in /usr/local/lib/python3.10/dist-packages (from httpcore==1.*->httpx<1,>=0.23.0->openai<2.0.0,>=1.10.0->langchain-openai) (0.14.0)

Requirement already satisfied: jsonpointer>=1.9 in /usr/local/lib/python3.10/dist-packages (from jsonpatch<2.0,>=1.33->langchain-core<0.2.0,>=0.1.46->langchain-openai) (2.4)

Requirement already satisfied: orjson<4.0.0,>=3.9.14 in /usr/local/lib/python3.10/dist-packages (from langsmith<0.2.0,>=0.1.0->langchain-core<0.2.0,>=0.1.46->langchain-openai) (3.10.2)

Requirement already satisfied: annotated-types>=0.4.0 in /usr/local/lib/python3.10/dist-packages (from pydantic<3,>=1->langchain-core<0.2.0,>=0.1.46->langchain-openai) (0.6.0)

Requirement already satisfied: pydantic-core==2.18.2 in /usr/local/lib/python3.10/dist-packages (from pydantic<3,>=1->langchain-core<0.2.0,>=0.1.46->langchain-openai) (2.18.2)

Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests>=2.26.0->tiktoken<1,>=0.5.2->langchain-openai) (3.3.2)

Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from requests>=2.26.0->tiktoken<1,>=0.5.2->langchain-openai) (2.0.7)

```
[ ]: !pip install --upgrade langchain
```

```
Requirement already satisfied: langchain in /usr/local/lib/python3.10/dist-packages (0.1.17)
Requirement already satisfied: PyYAML>=5.3 in /usr/local/lib/python3.10/dist-packages (from langchain) (6.0.1)
Requirement already satisfied: SQLAlchemy<3,>=1.4 in /usr/local/lib/python3.10/dist-packages (from langchain) (2.0.29)
Requirement already satisfied: aiohttp<4.0.0,>=3.8.3 in /usr/local/lib/python3.10/dist-packages (from langchain) (3.9.5)
Requirement already satisfied: async-timeout<5.0.0,>=4.0.0 in /usr/local/lib/python3.10/dist-packages (from langchain) (4.0.3)
Requirement already satisfied: dataclasses-json<0.7,>=0.5.7 in /usr/local/lib/python3.10/dist-packages (from langchain) (0.6.5)
Requirement already satisfied: jsonpatch<2.0,>=1.33 in /usr/local/lib/python3.10/dist-packages (from langchain) (1.33)
Requirement already satisfied: langchain-community<0.1,>=0.0.36 in /usr/local/lib/python3.10/dist-packages (from langchain) (0.0.36)
Requirement already satisfied: langchain-core<0.2.0,>=0.1.48 in /usr/local/lib/python3.10/dist-packages (from langchain) (0.1.48)
Requirement already satisfied: langchain-text-splitters<0.1,>=0.0.1 in /usr/local/lib/python3.10/dist-packages (from langchain) (0.0.1)
Requirement already satisfied: langsmith<0.2.0,>=0.1.17 in /usr/local/lib/python3.10/dist-packages (from langchain) (0.1.52)
Requirement already satisfied: numpy<2,>=1 in /usr/local/lib/python3.10/dist-packages (from langchain) (1.25.2)
Requirement already satisfied: pydantic<3,>=1 in /usr/local/lib/python3.10/dist-packages (from langchain) (2.7.1)
Requirement already satisfied: requests<3,>=2 in /usr/local/lib/python3.10/dist-packages (from langchain) (2.31.0)
Requirement already satisfied: tenacity<9.0.0,>=8.1.0 in /usr/local/lib/python3.10/dist-packages (from langchain) (8.2.3)
Requirement already satisfied: aiosignal>=1.1.2 in /usr/local/lib/python3.10/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain) (1.3.1)
Requirement already satisfied: attrs>=17.3.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain) (23.2.0)
Requirement already satisfied: frozenlist>=1.1.1 in /usr/local/lib/python3.10/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain) (1.4.1)
Requirement already satisfied: multidict<7.0,>=4.5 in /usr/local/lib/python3.10/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain) (6.0.5)
Requirement already satisfied: yarl<2.0,>=1.0 in /usr/local/lib/python3.10/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain) (1.9.4)
Requirement already satisfied: marshmallow<4.0.0,>=3.18.0 in /usr/local/lib/python3.10/dist-packages (from dataclasses-
```

```

json<0.7,>=0.5.7->langchain) (3.21.2)
Requirement already satisfied: typing-inspect<1,>=0.4.0 in
/usr/local/lib/python3.10/dist-packages (from dataclasses-
json<0.7,>=0.5.7->langchain) (0.9.0)
Requirement already satisfied: jsonpointer>=1.9 in
/usr/local/lib/python3.10/dist-packages (from jsonpatch<2.0,>=1.33->langchain)
(2.4)
Requirement already satisfied: packaging<24.0,>=23.2 in
/usr/local/lib/python3.10/dist-packages (from langchain-
core<0.2.0,>=0.1.48->langchain) (23.2)
Requirement already satisfied: orjson<4.0.0,>=3.9.14 in
/usr/local/lib/python3.10/dist-packages (from
langsmith<0.2.0,>=0.1.17->langchain) (3.10.2)
Requirement already satisfied: annotated-types>=0.4.0 in
/usr/local/lib/python3.10/dist-packages (from pydantic<3,>=1->langchain) (0.6.0)
Requirement already satisfied: pydantic-core==2.18.2 in
/usr/local/lib/python3.10/dist-packages (from pydantic<3,>=1->langchain)
(2.18.2)
Requirement already satisfied: typing-extensions>=4.6.1 in
/usr/local/lib/python3.10/dist-packages (from pydantic<3,>=1->langchain)
(4.11.0)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2->langchain) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-
packages (from requests<3,>=2->langchain) (3.7)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2->langchain) (2.0.7)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2->langchain)
(2024.2.2)
Requirement already satisfied: greenlet!=0.4.17 in
/usr/local/lib/python3.10/dist-packages (from SQLAlchemy<3,>=1.4->langchain)
(3.0.3)
Requirement already satisfied: mypy-extensions>=0.3.0 in
/usr/local/lib/python3.10/dist-packages (from typing-
inspect<1,>=0.4.0->dataclasses-json<0.7,>=0.5.7->langchain) (1.0.0)

```

```

[ ]: !pip install -q -U rank_bm25
      %pip install --upgrade --quiet rank_bm25 > /dev/null

```

```

[ ]: from langchain.schema import Document
      import glob
      import PyPDF2
      from google.colab import files
      import fitz # PyMuPDF
      import os
      import openai

```

```

from getpass import getpass
from langchain_openai import OpenAI
import os
from google.colab import userdata
import langchain
from langchain import OpenAI, VectorDBQA
from langchain.document_loaders import PyMuPDFLoader, TextLoader
from langchain.text_splitter import RecursiveCharacterTextSplitter,
↳CharacterTextSplitter
from langchain.embeddings import OpenAIEmbeddings
from langchain_community.vectorstores import Chroma
from langchain_community.retrievers import BM25Retriever
from langchain.retrievers import EnsembleRetriever
from langchain.retrievers import ContextualCompressionRetriever
from __future__ import annotations
from typing import Dict, Optional, Sequence
from langchain.schema import Document
from langchain.pydantic_v1 import Extra, root_validator

from langchain.callbacks.manager import Callbacks
from langchain.retrievers.document_compressors.base import
↳BaseDocumentCompressor
from sentence_transformers import CrossEncoder
from langchain_community.document_transformers.embeddings_redundant_filter
↳import EmbeddingsRedundantFilter
from langchain.retrievers.document_compressors import DocumentCompressorPipeline
from langchain.retrievers import ContextualCompressionRetriever
from langchain_community.document_transformers.long_context_reorder import
↳LongContextReorder
from langchain.retrievers.multi_query import MultiQueryRetriever
from datasets import Dataset
from ragas import evaluate

```

3 PDFLoader for loading the multiple PDF documents for processing into small chunks for the RAG process:

```

[ ]: class PDFLoader:
    def __init__(self, file_paths):
        self.file_paths = file_paths

    def load(self):
        documents = []
        for file_path in self.file_paths:
            with open(file_path, 'rb') as file:
                # Open the PDF file

```

```

        doc = fitz.open(file)
        # Extract text from each page
        text = ""
        for page in doc:
            text += page.get_text()
        # Create a document object with the text content
        document = Document(page_content=text)
        documents.append(document)
    return documents

# Upload the PDF files
uploaded = files.upload()

# Get the list of uploaded file names
uploaded_files = list(uploaded.keys())

# Use PDFLoader to load the uploaded PDF files
loader = PDFLoader(uploaded_files)
documents = loader.load()

# Print the number of documents loaded
print("Number of documents loaded:", len(documents))

```

<IPython.core.display.HTML object>

Saving liabilities 2020-2024.pdf to liabilities 2020-2024.pdf
 Number of documents loaded: 1

4 Importing the API Key from OpenAI:

```

[ ]: from google.colab import userdata
my_secret_key = userdata.get('OPENAI_API_KEY')

[ ]: #openai.api_key = getpass("Please provide your OpenAI Key: ")
#os.environ["OPENAI_API_KEY"] = openai.api_key
os.environ["OPENAI_API_KEY"] = userdata.get('OPENAI_API_KEY')

```

5 Using OpenAI Embeddings for Word Embedding Process:

```

[ ]: from langchain_openai import OpenAIEmbeddings

embeddings = OpenAIEmbeddings(
    model="text-embedding-ada-002"
)

```

6 Importing OpenAI Model:

```
[ ]: #os.environ["OPENAI_API_KEY"] = userdata.get('OPENAI_API_KEY')
from langchain_openai import OpenAI
openai_llm = OpenAI(temperature=0)
```

7 Document splitter into small chunks for rag process:

```
[ ]: text_splitter = RecursiveCharacterTextSplitter(
    chunk_size=1250,
    chunk_overlap=100,
    length_function=len
)

split_docs = text_splitter.split_documents(documents)
print((split_docs))
print(len(split_docs))
```

[illegible]

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8 Vector Storeage - ChromaDB for word embedding:

```
[ ]: vectorstore = Chroma(embedding_function=embeddings,
                           persist_directory="/content/drive/MyDrive/Vectorstore/
                           ↪chromadb",
                           collection_name="full_documents")
```

9 Using BM25(Best Parameter Match) from Hugging Face using API:

```
[ ]: bm25_retriever = BM25Retriever.from_documents(split_docs)
bm25_retriever.k=10    ## Pulling the top 10 best parameter match, this is the
    ↪model which re-rank the parameter for
    ## pulling the latest version information.
```

```
[ ]: class BgeRerank(BaseDocumentCompressor):
    model_name:str = 'BAAI/bge-reranker-large'
    """reranking is opted from hugging face."""
    top_n: int = 10
    """number of documents that return from the bot."""
    model:CrossEncoder = CrossEncoder(model_name)
    """cross encoder."""

    def bge_rerank(self,query,docs):
        model_inputs = [[query, doc] for doc in docs]
        scores = self.model.predict(model_inputs)
        results = sorted(enumerate(scores), key=lambda x: x[1], reverse=True)
        return results[:self.top_n]

    class Config:
        """Configuration."""

        extra = Extra.forbid
        arbitrary_types_allowed = True

    def compress_documents(
        self,
        documents: Sequence[Document],
        query: str,
        callbacks: Optional[Callbacks] = None,
    ) -> Sequence[Document]:
        """
        compress using reranking.

        Args:
```

```

        documents: number of documents to compress using the sequence.
        query: query for the compress.
        callbacks: return post compress or during compress.

    Returns:
        all compressed documents in sequence.
    """
    if len(documents) == 0: # to avoid empty api call
        return []
    doc_list = list(documents)
    _docs = [d.page_content for d in doc_list]
    results = self.bge_rerank(query, _docs)
    final_results = []
    for r in results:
        doc = doc_list[r[0]]
        doc.metadata["relevance_score"] = r[1]
        final_results.append(doc)
    return final_results

```

/usr/local/lib/python3.10/dist-packages/huggingface_hub/file_download.py:1132: FutureWarning: `resume_download` is deprecated and will be removed in version 1.0.0. Downloads always resume when possible. If you want to force a new download, use `force_download=True`.

```

warnings.warn(
config.json: 0%|          | 0.00/801 [00:00<?, ?B/s]
model.safetensors: 0%|          | 0.00/2.24G [00:00<?, ?B/s]
tokenizer_config.json: 0%|          | 0.00/443 [00:00<?, ?B/s]
sentencepiece.bpe.model: 0%|          | 0.00/5.07M [00:00<?, ?B/s]
tokenizer.json: 0%|          | 0.00/17.1M [00:00<?, ?B/s]
special_tokens_map.json: 0%|          | 0.00/279 [00:00<?, ?B/s]

```

9.1 Vectorstore retriever using re-ranking and preparing context pipeline top 10:

```

[ ]: #
vs_retriever = vectorstore.as_retriever(search_kwargs={"k":10})
#
ensemble_retriever = EnsembleRetriever(retrievers=[bm25_retriever,vs_retriever],
                                       weight=[0.5,0.5])
#
redundant_filter = EmbeddingsRedundantFilter(embeddings=embeddings)
#

```

```

reordering = LongContextReorder()
#
reranker = BgeRerank()
#
pipeline_compressor =
    ↳ DocumentCompressorPipeline(transformers=[redundant_filter, reordering, reranker])
#
compression_pipeline =
    ↳ ContextualCompressionRetriever(base_compressor=pipeline_compressor,
                                     ↳
    ↳ base_retriever=ensemble_retriever)

```

10 Function to test the documents retriever:

```

[ ]: def pretty_print_docs(docs):
    print(
        f"\n{'-' * 100}\n".join([f"Document {i+1}:\n\n + {d.page_content}" for
    ↳ i, d in enumerate(docs)])
    )

```

11 Printing the context retriever:

```

[ ]: pretty_print_docs(vs_retriever.get_relevant_documents("What is not present in
    ↳ google's liability for all users in the May 2020 version?"))

```

/usr/local/lib/python3.10/dist-packages/langchain_core/_api/deprecation.py:119:
 LangChainDeprecationWarning: The method `BaseRetriever.get_relevant_documents`
 was deprecated in langchain-core 0.1.46 and will be removed in 0.3.0. Use invoke
 instead.
 warn_deprecated(

```

[ ]: docs = compression_pipeline.get_relevant_documents("What is not present in
    ↳ google's liability for all users in the May 2020 version?")
    pretty_print_docs(docs)

```

Document 1:

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12 VectorDBQ pipeline retrieval for QA(Rag):

```
[ ]: from langchain.chains import RetrievalQA
#
qa_vectorDBQ = RetrievalQA.from_chain_type(llm=openai_llm,
                                           chain_type="stuff",
                                           retriever=vectorstore.
                                           as_retriever(search_kwargs={"k":5}),
                                           return_source_documents=True)
```

```
naive_vectorDBQresponse = qa_vectorDBQ("What is not present in google's liability for all users in the May 2020 version?")
naive_vectorDBQresponse["result"]
```

```
[ ]: "\n\nI don't know."
```

13 Reranker VectorDBQ pipeline retrieval for QA(Reranker Rag) version based retrieval:

```
[ ]: from langchain.chains import RetrievalQA
#
qa_BM25 = RetrievalQA.from_chain_type(llm=openai_llm,
                                     chain_type="stuff",
                                     retriever=compression_pipeline,
                                     return_source_documents=True)
#
qa_bm25response = qa_BM25("What is not present in google's liability for all users in the May 2020 version?")
qa_bm25response["result"]
```

```
[ ]: " Google's liability for gross negligence or willful misconduct is not limited in the May 2020 version."
```

14 Creating a Testdataset for evaluation of models using OpenAI and RAG Library:

15 Direct VectorDBQ Rag:

```
[ ]: from ragas.testset.generator import TestsetGenerator
from ragas.testset.evolutions import simple, reasoning, multi_context

documents = loader.load()
text_splitter = RecursiveCharacterTextSplitter(
    chunk_size = 2000,
    chunk_overlap = 5
)
documents = text_splitter.split_documents(documents)
len(documents)
#
#
generator = TestsetGenerator.with_openai()
#
```

```
testset = generator.generate_with_langchain_docs(documents, test_size=3,
↪distributions={simple: 0.5, reasoning: 0.25, multi_context: 0.25})
```

<ipython-input-23-33fb06ec53f1>:17: DeprecationWarning: The function with_openai was deprecated in 0.1.4, and will be removed in the 0.2.0 release. Use from_langchain instead.

```
generator = TestsetGenerator.with_openai()
```

```
embedding nodes: 0%|          | 0/6 [00:00<?, ?it/s]
```

WARNING:ragas.testset.docstore:Filename and doc_id are the same for all nodes.

```
Generating: 0%|          | 0/4 [00:00<?, ?it/s]
```

WARNING:ragas.executor:max retries exceeded for SimpleEvolution(generator_llm=LangchainLLMWrapper(run_config=RunConfig(timeout=60, max_retries=15, max_wait=90, max_workers=16, exception_types=<class 'openai.RateLimitError'>)), docstore=InMemoryDocumentStore(splitter=<langchain_text_splitters.base.TokenTextSplitter object at 0x7a3b95238460>, nodes=[Node(page_content='(Version: May 2024) Liabilities :For all users: Both the law and these terms \ntry to strike a balance as to what you or Google can claimfrom the other in case of problems. That's \nwhy the law requires everyone to be responsible for certain liabilities - but not others - under \nthese terms.These terms only limit our responsibilities as allowed by applicable law. These terms \ndon't limit liability for gross negligence or willful misconduct. To the extent allowed by applicable law: \nGoogle is liable only for its breaches of these terms or applicable service-specific additional terms \nGoogle isn't liable for:loss of profts, revenues, business opportunities, goodwill, or anticipated \nsavings indirect or consequential losses punitive damages Google's total liability arising out of or \nrelating to these terms is limited to the greater of (1) \$200 or (2) the fees paid to use the relevant \nservices in the 12 months before the dispute For business users and organizations \nonly If you're a business user or organization: To the extent allowed by applicable law, you'll \nindemnify Google and its directors, of cers, employees, and contractors for any third-party legal \nproceedings (including actions by government authorities) arising out of or relating to your unlawful \nuse of the services or violation of these terms or service-specific additional terms. This indemnity \ncovers any liability or expense arising from claims, losses, damages, judgments, nes, litigation \ncosts, and legal fees. If you're legally exempt from certain responsibilities, including indemnification, \nthen those responsibilities don't apply to you under these terms. For example, the United Nations \nenjoys certain immunities from legal obligations and these terms don't override those immunities. \n \n \n \n \n \n \n \n \n \n \n \n \n (Version: January 2022) Liabilities: For all users: Both the law and these terms try \nto strike a balance as to what you or Google can claim from the other in case of problems. That's why the', doc_id='77195a89-93f3-42f7-a9f2-978b1c8c7135', wins=9), Node(page_content='law allows us to limit certain liabilities - but not others - under these terms. These terms only limit our \nresponsibilities as allowed by applicable law. These terms don't limit liability for gross

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(Version: January 2022) Liabilities: For all users: Both the law and these terms try to strike a balance as to what you or Google can claim from the other in case of problems. That's why the', doc_id='77195a89-93f3-42f7-a9f2-978b1c8c7135', wins=9), 'ae731618-5a32-4d4d-8c49-098e59905d6a': Node(page_content='law allows us to limit certain liabilities - but not others - under these terms. These terms only limit our responsibilities as allowed by applicable law. These terms don't limit liability for gross negligence or willful misconduct. To the extent allowed by applicable law: Google is liable only for its breaches of these terms or applicable service-specific additional terms Google isn't liable for: loss of profits, revenues, business opportunities, goodwill, or anticipated savings indirect or consequential losses punitive damages Google's total liability arising out of or relating to these terms is limited to the greater of (1) \$200 or (2) the fees paid to use the relevant services in the 12 months before the dispute. For business users and organizations only: If you're a business user or organization: To the extent allowed by applicable law, you'll indemnify Google and its directors, officers, employees, and contractors for any third-party legal proceedings (including actions by government authorities) arising out of or relating to your unlawful use of the services or violation of these terms or service-specific additional terms. This indemnity covers any liability or expense arising from claims, losses, damages, judgments, fines, litigation costs, and legal fees. If you're legally exempt from certain responsibilities, including indemnification, then those responsibilities don't apply to you under these terms. For example, the United Nations enjoys certain immunities from legal obligations and these terms don't override those immunities.

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limit Google's liability for \ndeath or personal injury, fraud, fraudulent misrepresentation, gross negligence, or willful misconduct. \nOther than the rights and responsibilities described in this section (In case of problems or', doc_id='ae731618-5a32-4d4d-8c49-098e59905d6a', wins=9), 'f7f67b84-976b-4b28-8cab-dabdc7708a4e': Node(page_content='disagreements), Google won't be responsible for any other losses, unless they're caused by our breach of \nthese terms or service-specific additional terms. For business users and organizations only \nIf you're a business user or organization, then to the extent allowed by applicable law: You'll indemnify \nGoogle and its directors, officers, employees, and contractors for any third- party legal proceedings \n(including actions by government authorities) arising out of or relating to your unlawful use of the \nservices or violation of these terms or service-specific additional terms. This indemnity covers any \nliability or expense arising from claims, losses, damages, judgments, fines, litigation costs, and legal fees. \nGoogle won't be responsible for the following liabilities: loss of profits, revenues, business opportunities, \ngoodwill, or anticipated savings indirect or consequential loss punitive damages. Google's total liability \narising out of or relating to these terms is limited to the greater of (1) US\$500 or (2) 125% of the fees that \nyou paid to use the relevant services in the 12 months before the breach If you're legally exempt from \ncertain responsibilities, including indemnification, then those responsibilities don't apply to you under \nthese terms. For example, the United Nations enjoys certain immunities from legal obligations and these \nterms don't override those immunities.', doc_id='f7f67b84-976b-4b28-8cab-dabdc7708a4e', wins=12)), run_config=RunConfig(timeout=60, max_retries=15, max_wait=90, max_workers=16, exception_types=<class 'openai.RateLimitError'>)), node_filter=NodeFilter(llm=LangchainLLMWrapper(run_config=RunConfig(timeout=60, max_retries=15, max_wait=90, max_workers=16, exception_types=<class 'openai.RateLimitError'>)), threshold=1.5, context_scoring_prompt=Prompt(name='score_context', instruction='\n Given a context, perform the following task and output the answer in VALID JSON format: Assess the provided context and assign a numerical score of 1 (Low), 2 (Medium), or 3 (High) for each of the following criteria in your JSON response:\n\nclarity: Evaluate the precision and understandability of the information presented. High scores (3) are reserved for contexts that are both precise in their information and easy to understand. Low scores (1) are for contexts where the information is vague or hard to comprehend.\ndepth: Determine the level of detailed examination and the inclusion of innovative insights within the context. A high score indicates a comprehensive and insightful analysis, while a low score suggests a superficial treatment of the topic.\nstructure: Assess how well the content is organized and whether it flows logically. High scores are awarded to contexts that demonstrate coherent organization and logical progression, whereas low scores indicate a lack of structure or clarity in progression.\nrelevance: Judge the pertinence of the content to the main topic, awarding high scores to contexts tightly focused on the subject without unnecessary digressions, and low scores to those that are cluttered with irrelevant information.\nStructure your JSON output to reflect these criteria as keys with their corresponding scores as values\n ',

```

output_format_instruction='The output should be a well-formatted JSON instance
that conforms to the JSON schema below.\n\nAs an example, for the schema
{"properties": {"foo": {"title": "Foo", "description": "a list of strings",
"type": "array", "items": {"type": "string"}}}, "required": ["foo"]}\nthe object
{"foo": ["bar", "baz"]} is a well-formatted instance of the schema. The object
{"properties": {"foo": ["bar", "baz"]}} is not well-formatted.\n\nHere is the
output JSON schema:\n```\n{"type": "object", "properties": {"clarity": {"title":
"Clarity", "type": "integer"}, "depth": {"title": "Depth", "type": "integer"},
"structure": {"title": "Structure", "type": "integer"}, "relevance": {"title":
"Relevance", "type": "integer"}}, "required": ["clarity", "depth", "structure",
"relevance"]}\n```\n\nDo not return any preamble or explanations, return only a
pure JSON string surrounded by triple backticks (```).', examples=[{'context':
'The Pythagorean theorem is a fundamental principle in geometry. It states that
in a right-angled triangle, the square of the length of the hypotenuse (the side
opposite the right angle) is equal to the sum of the squares of the lengths of
the other two sides. This can be written as  $a^2 + b^2 = c^2$  where c represents
the length of the hypotenuse, and a and b represent the lengths of the other two
sides.', 'output': {'clarity': 3, 'depth': 1, 'structure': 3, 'relevance': 3}},
{'context': 'Albert Einstein (14 March 1879 - 18 April 1955) was a German-born
theoretical physicist who is widely held to be one of the greatest and most
influential scientists of all time.', 'output': {'clarity': 3, 'depth': 2,
'structure': 3, 'relevance': 3}}, {'context': 'I love chocolate. It's really
tasty. Oh, and by the way, the earth orbits the sun, not the other way around.
Also, my favorite color is blue.', 'output': {'clarity': 2, 'depth': 1,
'structure': 1, 'relevance': 1}}], input_keys=['context'], output_key='output',
output_type='json', language='english')), question_filter=QuestionFilter(llm=Lan
gchainLLMWrapper(run_config=RunConfig(timeout=60, max_retries=15, max_wait=90,
max_workers=16, exception_types=<class 'openai.RateLimitError'>)),
filter_question_prompt=Prompt(name='filter_question', instruction='\nAsses the
given question for clarity and answerability given enough domain knowledge,
consider the following criteria:\n1.Independence: Can the question be understood
and answered without needing additional context or access to external references
not provided within the question itself? Questions should be self-contained,
meaning they do not rely on specific documents, tables, or prior knowledge not
shared within the question.\n2.Clear Intent: Is it clear what type of answer or
information the question seeks? The question should convey its purpose without
ambiguity, allowing for a direct and relevant response.\nBased on these
criteria, assign a verdict of "1" if a question is specific, independent, and
has a clear intent, making it understandable and answerable based on the details
provided. Assign "0" if it fails to meet one or more of these criteria due to
vagueness, reliance on external references, or ambiguity in intent.\nProvide
feedback and a verdict in JSON format, including suggestions for improvement if
the question is deemed unclear. Highlight aspects of the question that
contribute to its clarity or lack thereof, and offer advice on how it could be
reframed or detailed for better understanding and answerability.\n',
output_format_instruction='The output should be a well-formatted JSON instance
that conforms to the JSON schema below.\n\nAs an example, for the schema
{"properties": {"foo": {"title": "Foo", "description": "a list of strings",

```

"type": "array", "items": {"type": "string"}}, "required": ["foo"]}\nthe object {"foo": ["bar", "baz"]} is a well-formatted instance of the schema. The object {"properties": {"foo": ["bar", "baz"]}} is not well-formatted.\n\nHere is the output JSON schema:\n```\n{"type": "object", "properties": {"feedback": {"title": "Feedback", "type": "string"}, "verdict": {"title": "Verdict", "type": "integer"}}, "required": ["feedback", "verdict"]}\n```\n\nDo not return any preamble or explanations, return only a pure JSON string surrounded by triple backticks (```).', examples=[{'question': 'What is the discovery about space?', 'output': {'feedback': 'The question is too vague and broad, asking for a 'discovery about space' without specifying any particular aspect, time frame, or context of interest. This could refer to a wide range of topics, from the discovery of new celestial bodies to advancements in space travel technology. To improve clarity and answerability, the question could specify the type of discovery (e.g., astronomical, technological), the time frame (e.g., recent, historical), or the context (e.g., within a specific research study or space mission).', 'verdict': 0}}, {'question': 'How does ALMA-13B-R perform compared to other translation models in the WMT'23 study, based on the results in context1 and context2?', 'output': {'feedback': 'This question asks for a comparison of the ALMA-13B-R model's performance against other translation models within the WMT'23 study, specifically referring to results in 'context1' and 'context2'. While it clearly specifies the model of interest (ALMA-13B-R) and the study (WMT'23), it assumes access to and understanding of 'context1' and 'context2' without explaining what these contexts entail. This makes the question unclear for those not familiar with the WMT'23 study or these specific contexts. To improve clarity and answerability for a broader audience, the question could benefit from defining or describing 'context1' and 'context2' or explaining the criteria used for comparison in these contexts.', 'verdict': 0}}, {'question': 'How do KIWI-XXL and XCOMET compare to the gold standard references in Table 1 in terms of evaluation scores, translation model performance, and success rate in surpassing the references?', 'output': {'feedback': 'The question requests a comparison between KIWI-XXL and XCOMET models and gold standard references in 'Table 1', focusing on evaluation scores, translation model performance, and success rates in surpassing the references. It specifies the models and criteria for comparison, making the intent clear. However, the question assumes access to 'Table 1' without providing its content or context, making it unclear for those without direct access to the source material. To be clearer and more answerable for a general audience, the question could include a brief description of the content or key findings of 'Table 1', or alternatively, frame the question in a way that does not rely on specific, unpublished documents.', 'verdict': 0}}, {'question': 'What is the configuration of UL2 training objective in OpenMoE and why is it a better choice for pre-training?', 'output': {'feedback': 'The question asks for the configuration of the UL2 training objective within the OpenMoE framework and the rationale behind its suitability for pre-training. It is clear in specifying the topic of interest (UL2 training objective, OpenMoE) and seeks detailed information on both the configuration and the reasons for its effectiveness in pre-training. However, the question might be challenging for those unfamiliar with the specific terminology or the context of OpenMoE and UL2. For broader clarity and

answerability, it would be helpful if the question included a brief explanation or context about OpenMoE and the UL2 training objective, or clarified the aspects of pre-training effectiveness it refers to (e.g., efficiency, accuracy, generalization).', 'verdict': 1}}, {'question': 'What is the detailed configuration of the UL2 training objective in OpenMoE, based on the provided context?', 'output': {'feedback': "The question seeks detailed information on the UL2 training objective's configuration within the OpenMoE framework, mentioning 'the provided context' without actually including or describing this context within the query. This makes the question unclear for those who do not have access to the unspecified context. For the question to be clear and answerable, it needs to either include the relevant context directly within the question or be framed in a way that does not require external information. Detailing the specific aspects of the configuration of interest (e.g., loss functions, data augmentation techniques) could also help clarify the query.", 'verdict': 0}}], input_keys=['question'], output_key='output', output_type='json', language='english')),

question_answer_prompt=Prompt(name='answer_formulate', instruction="Answer the question using the information from the given context. Output verdict as '1' if answer is present '-1' if answer is not present in the context.", output_format_instruction='', examples=[{'context': 'Climate change is significantly influenced by human activities, notably the emission of greenhouse gases from burning fossil fuels. The increased greenhouse gas concentration in the atmosphere traps more heat, leading to global warming and changes in weather patterns.', 'question': 'How do human activities contribute to climate change?', 'answer': {'answer': 'Human activities contribute to climate change primarily through the emission of greenhouse gases from burning fossil fuels. These emissions increase the concentration of greenhouse gases in the atmosphere, which traps more heat and leads to global warming and altered weather patterns.', 'verdict': '1'}}], {'context': 'The concept of artificial intelligence (AI) has evolved over time, but it fundamentally refers to machines designed to mimic human cognitive functions. AI can learn, reason, perceive, and, in some instances, react like humans, making it pivotal in fields ranging from healthcare to autonomous vehicles.', 'question': 'What are the key capabilities of artificial intelligence?', 'answer': {'answer': 'Artificial intelligence is designed to mimic human cognitive functions, with key capabilities including learning, reasoning, perception, and reacting to the environment in a manner similar to humans. These capabilities make AI pivotal in various fields, including healthcare and autonomous driving.', 'verdict': '1'}}], {'context': 'The novel "Pride and Prejudice" by Jane Austen revolves around the character Elizabeth Bennet and her family. The story is set in the 19th century in rural England and deals with issues of marriage, morality, and misconceptions.', 'question': "What year was 'Pride and Prejudice' published?", 'answer': {'answer': 'The answer to given question is not present in context', 'verdict': '-1'}}], input_keys=['context', 'question'], output_key='answer', output_type='json', language='english'),

find_relevant_context_prompt=Prompt(name='find_relevant_context', instruction='Given a question and set of contexts, find the most relevant contexts to answer the question.', output_format_instruction='',

```

examples=[{'question': 'What is the capital of France?', 'contexts': ['1. France
is a country in Western Europe. It has several cities, including Paris, Lyon,
and Marseille. Paris is not only known for its cultural landmarks like the
Eiffel Tower and the Louvre Museum but also as the administrative center.', '2.
The capital of France is Paris. It is also the most populous city in France,
with a population of over 2 million people. Paris is known for its cultural
landmarks like the Eiffel Tower and the Louvre Museum.', '3. Paris is the
capital of France. It is also the most populous city in France, with a
population of over 2 million people. Paris is known for its cultural landmarks
like the Eiffel Tower and the Louvre Museum.'], 'output': {'relevant_contexts':
[1, 2]}}], {'question': 'How does caffeine affect the body and what are its
common sources?', 'contexts': ['1. Caffeine is a central nervous system
stimulant. It can temporarily ward off drowsiness and restore alertness. It
primarily affects the brain, where it alters the function of
neurotransmitters.', '2. Regular physical activity is essential for maintaining
good health. It can help control weight, combat health conditions, boost energy,
and promote better sleep.', '3. Common sources of caffeine include coffee, tea,
cola, and energy drinks. These beverages are consumed worldwide and are known
for providing a quick boost of energy.'], 'output': {'relevant_contexts': [1,
2]}}], input_keys=['question', 'contexts'], output_key='output',
output_type='json', language='english'),
rewrite_invalid_question_prompt=Prompt(name='rewrite_question',
instruction='Given a context, question and feedback, rewrite the question to
improve its clarity and answerability based on the feedback provided.',
output_format_instruction='', examples=[{'context': "The Eiffel Tower was
constructed using iron and was originally intended as a temporary exhibit for
the 1889 World's Fair held in Paris. Despite its initial temporary purpose, the
Eiffel Tower quickly became a symbol of Parisian ingenuity and an iconic
landmark of the city, attracting millions of visitors each year. The tower's
design, created by Gustave Eiffel, was initially met with criticism from some
French artists and intellectuals, but it has since been celebrated as a
masterpiece of structural engineering and architectural design.", 'question':
'Who created the design for the Tower?', 'feedback': "The question asks about
the creator of the design for 'the Tower', but it does not specify which tower
it refers to. There are many towers worldwide, and without specifying the exact
tower, the question is unclear and unanswerable. To improve the question, it
should include the name or a clear description of the specific tower in
question.", 'output': 'Who created the design for the Eiffel Tower?'},
{'context': "'Exploring Zero-Shot Learning in Neural Networks' was published by
Smith and Lee in 2021, focusing on the application of zero-shot learning
techniques in artificial intelligence.", 'question': 'What datasets were used
for the zero-shot evaluations in this study?', 'feedback': "The question asks
about the datasets used for zero-shot evaluations in 'this study', without
specifying or providing any details about the study in question. This makes the
question unclear for those who do not have access to or knowledge of the
specific study. To improve clarity and answerability, the question should
specify the study it refers to, or provide enough context about the study for
the question to be understood and answered independently.", 'output': 'What

```


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ground_truth='If you're a business user or organization, you are responsible for indemnifying Google and its directors, officers, employees, and contractors for any third-party legal proceedings arising from your unlawful use of the services or violation of these terms or service-specific additional terms. This indemnity covers liability or expense arising from claims, losses, damages, judgments, fines, litigation costs, and legal fees.', evolution_type='simple',
metadata=[{}])

17 Creating a test dataset using Pandas for evaluation metrics:

```
[ ]: test_df = testset.to_pandas()
test_questions = test_df["question"].values.tolist()
test_groundtruths = test_df["ground_truth"].values.tolist()
test_contexts=test_df["contexts"].values.tolist()
test_df.head()
```

```
[ ]:                                     question \
0  What are the responsibilities of business user...
1  What types of liabilities are not limited by g...
2  What are the responsibilities of users and org...

                                     contexts \
0  [law allows us to limit certain liabilities - ...
1  [(Version: May 2024) Liabilities :For all user...
2  [law allows us to limit certain liabilities - ...

                                     ground_truth evolution_type metadata \
0  If you're a business user or organization, you...         simple      [{}]
1  loss of profits, revenues, business opportunit...         simple      [{}]
2  If you're a business user or organization, you...    reasoning      [{}]

episode_done
0          True
1          True
2          True
```


17.1 VectorDBQA rag- response

```
[ ]: answers = []
      contexts = []

      for question in test_questions:
          response = qa_vectorDBQ.invoke({"query" : question})
          answers.append(response["result"])
          contexts.append([context.page_content for context in
↪response['source_documents']])
```

18 Creating a dataset for metrics calculation:

```
[ ]: test_df = testset.to_pandas()
      test_questions = test_df["question"].values.tolist()
      test_groundtruths = test_df["ground_truth"].values.tolist()
      test_contexts=test_df["contexts"].values.tolist()
      test_df.head()
```

```
[ ]:                                     question \
0  What liabilities or expenses does Google assum...
1  What liabilities does the law not limit in cas...
2  What are the responsibilities of users and org...

                                     contexts \
0  [disagreements), Google won't be responsible f...
1  [law allows us to limit certain liabilities - ...
2  [law allows us to limit certain liabilities - ...

                                     ground_truth evolution_type metadata \
0  Google assumes responsibility for claims, loss...         simple    [{}]
1  The law does not limit liabilities in cases of...         simple    [{}]
2  If users and organizations engage in unlawful ...    reasoning    [{}]

      episode_done
0              True
1              True
2              True
```

19 View the test dataset created:

```
[ ]: from datasets import Dataset

      response_dataset_vectorDBQ = Dataset.from_dict({
          "question" : test_questions,
```

```

    "answer" : answers,
    "contexts" : test_contexts,
    "ground_truth" : test_groundtruths
})
response_dataset_vectorDBQ[0]

```

```

[ ]: {'question': 'What liabilities or expenses does Google assume responsibility for
in relation to the services provided?',
      'answer': ' Google assumes responsibility for any liabilities or expenses
related to the services provided, such as data breaches or service
interruptions.',
      'contexts': ['disagreements), Google won't be responsible for any other losses,
unless they're caused by our breach of \nthese terms or service-specific
additional terms. For business users and organizations only \nIf you're a
business user or organization, then to the extent allowed by applicable law:
You'll indemnify \nGoogle and its directors, officers, employees, and
contractors for any third- party legal proceedings \n(including actions by
government authorities) arising out of or relating to your unlawful use of the
\nservices or violation of these terms or service-specific additional terms.
This indemnity covers any \nliability or expense arising from claims, losses,
damages, judgments, fines, litigation costs, and legal fees. \nGoogle won't be
responsible for the following liabilities: loss of profits, revenues, business
opportunities, \ngoodwill, or anticipated savings indirect or consequential loss
punitive damages. Google's total liability \narising out of or relating to these
terms is limited to the greater of (1) US$500 or (2) 125% of the fees that \nyou
paid to use the relevant services in the 12 months before the breach If you're
legally exempt from \ncertain responsibilities, including indemnification, then
those responsibilities don't apply to you under \nthese terms. For example, the
United Nations enjoys certain immunities from legal obligations and these
\nterms don't override those immunities.'],
      'ground_truth': "Google assumes responsibility for claims, losses, damages,
judgments, fines, litigation costs, and legal fees arising from third-party
legal proceedings related to unlawful use of the services or violation of the
terms or service-specific additional terms. However, Google is not responsible
for loss of profits, revenues, business opportunities, goodwill, anticipated
savings, indirect or consequential loss, or punitive damages. Google's total
liability is limited to the greater of US$500 or 125% of the fees paid to use
the relevant services in the 12 months before the breach."}

```

20 Metrics through RAG Library:

```

[ ]: from ragas import evaluate
from ragas.metrics import (
    faithfulness,
    answer_relevancy,
    answer_correctness,

```

```

        context_recall,
        context_precision,
        answer_similarity,
        context_relevancy
    )

    metrics_final_rag = [
        faithfulness,
        answer_relevancy,
        context_recall,
        context_precision,
        answer_correctness,
        answer_similarity,
        context_relevancy
    ]

```

21 Metrics results:

```

[ ]: VectorDBQ_results = evaluate(response_dataset_vectorDBQ,
    ↪metrics_final_rag,raise_exceptions=False)
VectorDBQ_results

```

Evaluating: 0%| | 0/21 [00:00<?, ?it/s]

```

[ ]: {'faithfulness': 0.7500, 'answer_relevancy': 0.9603, 'context_recall': 1.0000,
    'context_precision': 1.0000, 'answer_correctness': 0.6258, 'answer_similarity':
    0.9365, 'context_relevancy': 0.0683}

```

21.1 Rag(version based control) with BM25 Re-ranker based response for metrics evaluation:

```

[ ]: answers_bm25re_ranker = []
    contexts_bm25re_ranker = []

    for question in test_questions:
        response = qa_BM25.invoke({"query" : question})
        answers_bm25re_ranker.append(response["result"])
        contexts_bm25re_ranker.append([context.page_content for context in
    ↪response['source_documents']])

```

22 View the test dataset created:

```
[ ]: response_dataset_bm25re_ranker = Dataset.from_dict({
    "question" : test_questions,
    "answer" : answers_bm25re_ranker,
    "contexts" : contexts_bm25re_ranker,
    "ground_truth" : test_groundtruths
})
response_dataset_bm25re_ranker[0]
```

```
[ ]: {'question': 'What are the responsibilities of business users and organizations
to indemnify Google?',
      'answer': ' To the extent allowed by applicable law, business users and
organizations are responsible for indemnifying Google and its directors,
officers, employees, and contractors for any third-party legal proceedings
arising from their unlawful use of the services or violation of the terms or
service-specific additional terms. This includes covering any liability or
expenses arising from claims, losses, damages, judgments, fines, litigation
costs, and legal fees. However, if a business user or organization is legally
exempt from certain responsibilities, such as indemnification, then those
responsibilities do not apply to them under these terms.',
      'contexts': ['certain immunities from legal obligations and these terms don't
override those immunities. \n \n \n \n \n \n \n \n \n \n \n \n \n \n \n (Version:
May 2020) Liabilities: For all users: These terms only limit our
\nresponsibilities as allowed by applicable law. Specifically, these terms don't
limit Google's liability for \ndeath or personal injury, fraud, fraudulent
misrepresentation, gross negligence, or willful misconduct. \nOther than the
rights and responsibilities described in this section (In case of problems or
\n disagreements), Google won't be responsible for any other losses, unless
they're caused by our breach of \nthese terms or service-specific additional
terms. For business users and organizations only \nIf you're a business user or
organization, then to the extent allowed by applicable law: You'll indemnify
\nGoogle and its directors, officers, employees, and contractors for any third-
party legal proceedings \n(including actions by government authorities) arising
out of or relating to your unlawful use of the \nservices or violation of these
terms or service-specific additional terms. This indemnity covers any
\nliability or expense arising from claims, losses, damages, judgments, fines,
litigation costs, and legal fees.',
      'terms or applicable service-speci!c additional terms Google isn't liable for:
loss of pro!ts, revenues, \nbusiness opportunities, goodwill, or anticipated
savings indirect or consequential losses punitive \ndamages Google's total
liability arising out of or relating to these terms is limited to the greater of
(1) \n$200 or (2) the fees paid to use the relevant services in the 12 months
before the dispute. For \nbusiness users and organizations only: If you're a
business user or organization: To the extent \nallowed by applicable law, you'll
indemnify Google and its directors, o!cers, employees, and contractors for \nany
third-party legal proceedings (including actions by government authorities)
```

arising out of or relating \nto your unlawful use of the services or violation of these terms or service- speci!c additional terms. This \nindemnity covers any liability or expense arising from claims, losses, damages, judgments, nes, litigation \ncosts, and legal fees. If you're legally exempt from certain responsibilities, including indemni!cation, then \nthose responsibilities don't apply to you under these terms. For example, the United Nations enjoys \ncertain immunities from legal obligations and these terms don't override those immunities.',

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23 Creating metrics using RAG library:

```
[ ]: from ragas.metrics import (
    faithfulness,
    answer_relevancy,
    answer_correctness,
    context_recall,
    context_precision,
    answer_similarity,
    context_relevancy
)

metrics_final_rag = [
    faithfulness,
    answer_relevancy,
```

```
context_recall,  
context_precision,  
answer_correctness,  
answer_similarity,  
context_relevancy  
]
```

24 Metrics results:

```
[ ]: BM25response_rag = evaluate(response_dataset_bm25re_ranker,␣  
    ↪metrics_final_rag,raise_exceptions=False)  
BM25response_rag
```

Evaluating: 0%| | 0/21 [00:00<?, ?it/s]

```
[ ]: {'faithfulness': 0.8333, 'answer_relevancy': 0.9083, 'context_recall': 1.0000,  
      'context_precision': 1.0000, 'answer_correctness': 0.6441, 'answer_similarity':  
      0.9381, 'context_relevancy': 0.0392}
```

```
//////////-----END OF THE CODE-----  
RAG END HERE-----//////////
```