

# MF815\_Final\_Report\_ver2

May 3, 2025

## 0.1 Install

```
[ ]: !pip install langchain
!pip install langchain-chroma
!pip install -U langchain-community
!pip install tiktoken
!pip install unstructured
```

```
Requirement already satisfied: langchain in /usr/local/lib/python3.11/dist-packages (0.3.25)
Requirement already satisfied: langchain-core<1.0.0,>=0.3.58 in /usr/local/lib/python3.11/dist-packages (from langchain) (0.3.58)
Requirement already satisfied: langchain-text-splitters<1.0.0,>=0.3.8 in /usr/local/lib/python3.11/dist-packages (from langchain) (0.3.8)
Requirement already satisfied: langsmith<0.4,>=0.1.17 in /usr/local/lib/python3.11/dist-packages (from langchain) (0.3.41)
Requirement already satisfied: pydantic<3.0.0,>=2.7.4 in /usr/local/lib/python3.11/dist-packages (from langchain) (2.11.3)
Requirement already satisfied: SQLAlchemy<3,>=1.4 in /usr/local/lib/python3.11/dist-packages (from langchain) (2.0.40)
Requirement already satisfied: requests<3,>=2 in /usr/local/lib/python3.11/dist-packages (from langchain) (2.32.3)
Requirement already satisfied: PyYAML>=5.3 in /usr/local/lib/python3.11/dist-packages (from langchain) (6.0.2)
Requirement already satisfied: tenacity!=8.4.0,<10.0.0,>=8.1.0 in /usr/local/lib/python3.11/dist-packages (from langchain-core<1.0.0,>=0.3.58->langchain) (9.1.2)
Requirement already satisfied: jsonpatch<2.0,>=1.33 in /usr/local/lib/python3.11/dist-packages (from langchain-core<1.0.0,>=0.3.58->langchain) (1.33)
Requirement already satisfied: packaging<25,>=23.2 in /usr/local/lib/python3.11/dist-packages (from langchain-core<1.0.0,>=0.3.58->langchain) (24.2)
Requirement already satisfied: typing-extensions>=4.7 in /usr/local/lib/python3.11/dist-packages (from langchain-core<1.0.0,>=0.3.58->langchain) (4.13.2)
Requirement already satisfied: httpx<1,>=0.23.0 in /usr/local/lib/python3.11/dist-packages (from langsmith<0.4,>=0.1.17->langchain)
```

(0.28.1)  
Requirement already satisfied: orjson<4.0.0,>=3.9.14 in  
/usr/local/lib/python3.11/dist-packages (from langsmith<0.4,>=0.1.17->langchain)  
(3.10.18)  
Requirement already satisfied: requests-toolbelt<2.0.0,>=1.0.0 in  
/usr/local/lib/python3.11/dist-packages (from langsmith<0.4,>=0.1.17->langchain)  
(1.0.0)  
Requirement already satisfied: zstandard<0.24.0,>=0.23.0 in  
/usr/local/lib/python3.11/dist-packages (from langsmith<0.4,>=0.1.17->langchain)  
(0.23.0)  
Requirement already satisfied: annotated-types>=0.6.0 in  
/usr/local/lib/python3.11/dist-packages (from pydantic<3.0.0,>=2.7.4->langchain)  
(0.7.0)  
Requirement already satisfied: pydantic-core==2.33.1 in  
/usr/local/lib/python3.11/dist-packages (from pydantic<3.0.0,>=2.7.4->langchain)  
(2.33.1)  
Requirement already satisfied: typing-inspection>=0.4.0 in  
/usr/local/lib/python3.11/dist-packages (from pydantic<3.0.0,>=2.7.4->langchain)  
(0.4.0)  
Requirement already satisfied: charset-normalizer<4,>=2 in  
/usr/local/lib/python3.11/dist-packages (from requests<3,>=2->langchain) (3.4.1)  
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-  
packages (from requests<3,>=2->langchain) (3.10)  
Requirement already satisfied: urllib3<3,>=1.21.1 in  
/usr/local/lib/python3.11/dist-packages (from requests<3,>=2->langchain) (2.4.0)  
Requirement already satisfied: certifi>=2017.4.17 in  
/usr/local/lib/python3.11/dist-packages (from requests<3,>=2->langchain)  
(2025.4.26)  
Requirement already satisfied: greenlet>=1 in /usr/local/lib/python3.11/dist-  
packages (from SQLAlchemy<3,>=1.4->langchain) (3.2.1)  
Requirement already satisfied: anyio in /usr/local/lib/python3.11/dist-packages  
(from httpx<1,>=0.23.0->langsmith<0.4,>=0.1.17->langchain) (4.9.0)  
Requirement already satisfied: httpcore==1.\* in /usr/local/lib/python3.11/dist-  
packages (from httpx<1,>=0.23.0->langsmith<0.4,>=0.1.17->langchain) (1.0.9)  
Requirement already satisfied: h11>=0.16 in /usr/local/lib/python3.11/dist-  
packages (from  
httpcore==1.\*->httpx<1,>=0.23.0->langsmith<0.4,>=0.1.17->langchain) (0.16.0)  
Requirement already satisfied: jsonpointer>=1.9 in  
/usr/local/lib/python3.11/dist-packages (from jsonpatch<2.0,>=1.33->langchain-  
core<1.0.0,>=0.3.58->langchain) (3.0.0)  
Requirement already satisfied: sniffio>=1.1 in /usr/local/lib/python3.11/dist-  
packages (from anyio->httpx<1,>=0.23.0->langsmith<0.4,>=0.1.17->langchain)  
(1.3.1)  
Requirement already satisfied: langchain-chroma in  
/usr/local/lib/python3.11/dist-packages (0.2.3)  
Requirement already satisfied: langchain-core>=0.3.52 in  
/usr/local/lib/python3.11/dist-packages (from langchain-chroma) (0.3.58)  
Requirement already satisfied: numpy>=1.26.0 in /usr/local/lib/python3.11/dist-

packages (from langchain-chroma) (2.0.2)  
Requirement already satisfied: chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0 in /usr/local/lib/python3.11/dist-packages (from langchain-chroma) (0.6.3)  
Requirement already satisfied: build>=1.0.3 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (1.2.2.post1)  
Requirement already satisfied: pydantic>=1.9 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (2.11.3)  
Requirement already satisfied: chroma-hnswlib==0.7.6 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (0.7.6)  
Requirement already satisfied: fastapi>=0.95.2 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (0.115.12)  
Requirement already satisfied: uvicorn>=0.18.3 in /usr/local/lib/python3.11/dist-packages (from uvicorn[standard]>=0.18.3->chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (0.34.2)  
Requirement already satisfied: posthog>=2.4.0 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (4.0.1)  
Requirement already satisfied: typing\_extensions>=4.5.0 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (4.13.2)  
Requirement already satisfied: onnxruntime>=1.14.1 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (1.21.1)  
Requirement already satisfied: opentelemetry-api>=1.2.0 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (1.32.1)  
Requirement already satisfied: opentelemetry-exporter-otlp-proto-grpc>=1.2.0 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (1.32.1)  
Requirement already satisfied: opentelemetry-instrumentation-fastapi>=0.41b0 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (0.53b1)  
Requirement already satisfied: opentelemetry-sdk>=1.2.0 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (1.32.1)  
Requirement already satisfied: tokenizers>=0.13.2 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (0.21.1)  
Requirement already satisfied: pypika>=0.48.9 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (0.48.9)  
Requirement already satisfied: tqdm>=4.65.0 in /usr/local/lib/python3.11/dist-

packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (4.67.1)  
 Requirement already satisfied: overrides>=7.3.1 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (7.7.0)  
 Requirement already satisfied: importlib-resources in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (6.5.2)  
 Requirement already satisfied: grpcio>=1.58.0 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (1.71.0)  
 Requirement already satisfied: bcrypt>=4.0.1 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (4.3.0)  
 Requirement already satisfied: typer>=0.9.0 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (0.15.3)  
 Requirement already satisfied: kubernetes>=28.1.0 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (32.0.1)  
 Requirement already satisfied: tenacity>=8.2.3 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (9.1.2)  
 Requirement already satisfied: PyYAML>=6.0.0 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (6.0.2)  
 Requirement already satisfied: mmh3>=4.0.1 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (5.1.0)  
 Requirement already satisfied: orjson>=3.9.12 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (3.10.18)  
 Requirement already satisfied: httpx>=0.27.0 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (0.28.1)  
 Requirement already satisfied: rich>=10.11.0 in /usr/local/lib/python3.11/dist-packages (from chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4.0->langchain-chroma) (14.0.0)  
 Requirement already satisfied: langsmith<0.4,>=0.1.125 in /usr/local/lib/python3.11/dist-packages (from langchain-core>=0.3.52->langchain-chroma) (0.3.41)  
 Requirement already satisfied: jsonpatch<2.0,>=1.33 in /usr/local/lib/python3.11/dist-packages (from langchain-core>=0.3.52->langchain-chroma) (1.33)  
 Requirement already satisfied: packaging<25,>=23.2 in /usr/local/lib/python3.11/dist-packages (from langchain-core>=0.3.52->langchain-chroma) (24.2)  
 Requirement already satisfied: pyproject\_hooks in

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/usr/local/lib/python3.11/dist-packages (from build>=1.0.3-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.2.0)
Requirement already satisfied: starlette<0.47.0,>=0.40.0 in
/usr/local/lib/python3.11/dist-packages (from fastapi>=0.95.2-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.46.2)
Requirement already satisfied: anyio in /usr/local/lib/python3.11/dist-packages
(from httpx>=0.27.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (4.9.0)
Requirement already satisfied: certifi in /usr/local/lib/python3.11/dist-
packages (from httpx>=0.27.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (2025.4.26)
Requirement already satisfied: httpcore==1.* in /usr/local/lib/python3.11/dist-
packages (from httpx>=0.27.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.0.9)
Requirement already satisfied: idna in /usr/local/lib/python3.11/dist-packages
(from httpx>=0.27.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (3.10)
Requirement already satisfied: h11>=0.16 in /usr/local/lib/python3.11/dist-
packages (from httpcore==1.*->httpx>=0.27.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.16.0)
Requirement already satisfied: jsonpointer>=1.9 in
/usr/local/lib/python3.11/dist-packages (from jsonpatch<2.0,>=1.33->langchain-
core>=0.3.52->langchain-chroma) (3.0.0)
Requirement already satisfied: six>=1.9.0 in /usr/local/lib/python3.11/dist-
packages (from kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.17.0)
Requirement already satisfied: python-dateutil>=2.5.3 in
/usr/local/lib/python3.11/dist-packages (from kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (2.9.0.post0)
Requirement already satisfied: google-auth>=1.0.1 in
/usr/local/lib/python3.11/dist-packages (from kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (2.38.0)
Requirement already satisfied: websocket-
client!=0.40.0,!0.41.*,!0.42.*,>=0.32.0 in /usr/local/lib/python3.11/dist-
packages (from kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.8.0)
Requirement already satisfied: requests in /usr/local/lib/python3.11/dist-

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packages (from kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (2.32.3)
Requirement already satisfied: requests-oauthlib in
/usr/local/lib/python3.11/dist-packages (from kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (2.0.0)
Requirement already satisfied: oauthlib>=3.2.2 in
/usr/local/lib/python3.11/dist-packages (from kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (3.2.2)
Requirement already satisfied: urllib3>=1.24.2 in
/usr/local/lib/python3.11/dist-packages (from kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (2.4.0)
Requirement already satisfied: durationpy>=0.7 in
/usr/local/lib/python3.11/dist-packages (from kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.9)
Requirement already satisfied: requests-toolbelt<2.0.0,>=1.0.0 in
/usr/local/lib/python3.11/dist-packages (from
langsmith<0.4,>=0.1.125->langchain-core>=0.3.52->langchain-chroma) (1.0.0)
Requirement already satisfied: zstandard<0.24.0,>=0.23.0 in
/usr/local/lib/python3.11/dist-packages (from
langsmith<0.4,>=0.1.125->langchain-core>=0.3.52->langchain-chroma) (0.23.0)
Requirement already satisfied: coloredlogs in /usr/local/lib/python3.11/dist-
packages (from onnxruntime>=1.14.1-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (15.0.1)
Requirement already satisfied: flatbuffers in /usr/local/lib/python3.11/dist-
packages (from onnxruntime>=1.14.1-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (25.2.10)
Requirement already satisfied: protobuf in /usr/local/lib/python3.11/dist-
packages (from onnxruntime>=1.14.1-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (5.29.4)
Requirement already satisfied: sympy in /usr/local/lib/python3.11/dist-packages
(from onnxruntime>=1.14.1-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.13.1)
Requirement already satisfied: deprecated>=1.2.6 in
/usr/local/lib/python3.11/dist-packages (from opentelemetry-api>=1.2.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.2.18)
Requirement already satisfied: importlib-metadata<8.7.0,>=6.0 in
/usr/local/lib/python3.11/dist-packages (from opentelemetry-api>=1.2.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4

```

```

.0->langchain-chroma) (8.6.1)
Requirement already satisfied: googleapis-common-protos~=1.52 in
/usr/local/lib/python3.11/dist-packages (from opentelemetry-exporter-otlp-proto-
grpc>=1.2.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.70.0)
Requirement already satisfied: opentelemetry-exporter-otlp-proto-common==1.32.1
in /usr/local/lib/python3.11/dist-packages (from opentelemetry-exporter-otlp-
proto-grpc>=1.2.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.32.1)
Requirement already satisfied: opentelemetry-proto==1.32.1 in
/usr/local/lib/python3.11/dist-packages (from opentelemetry-exporter-otlp-proto-
grpc>=1.2.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.32.1)
Requirement already satisfied: opentelemetry-instrumentation-asgi==0.53b1 in
/usr/local/lib/python3.11/dist-packages (from opentelemetry-instrumentation-fast
api>=0.41b0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.53b1)
Requirement already satisfied: opentelemetry-instrumentation==0.53b1 in
/usr/local/lib/python3.11/dist-packages (from opentelemetry-instrumentation-fast
api>=0.41b0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.53b1)
Requirement already satisfied: opentelemetry-semantic-conventions==0.53b1 in
/usr/local/lib/python3.11/dist-packages (from opentelemetry-instrumentation-fast
api>=0.41b0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.53b1)
Requirement already satisfied: opentelemetry-util-http==0.53b1 in
/usr/local/lib/python3.11/dist-packages (from opentelemetry-instrumentation-fast
api>=0.41b0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.53b1)
Requirement already satisfied: wrapt<2.0.0,>=1.0.0 in
/usr/local/lib/python3.11/dist-packages (from opentelemetry-
instrumentation==0.53b1->opentelemetry-instrumentation-fastapi>=0.41b0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.17.2)
Requirement already satisfied: asgiref~=3.0 in /usr/local/lib/python3.11/dist-
packages (from opentelemetry-instrumentation-asgi==0.53b1->opentelemetry-
instrumentation-fastapi>=0.41b0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (3.8.1)
Requirement already satisfied: backoff>=1.10.0 in
/usr/local/lib/python3.11/dist-packages (from posthog>=2.4.0-

```

```

>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (2.2.1)
Requirement already satisfied: distro>=1.5.0 in /usr/lib/python3/dist-packages
(from posthog>=2.4.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.7.0)
Requirement already satisfied: annotated-types>=0.6.0 in
/usr/local/lib/python3.11/dist-packages (from pydantic>=1.9-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.7.0)
Requirement already satisfied: pydantic-core==2.33.1 in
/usr/local/lib/python3.11/dist-packages (from pydantic>=1.9-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (2.33.1)
Requirement already satisfied: typing-inspection>=0.4.0 in
/usr/local/lib/python3.11/dist-packages (from pydantic>=1.9-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.4.0)
Requirement already satisfied: markdown-it-py>=2.2.0 in
/usr/local/lib/python3.11/dist-packages (from rich>=10.11.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (3.0.0)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in
/usr/local/lib/python3.11/dist-packages (from rich>=10.11.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (2.19.1)
Requirement already satisfied: huggingface-hub<1.0,>=0.16.4 in
/usr/local/lib/python3.11/dist-packages (from tokenizers>=0.13.2-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.30.2)
Requirement already satisfied: click>=8.0.0 in /usr/local/lib/python3.11/dist-
packages (from typer>=0.9.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (8.1.8)
Requirement already satisfied: shellingham>=1.3.0 in
/usr/local/lib/python3.11/dist-packages (from typer>=0.9.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.5.4)
Requirement already satisfied: httptools>=0.6.3 in
/usr/local/lib/python3.11/dist-packages (from uvicorn[standard]>=0.18.3-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.6.4)
Requirement already satisfied: python-dotenv>=0.13 in
/usr/local/lib/python3.11/dist-packages (from uvicorn[standard]>=0.18.3-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.1.0)
Requirement already satisfied: uvloop!=0.15.0,!0.15.1,>=0.14.0 in
/usr/local/lib/python3.11/dist-packages (from uvicorn[standard]>=0.18.3-

```



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>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.21.0)
Requirement already satisfied: watchfiles>=0.13 in
/usr/local/lib/python3.11/dist-packages (from uvicorn[standard]>=0.18.3-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.0.5)
Requirement already satisfied: websockets>=10.4 in
/usr/local/lib/python3.11/dist-packages (from uvicorn[standard]>=0.18.3-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (15.0.1)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in
/usr/local/lib/python3.11/dist-packages (from google-auth>=1.0.1-
>kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (5.5.2)
Requirement already satisfied: pyasn1-modules>=0.2.1 in
/usr/local/lib/python3.11/dist-packages (from google-auth>=1.0.1-
>kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.4.2)
Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.11/dist-
packages (from google-auth>=1.0.1->kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (4.9.1)
Requirement already satisfied: filelock in /usr/local/lib/python3.11/dist-
packages (from huggingface-hub<1.0,>=0.16.4->tokenizers>=0.13.2-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (3.18.0)
Requirement already satisfied: fsspec>=2023.5.0 in
/usr/local/lib/python3.11/dist-packages (from huggingface-hub<1.0,>=0.16.4-
>tokenizers>=0.13.2-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (2025.3.2)
Requirement already satisfied: zipp>=3.20 in /usr/local/lib/python3.11/dist-
packages (from importlib-metadata<8.7.0,>=6.0->opentelemetry-api>=1.2.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (3.21.0)
Requirement already satisfied: mdurl~=0.1 in /usr/local/lib/python3.11/dist-
packages (from markdown-it-py>=2.2.0->rich>=10.11.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.1.2)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.11/dist-packages (from requests->kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (3.4.1)
Requirement already satisfied: sniffio>=1.1 in /usr/local/lib/python3.11/dist-
packages (from anyio->httpx>=0.27.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4

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```
.0->langchain-chroma) (1.3.1)
Requirement already satisfied: humanfriendly>=9.1 in
/usr/local/lib/python3.11/dist-packages (from coloredlogs->onnxruntime>=1.14.1-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (10.0)
Requirement already satisfied: mpmath<1.4,>=1.1.0 in
/usr/local/lib/python3.11/dist-packages (from sympy->onnxruntime>=1.14.1-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (1.3.0)
Requirement already satisfied: pyasn1<0.7.0,>=0.6.1 in
/usr/local/lib/python3.11/dist-packages (from pyasn1-modules>=0.2.1->google-auth
>=1.0.1->kubernetes>=28.1.0-
>chromadb!=0.5.10,!0.5.11,!0.5.12,!0.5.4,!0.5.5,!0.5.7,!0.5.9,<0.7.0,>=0.4
.0->langchain-chroma) (0.6.1)
Collecting langchain-community
  Using cached langchain_community-0.3.23-py3-none-any.whl.metadata (2.5 kB)
Requirement already satisfied: langchain-core<1.0.0,>=0.3.56 in
/usr/local/lib/python3.11/dist-packages (from langchain-community) (0.3.58)
Requirement already satisfied: langchain<1.0.0,>=0.3.24 in
/usr/local/lib/python3.11/dist-packages (from langchain-community) (0.3.25)
Requirement already satisfied: SQLAlchemy<3,>=1.4 in
/usr/local/lib/python3.11/dist-packages (from langchain-community) (2.0.40)
Requirement already satisfied: requests<3,>=2 in /usr/local/lib/python3.11/dist-
packages (from langchain-community) (2.32.3)
Requirement already satisfied: PyYAML>=5.3 in /usr/local/lib/python3.11/dist-
packages (from langchain-community) (6.0.2)
Requirement already satisfied: aiohttp<4.0.0,>=3.8.3 in
/usr/local/lib/python3.11/dist-packages (from langchain-community) (3.11.15)
Requirement already satisfied: tenacity!=8.4.0,<10,>=8.1.0 in
/usr/local/lib/python3.11/dist-packages (from langchain-community) (9.1.2)
Collecting dataclasses-json<0.7,>=0.5.7 (from langchain-community)
  Using cached dataclasses_json-0.6.7-py3-none-any.whl.metadata (25 kB)
Collecting pydantic-settings<3.0.0,>=2.4.0 (from langchain-community)
  Using cached pydantic_settings-2.9.1-py3-none-any.whl.metadata (3.8 kB)
Requirement already satisfied: langsmith<0.4,>=0.1.125 in
/usr/local/lib/python3.11/dist-packages (from langchain-community) (0.3.41)
Collecting httpx-sse<1.0.0,>=0.4.0 (from langchain-community)
  Using cached httpx_sse-0.4.0-py3-none-any.whl.metadata (9.0 kB)
Requirement already satisfied: numpy>=1.26.2 in /usr/local/lib/python3.11/dist-
packages (from langchain-community) (2.0.2)
Requirement already satisfied: aiohappyeyeballs>=2.3.0 in
/usr/local/lib/python3.11/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain-
community) (2.6.1)
Requirement already satisfied: aiosignal>=1.1.2 in
/usr/local/lib/python3.11/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain-
community) (1.3.2)
Requirement already satisfied: attrs>=17.3.0 in /usr/local/lib/python3.11/dist-
packages (from aiohttp<4.0.0,>=3.8.3->langchain-community) (25.3.0)
```

Requirement already satisfied: frozenlist>=1.1.1 in  
 /usr/local/lib/python3.11/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain-  
 community) (1.6.0)

Requirement already satisfied: multidict<7.0,>=4.5 in  
 /usr/local/lib/python3.11/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain-  
 community) (6.4.3)

Requirement already satisfied: propcache>=0.2.0 in  
 /usr/local/lib/python3.11/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain-  
 community) (0.3.1)

Requirement already satisfied: yarl<2.0,>=1.17.0 in  
 /usr/local/lib/python3.11/dist-packages (from aiohttp<4.0.0,>=3.8.3->langchain-  
 community) (1.20.0)

Collecting marshmallow<4.0.0,>=3.18.0 (from dataclasses-  
 json<0.7,>=0.5.7->langchain-community)

Using cached marshmallow-3.26.1-py3-none-any.whl.metadata (7.3 kB)

Collecting typing-inspect<1,>=0.4.0 (from dataclasses-  
 json<0.7,>=0.5.7->langchain-community)

Using cached typing\_inspect-0.9.0-py3-none-any.whl.metadata (1.5 kB)

Requirement already satisfied: langchain-text-splitters<1.0.0,>=0.3.8 in  
 /usr/local/lib/python3.11/dist-packages (from  
 langchain<1.0.0,>=0.3.24->langchain-community) (0.3.8)

Requirement already satisfied: pydantic<3.0.0,>=2.7.4 in  
 /usr/local/lib/python3.11/dist-packages (from  
 langchain<1.0.0,>=0.3.24->langchain-community) (2.11.3)

Requirement already satisfied: jsonpatch<2.0,>=1.33 in  
 /usr/local/lib/python3.11/dist-packages (from langchain-  
 core<1.0.0,>=0.3.56->langchain-community) (1.33)

Requirement already satisfied: packaging<25,>=23.2 in  
 /usr/local/lib/python3.11/dist-packages (from langchain-  
 core<1.0.0,>=0.3.56->langchain-community) (24.2)

Requirement already satisfied: typing-extensions>=4.7 in  
 /usr/local/lib/python3.11/dist-packages (from langchain-  
 core<1.0.0,>=0.3.56->langchain-community) (4.13.2)

Requirement already satisfied: httpx<1,>=0.23.0 in  
 /usr/local/lib/python3.11/dist-packages (from  
 langsmith<0.4,>=0.1.125->langchain-community) (0.28.1)

Requirement already satisfied: orjson<4.0.0,>=3.9.14 in  
 /usr/local/lib/python3.11/dist-packages (from  
 langsmith<0.4,>=0.1.125->langchain-community) (3.10.18)

Requirement already satisfied: requests-toolbelt<2.0.0,>=1.0.0 in  
 /usr/local/lib/python3.11/dist-packages (from  
 langsmith<0.4,>=0.1.125->langchain-community) (1.0.0)

Requirement already satisfied: zstandard<0.24.0,>=0.23.0 in  
 /usr/local/lib/python3.11/dist-packages (from  
 langsmith<0.4,>=0.1.125->langchain-community) (0.23.0)

Requirement already satisfied: python-dotenv>=0.21.0 in  
 /usr/local/lib/python3.11/dist-packages (from pydantic-  
 settings<3.0.0,>=2.4.0->langchain-community) (1.1.0)

Requirement already satisfied: typing-inspection>=0.4.0 in /usr/local/lib/python3.11/dist-packages (from pydantic-settings<3.0.0,>=2.4.0->langchain-community) (0.4.0)

Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2->langchain-community) (3.4.1)

Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2->langchain-community) (3.10)

Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2->langchain-community) (2.4.0)

Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2->langchain-community) (2025.4.26)

Requirement already satisfied: greenlet>=1 in /usr/local/lib/python3.11/dist-packages (from SQLAlchemy<3,>=1.4->langchain-community) (3.2.1)

Requirement already satisfied: anyio in /usr/local/lib/python3.11/dist-packages (from httpx<1,>=0.23.0->langsmith<0.4,>=0.1.125->langchain-community) (4.9.0)

Requirement already satisfied: httpcore==1.\* in /usr/local/lib/python3.11/dist-packages (from httpx<1,>=0.23.0->langsmith<0.4,>=0.1.125->langchain-community) (1.0.9)

Requirement already satisfied: h11>=0.16 in /usr/local/lib/python3.11/dist-packages (from httpcore==1.\*->httpx<1,>=0.23.0->langsmith<0.4,>=0.1.125->langchain-community) (0.16.0)

Requirement already satisfied: jsonpointer>=1.9 in /usr/local/lib/python3.11/dist-packages (from jsonpatch<2.0,>=1.33->langchain-core<1.0.0,>=0.3.56->langchain-community) (3.0.0)

Requirement already satisfied: annotated-types>=0.6.0 in /usr/local/lib/python3.11/dist-packages (from pydantic<3.0.0,>=2.7.4->langchain<1.0.0,>=0.3.24->langchain-community) (0.7.0)

Requirement already satisfied: pydantic-core==2.33.1 in /usr/local/lib/python3.11/dist-packages (from pydantic<3.0.0,>=2.7.4->langchain<1.0.0,>=0.3.24->langchain-community) (2.33.1)

Collecting mpy-extensions>=0.3.0 (from typing-inspect<1,>=0.4.0->dataclasses-json<0.7,>=0.5.7->langchain-community)

Using cached mpy\_extensions-1.1.0-py3-none-any.whl.metadata (1.1 kB)

Requirement already satisfied: sniffio>=1.1 in /usr/local/lib/python3.11/dist-packages (from anyio->httpx<1,>=0.23.0->langsmith<0.4,>=0.1.125->langchain-community) (1.3.1)

Using cached langchain\_community-0.3.23-py3-none-any.whl (2.5 MB)

Using cached dataclasses\_json-0.6.7-py3-none-any.whl (28 kB)

Using cached httpx\_sse-0.4.0-py3-none-any.whl (7.8 kB)

Using cached pydantic\_settings-2.9.1-py3-none-any.whl (44 kB)

Using cached marshmallow-3.26.1-py3-none-any.whl (50 kB)

Using cached typing\_inspect-0.9.0-py3-none-any.whl (8.8 kB)

Using cached mpy\_extensions-1.1.0-py3-none-any.whl (5.0 kB)

Installing collected packages: mpy-extensions, marshmallow, httpx-sse, typing-

```

inspect, pydantic-settings, dataclasses-json, langchain-community
Successfully installed dataclasses-json-0.6.7 httpx-sse-0.4.0 langchain-
community-0.3.23 marshmallow-3.26.1 mpy-extensions-1.1.0 pydantic-
settings-2.9.1 typing-inspect-0.9.0
Collecting tiktoken
  Downloading tiktoken-0.9.0-cp311-cp311-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (6.7 kB)
Requirement already satisfied: regex>=2022.1.18 in
/usr/local/lib/python3.11/dist-packages (from tiktoken) (2024.11.6)
Requirement already satisfied: requests>=2.26.0 in
/usr/local/lib/python3.11/dist-packages (from tiktoken) (2.32.3)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.11/dist-packages (from requests>=2.26.0->tiktoken)
(3.4.1)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-
packages (from requests>=2.26.0->tiktoken) (3.10)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.11/dist-packages (from requests>=2.26.0->tiktoken)
(2.4.0)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.11/dist-packages (from requests>=2.26.0->tiktoken)
(2025.4.26)
Downloading
tiktoken-0.9.0-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (1.2
MB)
1.2/1.2 MB
13.2 MB/s eta 0:00:00
Installing collected packages: tiktoken
Successfully installed tiktoken-0.9.0
Collecting unstructured
  Downloading unstructured-0.17.2-py3-none-any.whl.metadata (24 kB)
Collecting chardet (from unstructured)
  Downloading chardet-5.2.0-py3-none-any.whl.metadata (3.4 kB)
Collecting filetype (from unstructured)
  Downloading filetype-1.2.0-py2.py3-none-any.whl.metadata (6.5 kB)
Collecting python-magic (from unstructured)
  Downloading python_magic-0.4.27-py2.py3-none-any.whl.metadata (5.8 kB)
Collecting lxml (from unstructured)
  Downloading lxml-5.4.0-cp311-cp311-manylinux_2_28_x86_64.whl.metadata (3.5 kB)
Requirement already satisfied: nltk in /usr/local/lib/python3.11/dist-packages
(from unstructured) (3.9.1)
Requirement already satisfied: requests in /usr/local/lib/python3.11/dist-
packages (from unstructured) (2.32.3)
Requirement already satisfied: beautifulsoup4 in /usr/local/lib/python3.11/dist-
packages (from unstructured) (4.13.4)
Collecting emoji (from unstructured)
  Downloading emoji-2.14.1-py3-none-any.whl.metadata (5.7 kB)
Requirement already satisfied: dataclasses-json in

```

```

/usr/local/lib/python3.11/dist-packages (from unstructured) (0.6.7)
Collecting python-iso639 (from unstructured)
  Downloading python_iso639-2025.2.18-py3-none-any.whl.metadata (14 kB)
Collecting langdetect (from unstructured)
  Downloading langdetect-1.0.9.tar.gz (981 kB)
                                981.5/981.5 kB
16.9 MB/s eta 0:00:00
  Installing build dependencies ... done
  Getting requirements to build wheel ... done
  Preparing metadata (pyproject.toml) ... done
Requirement already satisfied: numpy in /usr/local/lib/python3.11/dist-packages
(from unstructured) (2.0.2)
Collecting rapidfuzz (from unstructured)
  Downloading rapidfuzz-3.13.0-cp311-cp311-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (12 kB)
Requirement already satisfied: backoff in /usr/local/lib/python3.11/dist-
packages (from unstructured) (2.2.1)
Requirement already satisfied: typing-extensions in
/usr/local/lib/python3.11/dist-packages (from unstructured) (4.13.2)
Collecting unstructured-client (from unstructured)
  Downloading unstructured_client-0.34.0-py3-none-any.whl.metadata (21 kB)
Requirement already satisfied: wrapt in /usr/local/lib/python3.11/dist-packages
(from unstructured) (1.17.2)
Requirement already satisfied: tqdm in /usr/local/lib/python3.11/dist-packages
(from unstructured) (4.67.1)
Requirement already satisfied: psutil in /usr/local/lib/python3.11/dist-packages
(from unstructured) (5.9.5)
Collecting python-oxmsg (from unstructured)
  Downloading python_oxmsg-0.0.2-py3-none-any.whl.metadata (5.0 kB)
Collecting html5lib (from unstructured)
  Downloading html5lib-1.1-py2.py3-none-any.whl.metadata (16 kB)
Requirement already satisfied: soupsieve>1.2 in /usr/local/lib/python3.11/dist-
packages (from beautifulsoup4->unstructured) (2.7)
Requirement already satisfied: marshmallow<4.0.0,>=3.18.0 in
/usr/local/lib/python3.11/dist-packages (from dataclasses-json->unstructured)
(3.26.1)
Requirement already satisfied: typing-inspect<1,>=0.4.0 in
/usr/local/lib/python3.11/dist-packages (from dataclasses-json->unstructured)
(0.9.0)
Requirement already satisfied: six>=1.9 in /usr/local/lib/python3.11/dist-
packages (from html5lib->unstructured) (1.17.0)
Requirement already satisfied: webencodings in /usr/local/lib/python3.11/dist-
packages (from html5lib->unstructured) (0.5.1)
Requirement already satisfied: click in /usr/local/lib/python3.11/dist-packages
(from nltk->unstructured) (8.1.8)
Requirement already satisfied: joblib in /usr/local/lib/python3.11/dist-packages
(from nltk->unstructured) (1.4.2)
Requirement already satisfied: regex>=2021.8.3 in

```

/usr/local/lib/python3.11/dist-packages (from nltk->unstructured) (2024.11.6)  
 Collecting olefile (from python-oxmsg->unstructured)  
   Downloading olefile-0.47-py2.py3-none-any.whl.metadata (9.7 kB)  
 Requirement already satisfied: charset-normalizer<4,>=2 in  
 /usr/local/lib/python3.11/dist-packages (from requests->unstructured) (3.4.1)  
 Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-  
 packages (from requests->unstructured) (3.10)  
 Requirement already satisfied: urllib3<3,>=1.21.1 in  
 /usr/local/lib/python3.11/dist-packages (from requests->unstructured) (2.4.0)  
 Requirement already satisfied: certifi>=2017.4.17 in  
 /usr/local/lib/python3.11/dist-packages (from requests->unstructured)  
 (2025.4.26)  
 Collecting aiofiles>=24.1.0 (from unstructured-client->unstructured)  
   Downloading aiofiles-24.1.0-py3-none-any.whl.metadata (10 kB)  
 Requirement already satisfied: cryptography>=3.1 in /usr/lib/python3/dist-  
 packages (from unstructured-client->unstructured) (3.4.8)  
 Collecting eval-type-backport>=0.2.0 (from unstructured-client->unstructured)  
   Downloading eval\_type\_backport-0.2.2-py3-none-any.whl.metadata (2.2 kB)  
 Requirement already satisfied: httpx>=0.27.0 in /usr/local/lib/python3.11/dist-  
 packages (from unstructured-client->unstructured) (0.28.1)  
 Requirement already satisfied: nest-asyncio>=1.6.0 in  
 /usr/local/lib/python3.11/dist-packages (from unstructured-client->unstructured)  
 (1.6.0)  
 Requirement already satisfied: pydantic>=2.11.2 in  
 /usr/local/lib/python3.11/dist-packages (from unstructured-client->unstructured)  
 (2.11.3)  
 Collecting pypdf>=4.0 (from unstructured-client->unstructured)  
   Downloading pypdf-5.4.0-py3-none-any.whl.metadata (7.3 kB)  
 Requirement already satisfied: requests-toolbelt>=1.0.0 in  
 /usr/local/lib/python3.11/dist-packages (from unstructured-client->unstructured)  
 (1.0.0)  
 Requirement already satisfied: typing-inspection>=0.4.0 in  
 /usr/local/lib/python3.11/dist-packages (from unstructured-client->unstructured)  
 (0.4.0)  
 Requirement already satisfied: anyio in /usr/local/lib/python3.11/dist-packages  
 (from httpx>=0.27.0->unstructured-client->unstructured) (4.9.0)  
 Requirement already satisfied: httpcore==1.\* in /usr/local/lib/python3.11/dist-  
 packages (from httpx>=0.27.0->unstructured-client->unstructured) (1.0.9)  
 Requirement already satisfied: h11>=0.16 in /usr/local/lib/python3.11/dist-  
 packages (from httpcore==1.\*->httpx>=0.27.0->unstructured-client->unstructured)  
 (0.16.0)  
 Requirement already satisfied: packaging>=17.0 in  
 /usr/local/lib/python3.11/dist-packages (from  
 marshmallow<4.0.0,>=3.18.0->dataclasses-json->unstructured) (24.2)  
 Requirement already satisfied: annotated-types>=0.6.0 in  
 /usr/local/lib/python3.11/dist-packages (from pydantic>=2.11.2->unstructured-  
 client->unstructured) (0.7.0)  
 Requirement already satisfied: pydantic-core==2.33.1 in

```

/usr/local/lib/python3.11/dist-packages (from pydantic>=2.11.2->unstructured-
client->unstructured) (2.33.1)
Requirement already satisfied: mpy-extensions>=0.3.0 in
/usr/local/lib/python3.11/dist-packages (from typing-
inspect<1,>=0.4.0->dataclasses-json->unstructured) (1.1.0)
Requirement already satisfied: sniffio>=1.1 in /usr/local/lib/python3.11/dist-
packages (from anyio->httpx>=0.27.0->unstructured-client->unstructured) (1.3.1)
Downloading unstructured-0.17.2-py3-none-any.whl (1.8 MB)
1.8/1.8 MB
53.1 MB/s eta 0:00:00
Downloading chardet-5.2.0-py3-none-any.whl (199 kB)
199.4/199.4 kB
14.0 MB/s eta 0:00:00
Downloading emoji-2.14.1-py3-none-any.whl (590 kB)
590.6/590.6 kB
30.8 MB/s eta 0:00:00
Downloading filetype-1.2.0-py2.py3-none-any.whl (19 kB)
Downloading html5lib-1.1-py2.py3-none-any.whl (112 kB)
112.2/112.2 kB
7.5 MB/s eta 0:00:00
Downloading lxml-5.4.0-cp311-cp311-manylinux_2_28_x86_64.whl (4.9 MB)
4.9/4.9 MB
92.4 MB/s eta 0:00:00
Downloading python_iso639-2025.2.18-py3-none-any.whl (167 kB)
167.6/167.6 kB
12.3 MB/s eta 0:00:00
Downloading python_magic-0.4.27-py2.py3-none-any.whl (13 kB)
Downloading python_oxmsg-0.0.2-py3-none-any.whl (31 kB)
Downloading
rapidfuzz-3.13.0-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (3.1
MB)
3.1/3.1 MB
86.6 MB/s eta 0:00:00
Downloading unstructured_client-0.34.0-py3-none-any.whl (189 kB)
189.4/189.4 kB
13.3 MB/s eta 0:00:00
Downloading aiofiles-24.1.0-py3-none-any.whl (15 kB)
Downloading eval_type_backport-0.2.2-py3-none-any.whl (5.8 kB)
Downloading pypdf-5.4.0-py3-none-any.whl (302 kB)
302.3/302.3 kB
16.8 MB/s eta 0:00:00
Downloading olefile-0.47-py2.py3-none-any.whl (114 kB)
114.6/114.6 kB
7.6 MB/s eta 0:00:00
Building wheels for collected packages: langdetect
  Building wheel for langdetect (pyproject.toml) ... done
  Created wheel for langdetect: filename=langdetect-1.0.9-py3-none-any.whl
size=993331

```



sha256=e3857d45451b2e1d982ca9ca1a12cbb500b92914477c5b3932b4ba8e7b583811

Stored in directory: /root/.cache/pip/wheels/0a/f2/b2/e5ca405801e05eb7c8ed5b3b4bcf1fcabdc6272c167640072e

Successfully built langdetect

Installing collected packages: filetype, rapidfuzz, python-magic, python-iso639, pypdf, olefile, lxml, langdetect, html5lib, eval-type-backport, emoji, chardet, aiofiles, python-oxmsg, unstructured-client, unstructured

Successfully installed aiofiles-24.1.0 chardet-5.2.0 emoji-2.14.1 eval-type-backport-0.2.2 filetype-1.2.0 html5lib-1.1 langdetect-1.0.9 lxml-5.4.0

olefile-0.47 pypdf-5.4.0 python-iso639-2025.2.18 python-magic-0.4.27 python-oxmsg-0.0.2 rapidfuzz-3.13.0 unstructured-0.17.2 unstructured-client-0.34.0

```
[ ]: !pip install "tensorflow>=2.15.0"
!pip install --upgrade tensorflow-hub
```

Collecting tensorflow>=2.15.0

Downloading tensorflow-2.19.0-cp311-cp311-

manylinux\_2\_17\_x86\_64.manylinux2014\_x86\_64.whl.metadata (4.1 kB)

Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (1.4.0)

Collecting astunparse>=1.6.0 (from tensorflow>=2.15.0)

Downloading astunparse-1.6.3-py3-none-any.whl.metadata (4.4 kB)

Requirement already satisfied: flatbuffers>=24.3.25 in

/usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (25.2.10)

Requirement already satisfied: gast!=0.5.0,!0.5.1,!0.5.2,>=0.2.1 in

/usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (0.6.0)

Collecting google-pasta>=0.1.1 (from tensorflow>=2.15.0)

Downloading google\_pasta-0.2.0-py3-none-any.whl.metadata (814 bytes)

Collecting libclang>=13.0.0 (from tensorflow>=2.15.0)

Downloading libclang-18.1.1-py2.py3-none-manylinux2010\_x86\_64.whl.metadata (5.2 kB)

Requirement already satisfied: opt-einsum>=2.3.2 in

/usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (3.4.0)

Requirement already satisfied: packaging in /usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (24.2)

Requirement already satisfied:

protobuf!=4.21.0,!4.21.1,!4.21.2,!4.21.3,!4.21.4,!4.21.5,<6.0.0dev,>=3.20.3 in /usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (5.29.4)

Requirement already satisfied: requests<3,>=2.21.0 in

/usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (2.32.3)

Requirement already satisfied: setuptools in /usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (75.2.0)

Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (1.17.0)

Requirement already satisfied: termcolor>=1.1.0 in

/usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (3.0.1)

Requirement already satisfied: typing-extensions>=3.6.6 in

/usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (4.13.2)

Requirement already satisfied: wrapt>=1.11.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (1.17.2)

Requirement already satisfied: grpcio<2.0,>=1.24.3 in /usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (1.71.0)

Collecting tensorboard~=2.19.0 (from tensorflow>=2.15.0)

  Downloading tensorboard-2.19.0-py3-none-any.whl.metadata (1.8 kB)

Requirement already satisfied: keras>=3.5.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (3.8.0)

Requirement already satisfied: numpy<2.2.0,>=1.26.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (2.0.2)

Requirement already satisfied: h5py>=3.11.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (3.13.0)

Requirement already satisfied: ml-dtypes<1.0.0,>=0.5.1 in /usr/local/lib/python3.11/dist-packages (from tensorflow>=2.15.0) (0.5.1)

Collecting tensorflow-io-gcs-filesystem>=0.23.1 (from tensorflow>=2.15.0)

  Downloading tensorflow\_io\_gcs\_filesystem-0.37.1-cp311-cp311-manylinux\_2\_17\_x86\_64.manylinux2014\_x86\_64.whl.metadata (14 kB)

Collecting wheel<1.0,>=0.23.0 (from astunparse>=1.6.0->tensorflow>=2.15.0)

  Downloading wheel-0.45.1-py3-none-any.whl.metadata (2.3 kB)

Requirement already satisfied: rich in /usr/local/lib/python3.11/dist-packages (from keras>=3.5.0->tensorflow>=2.15.0) (14.0.0)

Requirement already satisfied: namex in /usr/local/lib/python3.11/dist-packages (from keras>=3.5.0->tensorflow>=2.15.0) (0.0.9)

Requirement already satisfied: optree in /usr/local/lib/python3.11/dist-packages (from keras>=3.5.0->tensorflow>=2.15.0) (0.15.0)

Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorflow>=2.15.0) (3.4.1)

Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorflow>=2.15.0) (3.10)

Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorflow>=2.15.0) (2.4.0)

Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorflow>=2.15.0) (2025.4.26)

Requirement already satisfied: markdown>=2.6.8 in /usr/lib/python3/dist-packages (from tensorboard~=2.19.0->tensorflow>=2.15.0) (3.3.6)

Collecting tensorboard-data-server<0.8.0,>=0.7.0 (from tensorboard~=2.19.0->tensorflow>=2.15.0)

  Downloading tensorboard\_data\_server-0.7.2-py3-none-manylinux\_2\_31\_x86\_64.whl.metadata (1.1 kB)

Collecting werkzeug>=1.0.1 (from tensorboard~=2.19.0->tensorflow>=2.15.0)

  Downloading werkzeug-3.1.3-py3-none-any.whl.metadata (3.7 kB)

Requirement already satisfied: MarkupSafe>=2.1.1 in /usr/local/lib/python3.11/dist-packages (from werkzeug>=1.0.1->tensorboard~=2.19.0->tensorflow>=2.15.0) (3.0.2)

Requirement already satisfied: markdown-it-py>=2.2.0 in

```

/usr/local/lib/python3.11/dist-packages (from
rich->keras>=3.5.0->tensorflow>=2.15.0) (3.0.0)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in
/usr/local/lib/python3.11/dist-packages (from
rich->keras>=3.5.0->tensorflow>=2.15.0) (2.19.1)
Requirement already satisfied: mdurl~=0.1 in /usr/local/lib/python3.11/dist-
packages (from markdown-it-py>=2.2.0->rich->keras>=3.5.0->tensorflow>=2.15.0)
(0.1.2)
Downloading
tensorflow-2.19.0-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl
(644.9 MB)

644.9/644.9 MB
1.6 MB/s eta 0:00:00
Downloading astunparse-1.6.3-py2.py3-none-any.whl (12 kB)
Downloading google_pasta-0.2.0-py3-none-any.whl (57 kB)

57.5/57.5 kB
3.9 MB/s eta 0:00:00
Downloading libclang-18.1.1-py2.py3-none-manylinux2010_x86_64.whl (24.5
MB)

24.5/24.5 MB
82.1 MB/s eta 0:00:00
Downloading tensorboard-2.19.0-py3-none-any.whl (5.5 MB)

5.5/5.5 MB
102.1 MB/s eta 0:00:00
Downloading tensorflow_io_gcs_filesystem-0.37.1-cp311-cp311-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (5.1 MB)

5.1/5.1 MB
105.6 MB/s eta 0:00:00
Downloading tensorboard_data_server-0.7.2-py3-none-
manylinux_2_31_x86_64.whl (6.6 MB)

6.6/6.6 MB
116.2 MB/s eta 0:00:00
Downloading werkzeug-3.1.3-py3-none-any.whl (224 kB)

224.5/224.5 kB
13.1 MB/s eta 0:00:00
Downloading wheel-0.45.1-py3-none-any.whl (72 kB)

72.5/72.5 kB
4.8 MB/s eta 0:00:00
Installing collected packages: libclang, wheel, werkzeug, tensorflow-io-
gcs-fileSYSTEM, tensorboard-data-server, google-pasta, tensorboard, astunparse,
tensorflow
Successfully installed astunparse-1.6.3 google-pasta-0.2.0 libclang-18.1.1
tensorboard-2.19.0 tensorboard-data-server-0.7.2 tensorflow-2.19.0 tensorflow-
io-gcs-fileSYSTEM-0.37.1 werkzeug-3.1.3 wheel-0.45.1
Collecting tensorflow-hub
  Downloading tensorflow_hub-0.16.1-py2.py3-none-any.whl.metadata (1.3 kB)
Requirement already satisfied: numpy>=1.12.0 in /usr/local/lib/python3.11/dist-
packages (from tensorflow-hub) (2.0.2)

```

Requirement already satisfied: protobuf>=3.19.6 in  
 /usr/local/lib/python3.11/dist-packages (from tensorflow-hub) (5.29.4)

Collecting tf-keras>=2.14.1 (from tensorflow-hub)

  Downloading tf\_keras-2.19.0-py3-none-any.whl.metadata (1.8 kB)

Requirement already satisfied: tensorflow<2.20,>=2.19 in  
 /usr/local/lib/python3.11/dist-packages (from tf-keras>=2.14.1->tensorflow-hub)  
 (2.19.0)

Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.11/dist-  
 packages (from tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (1.4.0)

Requirement already satisfied: astunparse>=1.6.0 in  
 /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-  
 keras>=2.14.1->tensorflow-hub) (1.6.3)

Requirement already satisfied: flatbuffers>=24.3.25 in  
 /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-  
 keras>=2.14.1->tensorflow-hub) (25.2.10)

Requirement already satisfied: gast!=0.5.0,!0.5.1,!0.5.2,>=0.2.1 in  
 /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-  
 keras>=2.14.1->tensorflow-hub) (0.6.0)

Requirement already satisfied: google-pasta>=0.1.1 in  
 /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-  
 keras>=2.14.1->tensorflow-hub) (0.2.0)

Requirement already satisfied: libclang>=13.0.0 in  
 /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-  
 keras>=2.14.1->tensorflow-hub) (18.1.1)

Requirement already satisfied: opt-einsum>=2.3.2 in  
 /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-  
 keras>=2.14.1->tensorflow-hub) (3.4.0)

Requirement already satisfied: packaging in /usr/local/lib/python3.11/dist-  
 packages (from tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (24.2)

Requirement already satisfied: requests<3,>=2.21.0 in  
 /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-  
 keras>=2.14.1->tensorflow-hub) (2.32.3)

Requirement already satisfied: setuptools in /usr/local/lib/python3.11/dist-  
 packages (from tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub)  
 (75.2.0)

Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.11/dist-  
 packages (from tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub)  
 (1.17.0)

Requirement already satisfied: termcolor>=1.1.0 in  
 /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-  
 keras>=2.14.1->tensorflow-hub) (3.0.1)

Requirement already satisfied: typing-extensions>=3.6.6 in  
 /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-  
 keras>=2.14.1->tensorflow-hub) (4.13.2)

Requirement already satisfied: wrapt>=1.11.0 in /usr/local/lib/python3.11/dist-  
 packages (from tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub)  
 (1.17.2)

Requirement already satisfied: grpcio<2.0,>=1.24.3 in

/usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (1.71.0)  
 Requirement already satisfied: tensorboard~=2.19.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (2.19.0)  
 Requirement already satisfied: keras>=3.5.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (3.8.0)  
 Requirement already satisfied: h5py>=3.11.0 in /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (3.13.0)  
 Requirement already satisfied: ml-dtypes<1.0.0,>=0.5.1 in /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (0.5.1)  
 Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /usr/local/lib/python3.11/dist-packages (from tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (0.37.1)  
 Requirement already satisfied: wheel<1.0,>=0.23.0 in /usr/local/lib/python3.11/dist-packages (from astunparse>=1.6.0->tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (0.45.1)  
 Requirement already satisfied: rich in /usr/local/lib/python3.11/dist-packages (from keras>=3.5.0->tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (14.0.0)  
 Requirement already satisfied: namex in /usr/local/lib/python3.11/dist-packages (from keras>=3.5.0->tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (0.0.9)  
 Requirement already satisfied: optree in /usr/local/lib/python3.11/dist-packages (from keras>=3.5.0->tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (0.15.0)  
 Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (3.4.1)  
 Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (3.10)  
 Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (2.4.0)  
 Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.11/dist-packages (from requests<3,>=2.21.0->tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (2025.4.26)  
 Requirement already satisfied: markdown>=2.6.8 in /usr/lib/python3/dist-packages (from tensorboard~=2.19.0->tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub) (3.3.6)  
 Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in

```

/usr/local/lib/python3.11/dist-packages (from
tensorboard~=2.19.0->tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub)
(0.7.2)
Requirement already satisfied: werkzeug>=1.0.1 in
/usr/local/lib/python3.11/dist-packages (from
tensorboard~=2.19.0->tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub)
(3.1.3)
Requirement already satisfied: MarkupSafe>=2.1.1 in
/usr/local/lib/python3.11/dist-packages (from
werkzeug>=1.0.1->tensorboard~=2.19.0->tensorflow<2.20,>=2.19->tf-
keras>=2.14.1->tensorflow-hub) (3.0.2)
Requirement already satisfied: markdown-it-py>=2.2.0 in
/usr/local/lib/python3.11/dist-packages (from
rich->keras>=3.5.0->tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub)
(3.0.0)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in
/usr/local/lib/python3.11/dist-packages (from
rich->keras>=3.5.0->tensorflow<2.20,>=2.19->tf-keras>=2.14.1->tensorflow-hub)
(2.19.1)
Requirement already satisfied: mdurl~=0.1 in /usr/local/lib/python3.11/dist-
packages (from markdown-it-
py>=2.2.0->rich->keras>=3.5.0->tensorflow<2.20,>=2.19->tf-
keras>=2.14.1->tensorflow-hub) (0.1.2)
Downloading tensorflow_hub-0.16.1-py2.py3-none-any.whl (30 kB)
Downloading tf_keras-2.19.0-py3-none-any.whl (1.7 MB)
1.7/1.7 MB
24.4 MB/s eta 0:00:00
Installing collected packages: tf-keras, tensorflow-hub
Successfully installed tensorflow-hub-0.16.1 tf-keras-2.19.0

```

[ ]:

```

[1]: # Import the libraries

import os
import sys
from IPython.display import HTML, display

import numpy as np
import pandas as pd
import tensorflow as tf
from math import ceil
from scipy.spatial.distance import cosine

import matplotlib.pyplot as plt
import seaborn as sns

```

```

import collections
import random
import time
import string
import re

import nltk
nltk.download('stopwords')
nltk.download('punkt')
nltk.download('punkt_tab')
nltk.download('wordnet')
from nltk.corpus import stopwords
from nltk.stem import WordNetLemmatizer
from nltk.tokenize import word_tokenize
from nltk.tokenize import sent_tokenize

from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.naive_bayes import MultinomialNB
from sklearn.model_selection import GridSearchCV
from sklearn.svm import SVC
from sklearn.metrics import roc_curve, auc
from sklearn.metrics import confusion_matrix
from sklearn.metrics import classification_report

from tensorflow.keras.preprocessing.sequence import pad_sequences
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.models import Sequential, Model
from tensorflow.keras.layers import Input, Embedding, Dense, Convolution1D,
↳MaxPooling1D, GlobalMaxPooling1D, Flatten, Dropout, LSTM, Bidirectional

```

```

[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt.zip.
[nltk_data] Downloading package punkt_tab to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt_tab.zip.
[nltk_data] Downloading package wordnet to /root/nltk_data...

```

```

[2]: from google.colab import drive
drive.mount('/content/gdrive')

```

Mounted at /content/gdrive

```

[3]: %cd /content/gdrive/MyDrive/Colab Notebooks/MF815/NLP/NLP_app

```

/content/gdrive/MyDrive/Colab Notebooks/MF815/NLP/NLP\_app

```
[4]: !ls
```

```
df.csv MutualFundSummary10
df_main.csv MutualFundSummary2
df_RAG2_5.csv MutualFundSummary2_5
df_RAG2.csv MutualFundSummary3
df_RAG3_5.csv MutualFundSummary3_5
df_RAG3.csv MutualFundSummary4
df_RAG4.csv MutualFundSummary4_5
df_RAG_all.csv MutualFundSummary5
df_RAG.csv MutualFundSummary6
df_summary.csv MutualFundSummary7
docs MutualFundSummary8
FundArticlesHealthy.csv MutualFundSummary9
FundArticlesUnhealthy.csv NLP_Deep_Learning_Questrom_WS_03_2020.ipynb
glove.6B.50d.txt word2vec_model.pkl
MutualFundLabels.csv word2vec_MutualFundSummary.txt
MutualFundSummary word2vec_perso.txt
MutualFundSummary1
```

```
[5]: DIRECTORY = '/content/gdrive/MyDrive/Colab Notebooks/MF815/NLP/NLP_app'

SUMMARY_PATH = '/content/gdrive/MyDrive/Colab Notebooks/MF815/NLP/NLP_app/
↳MutualFundSummary'
SUMMARY_LABELS_PATH = '/content/gdrive/MyDrive/Colab Notebooks/MF815/NLP/
↳NLP_app/MutualFundLabels.csv'

HEALTHY_ARTICLES_PATH = os.path.join(DIRECTORY, "Data", "FundArticlesHealthy.
↳csv")
UNHEALTHY_ARTICLES_PATH = os.path.join(DIRECTORY, "Data", "
↳FundArticlesUnhealthy.csv")

glove_word2vec = 'glove.6B.50d.txt'
our_word2vec = 'word2vec_perso.txt'
new_word2vec = 'word2vec_MutualFundSummary.txt'
```

```
[6]: # Progress bar
def progress(value, max=100):
    return HTML("""
        <progress
            value='{value}'
            max='{max}',
            style='width: 100%'
        >
            {value}
        </progress>
    """).format(value=value, max=max)
```



```

# Save a word2vec dictionary.
def save_word2vec(filename):
    #with open(os.path.join('/Users/haoxing/Documents/Work/Teaching/Machine_
    ↪learning for Finance/Codes/NLP/NLP_app', filename), 'a' , encoding='utf-8')
    ↪as f :
        with open(os.path.join('/content/gdrive/MyDrive/Colab Notebooks/MF815/NLP/
    ↪NLP_app/', filename), 'a' , encoding='utf-8') as f :
            for k, v in word2vec.items():
                line = k+ ' '+str(list(v)).strip('[]').replace(',','')+'\n'
                f.write(line)

# Load a word2vec dictionary.
def load_word2vec(filename):
    word2vec = {}
    #with open(os.path.join('/Users/haoxing/Documents/Work/Teaching/Machine_
    ↪learning for Finance/Codes/NLP/NLP_app', filename), encoding='utf8') as f:
        with open(os.path.join('/content/gdrive/MyDrive/Colab Notebooks/MF815/NLP/
    ↪NLP_app/', filename), encoding='utf8') as f:
            for line in f:
                try :
                    values = line.split()
                    word = values[0]
                    vec = np.asarray(values[1:], dtype='float32')
                    word2vec[word] = vec
                except :
                    None
    return word2vec

# read the repo in PATH and append the texts in a list
def get_data(PATH):
    list_dir = os.listdir(PATH)
    texts = []
    fund_names = []
    out = display(progress(0, len(list_dir)-1), display_id=True)
    for ii, filename in enumerate(list_dir) :
        with open(PATH+'/'+filename, 'r', encoding="utf8") as f :
            txt = f.read()
            try :
                txt_split = txt.split('<head_breaker>')
                summary = txt_split[1].strip()
                fund_name = txt_split[0].strip()
            except :
                summary = txt
                fund_name = ''
    texts.append(summary)
    fund_names.append(fund_name)

```

```

        out.update(progress(ii, len(list_dir)-1))
    return fund_names, texts

```

```

[7]: # Get the summaries
fund_names, summaries = get_data(SUMMARY_PATH)

```

<IPython.core.display.HTML object>

```

[8]: len(fund_names)

```

```

[8]: 545

```

```

[9]: len(summaries)

```

```

[9]: 545

```

```

[10]: fund_names[20]

```

```

[10]: 'AB Municipal Bond Inflation Strategy'

```

```

[11]: type(summaries), type(fund_names)

```

```

[11]: (list, list)

```

```

[12]: df_summary = pd.read_csv('/content/gdrive/MyDrive/Colab Notebooks/MF815/NLP/
↳NLP_app/df_summary.csv')
df_summary

```

```

[12]:
      id                                     fund_name \
0    0000051931-18-000151    American Funds College 2018 Fund
1    0000051931-18-000151    American Funds College 2021 Fund
2    0000051931-18-000151    American Funds College 2024 Fund
3    0000051931-18-000151    American Funds College 2027 Fund
4    0000051931-18-000151    American Funds College 2030 Fund
..    ...
427  0001710607-18-000172    American Century Diversified Corporate Bond ETF
428  0001710607-18-000172    American Century Diversified Municipal Bond ETF
429  0001710607-18-000172    American Century Quality Diversified Internati...
430  0001710607-18-000172    American Century STOXX U.S. Quality Growth ETF
431  0001710607-18-000172    American Century STOXX U.S. Quality Value ETF

      Performance fee?      Investment Strategy Leverage? \
0                    NaN    Balanced Fund (Low Risk)      Yes
1                    NaN    Balanced Fund (Low Risk)      Yes
2                    NaN    Balanced Fund (Low Risk)      Yes
3                    NaN    Balanced Fund (Low Risk)      Yes
4                    NaN    Balanced Fund (Low Risk)      Yes

```

..	...	...	...
427	NaN	Fixed Income Long Only (Low Risk)	Yes
428	NaN	Fixed Income Long Only (Low Risk)	No
429	NaN	Equity Long Only (Low Risk)	Yes
430	NaN	Equity Long Only (Low Risk)	Yes
431	NaN	Equity Long Only (Low Risk)	Yes

		Portfolio composition	Concentration \
0		Investment grade securities	Diversified
1		Investment grade securities	Diversified
2		Investment grade securities	Diversified
3		Investment grade securities	Diversified
4		Investment grade securities	Diversified
..		...	...
427		Investment grade securities	Diversified
428		Investment grade securities	Diversified
429	Sub-investment grade securities or emerging ma...		Diversified
430		Listed Equities	Diversified
431		Listed Equities	Diversified

	Investment_Strategy_label	Predicted investment strategy \
0	2.0	Balanced Fund (Low Risk)
1	2.0	Balanced Fund (Low Risk)
2	2.0	Balanced Fund (Low Risk)
3	2.0	Balanced Fund (Low Risk)
4	2.0	Balanced Fund (Low Risk)
..	...	...
427	1.0	Fixed Income Long Only (Low Risk)
428	1.0	Fixed Income Long Only (Low Risk)
429	0.0	Equity Long Only (Low Risk)
430	0.0	Equity Long Only (Low Risk)
431	0.0	Equity Long Only (Low Risk)

	investment strategy evidence \
0	American Funds College 2018 Fund <head_breaker...
1	American Funds College 2021 Fund <head_breaker...
2	American Funds College 2024 Fund <head_breaker...
3	American Funds College 2027 Fund <head_breaker...
4	American Funds College 2030 Fund <head_breaker...
..	...
427	American Century Diversified Corporate Bond ET...
428	American Century Diversified Municipal Bond ET...
429	American Century Quality Diversified Internati...
430	American Century STOXX U.S. Quality Growth ETF...
431	American Century STOXX U.S. Quality Value ETF ...

source meta data Prediction

```

0    {'source': 'MutualFundSummary/American Funds C...      2.0
1    {'source': 'MutualFundSummary/American Funds C...      2.0
2    {'source': 'MutualFundSummary1/American Funds ...      2.0
3    {'source': 'MutualFundSummary1/American Funds ...      2.0
4    {'source': 'MutualFundSummary/American Funds C...      2.0
..
427 {'source': 'MutualFundSummary/American Century...      1.0
428 {'source': 'MutualFundSummary/American Century...      1.0
429 {'source': 'MutualFundSummary/American Century...      0.0
430 {'source': 'MutualFundSummary/American Century...      0.0
431 {'source': 'MutualFundSummary/American Century...      0.0

```

[432 rows x 12 columns]

```

[13]: common_fund_names = []
      for index, name in enumerate(fund_names):
          # Check if the current fund name is in the set of common names
          if name in set(df_summary['fund_name']):
              # If it is, append the corresponding summary (using the same index)
              common_fund_names.append(fund_names[index])
      len(common_fund_names)

```

[13]: 432

```

[14]: common_summaries = []
      for index, name in enumerate(fund_names):
          # Check if the current fund name is in the set of common names
          if name in set(df_summary['fund_name']):
              # If it is, append the corresponding summary (using the same index)
              common_summaries.append(summaries[index])
      len(common_summaries)

```

[14]: 432

```

[15]: #checking
      common_fund_names[1]

```

[15]: 'ALL CAP GROWTH FUND'

```

[16]: common_summaries[1]

```

```

[16]: 'Fund Summary\nInvestment Objective\nThe fund seeks long-term capital
      growth.\nFees and Expenses\nThe following table describes the fees and expenses
      you may pay if you buy and hold shares of the fund. You may qualify for sales
      charge discounts if you and your family invest, or agree to invest in the
      future, at least $50,000 in American Century Investments funds. More information
      about these and other discounts is available from your financial professional

```

and in Calculation of Sales Charges on page 12 of the fund's prospectus, Appendix A of the fund's prospectus and Sales Charges in Appendix B of the statement of additional information.

**Shareholder Fees** (fees paid directly from your investment)

Investor Class	Maximum Sales Charge (Load) Imposed on Purchases (as a percentage of offering price)	Maximum Deferred Sales Charge (Load) (as a percentage of the lower of the original offering price or redemption proceeds when redeemed within one year of purchase)	Maximum Annual Account Maintenance Fee (waived for unmatured Giftrust accounts or if ineligible investments total at least \$10,000)	Annual Fund Operating Expenses (expenses that you pay each year as a percentage of the value of your investment)
Investor Class	5.75%		\$25	1.00%
I Class				0.80%
C Class				0.25%
R Class				0.01%
Portfolio Turnover				44%

**Distribution and Service (12b-1) Fees**

Investor Class	1 year	3 years	5 years	10 years
Investor Class	\$103	\$322	\$559	\$1,236
I Class	\$83	\$259	\$450	\$1,002
C Class	\$696	\$952	\$1,228	\$2,010
R Class	\$204	\$632	\$1,084	\$2,334
Portfolio Turnover				

The fund pays transaction costs, such as commissions, when it buys and sells securities (or "turns over" its portfolio). A higher portfolio turnover rate may indicate higher transaction costs and may result in higher taxes when fund shares are held in a taxable account. These costs, which are not reflected in annual fund operating expenses or in the example, affect the fund's performance. During the most recent fiscal year, the fund's portfolio turnover rate was 44% of the average value of its portfolio.

**Principal Investment Strategies**

The portfolio managers look for stocks of companies of all sizes they believe will increase in value over time, using an investment strategy developed by the fund's investment advisor. In implementing this strategy, the portfolio managers make their investment decisions based primarily on their analysis of individual companies, rather than on broad economic forecasts. The portfolio managers use a variety of analytical research tools and techniques to identify companies that meet their investment criteria. Under normal market conditions, the fund's portfolio will primarily consist of securities of companies demonstrating business improvement. Analytical

indicators helping to identify signs of business improvement could include accelerating earnings or revenue growth rates, increasing cash flows, or other indications of the relative strength of a company's business. These techniques help the portfolio managers buy or hold the stocks of companies they believe have favorable growth prospects and sell the stocks of companies whose characteristics no longer meet their criteria.

Although the portfolio managers intend to invest the fund's assets primarily in U.S. securities, the fund may invest in securities of foreign companies when these securities meet the portfolio managers' standards of selection.

The fund may write covered calls on a portion of the fund's holdings in common stock when the portfolio managers believe call premiums are attractive relative to the price of the underlying security.

**Principal Risks**

- Growth Stocks** - Investments in growth stocks may be more volatile than other stocks and the overall stock market. These stocks are typically priced higher than other stocks because of their growth potential, which may or may not be realized.
- Small and Mid Cap Stocks** - The fund invests in mid-sized and smaller companies, which may be more volatile and subject to greater risk than larger companies. Smaller companies may have limited financial resources, product lines and markets, and their securities may trade less frequently and in more limited volumes than the securities of larger companies, which could lead to higher transaction costs.
- Style Risk** - If at any time the market is not favoring the fund's growth investment style, the fund's gains may not be as big as, or its losses may be bigger than, those of other equity funds using different investment styles.
- Foreign Securities** - The fund may invest in foreign securities, which can be riskier than investing in U.S. securities. Securities of foreign issuers may be less liquid, more volatile and harder to value than U.S. securities.
- Covered Call Risk** - Writing covered calls may limit the fund's ability to participate in price increases of the underlying securities and could lower the fund's return.
- Price Volatility** - The value of the fund's shares may fluctuate significantly in the short term.
- Market Risk** - The value of the fund's shares will go up and down based on the performance of the companies whose securities it owns and other factors generally affecting the securities market.
- Principal Loss** - At any given time your shares may be worth less than the price you paid for them. In other words, it is possible to lose money by investing in the fund.

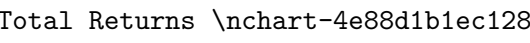
An investment in the fund is not a bank deposit, and it is not insured or guaranteed by the Federal Deposit Insurance Corporation (FDIC) or any other government agency.

**Fund Performance**

The following bar chart and table provide some indication of the risks of investing in the fund. The bar chart shows changes in the fund's performance from year to year for Investor Class shares. The table shows how the fund's average annual returns for the periods shown compared with those of a broad measure of market performance. The fund's past performance (before and after taxes) is not necessarily an indication of how the fund will perform in the future. For current performance information, please visit [americancentury.com](http://americancentury.com).

Sales charges and account fees, if applicable, are not reflected in the bar chart. If those charges were included, returns would be less than those shown.

Calendar Year Total Returns



Highest Performance Quarter

(1Q 2012): 18.71% Lowest Performance Quarter (4Q 2008): -26.56%\nAverage Annual Total Returns \nFor the calendar year ended December 31, 2017\n1 year\n5 years\n10 years\nSince Inception\nInception Date\nInvestor Class Return Before Taxes\n24.87%\n14.13%\n6.76%\n-\n11/25/1983\nReturn After Taxes on Distributions\n22.57%\n11.48%\n5.36%\n-\n11/25/1983\nReturn After Taxes on Distributions and Sale of Fund Shares\n15.98%\n10.85%\n5.22%\n-\n11/25/1983\nI Class Return Before Taxes\n25.14%\n14.36%\n-\n15.32%\n09/30/2011\nA Class1 Return Before Taxes\n17.42%\n12.51%\n5.87%\n-\n09/30/2011\nC Class1 Return Before Taxes\n23.63%\n12.99%\n5.70%\n-\n09/30/2011\nR Class1 Return Before Taxes\n24.24%\n13.57%\n6.23%\n-\n09/30/2011\nRussell 3000® Growth Index\n(reflects no deduction for fees, expenses or taxes)\n29.59%\n17.15%\n9.93%\n-\n-\n\n1 \nHistorical performance for A, C and R Classes prior to their inception is based on the performance of Investor Class shares. A, C and R Class performance has been adjusted to reflect differences in sales charges, if applicable, and expenses between classes.\nThe after-tax returns are shown only for Investor Class shares. After-tax returns for other share classes will vary. After-tax returns are calculated using the historical highest individual federal marginal income tax rates and do not reflect the impact of state and local taxes. Actual after-tax returns depend on an investor's tax situation and may differ from those shown. After-tax returns are not relevant to investors who hold their fund shares through tax-deferred arrangements, such as 401(k) plans or IRAs.\nPortfolio Management \nInvestment Advisor \nAmerican Century Investment Management, Inc. \nPortfolio Managers \nGregory J. Woodhams , CFA, Co-CIO, Global Growth Equity, Senior Vice President and Senior Portfolio Manager, has been a member of the team that manages the fund since 2018.\nJoseph Reiland , CFA, Vice President and Portfolio Manager, has been a member of the team that manages the fund since 2018.\n4#\n\n\n\nPurchase and Sale of Fund Shares \nYou may purchase or redeem shares of the fund on any business day through our website at americancentury.com, in person (at one of our Investor Centers), by mail (American Century Investments, P.O. Box 419200, Kansas City, MO 64141-6200), by telephone at 1-800-345-2021 (Investor Services Representative) or 1-800-345-3533 (Business, Not-For-Profit and Employer-Sponsored Retirement Plans), or through a financial intermediary. Shares may be purchased and redemption proceeds received by electronic bank transfer, by check or by wire. \nUnless otherwise specified below, the minimum initial investment amount to open an account is \$2,500 (\$2,000 for Coverdell Education Savings Accounts). Investors opening accounts through financial intermediaries may open an account with \$250 for Investor, A, C and R Classes, but the financial intermediaries may require their clients to meet different investment minimums. The minimum may be waived for broker-dealer sponsored wrap program accounts, fee based accounts, and accounts through bank/trust and wealth management advisory organizations. \nThe minimum initial investment amount for I Class is generally \$5 million (\$3 million for endowments and foundations), but the minimum may be waived if you have an aggregate investment in the American Century family of funds of \$10 million or more (\$5 million for endowments and foundations). This includes accounts held directly with American Century and those held through a financial intermediary. \nFor Investor, A, C and R Classes, there is no minimum

initial investment amount for certain employer-sponsored retirement plans, however, financial intermediaries or plan recordkeepers may require plans to meet different minimums. For purposes of fund minimums, employer-sponsored retirement plans do not include SEP IRAs, SIMPLE IRAs or SARSEPs. Employer-sponsored retirement plans are not eligible to invest in the I Class.\nThere is a \$50 minimum for subsequent purchases, except there is no subsequent purchase minimum for financial intermediaries or employer-sponsored retirement plans.\nPurchase and Sale of Fund Shares Through a Giftrust® \nPrior to June 21, 2017, All Cap Growth shares could be purchased to establish a Giftrust, which was a product created by American Century as a way to invest in the fund for someone other than yourself through a one-time gift held in an irrevocable trust.\nAs of June 21, 2017, no new Giftrusts may be opened. However, additional shares may be purchased for Giftrusts established prior to August 1, 2002, by check or by wire.\nOnce a Giftrust matures, the shares are transferred out of the Giftrust and into a new account registered in the beneficiary's individual name. The beneficiary may purchase additional shares or redeem shares in the new account as indicated above in the Purchase and Sale of Fund Shares section.\nTax Information \nFund distributions are generally taxable as ordinary income or capital gains, unless you are investing through a tax-deferred account such as a 401(k) or individual retirement account (in which case you may be taxed upon withdrawal of your investment from such account). \nPayments to Broker-Dealers and Other Financial Intermediaries \nIf you purchase the fund through a broker-dealer or other financial intermediary (such as a bank, insurance company, plan sponsor or financial professional), the fund and its related companies may pay the intermediary for the sale of fund shares and related services. These payments may create a conflict of interest by influencing the broker-dealer or other intermediary and your salesperson to recommend the fund over another investment. Ask your salesperson or visit your financial intermediary's website for more information.'

## 0.2 split to train, validation, test

```
[17]: X_train, X_val_test, y_train, y_val_test = train_test_split(
      common_summaries, common_fund_names, test_size=0.4, random_state=815)
```

```
[18]: #split to test and validation set
      X_val, X_test, y_val, y_test = train_test_split(
          X_val_test, y_val_test, test_size=0.5, random_state=815)
```

```
[19]: len(X_train), len(X_val), len(X_test)
```

```
[19]: (259, 86, 87)
```

```
[20]: y_train
```



[20]: ['MFS Maryland Municipal Bond Fund',  
 'Janus Henderson Enterprise Portfolio',  
 'Ivy Municipal Bond Fund',  
 'Fidelity Advisor New Insights Fund',  
 'CAPITAL VALUE FUND',  
 'Franklin FTSE Mexico ETF',  
 'Dreyfus Global Equity Income Fund',  
 'Fidelity Emerging Markets Discovery Fund',  
 'Short-Term Bond Fund',  
 'Capital Income Builder',  
 'Janus Henderson Balanced Fund',  
 'Federated MDT Large Cap Growth Fund',  
 'Ultra-Short Bond Fund',  
 'Ivy High Income Fund',  
 'Treasury Money Market Trust',  
 'Fidelity Advisor Energy Fund',  
 'MainStay VP International Equity Portfolio',  
 'Columbia Variable Portfolio - Emerging Markets Fund',  
 'American Funds College 2018 Fund',  
 'PIMCO California Intermediate Municipal Bond Fund',  
 'Columbia Variable Portfolio - Select Large-Cap Value Fund',  
 'MainStay VP Balanced Portfolio',  
 'Columbia Flexible Capital Income Fund',  
 'Janus Henderson Global Unconstrained Bond Portfolio',  
 'PIMCO REALPATH 2055',  
 'NORTHERN U.S. GOVERNMENT SELECT MONEY MARKET FUND',  
 'Eaton Vance Large-Cap Value Fund',  
 'Ivy Value Fund',  
 'T. Rowe Price Africa & Middle East Fund',  
 'Ivy Global Equity Income Fund',  
 'Fidelity Advisor Utilities Fund',  
 'American Funds Tax-Advantaged Growth and Income Portfolio',  
 'Fidelity Emerging Asia Fund',  
 'Vanguard Intermediate-Term Corporate Bond Index Fund',  
 'T. Rowe Price Emerging Markets Value Stock Fund',  
 'Fidelity Series Short-Term Credit Fund',  
 'Vanguard Energy Fund',  
 'Growth Fund',  
 'Columbia Variable Portfolio - Global Bond Fund',  
 'American Century STOXX U.S. Quality Value ETF',  
 'Janus Henderson Global Technology Fund',  
 'Blue Chip Income and Growth Fund',  
 'Columbia Variable Portfolio - Balanced Fund',  
 'Janus Henderson International Opportunities Fund',  
 'Fidelity Contrafund',  
 'American Funds 2055 Target Date Retirement Fund',  
 'MainStay VP MFS Utilities Portfolio',

'Fidelity Advisor Semiconductors Fund',  
 'Franklin Payout 2023 Fund',  
 'Ivy Securian Core Bond Fund',  
 'Columbia Small Cap Value Fund II',  
 'American Funds 2020 Target Date Retirement Fund',  
 'Franklin FTSE Hong Kong ETF',  
 'Columbia Select Large Cap Equity Fund',  
 'Vanguard Long-Term Corporate Bond Index Fund',  
 'Janus Henderson Flexible Bond Portfolio',  
 'Variable Portfolio - Oppenheimer International Growth Fund',  
 'Fidelity Advisor Freedom 2015 Fund',  
 'Franklin LibertyQ U.S. Small Cap Equity ETF',  
 'Dreyfus International Bond Fund',  
 'Franklin FTSE Italy ETF',  
 'American Century Diversified Corporate Bond ETF',  
 'MainStay VP Common Stock Portfolio',  
 'Fidelity Flex U.S. Bond Index Fund',  
 'T. Rowe Price Emerging Markets Stock Fund',  
 'Franklin FTSE Asia ex Japan ETF',  
 'AllianzGI Health Sciences Fund',  
 'PIMCO REALPATH 2030 Fund',  
 'Schwab New York Municipal Money Fund',  
 'Ivy Limited-Term Bond Fund',  
 'Franklin FTSE Australia ETF',  
 'Columbia Mid Cap Index Fund',  
 'SMALL CAP GROWTH FUND',  
 'Janus Henderson Global Technology Portfolio',  
 'T. Rowe Price Emerging Europe Fund',  
 'Portfolio Series - American Funds Managed Risk Global Allocation Portfolio',  
 'MainStay VP Income Builder Portfolio',  
 'American Funds College 2033 Fund',  
 'American Funds 2010 Target Date Retirement Fund',  
 'Fidelity Advisor Technology Fund',  
 'Janus Henderson U.S. Growth Opportunities Fund',  
 'JPMorgan Tax Aware Equity Fund',  
 'Columbia Variable Portfolio - Large Cap Index Fund',  
 'Janus Henderson Mid Cap Value Portfolio',  
 'Fidelity Emerging Europe, Middle East, Africa (EMEA) Fund',  
 'ULTRA FUND',  
 'JPMorgan Europe Dynamic Fund',  
 'Franklin FTSE Russia ETF',  
 'PIMCO REALPATH 2045 Fund',  
 'Vanguard Real Estate II Index Fund',  
 'American Funds Retirement Income Portfolio - Enhanced',  
 'BALANCED FUND',  
 'American Century Value ETF',  
 'Ivy Small Cap Growth Fund',

'Cornerstone Moderately Conservative Fund',  
 'Managed Risk Growth Fund',  
 'Eaton Vance Growth Fund',  
 'Portfolio Series - American Funds Growth and Income Portfolio',  
 'Fidelity Managed Retirement Income Fund',  
 'Ivy Small Cap Core Fund',  
 'Vanguard Russell 1000 Growth Index Fund',  
 'Franklin FTSE Europe Hedged ETF',  
 'Vanguard Intermediate-Term Investment-Grade Fund',  
 'Columbia Seligman Communications and Information Fund',  
 'Columbia Variable Portfolio - High Yield Bond Fund',  
 'Dreyfus Global Emerging Markets Fund',  
 'American Funds College 2021 Fund',  
 'MFS Global Growth Fund',  
 'Vanguard Short-Term Investment-Grade Fund',  
 'Portfolio Series - American Funds Managed Risk Growth and Income Portfolio',  
 'American Funds College 2024 Fund',  
 'American Funds College 2036 Fund',  
 'Ivy Managed International Opportunities Fund',  
 'Janus Henderson European Focus Fund',  
 'Columbia Variable Portfolio - Government Money Market Fund',  
 'NORTHERN MUNICIPAL MONEY MARKET FUND',  
 'Fidelity Contrafund K6',  
 'JPMorgan Equity Focus Fund',  
 'AllianzGI Focused Growth Fund',  
 'ADAPTIVE EQUITY FUND',  
 'Fidelity Emerging Markets Fund',  
 'USAA MSCI USA Small Cap Value Momentum Blend Index ETF',  
 'Janus Henderson Emerging Markets Fund',  
 'Franklin FTSE United Kingdom ETF',  
 'American Funds Moderate Growth and Income Portfolio',  
 'Fidelity GNMA Fund',  
 'Franklin Payout 2021 Fund',  
 'Franklin Liberty Intermediate Municipal Opportunities ETF',  
 'American Century Growth ETF',  
 'DELAWARE GLOBAL VALUE FUND',  
 'Fidelity Advisor Freedom 2020 Fund',  
 'JPMorgan New York Tax Free Bond Fund',  
 'Janus Henderson Overseas Portfolio',  
 'MainStay VP Mid Cap Core Portfolio',  
 'Western Asset Intermediate Maturity California Municipals Fund',  
 'Vanguard Ultra-Short-Term Bond Fund',  
 'Fidelity ZERO Extended Market Index Fund',  
 'Franklin FTSE China ETF',  
 'MFS South Carolina Municipal Bond Fund',  
 'CALIFORNIA HIGH-YIELD MUNICIPAL FUND',  
 'Federated MDT Balanced Fund',

'Fidelity Flex Short-Term Bond Fund',  
 'Small Cap Stock Fund',  
 'PIMCO REALPATH 2025 Fund',  
 'Eaton Vance New Jersey Municipal Income Fund',  
 'Eaton Vance TABS Short-Term Municipal Bond Fund',  
 'Ivy Asset Strategy Fund',  
 'PIMCO California Municipal Bond Fund',  
 'MainStay VP Emerging Markets Equity Portfolio',  
 'MFS Mississippi Municipal Bond Fund',  
 'Vanguard Real Estate Index Fund',  
 'Columbia Large Cap Value Fund',  
 'SUSTAINABLE EQUITY FUND',  
 'MainStay VP Eagle Small Growth Portfolio',  
 'Fidelity Series Corporate Bond Fund',  
 'Vanguard Short-Term Federal Fund',  
 'MainStay VP Epoch U.S. Small Cap Portfolio',  
 'Franklin Liberty U.S. Low Volatility ETF',  
 'Eaton Vance Global Small-Cap Fund',  
 'Fidelity Advisor Health Care Fund',  
 'Fidelity Advisor Freedom 2030 Fund',  
 'Franklin LibertyQ Global Dividend ETF',  
 'Vanguard Long-Term Treasury Index Fund',  
 'Janus Henderson Contrarian Fund',  
 'Ivy Micro Cap Growth Fund',  
 'Vanguard Russell 2000 Index Fund',  
 'Variable Portfolio - MFS Value Fund',  
 'AllianzGI Small-Cap Fund',  
 'MFS Utilities Fund',  
 'Ivy Tax-Managed Equity Fund',  
 'Total Return Strategy Fund',  
 'AllianzGI Income & Growth Fund',  
 'American Funds 2045 Target Date Retirement Fund',  
 'Variable Portfolio - Morgan Stanley Advantage Fund',  
 'USAA MSCI Emerging Markets Value Momentum Blend Index ETF',  
 'PIMCO REALPATH 2035 Fund',  
 'Janus Henderson International Value Fund',  
 'Janus Henderson International Small Cap Fund',  
 'Franklin FTSE South Korea ETF',  
 'MFS Global Equity Fund',  
 'DELAWARE EMERGING MARKETS FUND',  
 'International Growth and Income Fund',  
 'Columbia Large Cap Index Fund',  
 'Eaton Vance TABS 10-to-20 Year Laddered Municipal Bond Fund',  
 'PIMCO REALPATH 2050 Fund',  
 'Columbia Variable Portfolio - Mid Cap Growth Fund',  
 'Fidelity Advisor Freedom 2060 Fund',  
 'MFS New York Municipal Bond Fund',

'Vanguard Intermediate-Term Treasury Fund',  
 'Columbia Mid Cap Value Fund',  
 'Fidelity Managed Retirement 2025 Fund',  
 'Janus Henderson Global Research Fund',  
 'American Century Diversified Municipal Bond ETF',  
 'Columbia Variable Portfolio - Large Cap Growth Fund',  
 'American Funds 2030 Target Date Retirement Fund',  
 'Growth and Tax Strategy Fund',  
 'Janus Henderson Global Bond Portfolio',  
 'American Funds Tax-Exempt Preservation Portfolio',  
 'NT GROWTH FUND',  
 'Ivy Municipal High Income Fund',  
 'Delaware International Small Cap Fund',  
 'Vanguard Health Care Fund',  
 'Federated MDT Small Cap Core Fund',  
 'AllianzGI NFJ International Value Fund',  
 'Franklin FTSE Brazil ETF',  
 'Columbia Select International Equity Fund',  
 'Ivy Emerging Markets Equity Fund',  
 'MFS Municipal Income Fund',  
 'Vanguard Short-Term Treasury Index Fund',  
 'Columbia Variable Portfolio - Intermediate Bond Fund',  
 'Fidelity Advisor Freedom 2055 Fund',  
 'Fidelity Advisor Industrials Fund',  
 'Fidelity Simplicity RMD 2015 Fund',  
 'Managed Risk International Fund',  
 'Eaton Vance Municipal Opportunities Fund',  
 'Variable Portfolio - MFS Blended Research Core Equity Fund',  
 'JPMorgan Global Allocation Fund',  
 'PIMCO Gurtin California Municipal Opportunistic Value Fund',  
 'AllianzGI NFJ Mid-Cap Value Fund',  
 'Asset Allocation Fund',  
 'MFS Tennessee Municipal Bond Fund',  
 'CALIFORNIA INTERMEDIATE-TERM TAX-FREE BOND FUND',  
 'Fidelity Advisor Communications Equipment Fund',  
 'Government Securities Fund',  
 'Eaton Vance TABS 1-to-10 Year Laddered Municipal Bond Fund',  
 'Fidelity Simplicity RMD 2020 Fund',  
 'American Funds Retirement Income Portfolio - Moderate',  
 'Variable Portfolio - Wells Fargo Short Duration Government Fund',  
 'Ivy Mid Cap Growth Fund',  
 'Fidelity Municipal Income 2021 Fund',  
 'Variable Portfolio - TCW Core Plus Bond Fund',  
 'Columbia Select Global Growth Fund',  
 'Schwab California Municipal Money Fund',  
 'Fidelity Advisor Series Equity Value Fund',  
 'USAA MSCI USA Value Momentum Blend Index ETF',

'Eaton Vance Pennsylvania Municipal Income Fund',  
'HERITAGE FUND',  
'DELAWARE INTERNATIONAL VALUE EQUITY FUND',  
'MainStay VP T. Rowe Price Equity Income Portfolio',  
'Global Growth Fund',  
'Janus Henderson Growth and Income Fund',  
'Janus Henderson Forty Fund',  
'Columbia Variable Portfolio - Select Smaller-Cap Value Fund',  
'Janus Henderson Global Equity Income Fund',  
'MainStay VP Small Cap Core Portfolio',  
'Vanguard Intermediate-Term Treasury Index Fund',  
'Eaton Vance Small-Cap Fund',  
'Western Asset Massachusetts Municipals Fund',  
'Eaton Vance Special Equities Fund',  
'MFS North Carolina Municipal Bond Fund',  
'Janus Henderson Global Research Portfolio',  
'Franklin FTSE Taiwan ETF',  
'Fidelity Advisor Freedom 2040 Fund',  
'Ivy Global Income Allocation Fund',  
'Intermediate-Term Bond Fund',  
'PIMCO California Short Duration Municipal Income Fund',  
'Fidelity Simplicity RMD 2005 Fund',  
'Variable Portfolio - Victory Sycamore Established Value Fund',  
'Franklin Payout 2019 Fund']

0.3 Following the NLP application in class, use the skip-gram model to build a word embedding dictionary from the mutual fund prospectus in the training set

### 0.3.1 Tokenize the text

```
[21]: def lemma_tokenizer(text):
        lemmatizer=WordNetLemmatizer()
        return [lemmatizer.lemmatize(token) for token in word_tokenize(text.
        ↪replace("'", " "))]
```

```
[22]: stop_words = set(stopwords.words('english')+list(string.  
    punctuation)+['`', '!', '"', '[', ']', '*', ''])+['doe', 'ha', 'wa'])
```

```
[23]: # clean and tokenize the text
def tokenizer(txt):
    txt = txt.replace('\n', ' ').replace('\t', ' ').lower()
    word_tokens = word_tokenize(txt)
    filtered_sentence = [w for w in word_tokens if not w in stop_words]
    filtered_sentence = [w for w in filtered_sentence if re.sub("[^A-Za-z_"]
    +",',w) != '']
    return filtered_sentence
```

```
[ ]: #extract X_train as a list
#X_train_list = X_train.tolist()
```

```
[ ]: #import nltk
#nltk.download('punkt')
```

```
[ ]: #nltk.download('punkt_tab')
```

```
[24]: text_words = np.concatenate([tokenizer(summary) for summary in X_train])
```

```
[25]: text_words, text_words.size
```

```
[25]: (array(['mfs', 'maryland', 'municipal', ..., "'s", 'website',
        'information'], dtype='<U44'),
        464939)
```

### 0.3.2 Process Skip-Gram model Input

```
[26]: # Training Parameters
batch_size = 128 # The model will be trained batch per batch and one batch
               ↪ contains 128 rows
num_epochs = 2 # The model will go through all the data twice
```

```
[27]: # Word2Vec Parameters
embedding_size = 50 # Dimension of the embedding vector
max_vocabulary_size = 5000 # Total number of different words in the vocabulary
min_occurrence = 10 # Remove all words that does not appears at least n times
skip_window = 3 # How many words to consider left and right
num_skips = 4 # How many times to reuse an input to generate a label
```

```
[28]: # Build the dictionary and replace rare words with UNK token
count = [('UNK', -1)]
# Retrieve the most common words
count.extend(collections.Counter(text_words).most_common(max_vocabulary_size - 1))
# Remove samples with less than 'min_occurrence' occurrences
for i in range(len(count) - 1, -1, -1):
    if count[i][1] < min_occurrence:
        count.pop(i)
    else:
        # The collection is ordered, so stop when 'min_occurrence' is reached
        break
```

```
[29]: word2id = dict() #same as {}
for i, (word, _) in enumerate(count):
    word2id[word] = i
```

```
#word2id
```

```
[30]: id2word = dict(zip(word2id.values(), word2id.keys()))  
vocab_size = len(id2word)
```

```
[ ]: #id2word
```

```
[31]: print ('size of the vocabulary : '+str(vocab_size))
```

```
size of the vocabulary : 2699
```

```
[32]: len(word2id) #the words in 'id2word' and 'word2id' is same
```

```
[32]: 2699
```

```
[33]: # create data  
data = list() #[]  
unk_count = 0  
for word in text_words:  
    # Retrieve a word id, or assign it index 0 ('UNK') if not in dictionary  
    index = word2id.get(word, 0) #if we cannot find the word, it will return 0  
    ↪ instead of having an error  
    if index == 0: #which means we could not find the word in our dictionary  
        unk_count += 1  
        data.append(index)  
count[0] = ('UNK', unk_count) #update the number of 'UNK'
```

```
[34]: count[0]
```

```
[34]: ('UNK', 9345)
```

```
[35]: print(data[:20]) #377 is janus
```

```
[400, 0, 117, 138, 1, 292, 1347, 30, 4, 128, 1, 4, 128, 362, 39, 28, 1240, 25,  
554, 78]
```

```
[36]: # build OneHot vector from index  
def to_one_hot(data_point_index, vocab_size):  
    temp = np.zeros(vocab_size)  
    temp[data_point_index] = 1  
    return temp
```

```
[37]: # Generate training batch for the skip-gram model  
def batch_generator(batch_size, num_skips, skip_window, vocab_size):  
    data_index = 0  
    while True :  
        assert batch_size % num_skips == 0
```



```

assert num_skips <= 2 * skip_window
# batch is filled with 128 inputs
batch = np.ndarray(shape=(batch_size), dtype=np.int32)
# labels is filled with 128 outputs
labels = np.ndarray(shape=(batch_size), dtype=np.int32)
span = 2 * skip_window + 1
# buffer keep track of the visited indexes visited
buffer = collections.deque(maxlen=span)
if data_index + span > len(data):
    data_index = 0
    # We stop the loop when we went through all the corpus
    break
buffer.extend(data[data_index:data_index + span])
data_index += span
for i in range(batch_size // num_skips):
    # Take the context current word
    context_words = [w for w in range(span) if w != skip_window]
    # Randomly select num_skips words in the context
    words_to_use = random.sample(context_words, num_skips)
    for j, context_word in enumerate(words_to_use):
        # Creates one raw data
        batch[i * num_skips + j] = buffer[skip_window]
        labels[i * num_skips + j] = buffer[context_word]
    if data_index == len(data):
        buffer.extend(data[0:span])
        data_index = span
    else:
        buffer.append(data[data_index])
        data_index += 1
# Backtrack a little bit to avoid skipping words in the end of a batch
data_index = (data_index + len(data) - span) % len(data)

# translate word index to on-hot representation
batch_one_hot = np.array([to_one_hot(b, vocab_size) for b in batch])
labels_one_hot = np.array([to_one_hot(l, vocab_size) for l in labels])

# output one batch
yield batch_one_hot, labels_one_hot

```

[ ]:

### 0.3.3 Train the skip-gram model

```

[38]: # Create en compile the Autoencoder
def creat_word2vec_model():
    input_word = Input(shape=(vocab_size,))

```

```

encoded = Dense(embedding_size, activation='linear')(input_word)
decoded = Dense(vocab_size, activation='softmax')(encoded)

# The autoencoder is the whole model with hidden layer connected to the
↳ output layer.
autoencoder = Model(input_word, decoded)
# The encoder is just the input layer connected to the hidden layer. One
↳ the Autoencoder will be trained we will use
# the encoder to create our word vectors
encoder = Model(input_word, encoded)

autoencoder.compile(optimizer='adam', loss='binary_crossentropy')
return encoder, autoencoder

```

```

[39]: # We create the model
encoder, autoencoder = creat_word2vec_model()

```

```

[40]: autoencoder.summary()

```

Model: "functional"

Layer (type)	Output Shape	Param #
input_layer (InputLayer)	(None, 2699)	0
dense (Dense)	(None, 50)	135,000
dense_1 (Dense)	(None, 2699)	137,649

Total params: 272,649 (1.04 MB)

Trainable params: 272,649 (1.04 MB)

Non-trainable params: 0 (0.00 B)

```

[41]: # Finally we can train the model by feeding it with our batch generator !
autoencoder.fit(batch_generator(batch_size, num_skips, skip_window,
↳ vocab_size), steps_per_epoch=ceil(len(data) / batch_size), epochs=num_epochs)

```

```

Epoch 1/2
3633/3633          25s 7ms/step -
loss: 0.0933

```

```
Epoch 2/2
3633/3633          27s 7ms/step -
loss: 0.0028
```

```
[41]: <keras.src.callbacks.history.History at 0x7a92d00f30d0>
```

```
[42]: # Create the Vectorizer function (predicition of the encoder)
def vecotrize(word):
    word_one_hot = to_one_hot(word2id[word], vocab_size)
    return encoder.predict(np.array([word_one_hot]))[0]
```

```
[43]: # Create the word2vec dictionary
word2vec = {w : vecotrize(w) for w in word2id.keys()}

# This dictionary gives for all words it's vectorial representation.
```

```
1/1          0s 157ms/step
1/1          0s 29ms/step
1/1          0s 43ms/step
1/1          0s 39ms/step
1/1          0s 40ms/step
1/1          0s 40ms/step
1/1          0s 42ms/step
1/1          0s 47ms/step
1/1          0s 43ms/step
1/1          0s 38ms/step
1/1          0s 42ms/step
1/1          0s 37ms/step
1/1          0s 38ms/step
1/1          0s 38ms/step
1/1          0s 39ms/step
1/1          0s 38ms/step
1/1          0s 39ms/step
1/1          0s 41ms/step
1/1          0s 55ms/step
1/1          0s 39ms/step
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```
[ ]: # We can save the word2vec dictionary to reuse it later.
#new_word2vec.to_csv('word2vec_MutualFundSummary_train.txt')
```

```
[44]: type(word2vec)
```

```
[44]: dict
```

```
[ ]: #import pickle
#file_path_pickle = 'word2vec_model.pkl'
#print(f"Saving dictionary to {file_path_pickle} using pickle...")
#with open(file_path_pickle, 'wb') as f: # 'wb' means write binary
#     pickle.dump(word2vec, f)
#print("Saving complete.")
```

Saving dictionary to word2vec\_model.pkl using pickle...  
 Saving complete.

```
[ ]: #word2vec = load_word2vec("word2vec_perso.txt")
```

```
[45]: # for a given word, output the n closer words in the word2vec mapping.
def get_n_closer(w, n, word2vec):
    vect = word2vec[w]
    distances_dict = {k: cosine(v, vect) for k, v in word2vec.items()}

    closer_words = []
    for _ in range(n):
        min_key = min(distances_dict.keys(), key=lambda k: distances_dict[k])
        closer_words.append(min_key)
        del distances_dict[min_key]
    return closer_words
```

```
[49]: words_neighbors_1 = get_n_closer('risk', 10, word2vec)
print('words close to risk : ' + str(', '.join(words_neighbors_1)))
#words_neighbors_2 = get_n_closer('equiderivativity', 10, word2vec)
#print('words close to derivative : ' + str(', '.join(words_neighbors_2)))
```

words close to risk : risk, targets, slump, concerns, mortgage-, relative, treated, unavailable, participation, although

```
[50]: #plot closer words
# fit the TSNE dimension reduction model
from sklearn.manifold import TSNE
from sklearn.decomposition import PCA
vectors = np.array([v for k, v in word2vec.items()])
words = np.array([k for k, v in word2vec.items()])
print(vectors.shape)

tsne_model = TSNE(perplexity=40, n_components=2, init='pca', n_iter=2500,
    random_state=23)
vectors = tsne_model.fit_transform(vectors)

print(vectors.shape)
```

(2699, 50)

/usr/local/lib/python3.11/dist-packages/sklearn/manifold/\_t\_sne.py:1164:  
FutureWarning: 'n\_iter' was renamed to 'max\_iter' in version 1.5 and will be removed in 1.7.

warnings.warn(

(2699, 2)

```
[51]: reduced_word2vec = {words[i] : list(vectors[i]) for i in range (len(vectors))}
```

```
[52]: def create_neighbors_visualisation_data(words, num_neighbors, word2vec):
    words_neighbors = []
    for word in words :
```

```

    try :
        words_neighbors.append(get_n_closer(word, num_neighbors, word2vec))
    except :
        print(word + ' not in word2vec')

    words_neighbors = np.concatenate(words_neighbors)
    vectors_neighbors = np.array([reduced_word2vec[word] for word in
↪words_neighbors])

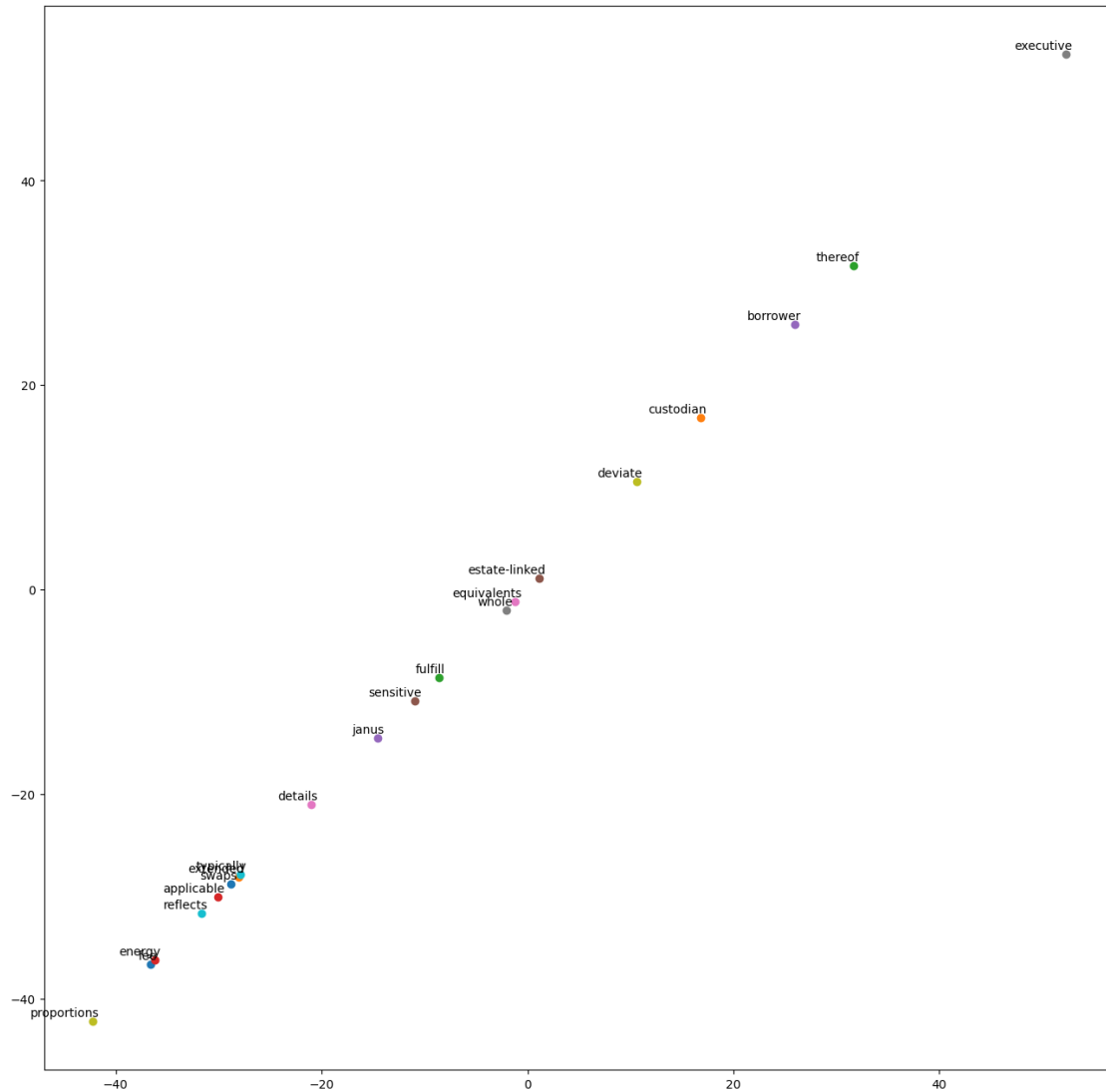
    return vectors_neighbors[:,0], vectors_neighbors[:,0], words_neighbors
x, y, labels = create_neighbors_visualisation_data(['fee', 'swaps'], 10,
↪word2vec)

```

```

[53]: plt.figure(figsize=(16, 16))
for i in range(len(x)):
    plt.scatter(x[i],y[i])
    plt.annotate(labels[i],
        xy=(x[i], y[i]),
        xytext=(5, 2),
        textcoords='offset points',
        ha='right',
        va='bottom')
plt.show()

```



[ ]:

## 0.4 Create a knowledge base

```
[64]: key_words = [ 'income', 'interest', 'bond', 'long', 'short',
                    'equity', 'stock', 'low', 'risk', 'risks', 'strategy',
                    ↪ 'strategies', 'return', 'volatility',
                    'fund', 'funds', 'balance', 'balanced', 'yield', 'position']
```

```
[55]: #print(f"\nLoading dictionary from {file_path_pickle} using pickle...")
#with open('word2vec_model.pkl', 'rb') as f: # 'rb' means read binary
#    word2vec = pickle.load(f)
#print("Loading complete.")
```

```
[56]: #word2vec = load_word2vec(new_word2vec)
```

```
[65]: # Creates the knowledge base by taking the num_neighbors closes neighbors of
      ↪ each key_words in word2vec
def create_knowledge_base(num_neighbors, word2vec, key_words):
    knowledge_base = set()
    out = display(progress(0, len(key_words)-1), display_id=True)
    for ii, key_word in enumerate(key_words) :
        knowledge_base.add(key_word)
        neighbors = []
        try :
            neighbors = get_n_closer(key_word, num_neighbors, word2vec)
        except :
            print(key_word + ' not in word2vec')

        knowledge_base.update(neighbors)

        out.update(progress(ii, len(key_words)-1))
    return knowledge_base
```

```
[66]: #word2vec = load_word2vec(our_word2vec)
knowledge_base = create_knowledge_base(5, word2vec, key_words)
```

<IPython.core.display.HTML object>

```
[67]: print(knowledge_base)
```

```
{np.str_('operated'), np.str_('amt'), np.str_('targets'), np.str_('given'),
'position', 'yield', np.str_('fluctuate'), np.str_('mergers'),
np.str_('participants'), np.str_('obsolescence'), np.str_('terrorism'),
np.str_('tax-advantaged'), np.str_('available'), 'income', np.str_('advisers'),
np.str_('shareholder'), np.str_('assurances'), 'risk', np.str_('necessarily'),
'balance', np.str_('number'), np.str_('hearing'), np.str_('values'),
np.str_('less'), np.str_('unusually'), np.str_('jad'), np.str_('hypothetical'),
np.str_('screens'), np.str_('neutral'), np.str_('statement'), np.str_('equity-
income'), np.str_('region'), np.str_('modify'), np.str_('separate'),
np.str_('conflicts'), np.str_('frequency'), np.str_('investments'),
np.str_('experience'), 'stock', 'interest', np.str_('infrequent'),
np.str_('consumer'), np.str_('successful'), 'risks', np.str_('absent'),
np.str_('partners'), np.str_('contractually'), np.str_('merger'), 'volatility',
np.str_('outstanding'), 'funds', 'short', np.str_('regarding'),
np.str_('corporation'), np.str_('consisting'), np.str_('security'),
np.str_('log'), np.str_('savings'), np.str_('decreased'), np.str_('thereof'),
np.str_('mortgage-'), np.str_('suited'), np.str_('insurers'),
np.str_('admiral'), np.str_('dramatically'), np.str_('consequently'),
np.str_('repayment'), np.str_('across'), np.str_('technology-related'),
np.str_('sells'), 'strategies', np.str_('slump'), np.str_('residential'),
```

```

np.str_('suite'), 'balanced', np.str_('australia'), 'strategy',
np.str_('sales'), np.str_('disclosures'), np.str_('andrew'), np.str_('ensure'),
np.str_('intermediaries'), np.str_('illustrates'), np.str_('frequently'),
np.str_('concerns'), 'fund', 'low', np.str_('care'), np.str_('applies'),
np.str_('mortgage-backed'), 'bond', np.str_('two'), 'long', 'equity',
np.str_('appendix'), 'return', np.str_('reviewed')}}

```

```

[63]: items_to_remove = {'balanced fund', 'fixed income', ' long only'}
      for item in items_to_remove:
          knowledge_base.discard(item)
      knowledge_base

```

```

[63]: {np.str_('absent'),
      np.str_('across'),
      np.str_('admiral'),
      np.str_('advisers'),
      np.str_('amt'),
      np.str_('andrew'),
      np.str_('appendix'),
      np.str_('applies'),
      np.str_('assurances'),
      np.str_('australia'),
      np.str_('available'),
      'balance',
      'balanced',
      'bond',
      np.str_('care'),
      np.str_('concerns'),
      np.str_('conflicts'),
      np.str_('consequently'),
      np.str_('consisting'),
      np.str_('consumer'),
      np.str_('contractually'),
      np.str_('corporation'),
      np.str_('decreased'),
      np.str_('disclosures'),
      np.str_('dramatically'),
      np.str_('ensure'),
      'equity',
      np.str_('equity-income'),
      np.str_('experience'),
      np.str_('fluctuate'),
      np.str_('frequency'),
      np.str_('frequently'),
      'fund',
      'funds',
      np.str_('given'),

```



np.str\_('hearing'),  
 np.str\_('hypothetical'),  
 np.str\_('illustrates'),  
 'income',  
 np.str\_('infrequent'),  
 np.str\_('insurers'),  
 'interest',  
 np.str\_('intermediaries'),  
 np.str\_('investments'),  
 np.str\_('jad'),  
 np.str\_('less'),  
 np.str\_('log'),  
 'long',  
 'low',  
 np.str\_('merger'),  
 np.str\_('mergers'),  
 np.str\_('modify'),  
 np.str\_('mortgage-'),  
 np.str\_('mortgage-backed'),  
 np.str\_('necessarily'),  
 np.str\_('neutral'),  
 np.str\_('number'),  
 np.str\_('obsolescence'),  
 np.str\_('operated'),  
 np.str\_('outstanding'),  
 np.str\_('participants'),  
 np.str\_('partners'),  
 'position',  
 np.str\_('regarding'),  
 np.str\_('region'),  
 np.str\_('repayment'),  
 np.str\_('residential'),  
 'return',  
 np.str\_('reviewed'),  
 'risk',  
 'risks',  
 np.str\_('sales'),  
 np.str\_('savings'),  
 np.str\_('screens'),  
 np.str\_('security'),  
 np.str\_('sells'),  
 np.str\_('separate'),  
 np.str\_('shareholder'),  
 'short',  
 np.str\_('slump'),  
 np.str\_('statement'),  
 'stock',

```

'strategies',
'strategy',
np.str_('successful'),
np.str_('suite'),
np.str_('suited'),
np.str_('targets'),
np.str_('tax-advantaged'),
np.str_('technology-related'),
np.str_('terrorism'),
np.str_('thereof'),
np.str_('two'),
np.str_('unusually'),
np.str_('values'),
'volatility',
'yield'}

```

```
[68]: y_train[1]
```

```
[68]: 'Janus Henderson Enterprise Portfolio'
```

```
[69]: df_summary[['fund_name', 'Prediction']]
```

```
[69]:
```

	fund_name	Prediction
0	American Funds College 2018 Fund	2.0
1	American Funds College 2021 Fund	2.0
2	American Funds College 2024 Fund	2.0
3	American Funds College 2027 Fund	2.0
4	American Funds College 2030 Fund	2.0
..	...	...
427	American Century Diversified Corporate Bond ETF	1.0
428	American Century Diversified Municipal Bond ETF	1.0
429	American Century Quality Diversified Internati...	0.0
430	American Century STOXX U.S. Quality Growth ETF	0.0
431	American Century STOXX U.S. Quality Value ETF	0.0

[432 rows x 2 columns]

```
[70]: # We create here the dataframe tha contains the summaries along with their
      ↪ labels
df_extraction_train = pd.DataFrame({'fund_name' : y_train, 'summary':X_train})
df_label = df_summary[['fund_name', 'Prediction']]
df_main_train = df_label.merge(df_extraction_train, on='fund_name', how='inner')
df_main_train
```

```
[70]:
```

	fund_name	Prediction	\
0	American Funds College 2018 Fund	2.0	
1	American Funds College 2021 Fund	2.0	

2	American Funds College 2024 Fund	2.0
3	American Funds College 2033 Fund	2.0
4	American Funds College 2036 Fund	2.0
..	...	...
254	American Century Growth ETF	0.0
255	American Century Value ETF	0.0
256	American Century Diversified Corporate Bond ETF	1.0
257	American Century Diversified Municipal Bond ETF	1.0
258	American Century STOXX U.S. Quality Value ETF	0.0

```

summary
0 American Funds College 2018 Fund\n\nInvestment...
1 American Funds College 2021 Fund\n\nInvestment...
2 American Funds College 2024 Fund\n\nInvestment...
3 American Funds College 2033 Fund\n\nInvestment...
4 American Funds College 2036 Fund\n\nInvestment...
..
254 Fund Summary\nInvestment Objective\nThe fund s...
255 Fund Summary\nInvestment Objective\nThe fund s...
256 Fund Summary\nInvestment Objective\nThe fund s...
257 Fund Summary\nInvestment Objective\nThe fund s...
258 Fund Summary\nInvestment Objective\nThe fund s...

```

[259 rows x 3 columns]

```
[71]: df_label.head()
```

```

[71]:
      fund_name  Prediction
0  American Funds College 2018 Fund      2.0
1  American Funds College 2021 Fund      2.0
2  American Funds College 2024 Fund      2.0
3  American Funds College 2027 Fund      2.0
4  American Funds College 2030 Fund      2.0

```

```
[72]: df_extraction_train.head()
```

```

[72]:
      fund_name \
0  MFS Maryland Municipal Bond Fund
1  Janus Henderson Enterprise Portfolio
2  Ivy Municipal Bond Fund
3  Fidelity Advisor New Insights Fund
4  CAPITAL VALUE FUND

summary
0  MFS Maryland Municipal Bond Fund\n\n \n\nSumma...
1  Janus Henderson Enterprise Fund\n(closed to ce...
2  Ivy Municipal Bond Fund\n\nObjective\n\nTo see...

```

```
3 Fund Summary\n\nFund/Class:\nFidelity Advisor@...
4 Fund Summary \nInvestment Objective \nThe fund...
```

```
[73]: # We create here the dataframe tha contains the summaries along with their
      ↪ labels
df_extraction_val = pd.DataFrame({'fund_name' : y_val, 'summary':X_val})
df_label = df_summary[['fund_name', 'Prediction']]
df_main_val = df_label.merge(df_extraction_val, on='fund_name', how='inner')
df_main_val
```

```
[73]:
```

	fund_name	Prediction \
0	American Funds College 2027 Fund	2.0
1	American Funds College 2030 Fund	2.0
2	American Funds College Enrollment Fund	1.0
3	American Funds U.S. Government Money Market Fund	1.0
4	Global Balanced Fund	2.0
..	...	...
81	Anchor Tactical Credit Strategies Fund	1.0
82	Federated MDT Small Cap Growth Fund	0.0
83	S&P 500 Index Fund	0.0
84	Managed Allocation Fund	2.0
85	American Century STOXX U.S. Quality Growth ETF	0.0

```
summary
0 American Funds College 2027 Fund\n\nInvestment...
1 American Funds College 2030 Fund\n\nInvestment...
2 American Funds College Enrollment Fund\n\nInve...
3 Investment objective The investment objective ...
4 Global Balanced Fund\n\nInvestment objectives ...
..
81 FUND SUMMARY - ANCHOR TACTICAL CREDIT STRATEGI...
82 Fund Summary Information\nFederated MDT Small ...
83 INVESTMENT OBJECTIVE\nThe USAA S&P 500 Index F...
84 INVESTMENT OBJECTIVE\nThe USAA Managed Allocat...
85 Fund Summary\nInvestment Objective\nThe fund s...
```

[86 rows x 3 columns]

```
[74]: # We create here the dataframe tha contains the summaries along with their
      ↪ labels
df_extraction_test = pd.DataFrame({'fund_name' : y_test, 'summary':X_test})
df_label = df_summary[['fund_name', 'Prediction']]
df_main_test = df_label.merge(df_extraction_test, on='fund_name', how='inner')
df_main_test
```

```
[74]:
```

	fund_name	Prediction \
0	Bond Fund	1.0

1	Corporate Bond Fund	1.0
2	Global Bond Fund	1.0
3	Global Growth and Income Fund	2.0
4	Global Small Capitalization Fund	0.0
..	...	...
82	Federated MDT All Cap Core Fund	0.0
83	Nasdaq-100 Index Fund	0.0
84	Income Stock Fund	0.0
85	USAA MSCI International Value Momentum Blend I...	0.0
86	American Century Quality Diversified Internati...	0.0

```

summary
0 Bond Fund\n\nInvestment objective The fund's i...
1 Investment objective The fund's investment obj...
2 Global Bond Fund\n\nInvestment objective The f...
3 Global Growth and Income Fund\n\nInvestment ob...
4 Global Small Capitalization Fund\n\nInvestment...
..
82 Fund Summary Information\nFederated MDT All Ca...
83 INVESTMENT OBJECTIVE\nThe USAA Nasdaq-100 Inde...
84 INVESTMENT OBJECTIVE\nThe USAA Income Stock Fu...
85 INVESTMENT OBJECTIVE\nThe USAA MSCI USA Value ...
86 Fund Summary\nInvestment Objective\nThe fund s...

```

[87 rows x 3 columns]

```

[75]: df_main_train['summary'] = df_main_train['summary'].astype(str)
df_main_val['summary'] = df_main_val['summary'].astype(str)
df_main_test['summary'] = df_main_test['summary'].astype(str)
df_main_train

```

	fund_name	Prediction \
0	American Funds College 2018 Fund	2.0
1	American Funds College 2021 Fund	2.0
2	American Funds College 2024 Fund	2.0
3	American Funds College 2033 Fund	2.0
4	American Funds College 2036 Fund	2.0
..	...	...
254	American Century Growth ETF	0.0
255	American Century Value ETF	0.0
256	American Century Diversified Corporate Bond ETF	1.0
257	American Century Diversified Municipal Bond ETF	1.0
258	American Century STOXX U.S. Quality Value ETF	0.0

```

summary
0 American Funds College 2018 Fund\n\nInvestment...
1 American Funds College 2021 Fund\n\nInvestment...

```

```

2    American Funds College 2024 Fund\n\nInvestment...
3    American Funds College 2033 Fund\n\nInvestment...
4    American Funds College 2036 Fund\n\nInvestment...
..
254 Fund Summary\nInvestment Objective\nThe fund s...
255 Fund Summary\nInvestment Objective\nThe fund s...
256 Fund Summary\nInvestment Objective\nThe fund s...
257 Fund Summary\nInvestment Objective\nThe fund s...
258 Fund Summary\nInvestment Objective\nThe fund s...

```

[259 rows x 3 columns]

```

[76]: # Takes a summary, the knowledge base and some hyper parameters and returns the
      ↪ "num_sent" sentences
      # of the summary that are closer to the the knowledge base in term of spacial
      ↪ distances.
def extract_sentence_distance(summary, knowledge, n_closer, n_reject, num_sent):
    # Split the summary into sentences.
    sentences = sent_tokenize(summary)
    sentence_scores = []
    # Loop over the sentences.
    for j, sentence in enumerate(sentences):
        # we tokenize and clean the sentence
        tokens = tokenizer(sentence)

        sentence_barycentre = np.zeros(embedding_size)
        effective_len = 0
        # Compute the barycentre of the sentence
        for token in tokens :
            try :
                sentence_barycentre += np.array(word2vec[token])
                effective_len += 1
            except KeyError :
                pass
            except :
                raise

        # Reject sentences with less than n_reject words in our word2vec map
        if effective_len <= n_reject :
            sentence_scores.append(1)

        else :
            sentence_barycentre = sentence_barycentre/effective_len
            # Compute the distance sentece_barycentre -> words in our knowledge
            ↪ base
            barycentre_distance = [cosine(sentence_barycentre,
            ↪ word2vec[key_word]) for key_word in knowledge]

```

```

        barycentre_distance.sort()
        # Create the score of the sentence by averaging the "n_closer"
        ↪smallest distances
        score = np.mean(barycentre_distance[:n_closer])
        sentence_scores.append(score)
        # Select the "num_sent" sentences that have the smallest score (smallest
        ↪distance score with the knowledge base)
        sentence_scores, sentences = zip(*sorted(zip(sentence_scores, sentences)))
        top_sentences = sentences[:num_sent]
        return ' '.join(top_sentences)

```

```

[81]: # It takes several minutes (5-10 minutes)
df_main_train['strategy_sentences_distance'] = df_main_train.apply(lambda x :
    ↪extract_sentence_distance(x['summary'], knowledge_base, n_closer=10,
    ↪n_reject=5, num_sent=5), axis=1)

```

```

-----
KeyboardInterrupt                                Traceback (most recent call last)
<ipython-input-81-653d2dc42d86> in <cell line: 0>()
      1 # It takes several minutes (5-10 minutes)
----> 2 df_main_train['strategy_sentences_distance'] = df_main_train.
    ↪apply(lambda x : extract_sentence_distance(x['summary'], knowledge_base,
    ↪n_closer=10, n_reject=5, num_sent=5), axis=1)

/usr/local/lib/python3.11/dist-packages/pandas/core/frame.py in apply(self,
    ↪func, axis, raw, result_type, args, by_row, engine, engine_kwargs, **kwargs)
   10372         kwargs=kwargs,
   10373     )
> 10374     return op.apply().__finalize__(self, method="apply")
   10375
   10376     def map(

/usr/local/lib/python3.11/dist-packages/pandas/core/apply.py in apply(self)
    914         return self.apply_raw(engine=self.engine, engine_kwargs=self.
    ↪engine_kwargs)
    915
--> 916         return self.apply_standard()
    917
    918     def agg(self):

/usr/local/lib/python3.11/dist-packages/pandas/core/apply.py in
    ↪apply_standard(self)
   1061     def apply_standard(self):
   1062         if self.engine == "python":
-> 1063             results, res_index = self.apply_series_generator()
   1064         else:
   1065             results, res_index = self.apply_series_numba()

```

```

/usr/local/lib/python3.11/dist-packages/pandas/core/apply.py in
    ↪ apply_series_generator(self)
    1079         for i, v in enumerate(series_gen):
    1080             # ignore SettingWithCopy here in case the user mutates
-> 1081             results[i] = self.func(v, *self.args, **self.kwargs)
    1082             if isinstance(results[i], ABCSeries):
    1083                 # If we have a view on v, we need to make a copy
    ↪ because

<ipython-input-81-653d2dc42d86> in <lambda>(x)
    1 # It takes several minutes (5-10 minutes)
----> 2 df_main_train['strategy_sentences_distance'] = df_main_train.
    ↪ apply(lambda x : extract_sentence_distance(x['summary'], knowledge_base,
    ↪ n_closer=10, n_reject=5, num_sent=5), axis=1)

<ipython-input-76-84cc2b415a80> in extract_sentence_distance(summary, knowledge
    ↪ n_closer, n_reject, num_sent)
    29         sentence_barycentre = sentence_barycentre/effective_len
    30         # Compute the distance sentece_barycentre -> words in our
    ↪ knowledge base
----> 31         barycentre_distance = [cosine(sentence_barycentre,
    ↪ word2vec[key_word]) for key_word in knowledge]
    32         barycentre_distance.sort()
    33         # Create the score of the sentence by averaging the
    ↪ "n_closer" smallest distances

<ipython-input-76-84cc2b415a80> in <listcomp>(.)
    29         sentence_barycentre = sentence_barycentre/effective_len
    30         # Compute the distance sentece_barycentre -> words in our
    ↪ knowledge base
----> 31         barycentre_distance = [cosine(sentence_barycentre,
    ↪ word2vec[key_word]) for key_word in knowledge]
    32         barycentre_distance.sort()
    33         # Create the score of the sentence by averaging the
    ↪ "n_closer" smallest distances

/usr/local/lib/python3.11/dist-packages/scipy/spatial/distance.py in cosine(u,
    ↪ v, w)
    736     # cosine distance is also referred to as 'uncentered correlation',
    737     # or 'reflective correlation'
--> 738     return correlation(u, v, w=w, centered=False)
    739
    740

/usr/local/lib/python3.11/dist-packages/scipy/spatial/distance.py in
    ↪ correlation(u, v, w, centered)
    685     dist = 1.0 - uv / math.sqrt(uu * vv)

```



```

686      # Clip the result to avoid rounding error
--> 687      return np.clip(dist, 0.0, 2.0)
688
689

/usr/local/lib/python3.11/dist-packages/numpy/_core/fromnumeric.py in clip(a,
↳ a_min, a_max, out, **kwargs)
2245
2246     """
-> 2247     return _wrapfunc(a, 'clip', a_min, a_max, out=out, **kwargs)
2248
2249

/usr/local/lib/python3.11/dist-packages/numpy/_core/fromnumeric.py in
↳ _wrapfunc(obj, method, *args, **kws)
55
56     try:
----> 57         return bound(*args, **kws)
58     except TypeError:
59         # A TypeError occurs if the object does have such a method in its
        class

/usr/local/lib/python3.11/dist-packages/numpy/_core/_methods.py in _clip(a, min_
↳ max, out, **kwargs)
97     return items
98
----> 99 def _clip(a, min=None, max=None, out=None, **kwargs):
100     if min is None and max is None:
101         raise ValueError("One of max or min must be given")

KeyboardInterrupt:

```

```
[82]: df_main_train
```

```
[82]:
```

	fund_name	Prediction \
0	American Funds College 2018 Fund	2.0
1	American Funds College 2021 Fund	2.0
2	American Funds College 2024 Fund	2.0
3	American Funds College 2033 Fund	2.0
4	American Funds College 2036 Fund	2.0
..	...	...
254	American Century Growth ETF	0.0
255	American Century Value ETF	0.0
256	American Century Diversified Corporate Bond ETF	1.0
257	American Century Diversified Municipal Bond ETF	1.0
258	American Century STOXX U.S. Quality Value ETF	0.0

summary \

```

0    American Funds College 2018 Fund\n\nInvestment...
1    American Funds College 2021 Fund\n\nInvestment...
2    American Funds College 2024 Fund\n\nInvestment...
3    American Funds College 2033 Fund\n\nInvestment...
4    American Funds College 2036 Fund\n\nInvestment...
..
254  Fund Summary\nInvestment Objective\nThe fund s...
255  Fund Summary\nInvestment Objective\nThe fund s...
256  Fund Summary\nInvestment Objective\nThe fund s...
257  Fund Summary\nInvestment Objective\nThe fund s...
258  Fund Summary\nInvestment Objective\nThe fund s...

```

#### strategy\_sentences\_distance

```

0    Equity-income and balanced funds generally str...
1    Equity-income and balanced funds generally str...
2    Equity-income and balanced funds generally str...
3    Equity-income and balanced funds generally str...
4    Equity-income and balanced funds generally str...
..
254  The fund will generally issue and redeem Creat...
255  To the extent that a large shareholder (includ...
256  •\nCash Transactions Risk - The fund may effec...
257  •\nCash Transactions Risk - The fund may effec...
258  An income sustainability screen based on divid...

```

[259 rows x 4 columns]

```
[83]: df_main_val['strategy_sentences_distance'] = df_main_val.apply(lambda x :
    ↪extract_sentence_distance(x['summary'], knowledge_base, n_closer=10,
    ↪n_reject=5, num_sent=5), axis=1)
```

```
[84]: df_main_test['strategy_sentences_distance'] = df_main_test.apply(lambda x :
    ↪extract_sentence_distance(x['summary'], knowledge_base, n_closer=10,
    ↪n_reject=5, num_sent=5), axis=1)
```

```
[85]: df_main_val
```

```
[85]:
```

	fund_name	Prediction	\
0	American Funds College 2027 Fund	2.0	
1	American Funds College 2030 Fund	2.0	
2	American Funds College Enrollment Fund	1.0	
3	American Funds U.S. Government Money Market Fund	1.0	
4	Global Balanced Fund	2.0	
..	...	...	
81	Anchor Tactical Credit Strategies Fund	1.0	
82	Federated MDT Small Cap Growth Fund	0.0	
83	S&P 500 Index Fund	0.0	

```

84             Managed Allocation Fund                2.0
85   American Century STOXX U.S. Quality Growth ETF    0.0

```

```

summary \
0   American Funds College 2027 Fund\n\nInvestment...
1   American Funds College 2030 Fund\n\nInvestment...
2   American Funds College Enrollment Fund\n\nInve...
3   Investment objective The investment objective ...
4   Global Balanced Fund\n\nInvestment objectives ...
..
81  FUND SUMMARY - ANCHOR TACTICAL CREDIT STRATEGI...
82  Fund Summary Information\nFederated MDT Small ...
83  INVESTMENT OBJECTIVE\nThe USAA S&P 500 Index F...
84  INVESTMENT OBJECTIVE\nThe USAA Managed Allocat...
85  Fund Summary\nInvestment Objective\nThe fund s...

```

```

strategy_sentences_distance
0   Equity-income and balanced funds generally str...
1   Equity-income and balanced funds generally str...
2   Issuers of these securities may be more suscep...
3   Although your actual costs may be higher or lo...
4   Falling interest rates may cause an issuer to ...
..
81  A general downturn in the securities market ma...
82  The Adviser implements its strategy using a qu...
83  Although your actual costs may be higher or lo...
84  In addition, market developments and other fac...
85  •\nSampling Risk - To the extent the fund us...

```

[86 rows x 4 columns]

```
[90]: df_main_test
```

```

[90]:
           fund_name Prediction \
0           Bond Fund         1.0
1   Corporate Bond Fund         1.0
2     Global Bond Fund         1.0
3   Global Growth and Income Fund         2.0
4   Global Small Capitalization Fund         0.0
..
82   Federated MDT All Cap Core Fund         0.0
83   Nasdaq-100 Index Fund         0.0
84   Income Stock Fund         0.0
85   USAA MSCI International Value Momentum Blend I...         0.0
86   American Century Quality Diversified Internati...         0.0

```

```
summary \
```

```

0 Bond Fund\n\nInvestment objective The fund's i...
1 Investment objective The fund's investment obj...
2 Global Bond Fund\n\nInvestment objective The f...
3 Global Growth and Income Fund\n\nInvestment ob...
4 Global Small Capitalization Fund\n\nInvestment...
..
82 Fund Summary Information\nFederated MDT All Ca...
83 INVESTMENT OBJECTIVE\nThe USAA Nasdaq-100 Inde...
84 INVESTMENT OBJECTIVE\nThe USAA Income Stock Fu...
85 INVESTMENT OBJECTIVE\nThe USAA MSCI USA Value ...
86 Fund Summary\nInvestment Objective\nThe fund s...

```

strategy\_sentences\_distance

```

0 Falling interest rates may cause an issuer to ...
1 Falling interest rates may cause an issuer to ...
2 Although the fund does not intend to limit its...
3 Issuers of these securities may be more suscep...
4 Issuers of these securities may be more suscep...
..
82 3\nTable of Contents\n(For the Period Ended De...
83 AVERAGE ANNUAL TOTAL RETURNS\nFor Periods Ende...
84 Although your actual costs may be higher or lo...
85 These securities may be subject to more abrupt...
86 The market value of depositary receipts is dep...

```

[87 rows x 4 columns]

```

[ ]: #def extract_sentence_match(summary, knowledge, num_sent):
#     sentences = sent_tokenize(summary)
#     sentence_scores = []
#     for j, sentence in enumerate(sentences):
#         set_tokens = set(tokenizer(sentence))
#
#         # Find the number of common words between the knowledge base and the
#         ↪sentence
#         inter_knowledge = set_tokens.intersection(knowledge)
#
#         sentence_scores.append(len(inter_knowledge))
#
#     sentence_scores, sentences = zip(*sorted(zip(sentence_scores, sentences)))
#     top_sentences = sentences[len(sentences)-num_sent-1:]
#     return ' '.join(top_sentences)

```

```

[ ]: #df_main['strategy_sentences_match'] = df_main.apply(lambda x :
#         ↪extract_sentence_match(x['Summary'], knowledge_base, num_sent=5), axis=1)

```

```

[86]: df_main_train

```

```

[86]:
      fund_name Prediction \
0      American Funds College 2018 Fund      2.0
1      American Funds College 2021 Fund      2.0
2      American Funds College 2024 Fund      2.0
3      American Funds College 2033 Fund      2.0
4      American Funds College 2036 Fund      2.0
..      ...
254      American Century Growth ETF      0.0
255      American Century Value ETF      0.0
256      American Century Diversified Corporate Bond ETF      1.0
257      American Century Diversified Municipal Bond ETF      1.0
258      American Century STOXX U.S. Quality Value ETF      0.0

      summary \
0      American Funds College 2018 Fund\n\nInvestment...
1      American Funds College 2021 Fund\n\nInvestment...
2      American Funds College 2024 Fund\n\nInvestment...
3      American Funds College 2033 Fund\n\nInvestment...
4      American Funds College 2036 Fund\n\nInvestment...
..      ...
254      Fund Summary\nInvestment Objective\nThe fund s...
255      Fund Summary\nInvestment Objective\nThe fund s...
256      Fund Summary\nInvestment Objective\nThe fund s...
257      Fund Summary\nInvestment Objective\nThe fund s...
258      Fund Summary\nInvestment Objective\nThe fund s...

      strategy_sentences_distance
0      Equity-income and balanced funds generally str...
1      Equity-income and balanced funds generally str...
2      Equity-income and balanced funds generally str...
3      Equity-income and balanced funds generally str...
4      Equity-income and balanced funds generally str...
..      ...
254      The fund will generally issue and redeem Creat...
255      To the extent that a large shareholder (includ...
256      •\nCash Transactions Risk - The fund may effec...
257      •\nCash Transactions Risk - The fund may effec...
258      An income sustainability screen based on divid...

[259 rows x 4 columns]

```

[ ]:

## 0.5 Information extraction using deep classifiers

```
[79]: #X = df_main['strategy_sentences_match'].values
X_train = df_main_train['strategy_sentences_distance'].values # uncomment to use
        ↳ the first sentence extraction method.
# Clean the texts
X_train = [' '.join(tokenizer(txt)) for txt in X_train]
X_train[0][:100]
```

```
[79]: 'equity-income balanced funds generally strive income growth stocks and/or bond
investments bond fund'
```

```
[87]: #X = df_main['strategy_sentences_match'].values
X_val = df_main_val['strategy_sentences_distance'].values # uncomment to use
        ↳ the first sentence extraction method.
# Clean the texts
X_val = [' '.join(tokenizer(txt)) for txt in X_val]
X_val[0][:100]
```

```
[87]: 'equity-income balanced funds generally strive income growth stocks and/or bond
investments bond fund'
```

```
[88]: #X = df_main['strategy_sentences_match'].values
X_test = df_main_test['strategy_sentences_distance'].values # uncomment to use
        ↳ the first sentence extraction method.
# Clean the texts
X_test = [' '.join(tokenizer(txt)) for txt in X_test]
X_test[0][:100]
```

```
[88]: 'falling interest rates may cause issuer redeem call refinance debt security
stated maturity may resu'
```

```
[91]: y_train = df_main_train['Prediction']
y_train
```

```
[91]: 0      2.0
1      2.0
2      2.0
3      2.0
4      2.0
...
254    0.0
255    0.0
256    1.0
257    1.0
258    0.0
Name: Prediction, Length: 259, dtype: float64
```

```
[92]: y_val = df_main_val['Prediction']
      y_val
```

```
[92]: 0      2.0
      1      2.0
      2      1.0
      3      1.0
      4      2.0
      ...
      81     1.0
      82     0.0
      83     0.0
      84     2.0
      85     0.0
      Name: Prediction, Length: 86, dtype: float64
```

```
[93]: y_test = df_main_test['Prediction']
      y_test
```

```
[93]: 0      1.0
      1      1.0
      2      1.0
      3      2.0
      4      0.0
      ...
      82     0.0
      83     0.0
      84     0.0
      85     0.0
      86     0.0
      Name: Prediction, Length: 87, dtype: float64
```

## 0.6 Data Pre-Processing

```
[94]: # In order to set the length of the document series (maxlen), we visualise the
      ↪ distribution of the number of words per documents.
      sizes = []
      out = display(progress(0, len(X_train)), display_id=True)
      for ii, txt in enumerate(X_train):
          sizes.append(len(word_tokenize(txt)))
          out.update(progress(ii, len(X_train)))

      sns.distplot(sizes, kde=False, rug=True)
```

<IPython.core.display.HTML object>

<ipython-input-94-bc141d98f3b4>:8: UserWarning:

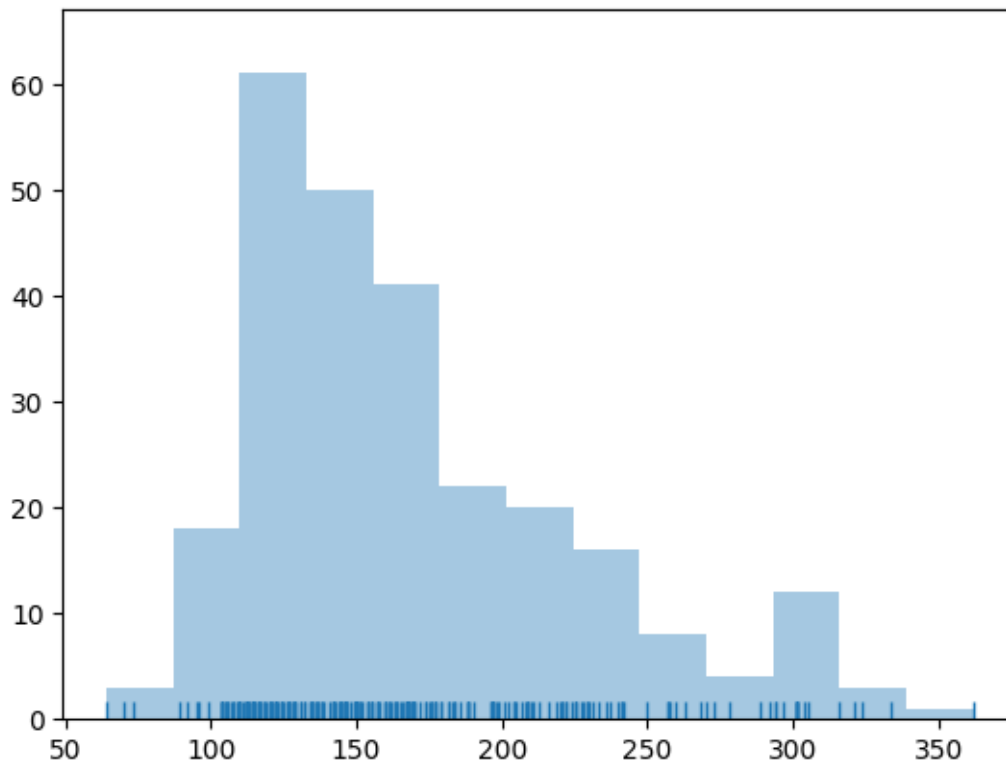
`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see <https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751>

```
sns.distplot(sizes, kde=False, rug=True)
```

[94]: <Axes: >



```
[140]: num_words = 2500 # Size of the vocabulary used. we only consider the 2500 most
        ↪ common words. The other words are removed from the texts.
        maxlen = 200 # Number of word considered for each document. we cut or lengthen
        ↪ the texts to have texts of 150 words.
        word_dimension = 50 # dimension of our word vectors.
```

```
[141]: # The Tokenizer provided by the Keras library allows to perform such
        ↪ transformation.
        keras_tokenizer = Tokenizer(num_words=num_words)
        keras_tokenizer.fit_on_texts(X_train)
```



```
# word_index is the dictionary that contains the index of each words in our
↳2500 long vocabulary.
word_index = keras_tokenizer.word_index
sequences_train = keras_tokenizer.texts_to_sequences(X_train)
sequences_val = keras_tokenizer.texts_to_sequences(X_val)
sequences_test=keras_tokenizer.texts_to_sequences(X_test)
```

```
[142]: print('Text : '+X_train[0])
       print('Index sequences : ' +str(sequences_train[0]))
```

Text : equity-income balanced funds generally strive income growth stocks and/or bond investments bond funds seek current income bond investments securities rated bb+ ba1 sometimes referred junk bonds. exposure lower rated securities may help fund achieve objective providing current income falling interest rates may cause issuer redeem call refinance debt security stated maturity may result fund reinvest proceeds lower yielding securities issuers securities may susceptible actions foreign governments imposition price controls punitive taxes could adversely impact value securities selection underlying funds allocation fund assets could cause fund lose value results lag relevant benchmarks funds similar objectives

Index sequences : [50, 29, 457, 16, 162, 687, 29, 84, 111, 39, 40, 49, 34, 49, 16, 458, 213, 29, 49, 34, 9, 261, 607, 608, 527, 484, 567, 185, 87, 68, 261, 9, 3, 328, 1, 322, 251, 568, 213, 29, 323, 46, 57, 3, 95, 206, 90, 304, 387, 171, 54, 252, 313, 3, 88, 1, 342, 207, 68, 324, 9, 58, 9, 3, 243, 334, 82, 228, 296, 38, 266, 343, 2, 31, 103, 121, 15, 9, 237, 104, 16, 174, 1, 65, 31, 95, 1, 224, 15, 96, 283, 194, 255, 16, 214, 229]

```
[143]: len(sequences_train)
```

```
[143]: 259
```

```
#Then we use the pad_sequence function provided by keras to truncate or
↳lengthen (by adding zeros)
#each text so they all have the same length : 170
feature_train = pad_sequences(sequences_train, maxlen=maxlen, dtype=float,
↳padding='post', truncating='post')
feature_val = pad_sequences(sequences_val, maxlen=maxlen, dtype=float,
↳padding='post', truncating='post')
feature_test=pad_sequences(sequences_test, maxlen=maxlen, dtype=float,
↳padding='post', truncating='post')
```

```
[145]: print(len(X_train[0]))
       len(feature_train[0])
```

```
714
```

```
[145]: 200
```

```
[146]: word2vec.get("stock")
```

```
[146]: array([-0.52702427,  0.546883   , -0.5217987 , -0.43095547, -0.5527872 ,
          0.4939101 ,  0.456268   , -0.50855875, -0.5313279 , -0.48267663,
         -0.49233153,  0.47901547,  0.48313826, -0.4651238 , -0.46131042,
         -0.4708229 ,  0.498532   ,  0.4933306 , -0.5404466 ,  0.47832614,
         -0.45568234,  0.46188068,  0.44874865, -0.46084365, -0.43395746,
          0.5326104 ,  0.45170507, -0.49335197,  0.5231367 ,  0.43798825,
          0.4742455 , -0.47718424, -0.4704817 , -0.50724834, -0.43765053,
         -0.4610433 ,  0.49027053, -0.49304688, -0.4748721 , -0.4476859 ,
          0.49050564,  0.49190056,  0.51036674, -0.4561873 ,  0.4454228 ,
          0.5108056 , -0.47885454, -0.5172404 , -0.44386956,  0.48884946],
        dtype=float32)
```

```
[147]: word_index.get("investments")
```

```
[147]: 34
```

```
[148]: X_train[0]
```

```
[148]: 'equity-income balanced funds generally strive income growth stocks and/or bond
investments bond funds seek current income bond investments securities rated bb+
ba1 sometimes referred junk bonds. exposure lower rated securities may help fund
achieve objective providing current income falling interest rates may cause
issuer redeem call refinance debt security stated maturity may result fund
reinvest proceeds lower yielding securities issuers securities may susceptible
actions foreign governments imposition price controls punitive taxes could
adversely impact value securities selection underlying funds allocation fund
assets could cause fund lose value results lag relevant benchmarks funds similar
objectives'
```

```
[149]: print ('length of the first sequence : '+str(len(sequences_train[0])) )
print ('length of the padded first sequence : '+str(len(feature_train[0])) )
```

```
length of the first sequence : 96
length of the padded first sequence : 200
```

```
[150]: #matrix representation of the words in our vocabulary
# word_index is the dictionary that contains the index of each words in our
↪2500 long vocabulary.
embedding_matrix = np.zeros((len(word_index) + 1, word_dimension))
for word, i in word_index.items():
    embedding_vector = word2vec.get(word)

    if embedding_vector is not None:
        embedding_matrix[i] = embedding_vector
```

```
[151]: embedding_matrix[1]
```

```
[151]: array([-0.51161611,  0.49861488, -0.45986888, -0.51044023, -0.4733614 ,
          0.48179847,  0.48942891, -0.52708107, -0.47881442, -0.44727966,
          -0.45656052,  0.4437072 ,  0.45148158, -0.47779301, -0.51318449,
          -0.47875041,  0.52369714,  0.45715469, -0.49631903,  0.52710831,
          -0.48395544,  0.5100708 ,  0.50592208, -0.46686277, -0.50518817,
           0.509       ,  0.43394583, -0.44495079,  0.45079893,  0.49803144,
           0.51884866, -0.4787567 , -0.46801475, -0.52083337, -0.500175  ,
          -0.53125322,  0.42735058, -0.47766268, -0.46364808, -0.49993426,
           0.46382937,  0.51606905,  0.50196582, -0.50648367,  0.51581132,
           0.44917157, -0.4634071 , -0.51167554, -0.50772369,  0.48334512])
```

```
[152]: embedding_matrix.shape
```

```
[152]: (2201, 50)
```

```
[153]: len(word_index) + 1
```

```
[153]: 2201
```

```
[154]: word_dimension
```

```
[154]: 50
```

## 0.7 First model: One dimensional Convolutional Neural Network

```
def create_CNN_model(): CNN = Sequential() # The Embedding layer takes the embedding
matrix as an argument and transform the inputted the sequences of index to sequences of vectors.
CNN.add(Embedding(len(word_index) + 1, word_dimension, weights=[embedding_matrix], in-
put_length=maxlen, trainable=False))

CNN.add(Convolution1D(64, 5, activation = 'relu'))
CNN.add(MaxPooling1D(pool_size = 5))

CNN.add(Convolution1D(32, 5, activation = 'relu'))
CNN.add(MaxPooling1D(pool_size = 5))

CNN.add(Flatten())
CNN.add(Dense(units = 128 , activation = 'relu'))
CNN.add(Dropout(0.5))
CNN.add(Dense(units = 1, activation = 'sigmoid'))

CNN.compile(optimizer = 'adam', loss = 'binary_crossentropy', metrics = ['accuracy'])

return CNN
```

```
[155]: def create_CNN_model():
        CNN = Sequential()
        CNN.add(Embedding(len(word_index) + 1, word_dimension,
        ↪weights=[embedding_matrix], input_length=maxlen, trainable=False))

        CNN.add(Convolution1D(64, 5, activation='relu'))
        CNN.add(MaxPooling1D(pool_size=5))

        CNN.add(Convolution1D(32, 5, activation='relu'))
        CNN.add(MaxPooling1D(pool_size=5))

        CNN.add(Flatten())
        CNN.add(Dense(units=128, activation='relu'))
        CNN.add(Dropout(0.5))
        CNN.add(Dense(units=3, activation='softmax'))

        CNN.compile(optimizer='adam', loss='sparse_categorical_crossentropy',
        ↪metrics=['accuracy'])

        return CNN
```

```
[156]: CNN_model = create_CNN_model()
```

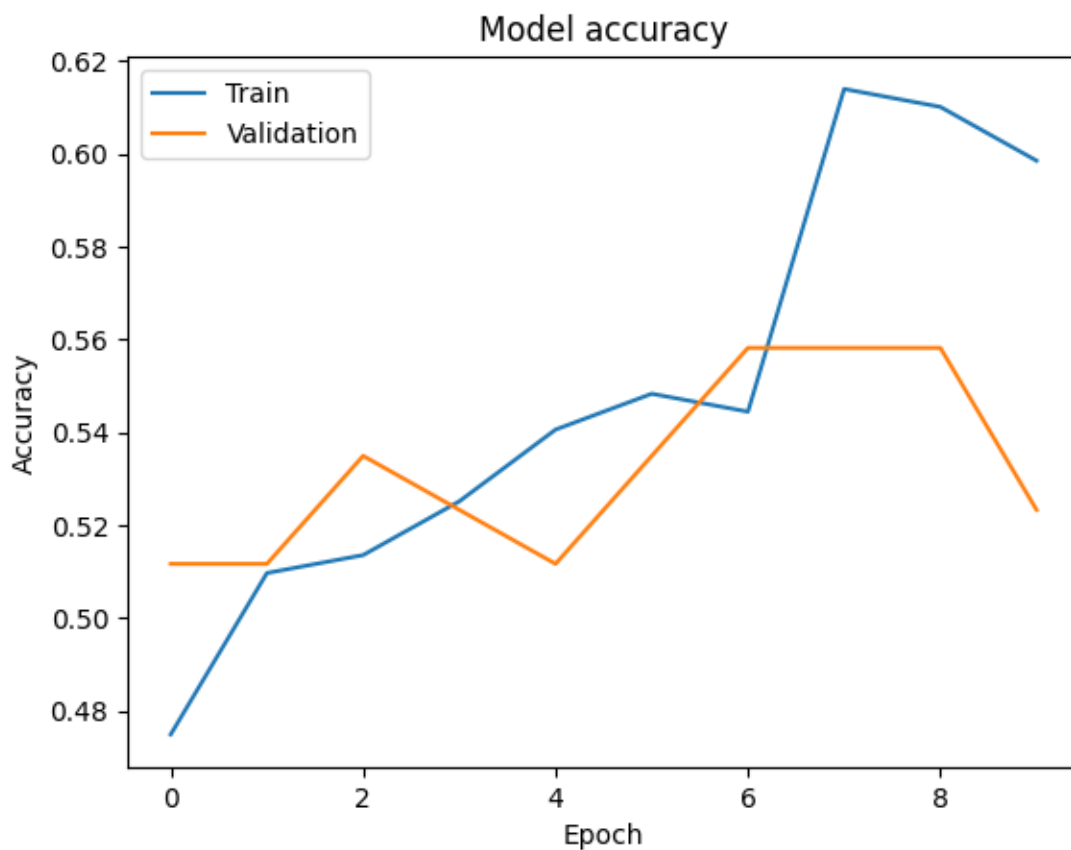
```
/usr/local/lib/python3.11/dist-packages/keras/src/layers/core/embedding.py:90:
UserWarning: Argument `input_length` is deprecated. Just remove it.
  warnings.warn(
```

```
[157]: CNN_history = CNN_model.fit(feature_train, y_train, epochs=10, batch_size=16,
        ↪validation_data=(feature_val, y_val))
```

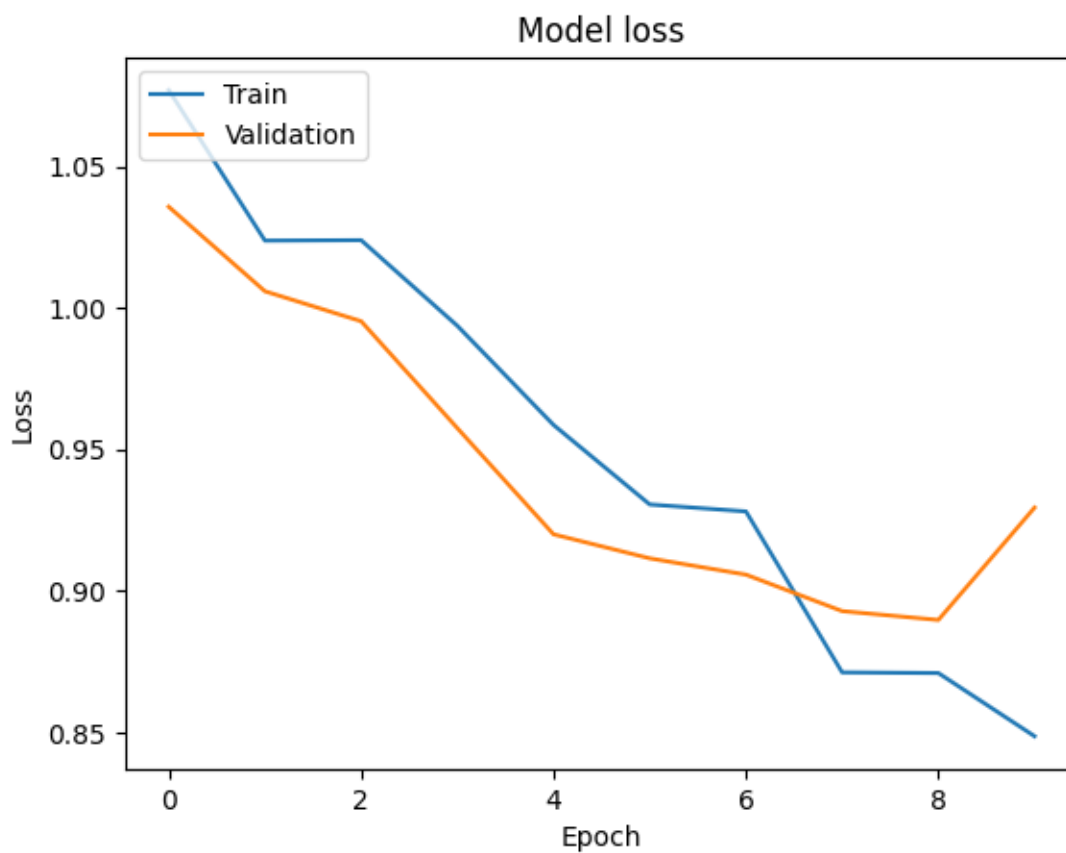
```
Epoch 1/10
17/17          6s 182ms/step -
accuracy: 0.4377 - loss: 1.1138 - val_accuracy: 0.5116 - val_loss: 1.0357
Epoch 2/10
17/17          1s 6ms/step -
accuracy: 0.4808 - loss: 1.0523 - val_accuracy: 0.5116 - val_loss: 1.0059
Epoch 3/10
17/17          0s 8ms/step -
accuracy: 0.5401 - loss: 0.9956 - val_accuracy: 0.5349 - val_loss: 0.9953
Epoch 4/10
17/17          0s 6ms/step -
accuracy: 0.4963 - loss: 1.0032 - val_accuracy: 0.5233 - val_loss: 0.9575
Epoch 5/10
17/17          0s 6ms/step -
accuracy: 0.5382 - loss: 0.9328 - val_accuracy: 0.5116 - val_loss: 0.9200
Epoch 6/10
17/17          0s 6ms/step -
```

accuracy: 0.5751 - loss: 0.9207 - val\_accuracy: 0.5349 - val\_loss: 0.9115  
Epoch 7/10  
17/17 0s 6ms/step -  
accuracy: 0.5232 - loss: 0.9376 - val\_accuracy: 0.5581 - val\_loss: 0.9057  
Epoch 8/10  
17/17 0s 8ms/step -  
accuracy: 0.6285 - loss: 0.8496 - val\_accuracy: 0.5581 - val\_loss: 0.8928  
Epoch 9/10  
17/17 0s 6ms/step -  
accuracy: 0.6083 - loss: 0.8763 - val\_accuracy: 0.5581 - val\_loss: 0.8897  
Epoch 10/10  
17/17 0s 6ms/step -  
accuracy: 0.5759 - loss: 0.9007 - val\_accuracy: 0.5233 - val\_loss: 0.9294

```
[158]: # Plot training & validation accuracy  
plt.plot(CNN_history.history['accuracy'])  
plt.plot(CNN_history.history['val_accuracy'])  
plt.title('Model accuracy')  
plt.ylabel('Accuracy')  
plt.xlabel('Epoch')  
plt.legend(['Train', 'Validation'], loc='upper left')  
plt.show()
```



```
[159]: # Plot training & validation loss values
plt.plot(CNN_history.history['loss'])
plt.plot(CNN_history.history['val_loss'])
plt.title('Model loss')
plt.ylabel('Loss')
plt.xlabel('Epoch')
plt.legend(['Train', 'Validation'], loc='upper left')
plt.show()
```



```
[161]: y_pred_CNN = CNN_model.predict(feature_val)
```

3/3                      0s 8ms/step

```
[162]: y_pred_label = np.argmax(y_pred_CNN, axis=1)
```

```
[163]: report=classification_report(y_val,y_pred_label)
print(report)
```

	precision	recall	f1-score	support
0.0	0.53	0.95	0.68	44
1.0	0.00	0.00	0.00	23
2.0	0.50	0.16	0.24	19
accuracy			0.52	86
macro avg	0.34	0.37	0.31	86
weighted avg	0.38	0.52	0.40	86

```
/usr/local/lib/python3.11/dist-packages/sklearn/metrics/_classification.py:1565:
UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 in labels
with no predicted samples. Use `zero_division` parameter to control this
behavior.
```

```
_warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
/usr/local/lib/python3.11/dist-packages/sklearn/metrics/_classification.py:1565:
UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 in labels
with no predicted samples. Use `zero_division` parameter to control this
behavior.
```

```
_warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
/usr/local/lib/python3.11/dist-packages/sklearn/metrics/_classification.py:1565:
UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 in labels
with no predicted samples. Use `zero_division` parameter to control this
behavior.
```

```
_warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
```

## 0.8 Second Model

```
[121]: def create_RNN_model():
        RNN = Sequential()
        RNN.add(Embedding(len(word_index) + 1, word_dimension,
↪weights=[embedding_matrix], input_length = maxlen, trainable=False))

        RNN.add(Bidirectional(LSTM(word_dimension)))
        RNN.add(Dense(word_dimension, activation='relu'))
        RNN.add(Dense(1, activation='sigmoid'))
        RNN.compile(loss='binary_crossentropy', optimizer='Adam',
↪metrics=['accuracy'])

        return RNN
```

```
[122]: RNN_model = create_RNN_model()
```

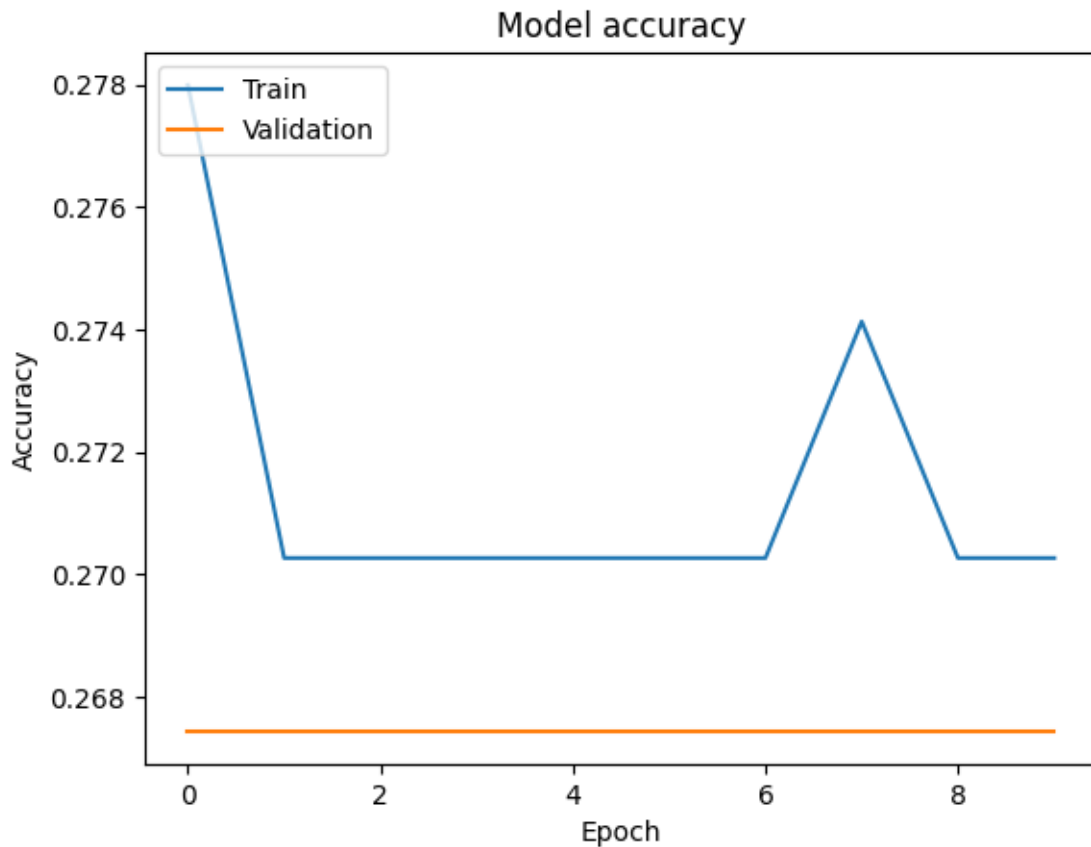
```
/usr/local/lib/python3.11/dist-packages/keras/src/layers/core/embedding.py:90:
UserWarning: Argument `input_length` is deprecated. Just remove it.
warnings.warn(
```

```
[123]: RNN_history = RNN_model.fit(feature_train, y_train, epochs=10, batch_size=16, validation_data=(feature_val, y_val))
```

```
Epoch 1/10
17/17          5s 41ms/step -
accuracy: 0.2814 - loss: 0.6618 - val_accuracy: 0.2674 - val_loss: 0.5685
Epoch 2/10
17/17          0s 29ms/step -
accuracy: 0.2620 - loss: 0.6315 - val_accuracy: 0.2674 - val_loss: 0.5798
Epoch 3/10
17/17          1s 25ms/step -
accuracy: 0.2785 - loss: 0.6273 - val_accuracy: 0.2674 - val_loss: 0.5816
Epoch 4/10
17/17          1s 31ms/step -
accuracy: 0.2715 - loss: 0.6117 - val_accuracy: 0.2674 - val_loss: 0.5654
Epoch 5/10
17/17          0s 24ms/step -
accuracy: 0.2859 - loss: 0.6053 - val_accuracy: 0.2674 - val_loss: 0.5819
Epoch 6/10
17/17          1s 27ms/step -
accuracy: 0.2736 - loss: 0.5916 - val_accuracy: 0.2674 - val_loss: 0.5642
Epoch 7/10
17/17          0s 18ms/step -
accuracy: 0.2882 - loss: 0.5757 - val_accuracy: 0.2674 - val_loss: 0.5690
Epoch 8/10
17/17          0s 23ms/step -
accuracy: 0.2676 - loss: 0.6535 - val_accuracy: 0.2674 - val_loss: 0.5725
Epoch 9/10
17/17          0s 17ms/step -
accuracy: 0.2687 - loss: 0.5083 - val_accuracy: 0.2674 - val_loss: 0.5594
Epoch 10/10
17/17          0s 17ms/step -
accuracy: 0.3005 - loss: 0.6018 - val_accuracy: 0.2674 - val_loss: 0.5869
```

```
[124]: # Plot training & validation accuracy values
plt.plot(RNN_history.history['accuracy'])
plt.plot(RNN_history.history['val_accuracy'])
plt.title('Model accuracy')
plt.ylabel('Accuracy')
plt.xlabel('Epoch')
plt.legend(['Train', 'Validation'], loc='upper left')
plt.show()
```





## 0.9 New word2vec

```
[ ]: word2vec_new=load_word2vec("/content/gdrive/MyDrive/Colab Notebooks/MF815/NLP/
↳NLP_app/word2vec_perso.txt")
```

```
[ ]: #matrix representation of the words in our vocabulary
# word_index is the dictionary that contains the index of each words in our
↳2500 long vocabulary.
embedding_matrix_new = np.zeros((len(word_index) + 1, word_dimension))
for word, i in word_index.items():
    embedding_vector = word2vec_new.get(word)

    if embedding_vector is not None:
        embedding_matrix_new[i] = embedding_vector
```

## 0.10 Transform document txt to vector

```
[164]: def document_vector_mean(feature_data, embedding_matrix):
    doc_vectors = []
    for doc in feature_data:
        word_vecs = []
        for idx in doc:
            if idx != 0:
                word_vec = embedding_matrix[idx]
                word_vecs.append(word_vec)
        if word_vecs:
            doc_vector = np.mean(word_vecs, axis=0)
        else:
            doc_vector = np.zeros(embedding_matrix.shape[1])
        doc_vectors.append(doc_vector)
    return np.array(doc_vectors)
```

```
[165]: def document_vector_norm_weighted(feature_data, embedding_matrix):
    doc_vectors = []
    for doc in feature_data:
        word_vecs = [embedding_matrix[idx] for idx in doc if idx != 0]
        if word_vecs:
            word_arr = np.array(word_vecs)
            norms = np.linalg.norm(word_arr, axis=1)
            sum_norms = norms.sum()
            if sum_norms == 0:
                doc_vector = np.mean(word_arr, axis=0) # Fallback to mean
            else:
                weights = norms / sum_norms
                doc_vector = np.dot(weights, word_arr)
        else:
            doc_vector = np.zeros(embedding_matrix.shape[1])
        doc_vectors.append(doc_vector)
    return np.array(doc_vectors)
```

```
[166]: feature_train_int = feature_train.astype(int)
feature_val_int=feature_val.astype(int)
feature_test_int=feature_test.astype(int)
X_train_vec=document_vector_mean(feature_train_int, embedding_matrix)
X_val_vec=document_vector_mean(feature_val_int, embedding_matrix)
X_test_vec=document_vector_mean(feature_test_int, embedding_matrix)
```

```
[167]: X_train_vec=document_vector_norm_weighted(feature_train_int, embedding_matrix)
X_val_vec=document_vector_norm_weighted(feature_val_int, embedding_matrix)
X_test_vec=document_vector_norm_weighted(feature_test_int, embedding_matrix)
```

```
[ ]: X_train_vec=document_vector_norm_weighted(feature_train_int,
↪embedding_matrix_new)
X_val_vec=document_vector_norm_weighted(feature_val_int, embedding_matrix_new)
X_test_vec=document_vector_norm_weighted(feature_test_int, embedding_matrix_new)
```

```
[168]: X_train_vec
```

```
[168]: array([[ -0.4801011 ,  0.49525288, -0.52563552, ..., -0.4736114 ,
           -0.48246902,  0.47728673],
          [-0.47958325,  0.49537869, -0.52638409, ..., -0.47432019,
           -0.48359371,  0.47665846],
          [-0.47958325,  0.49537869, -0.52638409, ..., -0.47432019,
           -0.48359371,  0.47665846],
          ...,
          [-0.48141966,  0.4890497 , -0.52176607, ..., -0.46657929,
           -0.48199077,  0.47881029],
          [-0.47767958,  0.48654023, -0.52420494, ..., -0.46318924,
           -0.4765423 ,  0.47752866],
          [-0.47847556,  0.4909724 , -0.5185461 , ..., -0.47229304,
           -0.48389164,  0.47661523]])
```

## 0.11 SVM

```
[169]: from sklearn.model_selection import RandomizedSearchCV, StratifiedKFold
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score, confusion_matrix,
↪classification_report
from scipy.stats import uniform, reciprocal
```

```
[170]: from sklearn.svm import SVC
liner_svm=SVC(kernel="linear",C=0.1,probability=True)
liner_svm.fit(X_train_vec,y_train)
```

```
[170]: SVC(C=0.1, kernel='linear', probability=True)
```

```
[171]: svc_val_pred=liner_svm.predict(X_val_vec)
```

```
[172]: print("\nClassification Report:test set")
print(classification_report(y_val, svc_val_pred))
```

```
Classification Report:test set
```

	precision	recall	f1-score	support
0.0	0.51	1.00	0.68	44
1.0	0.00	0.00	0.00	23
2.0	0.00	0.00	0.00	19

accuracy			0.51	86
macro avg	0.17	0.33	0.23	86
weighted avg	0.26	0.51	0.35	86

```
/usr/local/lib/python3.11/dist-packages/sklearn/metrics/_classification.py:1565:
UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 in labels
with no predicted samples. Use `zero_division` parameter to control this
behavior.
```

```
_warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
/usr/local/lib/python3.11/dist-packages/sklearn/metrics/_classification.py:1565:
UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 in labels
with no predicted samples. Use `zero_division` parameter to control this
behavior.
```

```
_warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
/usr/local/lib/python3.11/dist-packages/sklearn/metrics/_classification.py:1565:
UndefinedMetricWarning: Precision is ill-defined and being set to 0.0 in labels
with no predicted samples. Use `zero_division` parameter to control this
behavior.
```

```
_warn_prf(average, modifier, f"{metric.capitalize()} is", len(result))
```

```
[173]: param_distributions = {
    'C': reciprocal(0.1, 100),
    'kernel': ['linear', 'rbf', 'poly'],
    'gamma': ['scale', 'auto', 0.001, 0.01, 0.1, 1],
    'degree': [2, 3, 4],
    'class_weight': [None, 'balanced'],
    'shrinking': [True, False]
}

svm = SVC()
cv = StratifiedKFold(n_splits=5, shuffle=True, random_state=42)

random_search = RandomizedSearchCV(
    svm, param_distributions=param_distributions,
    n_iter=50, cv=cv, scoring='accuracy', verbose=2, n_jobs=-1, random_state=42
)
random_search.fit(X_train_vec, y_train)
```

Fitting 5 folds for each of 50 candidates, totalling 250 fits

```
[173]: RandomizedSearchCV(cv=StratifiedKFold(n_splits=5, random_state=42,
shuffle=True),
    estimator=SVC(), n_iter=50, n_jobs=-1,
    param_distributions={'C':
<scipy.stats._distn_infrastructure.rv_continuous_frozen object at
0x7a92b0588950>,
```

```

        'class_weight': [None, 'balanced'],
        'degree': [2, 3, 4],
        'gamma': ['scale', 'auto', 0.001, 0.01,
                  0.1, 1],
        'kernel': ['linear', 'rbf', 'poly'],
        'shrinking': [True, False]},
    random_state=42, scoring='accuracy', verbose=2)

```

```

[174]: X_trainval_features = np.vstack([X_train_vec, X_val_vec])
       y_trainval = np.hstack([y_train, y_val])

       final_svm = SVC(**random_search.best_params_)
       final_svm.fit(X_trainval_features, y_trainval)

```

```

[174]: SVC(C=np.float64(65.84106160121607), class_weight='balanced', gamma=1,
          kernel='poly', shrinking=False)

```

```

[175]: y_test_pred = final_svm.predict(X_test_vec)
       y_test_pred

```

```

[175]: array([0., 0., 0., 2., 2., 2., 2., 0., 2., 2., 2., 2., 2., 2., 2., 2., 2.,
            1., 1., 1., 1., 1., 0., 0., 0., 1., 0., 1., 1., 1., 0., 1., 1., 1.,
            1., 1., 0., 0., 0., 0., 0., 0., 1., 1., 1., 1., 1., 1., 2., 0., 0.,
            1., 0., 0., 0., 0., 2., 1., 0., 0., 0., 1., 1., 1., 2., 2., 2., 0.,
            0., 0., 0., 1., 1., 2., 2., 1., 1., 1., 0., 0., 0., 0., 0., 2., 2.,
            0., 2.])

```

```

[176]: report = classification_report(y_test, y_test_pred)
       print(report)

```

	precision	recall	f1-score	support
0.0	0.76	0.70	0.73	37
1.0	0.73	0.79	0.76	28
2.0	0.74	0.77	0.76	22
accuracy			0.75	87
macro avg	0.75	0.75	0.75	87
weighted avg	0.75	0.75	0.75	87

```

[177]: confusion_matrix(y_test, y_test_pred)

```

```

[177]: array([[26,  6,  5],
            [ 5, 22,  1],
            [ 3,  2, 17]])

```