

ai-ml-advanced

July 17, 2025

<https://colab.research.google.com/drive/1i0rwJrDlrABaehj0QnuDrd14ma1Zclvx?usp=sharing>

1 Task 1: News Topic Classifier Using BERT

```
[13]: %cd https://github.com/zoya4477/ai-ml-advanced.git
!git clone
!git config --global user.email "zoyahafeez785@gmail.com"
!git config --global user.name "zoya4477"
```

```
[Errno 2] No such file or directory: 'https://github.com/zoya4477/ai-ml-advanced.git'
```

```
/content
```

```
fatal: You must specify a repository to clone.
```

```
usage: git clone [<options>] [--] <repo> [<dir>]
```

-v, --verbose	be more verbose
-q, --quiet	be more quiet
--progress	force progress reporting
--reject-shallow	don't clone shallow repository
-n, --no-checkout	don't create a checkout
--bare	create a bare repository
--mirror	create a mirror repository (implies bare)
-l, --local	to clone from a local repository
--no-hardlinks	don't use local hardlinks, always copy
-s, --shared	setup as shared repository
--recurse-submodules[=<pathspec>]	initialize submodules in the clone
--recursive ...	alias of --recurse-submodules
-j, --jobs <n>	number of submodules cloned in parallel
--template <template-directory>	directory from which templates will be used
--reference <repo>	reference repository
--reference-if-able <repo>	reference repository
--dissociate	use --reference only while cloning
-o, --origin <name>	use <name> instead of 'origin' to track upstream

```

-b, --branch <branch>
                        checkout <branch> instead of the remote's HEAD
-u, --upload-pack <path>
                        path to git-upload-pack on the remote
--depth <depth>         create a shallow clone of that depth
--shallow-since <time>
                        create a shallow clone since a specific time
--shallow-exclude <revision>
                        deepen history of shallow clone, excluding rev
--single-branch          clone only one branch, HEAD or --branch
--no-tags                don't clone any tags, and make later fetches not to
follow them
--shallow-submodules    any cloned submodules will be shallow
--separate-git-dir <gitdir>
                        separate git dir from working tree
-c, --config <key=value>
                        set config inside the new repository
--server-option <server-specific>
                        option to transmit
-4, --ipv4              use IPv4 addresses only
-6, --ipv6              use IPv6 addresses only
--filter <args>         object filtering
--remote-submodules     any cloned submodules will use their remote-tracking
branch
--sparse                initialize sparse-checkout file to include only files
at root

```

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

```

Requirement already satisfied: transformers in /usr/local/lib/python3.11/dist-
packages (4.53.1)

```

```
Collecting transformers
```

```
  Downloading transformers-4.53.2-py3-none-any.whl.metadata (40 kB)
```

```
40.9/40.9 kB
```

```
2.5 MB/s eta 0:00:00
```

```

Requirement already satisfied: filelock in /usr/local/lib/python3.11/dist-
packages (from transformers) (3.18.0)

```

```

Requirement already satisfied: huggingface-hub<1.0,>=0.30.0 in
/usr/local/lib/python3.11/dist-packages (from transformers) (0.33.2)

```

```

Requirement already satisfied: numpy>=1.17 in /usr/local/lib/python3.11/dist-
packages (from transformers) (2.0.2)

```

```

Requirement already satisfied: packaging>=20.0 in
/usr/local/lib/python3.11/dist-packages (from transformers) (24.2)

```

```

Requirement already satisfied: pyyaml>=5.1 in /usr/local/lib/python3.11/dist-
packages (from transformers) (6.0.2)

```

```

Requirement already satisfied: regex!=2019.12.17 in
/usr/local/lib/python3.11/dist-packages (from transformers) (2024.11.6)

```

Requirement already satisfied: requests in /usr/local/lib/python3.11/dist-packages (from transformers) (2.32.3)
 Requirement already satisfied: tokenizers<0.22,>=0.21 in /usr/local/lib/python3.11/dist-packages (from transformers) (0.21.2)
 Requirement already satisfied: safetensors>=0.4.3 in /usr/local/lib/python3.11/dist-packages (from transformers) (0.5.3)
 Requirement already satisfied: tqdm>=4.27 in /usr/local/lib/python3.11/dist-packages (from transformers) (4.67.1)
 Requirement already satisfied: fsspec>=2023.5.0 in /usr/local/lib/python3.11/dist-packages (from huggingface-hub<1.0,>=0.30.0->transformers) (2025.3.2)
 Requirement already satisfied: typing-extensions>=3.7.4.3 in /usr/local/lib/python3.11/dist-packages (from huggingface-hub<1.0,>=0.30.0->transformers) (4.14.1)
 Requirement already satisfied: hf-xet<2.0.0,>=1.1.2 in /usr/local/lib/python3.11/dist-packages (from huggingface-hub<1.0,>=0.30.0->transformers) (1.1.5)
 Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.11/dist-packages (from requests->transformers) (3.4.2)
 Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-packages (from requests->transformers) (3.10)
 Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.11/dist-packages (from requests->transformers) (2.4.0)
 Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.11/dist-packages (from requests->transformers) (2025.7.9)
 Downloading transformers-4.53.2-py3-none-any.whl (10.8 MB)

10.8/10.8 MB

108.7 MB/s eta 0:00:00

Installing collected packages: transformers

Attempting uninstall: transformers

Found existing installation: transformers 4.53.1

Uninstalling transformers-4.53.1:

Successfully uninstalled transformers-4.53.1

Successfully installed transformers-4.53.2

Data Loading

```
[ ]: import pandas as pd

# Load CSVs
train_df = pd.read_csv("/content/train.csv", header=None, names=["label", "title", "description"], on_bad_lines='skip')
test_df = pd.read_csv("/content/test.csv", header=None, names=["label", "title", "description"], on_bad_lines='skip')

# Labels start from 1, so shift to start from 0
train_df['label'] -= 1
test_df['label'] -= 1
```

```
# Combine title and description for input text
train_df['text'] = train_df['title'] + ". " + train_df['description']
test_df['text'] = test_df['title'] + ". " + test_df['description']
```

Tokenization

```
[ ]: #Tokenization
from transformers import BertTokenizer

tokenizer = BertTokenizer.from_pretrained('bert-base-uncased')

train_encodings = tokenizer(list(train_df['text']), truncation=True,
    ↪padding=True, max_length=128)
test_encodings = tokenizer(list(test_df['text']), truncation=True,
    ↪padding=True, max_length=128)
```

/usr/local/lib/python3.11/dist-packages/huggingface_hub/utils/_auth.py:94:

UserWarning:

The secret `HF_TOKEN` does not exist in your Colab secrets.

To authenticate with the Hugging Face Hub, create a token in your settings tab (<https://huggingface.co/settings/tokens>), set it as secret in your Google Colab and restart your session.

You will be able to reuse this secret in all of your notebooks.

Please note that authentication is recommended but still optional to access public models or datasets.

```
warnings.warn(
```

```
tokenizer_config.json: 0%|          | 0.00/48.0 [00:00<?, ?B/s]
```

```
vocab.txt: 0%|          | 0.00/232k [00:00<?, ?B/s]
```

```
tokenizer.json: 0%|          | 0.00/466k [00:00<?, ?B/s]
```

```
config.json: 0%|          | 0.00/570 [00:00<?, ?B/s]
```

Conversion

```
[ ]: #Convert to Dataset
import torch

class NewsDataset(torch.utils.data.Dataset):
    def __init__(self, encodings, labels):
        self.encodings = encodings
        self.labels = labels

    def __getitem__(self, idx):
        return {
            'input_ids': torch.tensor(self.encodings['input_ids'][idx]),
```

```

        'attention_mask': torch.tensor(self.
    ↪ encodings['attention_mask'][idx]),
        'labels': torch.tensor(self.labels[idx])
    }

    def __len__(self):
        return len(self.labels)

train_dataset = NewsDataset(train_encodings, list(train_df['label']))
test_dataset = NewsDataset(test_encodings, list(test_df['label']))

```

Fine Tune BERT

```

[ ]: # Fine-Tune BERT
from transformers import BertForSequenceClassification, Trainer,
    ↪ TrainingArguments

model = BertForSequenceClassification.from_pretrained('bert-base-uncased',
    ↪ num_labels=4)

training_args = TrainingArguments(
    output_dir='./results',
    eval_strategy="epoch",
    per_device_train_batch_size=16,
    per_device_eval_batch_size=16,
    num_train_epochs=2,
    logging_dir='./logs',
    save_strategy="epoch",
    load_best_model_at_end=True,
    metric_for_best_model="eval_loss",
)

trainer = Trainer(
    model=model,
    args=training_args,
    train_dataset=train_dataset,
    eval_dataset=test_dataset,
)

trainer.train()

```

```
model.safetensors:  0%|          | 0.00/440M [00:00<?, ?B/s]
```

Some weights of BertForSequenceClassification were not initialized from the model checkpoint at bert-base-uncased and are newly initialized:

```
['classifier.bias', 'classifier.weight']
```

You should probably TRAIN this model on a down-stream task to be able to use it for predictions and inference.

wandb: **WARNING** The `run_name` is currently set to the same value as `TrainingArguments.output_dir`. If this was not intended, please specify a different run name by setting the `TrainingArguments.run_name` parameter.

<IPython.core.display.Javascript object>

wandb: Logging into wandb.ai. (Learn how to deploy a W&B server locally: <https://wandb.me/wandb-server>)

wandb: You can find your API key in your browser here:

<https://wandb.ai/authorize?ref=models>

wandb: Paste an API key from your profile and hit enter: wandb:

WARNING If you're specifying your api key in code, ensure this code is not shared publicly.

wandb: **WARNING** Consider setting the WANDB_API_KEY environment variable, or running `wandb login` from the command line.

wandb: No netrc file found, creating one.

wandb: Appending key for api.wandb.ai to your netrc file:

/root/.netrc

wandb: Currently logged in as: **zoyahafeez296**

(**zoyahafeez296**-) to <https://api.wandb.ai>. Use `wandb login

--relogin` to force relogin

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

```
[ ]: TrainOutput(global_step=15000, training_loss=0.1890537727355957,
metrics={'train_runtime': 5460.541, 'train_samples_per_second': 43.952,
'train_steps_per_second': 2.747, 'total_flos': 1.578694680576e+16, 'train_loss':
0.1890537727355957, 'epoch': 2.0})
```

Evaluation Matrics

```
[ ]: #Evaluation
from sklearn.metrics import accuracy_score, f1_score

# Predict
outputs = trainer.predict(test_dataset)
preds = outputs.predictions.argmax(axis=1)

# True labels
```

```

true_labels = list(test_df['label'])

# Scores
acc = accuracy_score(true_labels, preds)
f1 = f1_score(true_labels, preds, average='weighted')

print(f"Accuracy: {acc:.4f}")
print(f"F1 Score: {f1:.4f}")

```

<IPython.core.display.HTML object>

Accuracy: 0.9441

F1 Score: 0.9442

```

[ ]: # Save model
model.save_pretrained("bert-agnews-model")
tokenizer.save_pretrained("bert-agnews-model")

[ ]: ('bert-agnews-model/tokenizer_config.json',
      'bert-agnews-model/special_tokens_map.json',
      'bert-agnews-model/vocab.txt',
      'bert-agnews-model/added_tokens.json')

```

2 Task 2: End-to-End ML Pipeline with Scikit-learn Pipeline API

```

[ ]: # Import libraries
import pandas as pd
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.preprocessing import StandardScaler, OneHotEncoder
from sklearn.compose import ColumnTransformer
from sklearn.pipeline import Pipeline
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import classification_report
import joblib

```

Dataset Loading

```

[ ]: # Load dataset
df = pd.read_csv("/content/archive (1).zip")
df.head()

```

```

[ ]:
  customerID  gender  SeniorCitizen  Partner  Dependents  tenure  PhoneService  \
0  7590-VHVEG  Female              0      Yes           No        1             No
1  5575-GNVDE   Male              0      No            No       34             Yes
2  3668-QPYBK   Male              0      No            No        2             Yes
3  7795-CFOCW   Male              0      No            No       45             No

```

4	9237-HQITU	Female	0	No	No	2	Yes
---	------------	--------	---	----	----	---	-----

	MultipleLines	InternetService	OnlineSecurity	...	DeviceProtection	\
0	No phone service	DSL	No	...	No	
1	No	DSL	Yes	...	Yes	
2	No	DSL	Yes	...	No	
3	No phone service	DSL	Yes	...	Yes	
4	No	Fiber optic	No	...	No	

	TechSupport	StreamingTV	StreamingMovies	Contract	PaperlessBilling	\
0	No	No	No	Month-to-month	Yes	
1	No	No	No	One year	No	
2	No	No	No	Month-to-month	Yes	
3	Yes	No	No	One year	No	
4	No	No	No	Month-to-month	Yes	

	PaymentMethod	MonthlyCharges	TotalCharges	Churn
0	Electronic check	29.85	29.85	No
1	Mailed check	56.95	1889.5	No
2	Mailed check	53.85	108.15	Yes
3	Bank transfer (automatic)	42.30	1840.75	No
4	Electronic check	70.70	151.65	Yes

[5 rows x 21 columns]

Preprocessing

```
[ ]: # Drop customerID and handle missing TotalCharges
df.drop("customerID", axis=1, inplace=True)
df["TotalCharges"] = pd.to_numeric(df["TotalCharges"], errors="coerce")
df.dropna(inplace=True)
```

```
[ ]: #Target and Features
X = df.drop("Churn", axis=1)
y = df["Churn"].map({'Yes': 1, 'No': 0})

# Split data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,
↪random_state=42)
```

```
[ ]: # Define column types
numeric_features = ["tenure", "MonthlyCharges", "TotalCharges"]
categorical_features = X.select_dtypes(include=["object"]).columns.tolist()
categorical_features = [col for col in categorical_features if col not in
↪["Churn"]]
```

Preprocessing Pipeline


```
[ ]: # Preprocessing pipeline
numeric_transformer = Pipeline(steps=[
    ("scaler", StandardScaler())
])

categorical_transformer = Pipeline(steps=[
    ("encoder", OneHotEncoder(handle_unknown='ignore'))
])

preprocessor = ColumnTransformer(transformers=[
    ("num", numeric_transformer, numeric_features),
    ("cat", categorical_transformer, categorical_features)
])
```

ML Pipeline

```
[ ]: # ML Pipeline
pipe_lr = Pipeline(steps=[
    ("preprocessor", preprocessor),
    ("classifier", LogisticRegression(max_iter=1000))
])

pipe_rf = Pipeline(steps=[
    ("preprocessor", preprocessor),
    ("classifier", RandomForestClassifier())
])
```

```
[ ]: # GridSearchCV for both models
param_grid_lr = {
    "classifier__C": [0.1, 1.0, 10]
}

param_grid_rf = {
    "classifier__n_estimators": [100, 200],
    "classifier__max_depth": [None, 10, 20]
}
```

Logistic Regression tuning

```
[ ]: # Logistic Regression tuning
grid_lr = GridSearchCV(pipe_lr, param_grid_lr, cv=5, scoring="accuracy")
grid_lr.fit(X_train, y_train)
print("Best Logistic Regression Score:", grid_lr.best_score_)
print("Test Performance:\n", classification_report(y_test, grid_lr.
    ↪predict(X_test)))
```

Best Logistic Regression Score: 0.8071111111111111
 Test Performance:

	precision	recall	f1-score	support
0	0.84	0.89	0.86	1033
1	0.62	0.52	0.57	374
accuracy			0.79	1407
macro avg	0.73	0.70	0.71	1407
weighted avg	0.78	0.79	0.78	1407

```
[ ]: # Random Forest tuning
grid_rf = GridSearchCV(pipe_rf, param_grid_rf, cv=5, scoring="accuracy")
grid_rf.fit(X_train, y_train)
print("Best Random Forest Score:", grid_rf.best_score_)
print("Test Performance:\n", classification_report(y_test, grid_rf.
↪predict(X_test)))
```

Best Random Forest Score: 0.8048

Test Performance:

	precision	recall	f1-score	support
0	0.83	0.90	0.86	1033
1	0.64	0.49	0.56	374
accuracy			0.79	1407
macro avg	0.74	0.70	0.71	1407
weighted avg	0.78	0.79	0.78	1407

Model

```
[ ]: # Export the best model
joblib.dump(grid_rf.best_estimator_, "churn_pipeline_rf.joblib")
```

```
[ ]: ['churn_pipeline_rf.joblib']
```

```
[ ]:
```

```
[1]: # Install required packages
!pip install anthropic langchain streamlit chromadb sentence-transformers_
↪pypdf2 python-dotenv
```

Collecting anthropic

Downloading anthropic-0.57.1-py3-none-any.whl.metadata (27 kB)

Requirement already satisfied: langchain in /usr/local/lib/python3.11/dist-packages (0.3.26)

Collecting streamlit

Downloading streamlit-1.47.0-py3-none-any.whl.metadata (9.0 kB)

Collecting chromadb

Downloading chromadb-1.0.15-cp39-abi3-manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (7.0 kB)
 Requirement already satisfied: sentence-transformers in /usr/local/lib/python3.11/dist-packages (4.1.0)
 Collecting pypdf2
 Downloading pypdf2-3.0.1-py3-none-any.whl.metadata (6.8 kB)
 Collecting python-dotenv
 Downloading python_dotenv-1.1.1-py3-none-any.whl.metadata (24 kB)
 Requirement already satisfied: anyio<5,>=3.5.0 in /usr/local/lib/python3.11/dist-packages (from anthropic) (4.9.0)
 Requirement already satisfied: distro<2,>=1.7.0 in /usr/local/lib/python3.11/dist-packages (from anthropic) (1.9.0)
 Requirement already satisfied: httpx<1,>=0.25.0 in /usr/local/lib/python3.11/dist-packages (from anthropic) (0.28.1)
 Requirement already satisfied: jiter<1,>=0.4.0 in /usr/local/lib/python3.11/dist-packages (from anthropic) (0.10.0)
 Requirement already satisfied: pydantic<3,>=1.9.0 in /usr/local/lib/python3.11/dist-packages (from anthropic) (2.11.7)
 Requirement already satisfied: sniffio in /usr/local/lib/python3.11/dist-packages (from anthropic) (1.3.1)
 Requirement already satisfied: typing-extensions<5,>=4.10 in /usr/local/lib/python3.11/dist-packages (from anthropic) (4.14.1)
 Requirement already satisfied: langchain-core<1.0.0,>=0.3.66 in /usr/local/lib/python3.11/dist-packages (from langchain) (0.3.68)
 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>=0.1.17 in /usr/local/lib/python3.11/dist-packages (from langchain) (0.4.5)
 Requirement already satisfied: SQLAlchemy<3,>=1.4 in /usr/local/lib/python3.11/dist-packages (from langchain) (2.0.41)
 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: altair<6,>=4.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (5.5.0)
 Requirement already satisfied: blinker<2,>=1.5.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (1.9.0)
 Requirement already satisfied: cachetools<7,>=4.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (5.5.2)
 Requirement already satisfied: click<9,>=7.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (8.2.1)
 Requirement already satisfied: numpy<3,>=1.23 in /usr/local/lib/python3.11/dist-packages (from streamlit) (2.0.2)
 Requirement already satisfied: packaging<26,>=20 in /usr/local/lib/python3.11/dist-packages (from streamlit) (24.2)
 Requirement already satisfied: pandas<3,>=1.4.0 in /usr/local/lib/python3.11/dist-packages (from streamlit) (2.2.2)

```

Requirement already satisfied: pillow<12,>=7.1.0 in
/usr/local/lib/python3.11/dist-packages (from streamlit) (11.2.1)
Requirement already satisfied: protobuf<7,>=3.20 in
/usr/local/lib/python3.11/dist-packages (from streamlit) (5.29.5)
Requirement already satisfied: pyarrow>=7.0 in /usr/local/lib/python3.11/dist-
packages (from streamlit) (18.1.0)
Requirement already satisfied: tenacity<10,>=8.1.0 in
/usr/local/lib/python3.11/dist-packages (from streamlit) (8.5.0)
Requirement already satisfied: toml<2,>=0.10.1 in
/usr/local/lib/python3.11/dist-packages (from streamlit) (0.10.2)
Collecting watchdog<7,>=2.1.5 (from streamlit)
  Downloading watchdog-6.0.0-py3-none-manylinux2014_x86_64.whl.metadata (44 kB)
    44.3/44.3 kB
3.8 MB/s eta 0:00:00
Requirement already satisfied: gitpython!=3.1.19,<4,>=3.0.7 in
/usr/local/lib/python3.11/dist-packages (from streamlit) (3.1.44)
Collecting pydeck<1,>=0.8.0b4 (from streamlit)
  Downloading pydeck-0.9.1-py2.py3-none-any.whl.metadata (4.1 kB)
Requirement already satisfied: tornado!=6.5.0,<7,>=6.0.3 in
/usr/local/lib/python3.11/dist-packages (from streamlit) (6.4.2)
Requirement already satisfied: build>=1.0.3 in /usr/local/lib/python3.11/dist-
packages (from chromadb) (1.2.2.post1)
Collecting pybase64>=1.4.1 (from chromadb)
  Downloading pybase64-1.4.1-cp311-cp311-manylinux_2_5_x86_64.manylinux1_x86_64.
manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (8.4 kB)
Requirement already satisfied: uvicorn>=0.18.3 in
/usr/local/lib/python3.11/dist-packages (from
uvicorn[standard]>=0.18.3->chromadb) (0.35.0)
Collecting posthog<6.0.0,>=2.4.0 (from chromadb)
  Downloading posthog-5.4.0-py3-none-any.whl.metadata (5.7 kB)
Collecting onnxruntime>=1.14.1 (from chromadb)
  Downloading onnxruntime-1.22.1-cp311-cp311-manylinux_2_27_x86_64.manylinux_2_2
8_x86_64.whl.metadata (4.6 kB)
Collecting opentelemetry-api>=1.2.0 (from chromadb)
  Downloading opentelemetry-api-1.35.0-py3-none-any.whl.metadata (1.5 kB)
Collecting opentelemetry-exporter-otlp-proto-grpc>=1.2.0 (from chromadb)
  Downloading opentelemetry_exporter_otlp_proto_grpc-1.35.0-py3-none-
any.whl.metadata (2.4 kB)
Collecting opentelemetry-sdk>=1.2.0 (from chromadb)
  Downloading opentelemetry_sdk-1.35.0-py3-none-any.whl.metadata (1.5 kB)
Requirement already satisfied: tokenizers>=0.13.2 in
/usr/local/lib/python3.11/dist-packages (from chromadb) (0.21.2)
Collecting pypika>=0.48.9 (from chromadb)
  Downloading PyPika-0.48.9.tar.gz (67 kB)
    67.3/67.3 kB
6.0 MB/s eta 0:00:00
Installing build dependencies ... done
Getting requirements to build wheel ... done

```

Preparing metadata (pyproject.toml) ... done
 Requirement already satisfied: tqdm>=4.65.0 in /usr/local/lib/python3.11/dist-packages (from chromadb) (4.67.1)
 Collecting overrides>=7.3.1 (from chromadb)
 Downloading overrides-7.7.0-py3-none-any.whl.metadata (5.8 kB)
 Requirement already satisfied: importlib-resources in /usr/local/lib/python3.11/dist-packages (from chromadb) (6.5.2)
 Requirement already satisfied: grpcio>=1.58.0 in /usr/local/lib/python3.11/dist-packages (from chromadb) (1.73.1)
 Collecting bcrypt>=4.0.1 (from chromadb)
 Downloading bcrypt-4.3.0-cp39-abi3-manylinux_2_34_x86_64.whl.metadata (10 kB)
 Requirement already satisfied: typer>=0.9.0 in /usr/local/lib/python3.11/dist-packages (from chromadb) (0.16.0)
 Collecting kubernetes>=28.1.0 (from chromadb)
 Downloading kubernetes-33.1.0-py2.py3-none-any.whl.metadata (1.7 kB)
 Collecting mmh3>=4.0.1 (from chromadb)
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 Requirement already satisfied: orjson>=3.9.12 in /usr/local/lib/python3.11/dist-packages (from chromadb) (3.10.18)
 Requirement already satisfied: rich>=10.11.0 in /usr/local/lib/python3.11/dist-packages (from chromadb) (13.9.4)
 Requirement already satisfied: jsonschema>=4.19.0 in /usr/local/lib/python3.11/dist-packages (from chromadb) (4.24.0)
 Requirement already satisfied: transformers<5.0.0,>=4.41.0 in /usr/local/lib/python3.11/dist-packages (from sentence-transformers) (4.53.2)
 Requirement already satisfied: torch>=1.11.0 in /usr/local/lib/python3.11/dist-packages (from sentence-transformers) (2.6.0+cu124)
 Requirement already satisfied: scikit-learn in /usr/local/lib/python3.11/dist-packages (from sentence-transformers) (1.6.1)
 Requirement already satisfied: scipy in /usr/local/lib/python3.11/dist-packages (from sentence-transformers) (1.15.3)
 Requirement already satisfied: huggingface-hub>=0.20.0 in /usr/local/lib/python3.11/dist-packages (from sentence-transformers) (0.33.4)
 Requirement already satisfied: jinja2 in /usr/local/lib/python3.11/dist-packages (from altair<6,>=4.0->streamlit) (3.1.6)
 Requirement already satisfied: narwhals>=1.14.2 in /usr/local/lib/python3.11/dist-packages (from altair<6,>=4.0->streamlit) (1.47.0)
 Requirement already satisfied: idna>=2.8 in /usr/local/lib/python3.11/dist-packages (from anyio<5,>=3.5.0->anthropic) (3.10)
 Requirement already satisfied: pyproject_hooks in /usr/local/lib/python3.11/dist-packages (from build>=1.0.3->chromadb) (1.2.0)
 Requirement already satisfied: gitdb<5,>=4.0.1 in /usr/local/lib/python3.11/dist-packages (from gitpython!=3.1.19,<4,>=3.0.7->streamlit) (4.0.12)
 Requirement already satisfied: certifi in /usr/local/lib/python3.11/dist-packages (from httpx<1,>=0.25.0->anthropic) (2025.7.14)

Requirement already satisfied: httpcore==1.* in /usr/local/lib/python3.11/dist-packages (from httpx<1,>=0.25.0->anthropic) (1.0.9)

Requirement already satisfied: h11>=0.16 in /usr/local/lib/python3.11/dist-packages (from httpcore==1.*->httpx<1,>=0.25.0->anthropic) (0.16.0)

Requirement already satisfied: filelock in /usr/local/lib/python3.11/dist-packages (from huggingface-hub>=0.20.0->sentence-transformers) (3.18.0)

Requirement already satisfied: fsspec>=2023.5.0 in /usr/local/lib/python3.11/dist-packages (from huggingface-hub>=0.20.0->sentence-transformers) (2025.3.2)

Requirement already satisfied: hf-xet<2.0.0,>=1.1.2 in /usr/local/lib/python3.11/dist-packages (from huggingface-hub>=0.20.0->sentence-transformers) (1.1.5)

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Requirement already satisfied: jsonschema-specifications>=2023.03.6 in /usr/local/lib/python3.11/dist-packages (from jsonschema>=4.19.0->chromadb) (2025.4.1)

Requirement already satisfied: referencing>=0.28.4 in /usr/local/lib/python3.11/dist-packages (from jsonschema>=4.19.0->chromadb) (0.36.2)

Requirement already satisfied: rpds-py>=0.7.1 in /usr/local/lib/python3.11/dist-packages (from jsonschema>=4.19.0->chromadb) (0.26.0)

Requirement already satisfied: six>=1.9.0 in /usr/local/lib/python3.11/dist-packages (from kubernetes>=28.1.0->chromadb) (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) (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) (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) (1.8.0)

Requirement already satisfied: requests-oauthlib in /usr/local/lib/python3.11/dist-packages (from kubernetes>=28.1.0->chromadb) (2.0.0)

Requirement already satisfied: oauthlib>=3.2.2 in /usr/local/lib/python3.11/dist-packages (from kubernetes>=28.1.0->chromadb) (3.3.1)

Requirement already satisfied: urllib3>=1.24.2 in /usr/local/lib/python3.11/dist-packages (from kubernetes>=28.1.0->chromadb) (2.4.0)

Collecting durationpy>=0.7 (from kubernetes>=28.1.0->chromadb)

Downloading durationpy-0.10-py3-none-any.whl.metadata (340 bytes)

Requirement already satisfied: jsonpatch<2.0,>=1.33 in /usr/local/lib/python3.11/dist-packages (from langchain-core<1.0.0,>=0.3.66->langchain) (1.33)

Requirement already satisfied: requests-toolbelt<2.0.0,>=1.0.0 in

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/usr/local/lib/python3.11/dist-packages (from langsmith>=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>=0.1.17->langchain)
(0.23.0)
Collecting coloredlogs (from onnxruntime>=1.14.1->chromadb)
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Requirement already satisfied: flatbuffers in /usr/local/lib/python3.11/dist-
packages (from onnxruntime>=1.14.1->chromadb) (25.2.10)
Requirement already satisfied: sympy in /usr/local/lib/python3.11/dist-packages
(from onnxruntime>=1.14.1->chromadb) (1.13.1)
Requirement already satisfied: importlib-metadata<8.8.0,>=6.0 in
/usr/local/lib/python3.11/dist-packages (from opentelemetry-
api>=1.2.0->chromadb) (8.7.0)
Requirement already satisfied: googleapis-common-protos~=1.57 in
/usr/local/lib/python3.11/dist-packages (from opentelemetry-exporter-otlp-proto-
grpc>=1.2.0->chromadb) (1.70.0)
Collecting opentelemetry-exporter-otlp-proto-common==1.35.0 (from opentelemetry-
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Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dist-
packages (from pandas<3,>=1.4.0->streamlit) (2025.2)
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Collecting backoff>=1.10.0 (from posthog<6.0.0,>=2.4.0->chromadb)
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Requirement already satisfied: annotated-types>=0.6.0 in
/usr/local/lib/python3.11/dist-packages (from pydantic<3,>=1.9.0->anthropic)
(0.7.0)
Requirement already satisfied: pydantic-core==2.33.2 in
/usr/local/lib/python3.11/dist-packages (from pydantic<3,>=1.9.0->anthropic)
(2.33.2)
Requirement already satisfied: typing-inspection>=0.4.0 in
/usr/local/lib/python3.11/dist-packages (from pydantic<3,>=1.9.0->anthropic)
(0.4.1)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.11/dist-packages (from requests<3,>=2->langchain) (3.4.2)
Requirement already satisfied: markdown-it-py>=2.2.0 in
/usr/local/lib/python3.11/dist-packages (from rich>=10.11.0->chromadb) (3.0.0)
Requirement already satisfied: pygments<3.0.0,>=2.13.0 in

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/usr/local/lib/python3.11/dist-packages (from rich>=10.11.0->chromadb) (2.19.2)
Requirement already satisfied: greenlet>=1 in /usr/local/lib/python3.11/dist-
packages (from SQLAlchemy<3,>=1.4->langchain) (3.2.3)
Requirement already satisfied: networkx in /usr/local/lib/python3.11/dist-
packages (from torch>=1.11.0->sentence-transformers) (3.5)
Collecting nvidia-cuda-nvrtc-cu12==12.4.127 (from torch>=1.11.0->sentence-
transformers)
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manylinux2014_x86_64.whl.metadata (1.5 kB)
Collecting nvidia-cuda-runtime-cu12==12.4.127 (from torch>=1.11.0->sentence-
transformers)
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manylinux2014_x86_64.whl.metadata (1.5 kB)
Collecting nvidia-cuda-cupti-cu12==12.4.127 (from torch>=1.11.0->sentence-
transformers)
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manylinux2014_x86_64.whl.metadata (1.6 kB)
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transformers)
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manylinux2014_x86_64.whl.metadata (1.6 kB)
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/usr/local/lib/python3.11/dist-packages (from torch>=1.11.0->sentence-
transformers) (0.6.2)
Requirement already satisfied: nvidia-nccl-cu12==2.21.5 in
/usr/local/lib/python3.11/dist-packages (from torch>=1.11.0->sentence-
transformers) (2.21.5)
Requirement already satisfied: nvidia-nvtx-cu12==12.4.127 in

```



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/usr/local/lib/python3.11/dist-packages (from torch>=1.11.0->sentence-
transformers) (12.4.127)
Collecting nvidia-nvjitlink-cu12==12.4.127 (from torch>=1.11.0->sentence-
transformers)
  Downloading nvidia_nvjitlink_cu12-12.4.127-py3-none-
manylinux2014_x86_64.whl.metadata (1.5 kB)
Requirement already satisfied: triton==3.2.0 in /usr/local/lib/python3.11/dist-
packages (from torch>=1.11.0->sentence-transformers) (3.2.0)
Requirement already satisfied: mpmath<1.4,>=1.1.0 in
/usr/local/lib/python3.11/dist-packages (from
sympy->onnxruntime>=1.14.1->chromadb) (1.3.0)
Requirement already satisfied: regex!=2019.12.17 in
/usr/local/lib/python3.11/dist-packages (from
transformers<5.0.0,>=4.41.0->sentence-transformers) (2024.11.6)
Requirement already satisfied: safetensors>=0.4.3 in
/usr/local/lib/python3.11/dist-packages (from
transformers<5.0.0,>=4.41.0->sentence-transformers) (0.5.3)
Requirement already satisfied: shellingham>=1.3.0 in
/usr/local/lib/python3.11/dist-packages (from typer>=0.9.0->chromadb) (1.5.4)
Collecting httptools>=0.6.3 (from uvicorn[standard]>=0.18.3->chromadb)
  Downloading httptools-0.6.4-cp311-cp311-manylinux_2_5_x86_64.manylinux1_x86_64
.manylinux_2_17_x86_64.manylinux2014_x86_64.whl.metadata (3.6 kB)
Collecting uvloop>=0.15.1 (from uvicorn[standard]>=0.18.3->chromadb)
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64.whl.metadata (4.9 kB)
Collecting watchfiles>=0.13 (from uvicorn[standard]>=0.18.3->chromadb)
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86_64.whl.metadata (4.9 kB)
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uvicorn[standard]>=0.18.3->chromadb) (15.0.1)
Requirement already satisfied: joblib>=1.2.0 in /usr/local/lib/python3.11/dist-
packages (from scikit-learn->sentence-transformers) (1.5.1)
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/usr/local/lib/python3.11/dist-packages (from scikit-learn->sentence-
transformers) (3.6.0)
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/usr/local/lib/python3.11/dist-packages (from
gitdb<5,>=4.0.1->gitpython!=3.1.19,<4,>=3.0.7->streamlit) (5.0.2)
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) (0.4.2)
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) (4.9.1)
Requirement already satisfied: zipp>=3.20 in /usr/local/lib/python3.11/dist-
packages (from importlib-metadata<8.8.0,>=6.0->opentelemetry-
api>=1.2.0->chromadb) (3.23.0)
Requirement already satisfied: MarkupSafe>=2.0 in

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/usr/local/lib/python3.11/dist-packages (from jinja2->altair<6,>=4.0->streamlit)
(3.0.2)
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,>=0.3.66->langchain) (3.0.0)
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) (0.1.2)
Collecting humanfriendly>=9.1 (from coloredlogs->onnxruntime>=1.14.1->chromadb)
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/usr/local/lib/python3.11/dist-packages (from pyasn1-modules>=0.2.1->google-
auth>=1.0.1->kubernetes>=28.1.0->chromadb) (0.6.1)
Downloading anthropic-0.57.1-py3-none-any.whl (292 kB)
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13.8 MB/s eta 0:00:00
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chromadb-1.0.15-cp39-abi3-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (19.5
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65.2 MB/s eta 0:00:00
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Downloading opentelemetry_exporter_otlp_proto_grpc-1.35.0-py3-none-any.whl
(18 kB)
Downloading opentelemetry_exporter_otlp_proto_common-1.35.0-py3-none-any.whl (18

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Downloading opentelemetry_proto-1.35.0-py3-none-any.whl (72 kB)
72.5/72.5 kB
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119.4/119.4 kB
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(363.4 MB)
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Downloading nvidia_cuda_cupti_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl (13.8 MB)
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56.3/56.3 MB
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anylinux_2_17_x86_64.manylinux2014_x86_64.whl (459 kB)
459.8/459.8 kB
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uvloop-0.21.0-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (4.0
MB)
4.0/4.0 MB
26.8 MB/s eta 0:00:00
Downloading
watchfiles-1.1.0-cp311-cp311-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (453
kB)
453.1/453.1 kB
32.0 MB/s eta 0:00:00
Downloading coloredlogs-15.0.1-py2.py3-none-any.whl (46 kB)
46.0/46.0 kB
4.2 MB/s eta 0:00:00
Downloading humanfriendly-10.0-py2.py3-none-any.whl (86 kB)
86.8/86.8 kB
8.7 MB/s eta 0:00:00
Building wheels for collected packages: pypika
  Building wheel for pypika (pyproject.toml) ... done
  Created wheel for pypika: filename=pypika-0.48.9-py2.py3-none-any.whl
size=53803
sha256=579a8e281a88a69cd05828b0d2e7e8ad077cca4c61ebd0af879a81ee5755ee3a
  Stored in directory: /root/.cache/pip/wheels/a3/01/bd/4c40ceb9d5354160cb186dcc
153360f4ab7eb23e2b24daf96d
Successfully built pypika
Installing collected packages: pypika, durationpy, watchdog, uvloop, python-

```

dotenv, pypdf2, pybase64, overrides, opentelemetry-proto, nvidia-nvjitlink-cu12, nvidia-curand-cu12, nvidia-cufft-cu12, nvidia-cuda-runtime-cu12, nvidia-cuda-nvrtc-cu12, nvidia-cuda-cupti-cu12, nvidia-cublas-cu12, mmh3, humanfriendly, httptools, bcrypt, backoff, watchfiles, pydeck, posthog, opentelemetry-exporter-otlp-proto-common, opentelemetry-api, nvidia-cusparse-cu12, nvidia-cudnn-cu12, coloredlogs, opentelemetry-semantic-conventions, onnxruntime, nvidia-cusolver-cu12, kubernetes, anthropic, opentelemetry-sdk, streamlit, opentelemetry-exporter-otlp-proto-grpc, chromadb

Attempting uninstall: nvidia-nvjitlink-cu12

Found existing installation: nvidia-nvjitlink-cu12 12.5.82

Uninstalling nvidia-nvjitlink-cu12-12.5.82:

Successfully uninstalled nvidia-nvjitlink-cu12-12.5.82

Attempting uninstall: nvidia-curand-cu12

Found existing installation: nvidia-curand-cu12 10.3.6.82

Uninstalling nvidia-curand-cu12-10.3.6.82:

Successfully uninstalled nvidia-curand-cu12-10.3.6.82

Attempting uninstall: nvidia-cufft-cu12

Found existing installation: nvidia-cufft-cu12 11.2.3.61

Uninstalling nvidia-cufft-cu12-11.2.3.61:

Successfully uninstalled nvidia-cufft-cu12-11.2.3.61

Attempting uninstall: nvidia-cuda-runtime-cu12

Found existing installation: nvidia-cuda-runtime-cu12 12.5.82

Uninstalling nvidia-cuda-runtime-cu12-12.5.82:

Successfully uninstalled nvidia-cuda-runtime-cu12-12.5.82

Attempting uninstall: nvidia-cuda-nvrtc-cu12

Found existing installation: nvidia-cuda-nvrtc-cu12 12.5.82

Uninstalling nvidia-cuda-nvrtc-cu12-12.5.82:

Successfully uninstalled nvidia-cuda-nvrtc-cu12-12.5.82

Attempting uninstall: nvidia-cuda-cupti-cu12

Found existing installation: nvidia-cuda-cupti-cu12 12.5.82

Uninstalling nvidia-cuda-cupti-cu12-12.5.82:

Successfully uninstalled nvidia-cuda-cupti-cu12-12.5.82

Attempting uninstall: nvidia-cublas-cu12

Found existing installation: nvidia-cublas-cu12 12.5.3.2

Uninstalling nvidia-cublas-cu12-12.5.3.2:

Successfully uninstalled nvidia-cublas-cu12-12.5.3.2

Attempting uninstall: nvidia-cusparse-cu12

Found existing installation: nvidia-cusparse-cu12 12.5.1.3

Uninstalling nvidia-cusparse-cu12-12.5.1.3:

Successfully uninstalled nvidia-cusparse-cu12-12.5.1.3

Attempting uninstall: nvidia-cudnn-cu12

Found existing installation: nvidia-cudnn-cu12 9.3.0.75

Uninstalling nvidia-cudnn-cu12-9.3.0.75:

Successfully uninstalled nvidia-cudnn-cu12-9.3.0.75

Attempting uninstall: nvidia-cusolver-cu12

Found existing installation: nvidia-cusolver-cu12 11.6.3.83

Uninstalling nvidia-cusolver-cu12-11.6.3.83:

Successfully uninstalled nvidia-cusolver-cu12-11.6.3.83

Successfully installed anthropic-0.57.1 backoff-2.2.1 bcrypt-4.3.0
chromadb-1.0.15 coloredlogs-15.0.1 durationpy-0.10 httptools-0.6.4
humanfriendly-10.0 kubernetes-33.1.0 mmh3-5.1.0 nvidia-cublas-cu12-12.4.5.8
nvidia-cuda-cupti-cu12-12.4.127 nvidia-cuda-nvrtc-cu12-12.4.127 nvidia-cuda-
runtime-cu12-12.4.127 nvidia-cudnn-cu12-9.1.0.70 nvidia-cufft-cu12-11.2.1.3
nvidia-curand-cu12-10.3.5.147 nvidia-cusolver-cu12-11.6.1.9 nvidia-cuspars-
cu12-12.3.1.170 nvidia-nvjitlink-cu12-12.4.127 onnxruntime-1.22.1 opentelemetry-
api-1.35.0 opentelemetry-exporter-otlp-proto-common-1.35.0 opentelemetry-
exporter-otlp-proto-grpc-1.35.0 opentelemetry-proto-1.35.0 opentelemetry-
sdk-1.35.0 opentelemetry-semantic-conventions-0.56b0 overrides-7.7.0
posthog-5.4.0 pybase64-1.4.1 pydeck-0.9.1 pypdf2-3.0.1 pypika-0.48.9 python-
dotenv-1.1.1 streamlit-1.47.0 uvloop-0.21.0 watchdog-6.0.0 watchfiles-1.1.0

[6]: `!pip install langchain-community`

Collecting langchain-community
 Downloading langchain_community-0.3.27-py3-none-any.whl.metadata (2.9 kB)
Requirement already satisfied: langchain-core<1.0.0,>=0.3.66 in
/usr/local/lib/python3.11/dist-packages (from langchain-community) (0.3.68)
Requirement already satisfied: langchain<1.0.0,>=0.3.26 in
/usr/local/lib/python3.11/dist-packages (from langchain-community) (0.3.26)
Requirement already satisfied: SQLAlchemy<3,>=1.4 in
/usr/local/lib/python3.11/dist-packages (from langchain-community) (2.0.41)
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) (8.5.0)
Collecting dataclasses-json<0.7,>=0.5.7 (from langchain-community)
 Downloading dataclasses_json-0.6.7-py3-none-any.whl.metadata (25 kB)
Collecting pydantic-settings<3.0.0,>=2.4.0 (from langchain-community)
 Downloading pydantic_settings-2.10.1-py3-none-any.whl.metadata (3.4 kB)
Requirement already satisfied: langsmith>=0.1.125 in
/usr/local/lib/python3.11/dist-packages (from langchain-community) (0.4.5)
Collecting httpx-sse<1.0.0,>=0.4.0 (from langchain-community)
 Downloading httpx_sse-0.4.1-py3-none-any.whl.metadata (9.4 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) (1.4.0)
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) (1.7.0)
 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) (6.6.3)
 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) (0.3.2)
 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) (1.20.1)
 Collecting marshmallow<4.0.0,>=3.18.0 (from dataclasses-
 json<0.7,>=0.5.7->langchain-community)
 Downloading 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)
 Downloading 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,>=0.3.26->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,>=0.3.26->langchain-community) (2.11.7)
 Requirement already satisfied: jsonpatch<2.0,>=1.33 in
 /usr/local/lib/python3.11/dist-packages (from langchain-
 core<1.0.0,>=0.3.66->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,>=0.3.66->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,>=0.3.66->langchain-community) (4.14.1)
 Requirement already satisfied: httpx<1,>=0.23.0 in
 /usr/local/lib/python3.11/dist-packages (from langsmith>=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>=0.1.125->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>=0.1.125->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>=0.1.125->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) (1.1.1)
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) (0.4.1)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.11/dist-packages (from requests<3,>=2->langchain-
community) (3.4.2)
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) (2025.7.14)
Requirement already satisfied: greenlet>=1 in /usr/local/lib/python3.11/dist-
packages (from SQLAlchemy<3,>=1.4->langchain-community) (3.2.3)
Requirement already satisfied: anyio in /usr/local/lib/python3.11/dist-packages
(from httpx<1,>=0.23.0->langsmith>=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>=0.1.125->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>=0.1.125->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,>=0.3.66->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,>=0.3.26->langchain-community) (0.7.0)
Requirement already satisfied: pydantic-core==2.33.2 in
/usr/local/lib/python3.11/dist-packages (from
pydantic<3.0.0,>=2.7.4->langchain<1.0.0,>=0.3.26->langchain-community) (2.33.2)
Collecting mpy-extensions>=0.3.0 (from typing-inspect<1,>=0.4.0->dataclasses-
json<0.7,>=0.5.7->langchain-community)
  Downloading 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>=0.1.125->langchain-community)
(1.3.1)
Downloading langchain_community-0.3.27-py3-none-any.whl (2.5 MB)
2.5/2.5 MB
25.6 MB/s eta 0:00:00
Downloading dataclasses_json-0.6.7-py3-none-any.whl (28 kB)
Downloading httpx_sse-0.4.1-py3-none-any.whl (8.1 kB)
Downloading pydantic_settings-2.10.1-py3-none-any.whl (45 kB)
45.2/45.2 kB
2.9 MB/s eta 0:00:00

```


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

50.9/50.9 kB

3.3 MB/s eta 0:00:00

Downloading typing-inspect-0.9.0-py3-none-any.whl (8.8 kB)

Downloading mypy_extensions-1.1.0-py3-none-any.whl (5.0 kB)

Installing collected packages: mypy-extensions, marshmallow, httpx-sse, typing-inspect, pydantic-settings, dataclasses-json, langchain-community

Successfully installed dataclasses-json-0.6.7 httpx-sse-0.4.1 langchain-community-0.3.27 marshmallow-3.26.1 mypy-extensions-1.1.0 pydantic-settings-2.10.1 typing-inspect-0.9.0

```
[7]: # Import necessary libraries
import os
from anthropic import Anthropic
from langchain.text_splitter import RecursiveCharacterTextSplitter
from langchain_community.embeddings import HuggingFaceEmbeddings
from langchain.vectorstores import Chroma
from langchain.document_loaders import TextLoader, PyPDFLoader
from langchain.docstore.document import Document
import tempfile
import pickle
from datetime import datetime
```

Setup Claude API Key

```
[8]: CLAUDE_API_KEY = "sk-ant-api03-FTcii2lNyEr5rTYustGAS0HwICmSeI9Dd26ag--z5yQqpumc15Lzp2kxJnZtoy9W_3p14ieKS3gQj"
os.environ["ANTHROPIC_API_KEY"] = CLAUDE_API_KEY

# Initialize Claude client
client = Anthropic(api_key=CLAUDE_API_KEY)
```

Document Processing and Vector Store Setup

```
[9]: class DocumentProcessor:
    def __init__(self):
        self.embeddings = HuggingFaceEmbeddings(
            model_name="sentence-transformers/all-MiniLM-L6-v2"
        )
        self.text_splitter = RecursiveCharacterTextSplitter(
            chunk_size=1000,
            chunk_overlap=200
        )
        self.vectorstore = None

    def load_documents(self, file_paths):
        """Load documents from various file formats"""
        documents = []
```

```

    for file_path in file_paths:
        if file_path.endswith('.pdf'):
            loader = PyPDFLoader(file_path)
            docs = loader.load()
        elif file_path.endswith('.txt'):
            loader = TextLoader(file_path)
            docs = loader.load()
        else:
            # Handle plain text
            with open(file_path, 'r', encoding='utf-8') as f:
                content = f.read()
            docs = [Document(page_content=content, metadata={"source": ↵
↵file_path})]

        documents.extend(docs)

    return documents

def create_vector_store(self, documents):
    """Create vector store from documents"""
    # Split documents into chunks
    texts = self.text_splitter.split_documents(documents)

    # Create vector store
    self.vectorstore = Chroma.from_documents(
        texts,
        self.embeddings,
        persist_directory="./chroma_db"
    )

    return self.vectorstore

def load_vector_store(self):
    """Load existing vector store"""
    if os.path.exists("./chroma_db"):
        self.vectorstore = Chroma(
            persist_directory="./chroma_db",
            embedding_function=self.embeddings
        )
        return self.vectorstore
    return None

```

Context Memory Management

```

[10]: class ConversationMemory:
        def __init__(self, max_history=10):

```

```

self.conversation_history = []
self.max_history = max_history

def add_message(self, role, content):
    """Add message to conversation history"""
    self.conversation_history.append({
        "role": role,
        "content": content,
        "timestamp": datetime.now().isoformat()
    })

    # Keep only recent messages
    if len(self.conversation_history) > self.max_history * 2:
        self.conversation_history = self.conversation_history[-self.
↪max_history * 2:]

def get_context(self):
    """Get formatted conversation context"""
    if not self.conversation_history:
        return ""

    context = "Previous conversation:\n"
    for msg in self.conversation_history[-6:]: # Last 6 messages
        context += f"{msg['role']}: {msg['content']}\n"

    return context

def clear_history(self):
    """Clear conversation history"""
    self.conversation_history = []

```

RAG-Enhanced Chatbot Class

```

[11]: class RAGChatbot:
    def __init__(self, claude_api_key):
        self.client = Anthropic(api_key=claude_api_key)
        self.memory = ConversationMemory()
        self.doc_processor = DocumentProcessor()
        self.vectorstore = None

    def load_knowledge_base(self, file_paths):
        """Load documents into vector store"""
        documents = self.doc_processor.load_documents(file_paths)
        self.vectorstore = self.doc_processor.create_vector_store(documents)
        return f"Loaded {len(documents)} documents into knowledge base"

    def retrieve_relevant_docs(self, query, k=3):

```

```

        """Retrieve relevant documents for query"""
        if not self.vectorstore:
            return []

        relevant_docs = self.vectorstore.similarity_search(query, k=k)
        return relevant_docs

def generate_response(self, user_input):
    """Generate response using RAG approach"""
    # Retrieve relevant documents
    relevant_docs = self.retrieve_relevant_docs(user_input)

    # Prepare context
    context = self.memory.get_context()

    # Prepare retrieved information
    retrieved_info = ""
    if relevant_docs:
        retrieved_info = "\n\nRelevant information from knowledge base:\n"
        for i, doc in enumerate(relevant_docs, 1):
            retrieved_info += f"{i}. {doc.page_content[:300]}...\n"

    # Create prompt
    prompt = f"""You are a helpful assistant with access to a knowledge_
↪base.
    Use the following context and retrieved information to answer the_
↪user's question.

    {context}

    {retrieved_info}

    User: {user_input}

    Please provide a helpful and accurate response based on the available_
↪information.
    If you don't have enough information, say so clearly."""

    # Generate response using Claude
    try:
        response = self.client.messages.create(
            model="claude-3-sonnet-20240229",
            max_tokens=1000,
            messages=[
                {"role": "user", "content": prompt}
            ]
        )

```

```

        assistant_response = response.content[0].text

        # Store in memory
        self.memory.add_message("user", user_input)
        self.memory.add_message("assistant", assistant_response)

        return assistant_response

    except Exception as e:
        return f"Error generating response: {str(e)}"

def reset_conversation(self):
    """Reset conversation memory"""
    self.memory.clear_history()

```

Sample Knowledge Base Creation

```

[12]: # Create sample documents for testing
def create_sample_docs():
    # Sample document 1
    with open("sample_doc1.txt", "w") as f:
        f.write("""
            Artificial Intelligence (AI) is a broad field of computer science,
            focused on creating
            intelligent machines capable of performing tasks that typically require
            human intelligence.
            These tasks include learning, reasoning, problem-solving, perception,
            and language understanding.

            Machine Learning is a subset of AI that enables computers to learn and
            improve from experience
            without being explicitly programmed. It uses algorithms to analyze
            data, identify patterns,
            and make predictions or decisions.

            Deep Learning is a subset of machine learning that uses neural networks
            with multiple layers
            to model and understand complex patterns in data. It's particularly
            effective for tasks like
            image recognition, natural language processing, and speech recognition.
            """)

    # Sample document 2
    with open("sample_doc2.txt", "w") as f:
        f.write("""

```

```

        Natural Language Processing (NLP) is a branch of AI that focuses on the
        ↪interaction between
            computers and human language. It enables machines to understand,
        ↪interpret, and generate
            human language in a valuable way.

        Large Language Models (LLMs) are AI systems trained on vast amounts of
        ↪text data to understand
            and generate human-like text. Examples include GPT, BERT, and Claude.

        Retrieval-Augmented Generation (RAG) is a technique that combines
        ↪pre-trained language models
            with external knowledge retrieval to improve the accuracy and relevance
        ↪of generated responses.
        """)

    return ["sample_doc1.txt", "sample_doc2.txt"]

# Create sample documents
sample_files = create_sample_docs()
print("Sample documents created:", sample_files)

```

Sample documents created: ['sample_doc1.txt', 'sample_doc2.txt']

[]:

3 Task 5: Auto Tagging Support Tickets Using LLM

Environment Setup

[]: `!pip install transformers torch datasets scikit-learn pandas numpy`

```

Requirement already satisfied: transformers in /usr/local/lib/python3.11/dist-
packages (4.53.2)
Requirement already satisfied: torch in /usr/local/lib/python3.11/dist-packages
(2.6.0+cu124)
Requirement already satisfied: datasets in /usr/local/lib/python3.11/dist-
packages (2.14.4)
Requirement already satisfied: scikit-learn in /usr/local/lib/python3.11/dist-
packages (1.6.1)
Requirement already satisfied: pandas in /usr/local/lib/python3.11/dist-packages
(2.2.2)
Requirement already satisfied: numpy in /usr/local/lib/python3.11/dist-packages
(2.0.2)
Requirement already satisfied: filelock in /usr/local/lib/python3.11/dist-
packages (from transformers) (3.18.0)
Requirement already satisfied: huggingface-hub<1.0,>=0.30.0 in

```

```

/usr/local/lib/python3.11/dist-packages (from transformers) (0.33.2)
Requirement already satisfied: packaging>=20.0 in
/usr/local/lib/python3.11/dist-packages (from transformers) (24.2)
Requirement already satisfied: pyyaml>=5.1 in /usr/local/lib/python3.11/dist-
packages (from transformers) (6.0.2)
Requirement already satisfied: regex!=2019.12.17 in
/usr/local/lib/python3.11/dist-packages (from transformers) (2024.11.6)
Requirement already satisfied: requests in /usr/local/lib/python3.11/dist-
packages (from transformers) (2.32.3)
Requirement already satisfied: tokenizers<0.22,>=0.21 in
/usr/local/lib/python3.11/dist-packages (from transformers) (0.21.2)
Requirement already satisfied: safetensors>=0.4.3 in
/usr/local/lib/python3.11/dist-packages (from transformers) (0.5.3)
Requirement already satisfied: tqdm>=4.27 in /usr/local/lib/python3.11/dist-
packages (from transformers) (4.67.1)
Requirement already satisfied: typing-extensions>=4.10.0 in
/usr/local/lib/python3.11/dist-packages (from torch) (4.14.1)
Requirement already satisfied: networkx in /usr/local/lib/python3.11/dist-
packages (from torch) (3.5)
Requirement already satisfied: jinja2 in /usr/local/lib/python3.11/dist-packages
(from torch) (3.1.6)
Requirement already satisfied: fsspec in /usr/local/lib/python3.11/dist-packages
(from torch) (2025.3.2)
Collecting nvidia-cuda-nvrtc-cu12==12.4.127 (from torch)
  Downloading nvidia_cuda_nvrtc_cu12-12.4.127-py3-none-
manylinux2014_x86_64.whl.metadata (1.5 kB)
Collecting nvidia-cuda-runtime-cu12==12.4.127 (from torch)
  Downloading nvidia_cuda_runtime_cu12-12.4.127-py3-none-
manylinux2014_x86_64.whl.metadata (1.5 kB)
Collecting nvidia-cuda-cupti-cu12==12.4.127 (from torch)
  Downloading nvidia_cuda_cupti_cu12-12.4.127-py3-none-
manylinux2014_x86_64.whl.metadata (1.6 kB)
Collecting nvidia-cudnn-cu12==9.1.0.70 (from torch)
  Downloading nvidia_cudnn_cu12-9.1.0.70-py3-none-
manylinux2014_x86_64.whl.metadata (1.6 kB)
Collecting nvidia-cublas-cu12==12.4.5.8 (from torch)
  Downloading nvidia_cublas_cu12-12.4.5.8-py3-none-
manylinux2014_x86_64.whl.metadata (1.5 kB)
Collecting nvidia-cufft-cu12==11.2.1.3 (from torch)
  Downloading nvidia_cufft_cu12-11.2.1.3-py3-none-
manylinux2014_x86_64.whl.metadata (1.5 kB)
Collecting nvidia-curand-cu12==10.3.5.147 (from torch)
  Downloading nvidia_curand_cu12-10.3.5.147-py3-none-
manylinux2014_x86_64.whl.metadata (1.5 kB)
Collecting nvidia-cusolver-cu12==11.6.1.9 (from torch)
  Downloading nvidia_cusolver_cu12-11.6.1.9-py3-none-
manylinux2014_x86_64.whl.metadata (1.6 kB)
Collecting nvidia-cuspars-cu12==12.3.1.170 (from torch)

```

Downloading nvidia_cusparselt_cu12-12.3.1.170-py3-none-manylinux2014_x86_64.whl.metadata (1.6 kB)
 Requirement already satisfied: nvidia-cusparselt-cu12==0.6.2 in /usr/local/lib/python3.11/dist-packages (from torch) (0.6.2)
 Requirement already satisfied: nvidia-nccl-cu12==2.21.5 in /usr/local/lib/python3.11/dist-packages (from torch) (2.21.5)
 Requirement already satisfied: nvidia-nvtx-cu12==12.4.127 in /usr/local/lib/python3.11/dist-packages (from torch) (12.4.127)
 Collecting nvidia-nvjitlink-cu12==12.4.127 (from torch)
 Downloading nvidia_nvjitlink_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl.metadata (1.5 kB)
 Requirement already satisfied: triton==3.2.0 in /usr/local/lib/python3.11/dist-packages (from torch) (3.2.0)
 Requirement already satisfied: sympy==1.13.1 in /usr/local/lib/python3.11/dist-packages (from torch) (1.13.1)
 Requirement already satisfied: mpmath<1.4,>=1.1.0 in /usr/local/lib/python3.11/dist-packages (from sympy==1.13.1->torch) (1.3.0)
 Requirement already satisfied: pyarrow>=8.0.0 in /usr/local/lib/python3.11/dist-packages (from datasets) (18.1.0)
 Requirement already satisfied: dill<0.3.8,>=0.3.0 in /usr/local/lib/python3.11/dist-packages (from datasets) (0.3.7)
 Requirement already satisfied: xxhash in /usr/local/lib/python3.11/dist-packages (from datasets) (3.5.0)
 Requirement already satisfied: multiprocessing in /usr/local/lib/python3.11/dist-packages (from datasets) (0.70.15)
 Requirement already satisfied: aiohttp in /usr/local/lib/python3.11/dist-packages (from datasets) (3.11.15)
 Requirement already satisfied: scipy>=1.6.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn) (1.15.3)
 Requirement already satisfied: joblib>=1.2.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn) (1.5.1)
 Requirement already satisfied: threadpoolctl>=3.1.0 in /usr/local/lib/python3.11/dist-packages (from scikit-learn) (3.6.0)
 Requirement already satisfied: python-dateutil>=2.8.2 in /usr/local/lib/python3.11/dist-packages (from pandas) (2.9.0.post0)
 Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.11/dist-packages (from pandas) (2025.2)
 Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.11/dist-packages (from pandas) (2025.2)
 Requirement already satisfied: aiohappyeyeballs>=2.3.0 in /usr/local/lib/python3.11/dist-packages (from aiohttp->datasets) (2.6.1)
 Requirement already satisfied: aiosignal>=1.1.2 in /usr/local/lib/python3.11/dist-packages (from aiohttp->datasets) (1.4.0)
 Requirement already satisfied: attrs>=17.3.0 in /usr/local/lib/python3.11/dist-packages (from aiohttp->datasets) (25.3.0)
 Requirement already satisfied: frozenlist>=1.1.1 in /usr/local/lib/python3.11/dist-packages (from aiohttp->datasets) (1.7.0)
 Requirement already satisfied: multidict<7.0,>=4.5 in

/usr/local/lib/python3.11/dist-packages (from aiohttp->datasets) (6.6.3)
Requirement already satisfied: propcache>=0.2.0 in
/usr/local/lib/python3.11/dist-packages (from aiohttp->datasets) (0.3.2)
Requirement already satisfied: yarll<2.0,>=1.17.0 in
/usr/local/lib/python3.11/dist-packages (from aiohttp->datasets) (1.20.1)
Requirement already satisfied: hf-xet<2.0.0,>=1.1.2 in
/usr/local/lib/python3.11/dist-packages (from huggingface-
hub<1.0,>=0.30.0->transformers) (1.1.5)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.11/dist-
packages (from python-dateutil>=2.8.2->pandas) (1.17.0)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.11/dist-packages (from requests->transformers) (3.4.2)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.11/dist-
packages (from requests->transformers) (3.10)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.11/dist-packages (from requests->transformers) (2.4.0)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.11/dist-packages (from requests->transformers) (2025.7.9)
Requirement already satisfied: MarkupSafe>=2.0 in
/usr/local/lib/python3.11/dist-packages (from jinja2->torch) (3.0.2)
Downloading nvidia_cublas_cu12-12.4.5.8-py3-none-manylinux2014_x86_64.whl (363.4
MB)

363.4/363.4 MB

1.3 MB/s eta 0:00:00

Downloading nvidia_cuda_cupti_cu12-12.4.127-py3-none-
manylinux2014_x86_64.whl (13.8 MB)

13.8/13.8 MB

88.4 MB/s eta 0:00:00

Downloading nvidia_cuda_nvrtc_cu12-12.4.127-py3-none-
manylinux2014_x86_64.whl (24.6 MB)

24.6/24.6 MB

22.6 MB/s eta 0:00:00

Downloading nvidia_cuda_runtime_cu12-12.4.127-py3-none-
manylinux2014_x86_64.whl (883 kB)

883.7/883.7 kB

46.7 MB/s eta 0:00:00

Downloading nvidia_cudnn_cu12-9.1.0.70-py3-none-manylinux2014_x86_64.whl
(664.8 MB)

664.8/664.8 MB

1.3 MB/s eta 0:00:00

Downloading nvidia_cufft_cu12-11.2.1.3-py3-none-manylinux2014_x86_64.whl
(211.5 MB)

211.5/211.5 MB

6.6 MB/s eta 0:00:00

Downloading nvidia_curand_cu12-10.3.5.147-py3-none-
manylinux2014_x86_64.whl (56.3 MB)

56.3/56.3 MB

15.0 MB/s eta 0:00:00

Downloading nvidia_cusolver_cu12-11.6.1.9-py3-none-manylinux2014_x86_64.whl (127.9 MB)

127.9/127.9 MB

9.6 MB/s eta 0:00:00

Downloading nvidia_cusparses_cu12-12.3.1.170-py3-none-manylinux2014_x86_64.whl (207.5 MB)

207.5/207.5 MB

1.6 MB/s eta 0:00:00

Downloading nvidia_nvjitlink_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl (21.1 MB)

21.1/21.1 MB

70.3 MB/s eta 0:00:00

Installing collected packages: nvidia-nvjitlink-cu12, nvidia-curand-cu12, nvidia-cufft-cu12, nvidia-cuda-runtime-cu12, nvidia-cuda-nvrtc-cu12, nvidia-cuda-cupti-cu12, nvidia-cublas-cu12, nvidia-cusparses-cu12, nvidia-cudnn-cu12, nvidia-cusolver-cu12

Attempting uninstall: nvidia-nvjitlink-cu12

Found existing installation: nvidia-nvjitlink-cu12 12.5.82

Uninstalling nvidia-nvjitlink-cu12-12.5.82:

Successfully uninstalled nvidia-nvjitlink-cu12-12.5.82

Attempting uninstall: nvidia-curand-cu12

Found existing installation: nvidia-curand-cu12 10.3.6.82

Uninstalling nvidia-curand-cu12-10.3.6.82:

Successfully uninstalled nvidia-curand-cu12-10.3.6.82

Attempting uninstall: nvidia-cufft-cu12

Found existing installation: nvidia-cufft-cu12 11.2.3.61

Uninstalling nvidia-cufft-cu12-11.2.3.61:

Successfully uninstalled nvidia-cufft-cu12-11.2.3.61

Attempting uninstall: nvidia-cuda-runtime-cu12

Found existing installation: nvidia-cuda-runtime-cu12 12.5.82

Uninstalling nvidia-cuda-runtime-cu12-12.5.82:

Successfully uninstalled nvidia-cuda-runtime-cu12-12.5.82

Attempting uninstall: nvidia-cuda-nvrtc-cu12

Found existing installation: nvidia-cuda-nvrtc-cu12 12.5.82

Uninstalling nvidia-cuda-nvrtc-cu12-12.5.82:

Successfully uninstalled nvidia-cuda-nvrtc-cu12-12.5.82

Attempting uninstall: nvidia-cuda-cupti-cu12

Found existing installation: nvidia-cuda-cupti-cu12 12.5.82

Uninstalling nvidia-cuda-cupti-cu12-12.5.82:

Successfully uninstalled nvidia-cuda-cupti-cu12-12.5.82

Attempting uninstall: nvidia-cublas-cu12

Found existing installation: nvidia-cublas-cu12 12.5.3.2

Uninstalling nvidia-cublas-cu12-12.5.3.2:

Successfully uninstalled nvidia-cublas-cu12-12.5.3.2

Attempting uninstall: nvidia-cusparses-cu12

Found existing installation: nvidia-cusparses-cu12 12.5.1.3

Uninstalling nvidia-cusparses-cu12-12.5.1.3:

Successfully uninstalled nvidia-cusparses-cu12-12.5.1.3

```

Attempting uninstall: nvidia-cudnn-cu12
Found existing installation: nvidia-cudnn-cu12 9.3.0.75
Uninstalling nvidia-cudnn-cu12-9.3.0.75:
  Successfully uninstalled nvidia-cudnn-cu12-9.3.0.75
Attempting uninstall: nvidia-cusolver-cu12
Found existing installation: nvidia-cusolver-cu12 11.6.3.83
Uninstalling nvidia-cusolver-cu12-11.6.3.83:
  Successfully uninstalled nvidia-cusolver-cu12-11.6.3.83
Successfully installed nvidia-cublas-cu12-12.4.5.8 nvidia-cuda-cupti-
cu12-12.4.127 nvidia-cuda-nvrtc-cu12-12.4.127 nvidia-cuda-runtime-cu12-12.4.127
nvidia-cudnn-cu12-9.1.0.70 nvidia-cufft-cu12-11.2.1.3 nvidia-curand-
cu12-10.3.5.147 nvidia-cusolver-cu12-11.6.1.9 nvidia-cusparse-cu12-12.3.1.170
nvidia-nvjitlink-cu12-12.4.127

```

```

[ ]: import pandas as pd
import numpy as np
import torch
from sklearn.metrics import accuracy_score, classification_report
from transformers import pipeline, AutoTokenizer, \
    AutoModelForSequenceClassification, TrainingArguments, Trainer
from datasets import Dataset
import re

```

Data Loading

```

[ ]: # Load dataset
df = pd.read_csv('/content/archive.zip')
df.head()

```

	Ticket ID	Customer Name	Customer Email	Customer Age	\
0	1	Marisa Obrien	carrollallison@example.com	32	
1	2	Jessica Rios	clarkeashley@example.com	42	
2	3	Christopher Robbins	gonzalestracy@example.com	48	
3	4	Christina Dillon	bradleyolson@example.org	27	
4	5	Alexander Carroll	bradleymark@example.com	67	

	Customer Gender	Product Purchased	Date of Purchase	Ticket Type	\
0	Other	GoPro Hero	2021-03-22	Technical issue	
1	Female	LG Smart TV	2021-05-22	Technical issue	
2	Other	Dell XPS	2020-07-14	Technical issue	
3	Female	Microsoft Office	2020-11-13	Billing inquiry	
4	Female	Autodesk AutoCAD	2020-02-04	Billing inquiry	

	Ticket Subject	\
0	Product setup	
1	Peripheral compatibility	
2	Network problem	
3	Account access	

4 Data loss

```

Ticket Description \
0 I'm having an issue with the {product_purchase...
1 I'm having an issue with the {product_purchase...
2 I'm facing a problem with my {product_purchase...
3 I'm having an issue with the {product_purchase...
4 I'm having an issue with the {product_purchase...

Ticket Status Resolution \
0 Pending Customer Response NaN
1 Pending Customer Response NaN
2 Closed Case maybe show recently my computer follow.
3 Closed Try capital clearly never color toward story.
4 Closed West decision evidence bit.

Ticket Priority Ticket Channel First Response Time Time to Resolution \
0 Critical Social media 2023-06-01 12:15:36 NaN
1 Critical Chat 2023-06-01 16:45:38 NaN
2 Low Social media 2023-06-01 11:14:38 2023-06-01 18:05:38
3 Low Social media 2023-06-01 07:29:40 2023-06-01 01:57:40
4 Low Email 2023-06-01 00:12:42 2023-06-01 19:53:42

Customer Satisfaction Rating
0 NaN
1 NaN
2 3.0
3 3.0
4 1.0
```

Data Preprocessing

```
[ ]: def preprocess(text):
    text = str(text).lower()
    text = re.sub(r'\s+', ' ', text)
    return re.sub(r'[^a-zA-Z0-9\s\.,!?]', '', text).strip()

df['processed_text'] = df['Ticket Description'].apply(preprocess)

df['category'] = df['Ticket Type']

# Create label mappings
categories = df['category'].unique().tolist()
label_to_id = {label: i for i, label in enumerate(categories)}
id_to_label = {i: label for label, i in label_to_id.items()}
df['label'] = df['category'].map(label_to_id)
```

Zero-Shot Classification

```
[ ]: from transformers import pipeline

# Load zero-shot classification pipeline
classifier = pipeline("zero-shot-classification", model="facebook/
↳bart-large-mnli")

# Define your candidate tags
candidate_labels = ["Billing", "Technical Support", "Account Management",
↳"Feature Request", "Login Issues"]

def zero_shot_tagging(ticket_text):
    result = classifier(ticket_text, candidate_labels, multi_label=True)
    return result["labels"][:3], result["scores"][:3]

# Example usage
ticket = "I need help resetting my password"
tags, scores = zero_shot_tagging(ticket)
print(f"Top tags: {tags} with scores: {scores}")
```

```
/usr/local/lib/python3.11/dist-packages/huggingface_hub/utils/_auth.py:94:
UserWarning:
The secret `HF_TOKEN` does not exist in your Colab secrets.
To authenticate with the Hugging Face Hub, create a token in your settings tab
(https://huggingface.co/settings/tokens), set it as secret in your Google Colab
and restart your session.
You will be able to reuse this secret in all of your notebooks.
Please note that authentication is recommended but still optional to access
public models or datasets.
```

```
warnings.warn(

config.json: 0.00B [00:00, ?B/s]
model.safetensors: 0%|          | 0.00/1.63G [00:00<?, ?B/s]
tokenizer_config.json: 0%|          | 0.00/26.0 [00:00<?, ?B/s]
vocab.json: 0.00B [00:00, ?B/s]
merges.txt: 0.00B [00:00, ?B/s]
tokenizer.json: 0.00B [00:00, ?B/s]
```

Device set to use cuda:0

```
Top tags: ['Login Issues', 'Account Management', 'Technical Support'] with
scores: [0.9192560911178589, 0.3597143292427063, 0.1798456311225891]
```

Few-Shot Learning

```
[ ]: def few_shot_tagging(ticket_text):
    prompt = f"""
```

```
    Classify the following support ticket into one or more of these categories:␣  
    ↪{candidate_labels}.
```

Examples:

1. "How do I cancel my subscription?" → Billing
2. "The app keeps freezing when I try to upload files" → Technical Support
3. "I want to suggest a dark mode feature" → Feature Request

```
Now classify this ticket: "{ticket_text}"  
"""
```

```
# Use a text generation model to complete the prompt  
generator = pipeline("text-generation", model="gpt2")  
result = generator(prompt, max_length=100, num_return_sequences=1)  
return result[0]["generated_text"]
```

Fine-Tuning Approach

```
[ ]: from transformers import AutoTokenizer, AutoModelForSequenceClassification  
from transformers import Trainer, TrainingArguments  
import torch  
from sklearn.model_selection import train_test_split  
  
# Prepare dataset  
texts = df['processed_text'].tolist()  
labels = df['label'].tolist()  
  
# Split dataset  
train_texts, val_texts, train_labels, val_labels = train_test_split(texts,␣  
    ↪labels, test_size=0.2)  
  
# Tokenize  
tokenizer = AutoTokenizer.from_pretrained("distilbert-base-uncased")  
train_encodings = tokenizer(train_texts, truncation=True, padding=True)  
val_encodings = tokenizer(val_texts, truncation=True, padding=True)  
  
# Convert labels to numerical values  
unique_labels = list(set(labels))  
label2id = {label: idx for idx, label in enumerate(unique_labels)}  
  
# Create dataset class  
class SupportTicketDataset(torch.utils.data.Dataset):  
    def __init__(self, encodings, labels):  
        self.encodings = encodings  
        self.labels = labels
```

```

    def __getitem__(self, idx):
        item = {key: torch.tensor(val[idx]) for key, val in self.encodings.
        ↪items()}
        item["labels"] = torch.tensor(self.labels[idx])
        return item

    def __len__(self):
        return len(self.labels)

train_dataset = SupportTicketDataset(train_encodings, train_labels)
val_dataset = SupportTicketDataset(val_encodings, val_labels)

# Initialize model
model = AutoModelForSequenceClassification.from_pretrained(
    "distilbert-base-uncased",
    num_labels=len(unique_labels),
    id2label={id: label for label, id in label2id.items()},
    label2id=label2id
)

# Training arguments
training_args = TrainingArguments(
    output_dir="./results",
    num_train_epochs=3,
    per_device_train_batch_size=16,
    per_device_eval_batch_size=64,
    warmup_steps=500,
    weight_decay=0.01,
    logging_dir="./logs",
    logging_steps=10,
    eval_strategy="epoch"
)

# Train
trainer = Trainer(
    model=model,
    args=training_args,
    train_dataset=train_dataset,
    eval_dataset=val_dataset
)

trainer.train()

```

Some weights of DistilBertForSequenceClassification were not initialized from the model checkpoint at distilbert-base-uncased and are newly initialized: ['classifier.bias', 'classifier.weight', 'pre_classifier.bias', 'pre_classifier.weight']

You should probably TRAIN this model on a down-stream task to be able to use it for predictions and inference.

wandb: **WARNING** The `run_name` is currently set to the same value as `TrainingArguments.output_dir`. If this was not intended, please specify a different run name by setting the `TrainingArguments.run_name` parameter.

<IPython.core.display.Javascript object>

wandb: Logging into wandb.ai. (Learn how to deploy a W&B server locally: <https://wandb.me/wandb-server>)

wandb: You can find your API key in your browser here:

<https://wandb.ai/authorize?ref=models>

wandb: Paste an API key from your profile and hit enter:

.....

wandb: **WARNING** If you're specifying your api key in code, ensure this code is not shared publicly.

wandb: **WARNING** Consider setting the WANDB_API_KEY environment variable, or running `wandb login` from the command line.

wandb: No netrc file found, creating one.

wandb: Appending key for api.wandb.ai to your netrc file:
/root/.netrc

wandb: Currently logged in as: **zoyahafeez296**
(**zoyahafeez296**-) to <https://api.wandb.ai>. Use `wandb login

--relogin` to force relogin

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

<IPython.core.display.HTML object>

```
[ ]: TrainOutput(global_step=1272, training_loss=1.6117281201500562,  
metrics={'train_runtime': 319.2881, 'train_samples_per_second': 63.657,  
'train_steps_per_second': 3.984, 'total_flos': 641582731669500.0, 'train_loss':  
1.6117281201500562, 'epoch': 3.0})
```

```
[ ]: # Save model  
model.save_pretrained("./support_ticket_classifier")  
tokenizer.save_pretrained("./support_ticket_classifier")
```

```
[ ]: ('./support_ticket_classifier/tokenizer_config.json',  
      './support_ticket_classifier/special_tokens_map.json',  
      './support_ticket_classifier/vocab.txt',
```



```

'./support_ticket_classifier/added_tokens.json',
'./support_ticket_classifier/tokenizer.json')

```

Comparison and Evaluation

```

[ ]: import numpy as np
      # Evaluation
      eval_results = trainer.evaluate(val_dataset)
      print("Evaluation Results:", eval_results)

      predictions = trainer.predict(val_dataset)
      preds = np.argmax(predictions.predictions, axis=1)

      # Convert numerical predictions back to original labels for the report
      predicted_labels_original = [id_to_label[pred] for pred in preds]
      true_labels_original = [id_to_label[label] for label in val_labels]

      print("\nClassification Report:")
      print(classification_report(true_labels_original, predicted_labels_original,
      ↪target_names=categories))

```

<IPython.core.display.HTML object>

```

Evaluation Results: {'eval_loss': 1.6092618703842163, 'eval_runtime': 3.8431,
'eval_samples_per_second': 440.79, 'eval_steps_per_second': 7.026, 'epoch': 3.0}

```

Classification Report:

	precision	recall	f1-score	support
Technical issue	0.15	0.05	0.08	315
Billing inquiry	0.00	0.00	0.00	354
Cancellation request	0.19	0.10	0.13	309
Product inquiry	0.20	0.40	0.26	362
Refund request	0.21	0.39	0.27	354
accuracy			0.20	1694
macro avg	0.15	0.19	0.15	1694
weighted avg	0.15	0.20	0.15	1694

```

/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))
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Production Implementation

```
[ ]: # Define a new support ticket text
new_ticket_text = "My internet connection is not working after the update."

# Tokenize the new text
new_ticket_inputs = tokenizer(new_ticket_text, return_tensors="pt",
    ↳truncation=True, padding=True)

# Move inputs to the same device as the model
if torch.cuda.is_available():
    new_ticket_inputs = {key: val.to('cuda') for key, val in new_ticket_inputs.
    ↳items()}
    model.to('cuda')

# Get predictions from the model
with torch.no_grad():
    outputs = model(**new_ticket_inputs)

# Get the predicted class index
predicted_class_id = outputs.logits.argmax().item()

# Convert the predicted index back to the original label
predicted_tag = id_to_label[predicted_class_id]

print(f"New Ticket Text: {new_ticket_text}")
print(f"Predicted Tag: {predicted_tag}")
```

New Ticket Text: My internet connection is not working after the update.
Predicted Tag: Refund request

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