News___Topic___Classifier

October 14, 2025

1 News Topic Classifier

End-to-end ML/NLP project you can run locally.

Highlights - Dataset: scikit-learn **20 Newsgroups** (text classification) - Pipeline: **TF-IDF** → **LinearSVC** - EDA, metrics, confusion matrix, **top features per class** - **GridSearchCV** for hyperparameter tuning - Save & load model with **joblib**

[7]:
```
import sys, os, numpy as np, pandas as pd, matplotlib
import sklearn
print("Python:", sys.version.split()[0])
print("pandas:", pd.__version__)
print("numpy:", np.__version__)
print("scikit-learn:", sklearn.__version__)
print("matplotlib:", matplotlib.__version__)
```

```
Python: 3.11.13
pandas: 2.3.3
numpy: 2.3.3
scikit-learn: 1.7.2
matplotlib: 3.10.6
```

1.1 1) Load Dataset

[8]:
```
from sklearn.datasets import fetch_20newsgroups

# Choosing a subset of categories to keep training fast & balanced
categories = [
    "comp.graphics",
    "rec.autos",
    "sci.space",
    "sci.med",
    "rec.sport.baseball",
    "talk.politics.mideast",
    "talk.religion.misc",
    "comp.sys.ibm.pc.hardware",
]
```

```
remove = ("headers", "footers", "quotes")

train_data = fetch_20newsgroups(subset="train", categories=categories,␣
 ↪remove=remove)
test_data  = fetch_20newsgroups(subset="test",  categories=categories,␣
 ↪remove=remove)

X_train, y_train = train_data.data, train_data.target
X_test,  y_test  = test_data.data,  test_data.target
target_names = train_data.target_names

len(X_train), len(X_test), target_names[:5]
```

[8]:
```
(4493,
 2991,
 ['comp.graphics',
  'comp.sys.ibm.pc.hardware',
  'rec.autos',
  'rec.sport.baseball',
  'sci.med'])
```

1.2 2) EDA

[9]:
```
import pandas as pd, numpy as np
train_df = pd.DataFrame({"text": X_train, "y": y_train})
train_df["label"] = train_df["y"].apply(lambda i: target_names[i])
print(train_df["label"].value_counts())
train_df.sample(3)[["label", "text"]]
```

```
label
rec.sport.baseball          597
sci.med                     594
rec.autos                   594
sci.space                   593
comp.sys.ibm.pc.hardware    590
comp.graphics               584
talk.politics.mideast       564
talk.religion.misc          377
Name: count, dtype: int64
```

[9]:

	label	text
1974	rec.autos	\n\n What I don't understand is why \n\n\n\nYe…
2835	sci.space	\nVoyager has the unusual luck to be on a st…
536	talk.politics.mideast	\nOY] Henrik (?),\nOY] Your ignorance manifest…

1.3 3) Build Pipeline & Train

[10]:
```
from sklearn.pipeline import Pipeline
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.svm import LinearSVC

pipe = Pipeline([
    ("tfidf", TfidfVectorizer(stop_words="english", ngram_range=(1,2),␣
 ↪min_df=2, max_df=0.9)),
    ("clf", LinearSVC(C=1.0))
])

pipe.fit(X_train, y_train)
"Model trained!"
```

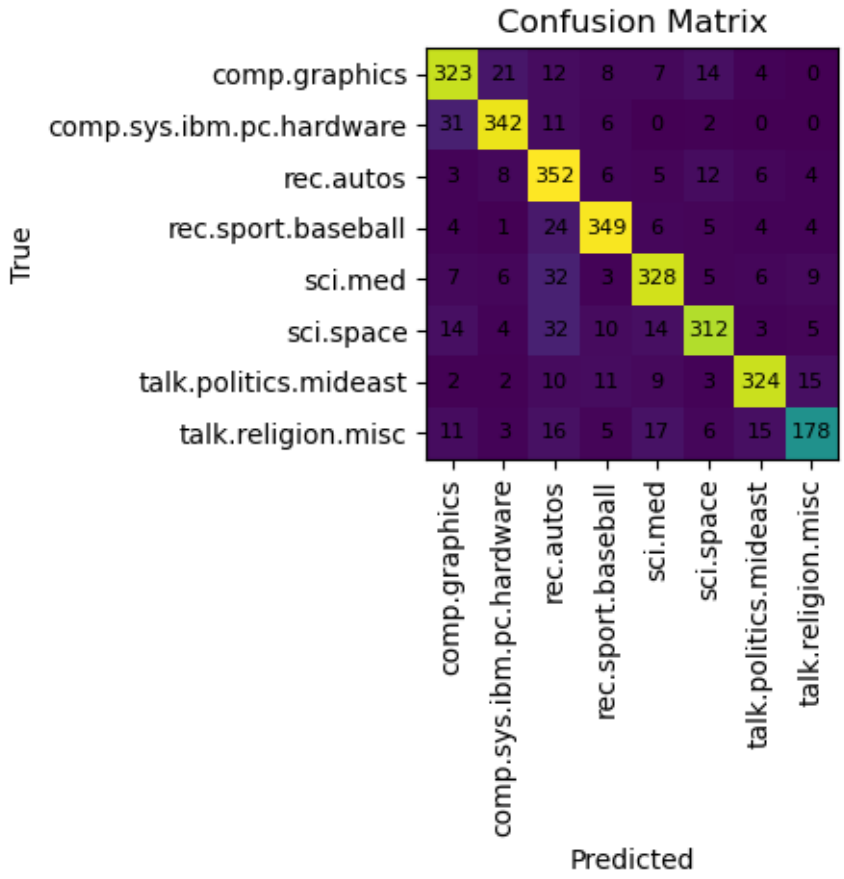
[10]:
```
'Model trained!'
```

1.4 4) Evaluate

[11]:
```
from sklearn.metrics import classification_report, confusion_matrix,␣
 ↪accuracy_score
import matplotlib.pyplot as plt

preds = pipe.predict(X_test)
print("Accuracy:", round(accuracy_score(y_test, preds), 4))
print(classification_report(y_test, preds, target_names=target_names))

cm = confusion_matrix(y_test, preds)
fig = plt.figure()
plt.imshow(cm, interpolation="nearest")
plt.title("Confusion Matrix")
plt.xticks(range(len(target_names)), target_names, rotation=90)
plt.yticks(range(len(target_names)), target_names)
for i in range(cm.shape[0]):
    for j in range(cm.shape[1]):
        plt.text(j, i, cm[i, j], ha="center", va="center", fontsize=8)
plt.xlabel("Predicted"); plt.ylabel("True")
plt.tight_layout(); plt.show()
```

```
Accuracy: 0.8385
                          precision    recall  f1-score   support

           comp.graphics       0.82      0.83      0.82       389
comp.sys.ibm.pc.hardware       0.88      0.87      0.88       392
               rec.autos       0.72      0.89      0.80       396
     rec.sport.baseball        0.88      0.88      0.88       397
                 sci.med       0.85      0.83      0.84       396
```

```
                    sci.space       0.87      0.79      0.83       394
      talk.politics.mideast         0.90      0.86      0.88       376
         talk.religion.misc         0.83      0.71      0.76       251

                     accuracy                           0.84      2991
                    macro avg       0.84      0.83      0.84      2991
                 weighted avg       0.84      0.84      0.84      2991
```



1.5 5) Top Features per Class

[12]:
```python
# Extract top features using LinearSVC coefficients
clf = pipe.named_steps["clf"]
tfidf = pipe.named_steps["tfidf"]
feature_names = np.array(tfidf.get_feature_names_out())

def top_terms_per_class(class_index, top_n=15):
    # For LinearSVC (one-vs-rest), coef_ shape = [n_classes, n_features]
    coefs = clf.coef_[class_index]
```

```
    top_ids = np.argsort(coefs)[-top_n:][::-1]
    return feature_names[top_ids]

for i, name in enumerate(target_names):
    print(f"\nTop terms for class: {name}")
    print(", ".join(top_terms_per_class(i)))
```

```
Top terms for class: comp.graphics
graphics, image, 3d, 68070, file, package, code, animation, files, 3do,
algorithm, pov, images, tiff, polygon

Top terms for class: comp.sys.ibm.pc.hardware
monitor, drive, card, motherboard, scsi, disk, pc, bios, port, memory, bus,
board, ide, gateway, cpu

Top terms for class: rec.autos
car, cars, ford, oil, engine, dealer, toyota, auto, honda, gt, vw, tires, bmw,
ites, rear

Top terms for class: rec.sport.baseball
baseball, stadium, team, cubs, game, games, year, players, ball, phillies,
season, alomar, league, braves, teams

Top terms for class: sci.med
doctor, medical, msg, disease, treatment, health, cancer, pain, effects, diet,
needles, drugs, patients, skin, eye

Top terms for class: sci.space
space, orbit, spacecraft, nasa, launch, moon, shuttle, solar, flight, dc, earth,
lunar, mars, mining, centaur

Top terms for class: talk.politics.mideast
israel, israeli, jews, turkish, loser, arab, armenians, retarded, turkey, arabs,
armenian, peace, lebanon, adl, ihr

Top terms for class: talk.religion.misc
god, koresh, jesus, kent, objective, fbi, christians, bible, christian, tyre,
moral, lord, wrong, beliefs, ye
```

1.6 6) Hyperparameter Tuning (GridSearchCV)

[13]:
```
from sklearn.model_selection import GridSearchCV

param_grid = {
    "tfidf__ngram_range": [(1,1), (1,2)],
    "clf__C": [0.5, 1.0, 2.0]
```

```
}
grid = GridSearchCV(pipe, param_grid, cv=3, n_jobs=-1, verbose=1)
grid.fit(X_train, y_train)

print("Best params:", grid.best_params_)
print("Best CV score:", round(grid.best_score_, 4))

best_model = grid.best_estimator_
print("Test accuracy (best model):", round(accuracy_score(y_test, best_model.
  ↪predict(X_test)), 4))
```

```
Fitting 3 folds for each of 6 candidates, totalling 18 fits
Best params: {'clf__C': 0.5, 'tfidf__ngram_range': (1, 1)}
Best CV score: 0.848
Test accuracy (best model): 0.8392
```

1.7 7) Save Model & Try Predictions

[14]:
```
import joblib, os

artifact = os.path.abspath("news_topic_svm.joblib")
joblib.dump(best_model, artifact)
print("Saved model to:", artifact)

# Attach target_names to the pipeline for the Streamlit app
setattr(best_model, "target_names_", target_names)

def predict(texts):
    pred_idx = best_model.predict(texts)
    return [target_names[i] for i in pred_idx]

samples = [
    "The Hubble telescope captured new images of a distant galaxy cluster.",
    "My new graphics card struggles with ray tracing in the latest game.",
    "The team traded two pitchers before the baseball season opener."
]
predict(samples)
```

```
Saved model to: /Users/bandaanusha/Documents/AI-Projects/news_topic_svm.joblib
```

[14]:
```
['sci.space', 'comp.graphics', 'rec.sport.baseball']
```