



Scikit-learn

COMSW4705 Fall 2021

- Data gathering/preprocessing
- Vectorization
- Training
- Prediction

```
from sklearn.datasets import fetch_20newsgroups
from sklearn.feature_extraction.text import TfidfVectorizer
import sklearn.metrics
import sklearn.neighbors
```

```
print("Loading 20 newsgroups dataset for categories:")
data_train = fetch_20newsgroups(subset='train', shuffle=True, random_state=42)
data_test = fetch_20newsgroups(subset='test', shuffle=True, random_state=42)
print('data loaded')
```

```
'''Create tf-idf vectors for the input'''
vectorizer = TfidfVectorizer(sublinear_tf=True, max_df=0.9,
                             stop_words='english')
```

```
X_train = vectorizer.fit_transform(data_train.data)
```

```
X_test = vectorizer.transform(data_test.data)
```

```
y_train = data_train.target
```

```
y_test = data_test.target
```

```
'''Train a K-Neighbors Classifier on the data'''
```

```
n_neighbors = 2
```

```
weights = 'uniform'
```

```
clf = sklearn.neighbors.KNeighborsClassifier(n_neighbors, weights=weights)
```

```
clf.fit(X_train, y_train)
```

```
'''Make predictions on the test data using the trained classifier'''
```

```
y_predicted = clf.predict(X_test)
```

```
print ('Classification report:')
```

[illegible]



```
from sklearn.datasets import fetch_20newsgroups
from sklearn.feature_extraction.text import
TfidfVectorizer
import sklearn.metrics
import sklearn.neighbors

print("Loading 20 newsgroups dataset for categories:")
data_train = fetch_20newsgroups(subset='train',
shuffle=True, random_state=42)
data_test = fetch_20newsgroups(subset='test',
shuffle=True, random_state=42)
```



f

```
'''Create tf-idf vectors for the input'''  
vectorizer = TfidfVectorizer(sublinear_tf=True, max_df=0.9,  
                             stop_words='english')  
X_train = vectorizer.fit_transform(data_train.data)  
X_test = vectorizer.transform(data_test.data)  
y_train = data_train.target  
y_test = data_test.target
```

,



```
'''Train a K-Neighbors Classifier on the data'''  
n_neighbors = 2  
weights = 'uniform'  
clf = sklearn.neighbors.KNeighborsClassifier(n_neighbors,  
weights=weights)  
clf.fit(X_train, y_train)
```



f

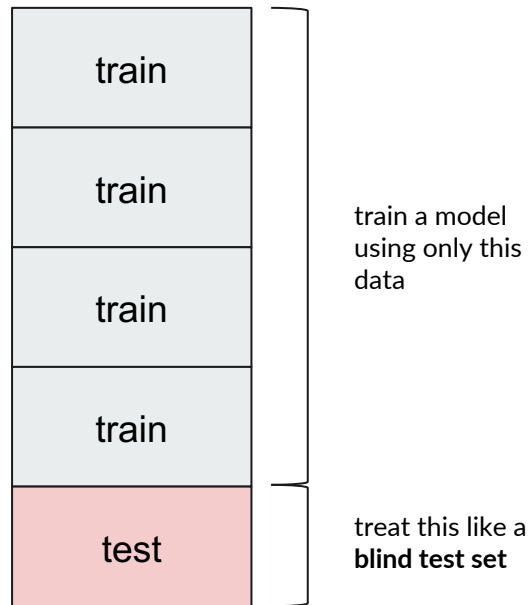
```
'''Make predictions on the test data using the trained
classifier'''
y_predicted = clf.predict(X_test)
print ('Classification report:')
print sklearn.metrics.classification_report(y_test,
y_predicted,

target_names=data_test.target_names)
```



Cross-validation

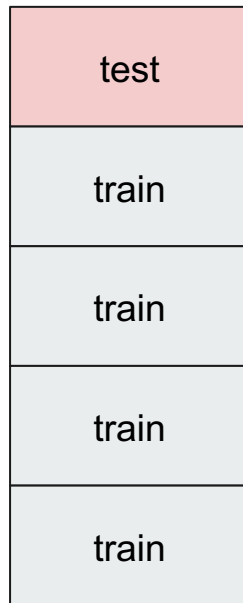
- N-fold cross-validation splits the training data into N sections, or “folds”, and iterates over them, treating each fold as a miniature test set in one iteration and training on all other data
- Useful for analyzing the robustness of your model, or training on small data
- Be mindful that you **do not** train on features that only appear in test!
 - Sklearn’s built-in cross validation functions
DO NOT DO THIS CORRECTLY!





Cross-validation

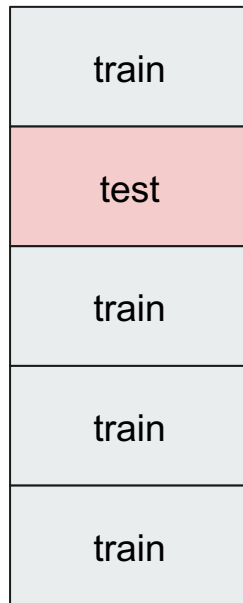
- N-fold cross-validation splits the training data into N sections, or “folds”, and iterates over them, treating each fold as a miniature test set in one iteration and training on all other data
- Useful for analyzing the robustness of your model, or training on small data
- Be mindful that you **do not** train on features that only appear in test!
 - Sklearn’s built-in cross validation functions
DO NOT DO THIS CORRECTLY!





Cross-validation

- N-fold cross-validation splits the training data into N sections, or “folds”, and iterates over them, treating each fold as a miniature test set in one iteration and training on all other data
- Useful for analyzing the robustness of your model, or training on small data
- Be mindful that you **do not** train on features that only appear in test!
 - Sklearn’s built-in cross validation functions
DO NOT DO THIS CORRECTLY!



...and so on;
average the accuracies
of all 5 iterations to get
the model accuracy



Cross-validation

- N-fold cross-validation splits the training data into N sections, or “folds”, and iterates over them, treating each fold as a miniature test set in one iteration and training on all other data
- Useful for analyzing the robustness of your model, or training on small data
- Be mindful that you **do not** train on features that only appear in test!
 - Sklearn’s built-in cross validation functions
DO NOT DO THIS CORRECTLY!
- Sklearn has useful [built-in iterators](#) you can use to split your data into the right folds



Tuning

- Models have various parameters and certain parameter settings are more appropriate for your problem
- The documentation will list them and their possible values

Parameters: **penalty** : str, 'l1' or 'l2', default: 'l2'

Used to specify the norm used in the penalization. The 'newton-cg', 'sag' and 'lbfgs' solvers support only l2 penalties.

New in version 0.19: l1 penalty with SAGA solver (allowing 'multinomial' + L1)

dual : bool, default: False

Dual or primal formulation. Dual formulation is only implemented for l2 penalty with liblinear solver. Prefer dual=False when $n_{\text{samples}} > n_{\text{features}}$.

tol : float, default: $1e-4$

Tolerance for stopping criteria.

C : float, default: 1.0

Inverse of regularization strength; must be a positive float. Like in support vector machines, smaller values specify stronger regularization.



Saving models

- Scikit-learn saves models to file using the built-in library **pickle**

```
pickle.dump(model, open('model.pkl', 'w+'))
```

- Models can be loaded in new files (without knowing what they originally were)

```
model = pickle.load(open('model.pkl', 'r'))
```

```
model.predict(...)
```

- Good idea to save your best-performing models while you try different model settings



Tips and Tricks

- Try simple things first
- Make educated guesses to narrow down the search space
 - Look at the features given in the data .csv
 - Think why certain models or feature combinations might be good
- Don't tune your parameters and features individually and exhaustively
 - i.e., don't write a single classifier and keep changing individual numbers -- automate the search!
- Sklearn [vectorizers](#) are your friends for n-grams
 - They have options too - e.g., n-grams have a range and vocabulary size
- HW1: try first to improve your plain n-gram model -- then your feature model has a good foundation
- Come to office hours if you need help with the basics of machine learning



Homework 1

- Note policy on cheating
- HW 0 – several people who were not accepted into the class as their homeworks were too similar
- Last semester: some 15 people detected who cheated on homeworks.
- People caught cheating will be given a 0 and will be reported to the Dean.