UNIVERSITÄT
ZU KÖLN

SPRACHVERARBEITUNG: ÜBUNG

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01

SOLUTION TO EXERCISE 06

Solution to Exercise 05

- https://lehre.idh.uni-koeln.de/site/assets/files/5151/solution06.pdf

02

SMOOTHING

Add-One Smoothing

- In addition to the information on the lecture slides, 25–26
- Add-one smoothing is special case of Laplace smoothing
- Idea: Shift around mass from the probability distribution so that 0-probabilities never occur, by adding an invented occurrance to every feature
- Example (with made-up numbers):

$$p(feature1|class1) = \frac{8}{10} \tag{1}$$

$$p(feature2|class1) = \frac{0}{10} \tag{2}$$

$$p(class1|feature1, feature2) \propto \frac{8}{10} \times \frac{0}{10} \times p(class1) = 0 \tag{3}$$

- If feature2 never occured in the training data but occurs in an unseen sample, the probability for this class will always be 0, which is not what we want
- Solution:

$$p(feature1|class1) = \frac{8+1}{10+1} \tag{4}$$

$$p(feature2|class1) = \frac{0+1}{10+1} \tag{5}$$

$$p(class1|feature1, feature2) \propto \frac{9}{11} \times \frac{1}{11} \times p(class1) > 0 \tag{6}$$

03

NAIVE BAYES IN PYTHON

sklearn

- Python has a powerful library for all machine learning purposes, called `sklearn`
- Also contains a decision tree implementation: sklearn.tree.DecisionTreeClassifier

Train Dataset

Token features for spam and not-spam

```
import pandas as pd

data = {'casino': [1, 0, 1, 1, 0],
        'enlargement': [1, 1, 0, 1, 1],
        'meeting': [0, 0, 1, 1, 1],
        'profit': [0, 1, 0, 0, 0],
        'super': [1, 0, 1, 0, 0],
        'text': [1, 0, 0, 0, 1],
        'xxx': [1, 0, 0, 0, 1],
       'class': [0, 1, 0, 0, 1]}
df = pd.DataFrame(data)
print(df)
>    casino  enlargement  meeting  profit  super  text  xxx  class
> 0       1            1        0       0      1     1    1      0
> 1       0            1        0       1      0     0    0      1
> 2       1            0        1       0      1     0    0      0
> 3       1            1        1       0      0     0    0      0
> 4       0            1        1       0      0     1    1      1
```

Train Dataset

Separate the class variable (y) from the features (X) to let the classifier know what to predict

```
X = df.drop("class", axis=1)
print(X)
>    casino  enlargement  meeting  profit  super  text  xxx
> 0       1            1        0       0      1     1    1
> 1       0            1        0       1      0     0    0
> 2       1            0        1       0      1     0    0
> 3       1            1        1       0      0     0    0
> 4       0            1        1       0      0     1    1
y = df["class"]
print(y)
> 0    0
> 1    1
> 2    0
> 3    0
> 4    1
> Name: class, dtype: int64
```

Train the classifier

```
from sklearn.naive_bayes import BernoulliNB
clf = BernoulliNB() # Initialize an empty classifier
clf = clf.fit(X,y) # The fit-function carries out the actual training and runs the algorithm using the data
                                                    provided
```

Predict on test data and evaluate

```
test_df = pd.DataFrame({'casino': [1, 0, 0],
                        'enlargement': [0, 1, 0],
                        'meeting': [0, 0, 1],
                        'profit': [0, 1, 1],
                        'super': [1, 1, 1],
                        'text': [0, 1, 1],
                        'xxx': [1, 1, 0],
                        'class': [0, 0, 1]})
print(test_df)
>    casino  enlargement  meeting  profit  super  text  xxx  class
> 0       1            0        0       0      1     0    1      0
> 1       0            1        0       1      1     1    1      0
> 2       0            0        1       1      1     1    0      1

X_test = test_df.drop("class", axis=1)
y_test = test_df["class"]
y_pred = clf.predict(X_test)
print(y_pred)
> array([0, 1, 1])

from sklearn.metrics import classification_report
print(classification_report(y_test, y_pred))
>               precision    recall  f1-score   support
>
>            0       1.00      0.50      0.67         2
>            1       0.50      1.00      0.67         1
>
>     accuracy                           0.67         3
>    macro avg       0.75      0.75      0.67         3
> weighted avg       0.83      0.67      0.67         3
```

04

EXERCISE 07

Exercise 07

- https://lehre.idh.uni-koeln.de/site/assets/files/5151/exercise07.pdf


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