

worksheet_11

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1 Worksheet 11

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1.0.1 Topics

- Latent Semantic Analysis

1.0.2 Latent Semantic Analysis

In this section we will fetch news articles from 3 different categories. We will perform Tfidf vectorization on the corpus of documents and use SVD to represent our corpus in the feature space of topics that we've uncovered from SVD. We will attempt to cluster the documents into 3 clusters as we vary the number of singular vectors we use to represent the corpus, and compare the output to the clustering created by the news article categories. Do we end up with a better clustering the more singular vectors we use?

```
[1]: import numpy as np
from sklearn import metrics
import matplotlib.pyplot as plt
from sklearn.cluster import KMeans
from sklearn.datasets import fetch_20newsgroups
from sklearn.feature_extraction.text import TfidfVectorizer
from nltk.stem.snowball import SnowballStemmer
from nltk.tokenize import word_tokenize, sent_tokenize

categories = ['comp.os.ms-windows.misc', 'sci.space', 'rec.sport.baseball']
news_data = fetch_20newsgroups(subset='train', categories=categories)
vectorizer = TfidfVectorizer(stop_words='english', min_df=4, max_df=0.8)

stemmed_data = [" ".join(SnowballStemmer("english", ignore_stopwords=True).
    ↪stem(word)
        for sent in sent_tokenize(message)
        for word in word_tokenize(sent))
    for message in news_data.data]

dtm = vectorizer.fit_transform(stemmed_data)
terms = vectorizer.get_feature_names_out()
```

```

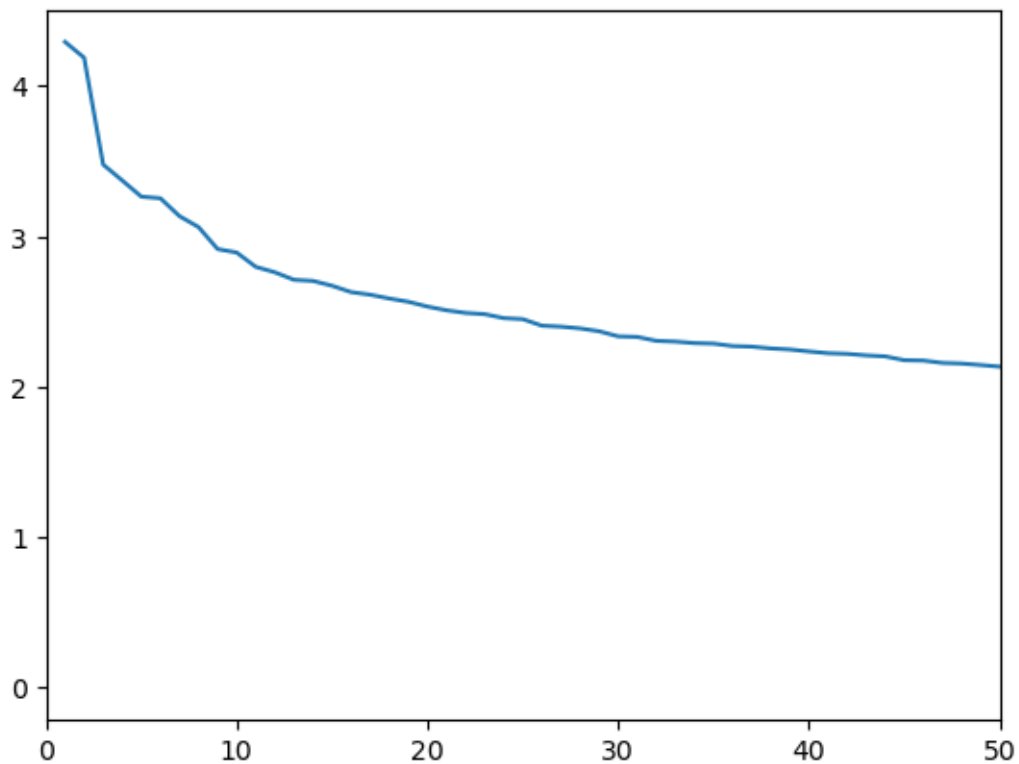
centered_dtm = dtm - np.mean(dtm, axis=0)

u, s, vt = np.linalg.svd(centered_dtm)
plt.xlim([0,50])
plt.plot(range(1,len(s)+1),s)
plt.show()

ag = []
max = len(u)
for k in range(1,25):
    vectorsk = u.dot(np.diag(s))[:,k]
    kmeans = KMeans(n_clusters=3, init='k-means++', max_iter=100, n_init=10,
    ↪random_state=0)
    kmeans.fit_predict(np.asarray(vectorsk))
    labelsk = kmeans.labels_
    ag.append(metrics.v_measure_score(labelsk, news_data.target)) # closer to 1
    ↪means closer to news categories

plt.plot(range(1,25),ag)
plt.ylabel('Agreement',size=20)
plt.xlabel('No of Prin Comps',size=20)
plt.show()

```



```

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packages\sklearn\cluster\_kmeans.py:1436: UserWarning: KMeans is known to have a
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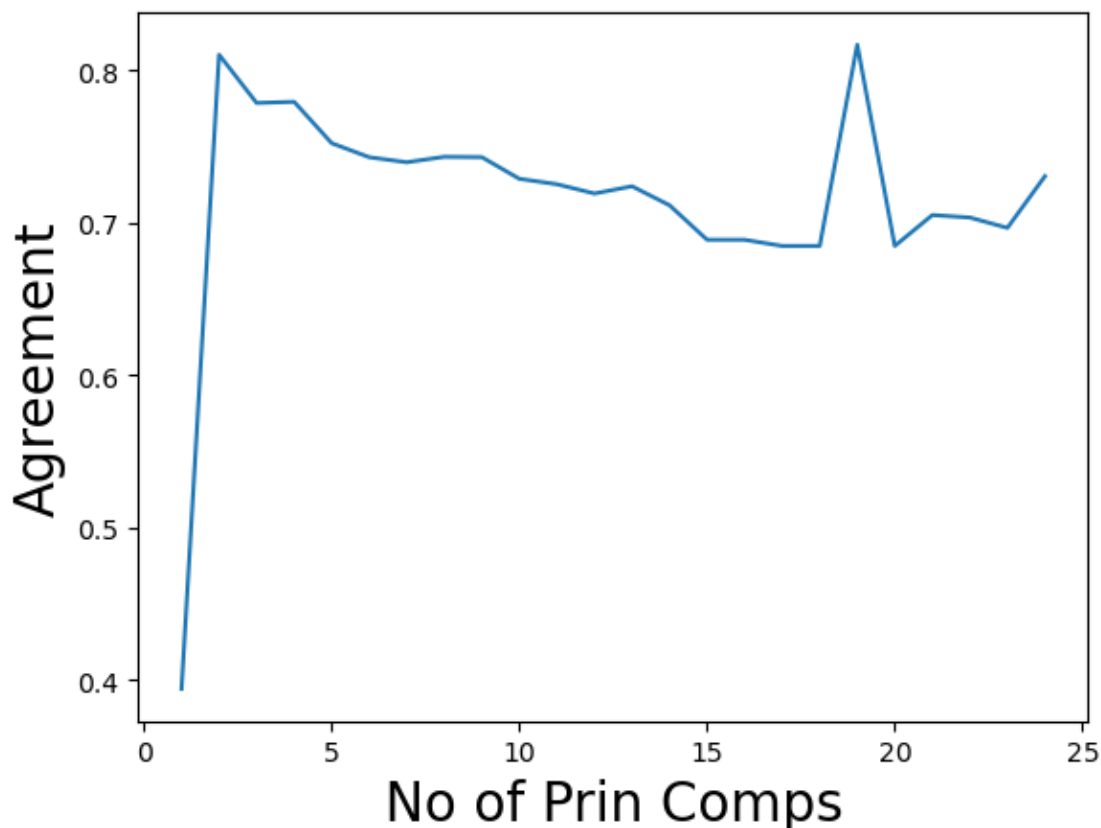
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```



1.0.3 Embeddings

The data comes from the [Yelp Dataset](#). Each line is a review that consists of a label (0 for negative reviews and 1 for positive reviews) and a set of words.

```
1 i will never forget this single breakfast experience in mad...
0 the search for decent chinese takeout in madison continues ...
0 sorry but me julio fell way below the standard even for med...
1 so this is the kind of food that will kill you so there s t...
```

In order to transform the set of words into vectors, we will rely on a method of feature engineering called word embeddings (Tfidf is one way to get these embeddings). Rather than simply indicating which words are present, word embeddings represent each word by “embedding” it in a low-dimensional vector space which may carry more information about the semantic meaning of the word. (for example in this space, the words “King” and “Queen” would be close).

`word2vec.txt` contains the `word2vec` embeddings for about 15 thousand words. Not every word in each review is present in the provided `word2vec.txt` file. We can treat these words as being “out of vocabulary” and ignore them.

1.0.4 Example

Let x_i denote the sentence "a hot dog is not a sandwich because it is not square" and let a toy word2vec dictionary be as follows:

hot	0.1	0.2	0.3
not	-0.1	0.2	-0.3
sandwich	0.0	-0.2	0.4
square	0.2	-0.1	0.5

we would first trim the sentence to only contain words in our vocabulary: "hot not sandwich not square" then embed x_i into the feature space:

$$\varphi_2(x_i) = \frac{1}{5}(\text{word2vec}(\text{hot}) + 2 \cdot \text{word2vec}(\text{not}) + \text{word2vec}(\text{sandwich}) + \text{word2vec}(\text{square})) = [0.02 \ 0.06 \ 0.12]^T$$

- a) Implement a function to trim out-of-vocabulary words from the reviews. Your function should return an nd array of the same dimension and dtype as the original loaded dataset.

```
[2]: import csv
import numpy as np

VECTOR_LEN = 300 # Length of word2vec vector
MAX_WORD_LEN = 64 # Max word length in dict.txt and word2vec.txt

def load_tsv_dataset(file):
    """
    Loads raw data and returns a tuple containing the reviews and their ratings.

    Parameters:
        file (str): File path to the dataset tsv file.

    Returns:
        An np.ndarray of shape N. N is the number of data points in the tsv_
        ↪ file.
        Each element dataset[i] is a tuple (label, review), where the label is
        an integer (0 or 1) and the review is a string.
    """
    dataset = np.loadtxt(file, delimiter='\t', comments=None, encoding='utf-8',
                        dtype='1,0')
    return dataset

def load_feature_dictionary(file):
    """
    Creates a map of words to vectors using the file that has the word2vec
    embeddings.

    Parameters:
```

```

    file (str): File path to the word2vec embedding file.

Returns:
    A dictionary indexed by words, returning the corresponding word2vec
    embedding np.ndarray.
"""
word2vec_map = dict()
with open(file) as f:
    read_file = csv.reader(f, delimiter='\t')
    for row in read_file:
        word, embedding = row[0], row[1:]
        word2vec_map[word] = np.array(embedding, dtype=float)
return word2vec_map

def trim_review(review, vocabulary):
    return ' '.join(list(filter(lambda word: word in vocabulary, review.
    ↪split()))))

def trim_reviews(dataset, vocabulary):
    return np.array(list(map(lambda review_sample: (review_sample[0], ↪
    ↪trim_review(review_sample[1], vocabulary)), dataset)))

train_dataset = load_tsv_dataset("./data/train_small.tsv")
test_dataset = load_tsv_dataset("./data/test_small.tsv")

word2vec_map = load_feature_dictionary('./data/word2vec.txt')

trim_train = trim_reviews(train_dataset, word2vec_map.keys())
trim_test = trim_reviews(test_dataset, word2vec_map.keys())

print(train_dataset[0][1])
print(trim_train[0][1])

print('hassle' in word2vec_map)
print('chocolate' in word2vec_map)
print('croissant' in word2vec_map)

```

i will never forget this single breakfast experience in madison it was awesome yes it is crowded and you have to sit with other groups at the large tables yes you have to pay cash yes it seems like you are eating breakfast in your grandmother s kitchen but seriously i like my grandmother s kitchen it is quite the experience and totally worth the perceived hassle the coffee was fresh and dark the chocolate croissant was to die for and the fruit covered french toast made from croissants was sinful if i ever find myself in madison again i will definitely go out of my way to return to this little gem of a breakfast nook i will never forget this single breakfast experience in madison it was awesome

yes it is crowded and you have to sit with other groups at the large tables yes
you have to pay cash yes it seems like you are eating breakfast in your
grandmother s kitchen but seriously i like my grandmother s kitchen it is quite
the experience and totally worth the perceived the coffee was fresh and dark the
chocolate was to die for and the fruit covered french toast made from was sinful
if i ever find myself in madison again i will definitely go out of my way to
return to this little gem of a breakfast

False

True

False