Tamkang University
淡江大學

文字探勘
(Text Mining)

處理和理解文本
(Processing and Understanding Text)

1082TM04
MBA, BDABI, TKU (E3611) (8480) (Spring 2020)
Mon, 7, 8, 9 (14:10-17:00) (B206)

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課程大綱 (Syllabus)

週次 (Week)	日期 (Date)	內容 (Subject/Topics)
1	2020/03/02	文字探勘課程介紹 (Course Orientation on Text Mining)
2	2020/03/09	文字探勘基礎：自然語言處理 (Foundations of Text Mining: Natural Language Processing; NLP)
3	2020/03/16	Python自然語言處理 (Python for Natural Language Processing)
4	2020/03/23	處理和理解文本 (Processing and Understanding Text)
5	2020/03/30	文本表達特徵工程 (Feature Engineering for Text Representation)
6	2020/04/06	人工智慧文本分析個案研究 I (Case Study on Artificial Intelligence for Text Analytics I)

課程大綱 (Syllabus)

週次 (Week)	日期 (Date)	內容 (Subject/Topics)
7	2020/04/13	文本分類 (Text Classification)
8	2020/04/20	文本摘要和主題模型 (Text Summarization and Topic Models)
9	2020/04/27	期中報告 (Midterm Project Report)
10	2020/05/04	文本相似度和分群 (Text Similarity and Clustering)
11	2020/05/11	語意分析和命名實體識別 (Semantic Analysis and Named Entity Recognition; NER)
12	2020/05/18	情感分析 (Sentiment Analysis)

課程大綱 (Syllabus)

週次 (Week)	日期 (Date)	內容 (Subject/Topics)
13	2020/05/25	人工智慧文本分析個案研究 II (Case Study on Artificial Intelligence for Text Analytics II)
14	2020/06/01	深度學習和通用句子嵌入模型 (Deep Learning and Universal Sentence-Embedding Models)
15	2020/06/08	問答系統與對話系統 (Question Answering and Dialogue Systems)
16	2020/06/15	期末報告 I (Final Project Presentation I)
17	2020/06/22	期末報告 II (Final Project Presentation II)
18	2020/06/29	教師彈性補充教學

Outline

- Processing Text
- Understanding Text

Processing and Understanding Text

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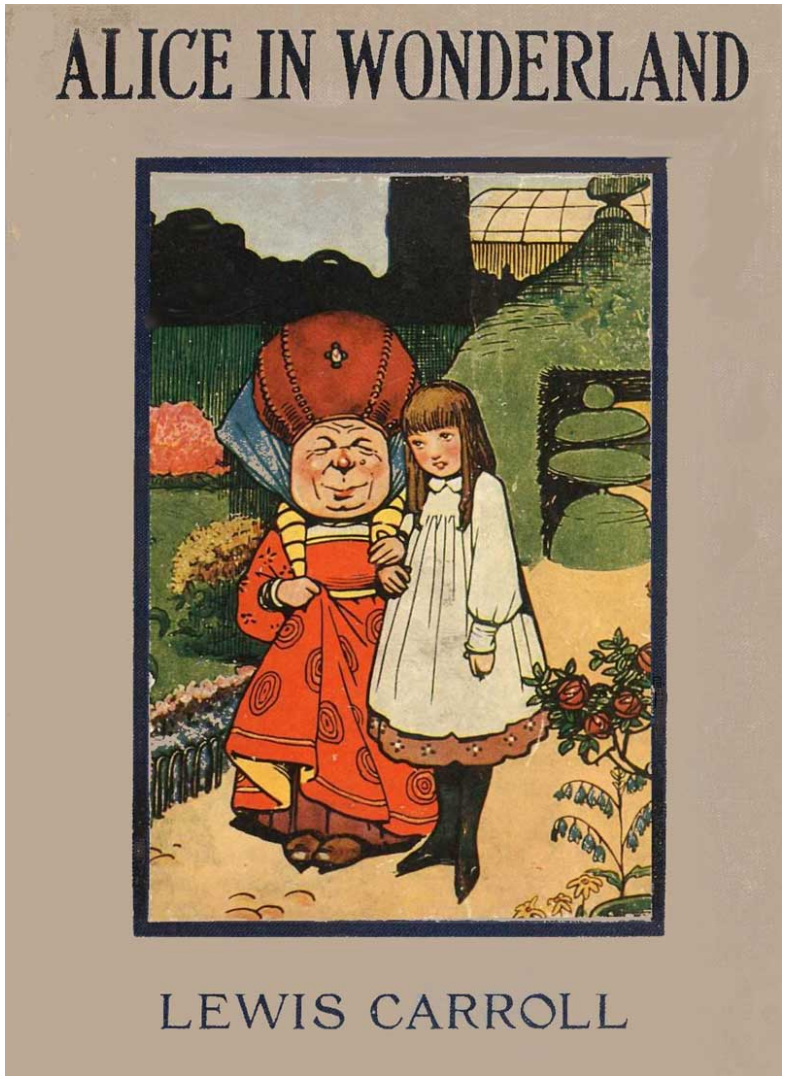
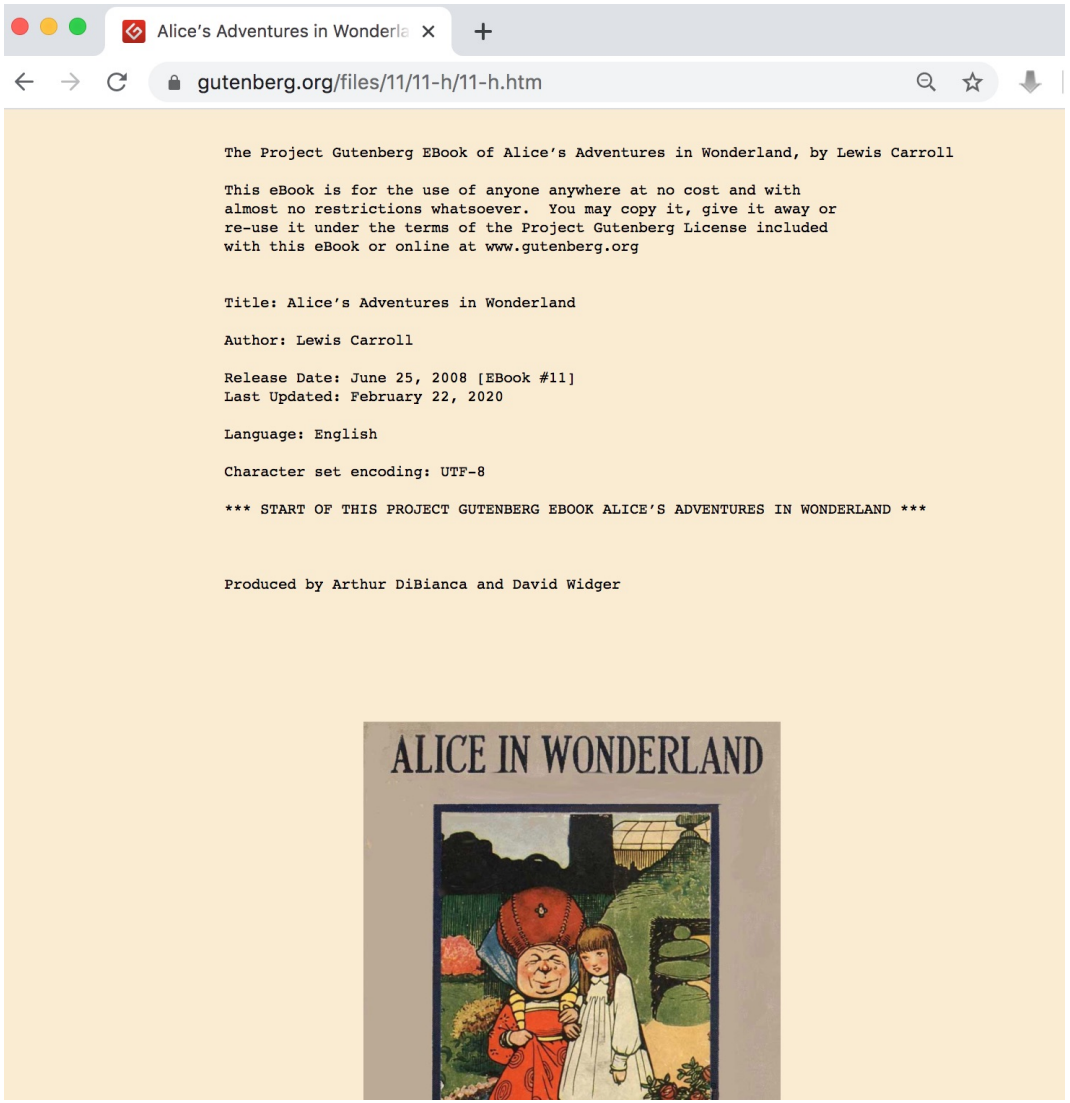
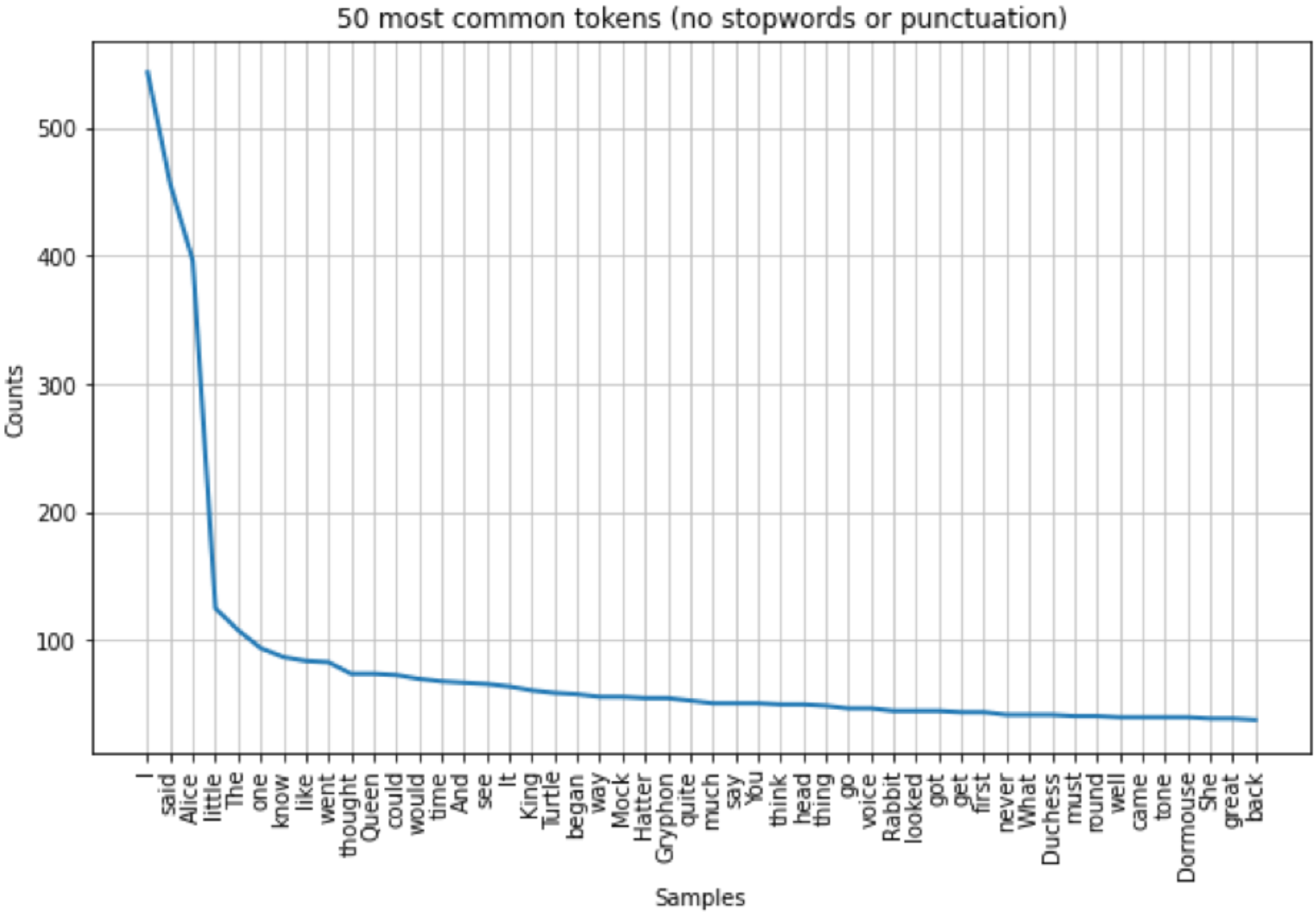
Free eBooks - Project Gutenberg
Alice in Wonderland





https://www.gutenberg.org/files/11/11-h/11-h.htm

Alice Top 50 Tokens

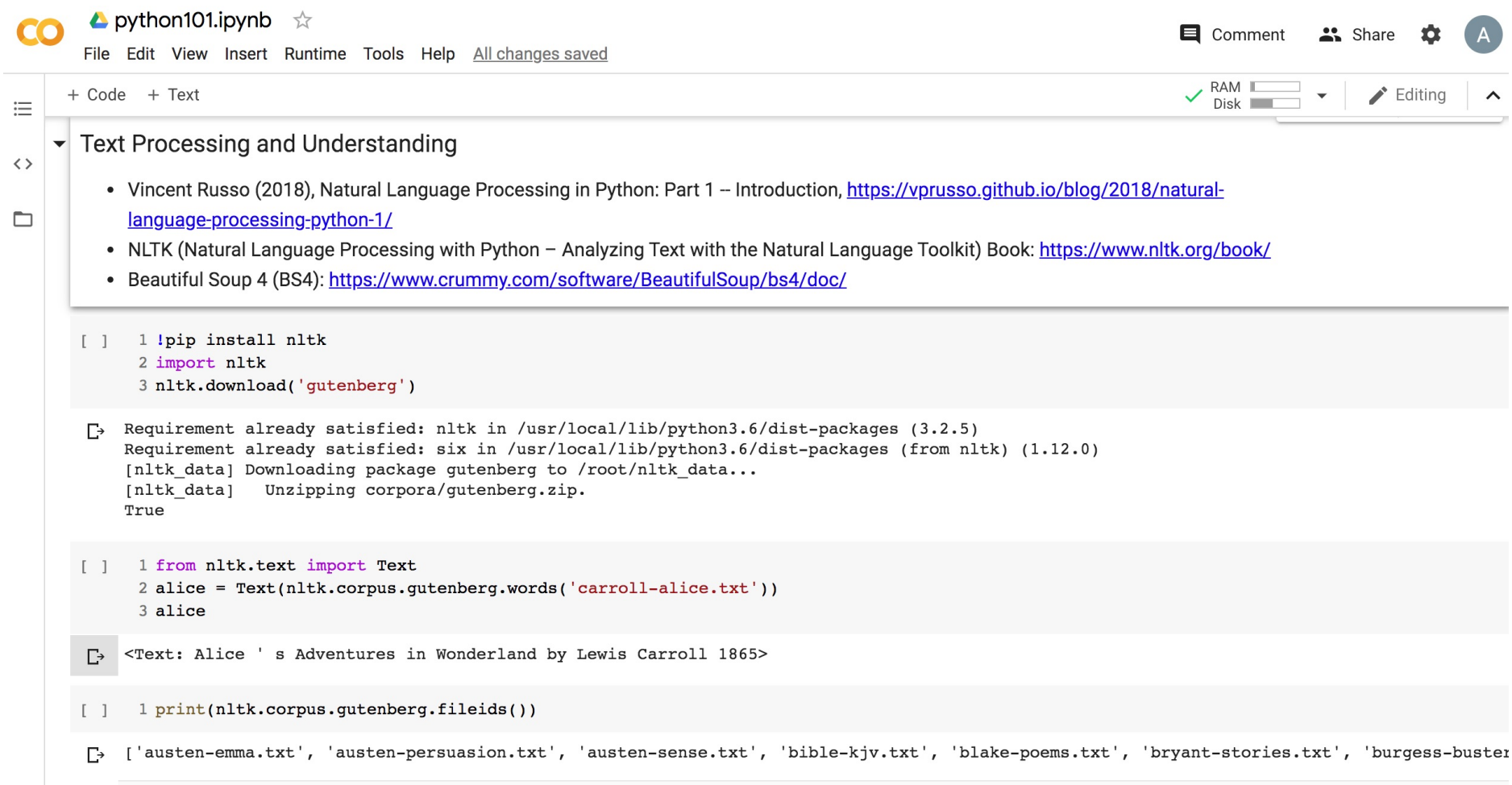


https://tinyurl.com/imtkupython101

Python in Google Colab (Python101)

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT

```
nltk.download('gutenberg')
alice = Text(nltk.corpus.gutenberg.words('carroll-alice.txt'))
```



https://tinyurl.com/imtkupython101

alice.concordance("Alice")

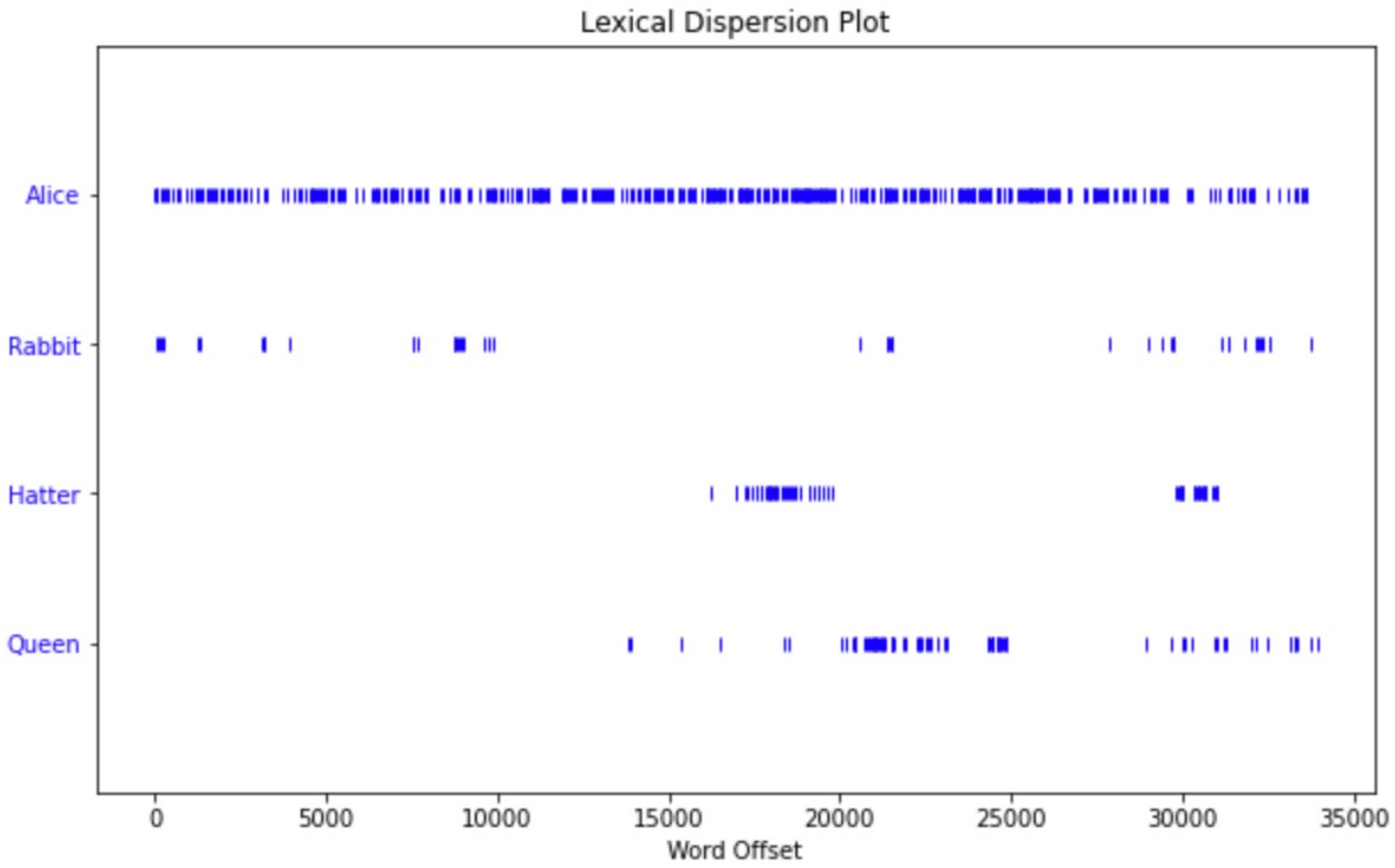
```
 1 alice.concordance("Alice")
```

```
Displaying 25 of 398 matches:
                                      Alice ' s Adventures in Wonderland by Lewi
] CHAPTER I . Down the Rabbit - Hole Alice was beginning to get very tired of s
what is the use of a book ,' thought Alice ' without pictures or conversation ?
so VERY remarkable in that ; nor did Alice think it so VERY much out of the way
looked at it , and then hurried on , Alice started to her feet , for it flashed
 hedge . In another moment down went Alice after it , never once considering ho
ped suddenly down , so suddenly that Alice had not a moment to think about stop
she fell past it . ' Well !' thought Alice to herself , ' after such a fall as
down , I think --' ( for , you see , Alice had learnt several things of this so
tude or Longitude I ' ve got to ?' ( Alice had no idea what Latitude was , or L
 . There was nothing else to do , so Alice soon began talking again . ' Dinah '
cats eat bats , I wonder ?' And here Alice began to get rather sleepy , and wen
dry leaves , and the fall was over . Alice was not a bit hurt , and she jumped
 not a moment to be lost : away went Alice like the wind , and was just in time
 but they were all locked ; and when Alice had been all the way down one side a
on it except a tiny golden key , and Alice ' s first thought was that it might
and to her great delight it fitted ! Alice opened the door and found that it le
ead would go through ,' thought poor Alice , ' it would be of very little use w
ay things had happened lately , that Alice had begun to think that very few thi
ertainly was not here before ,' said Alice ,) and round the neck of the bottle
ay ' Drink me ,' but the wise little Alice was not going to do THAT in a hurry
bottle was NOT marked ' poison ,' so Alice ventured to taste it , and finding i
* * ' What a curious feeling !' said Alice ; ' I must be shutting up like a tel
 for it might end , you know ,' said Alice to herself , ' in my going out altog
garden at once ; but , alas for poor Alice ! when she got to the door , she fou
```

https://tinyurl.com/imtkupython101

alice.dispersion_plot(["Alice", "Rabbit", "Hatter", "Queen"])

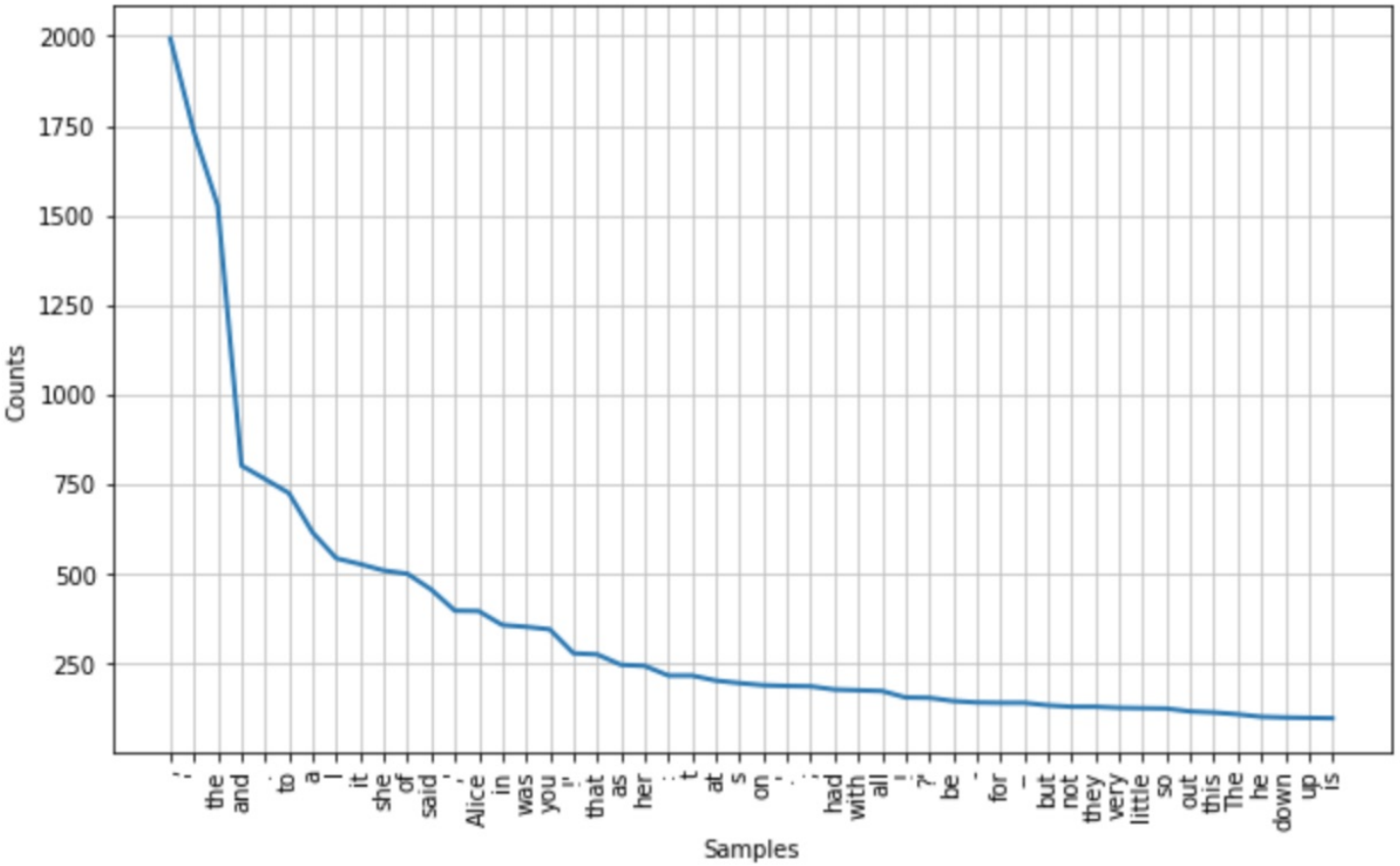
```
1 import matplotlib.pyplot as plt
2 plt.figure(figsize=(10, 6))
3 alice.dispersion_plot(["Alice", "Rabbit", "Hatter", "Queen"])
```



https://tinyurl.com/imtkupython101

fdist = nltk.FreqDist(alice)
fdist.plot(50)

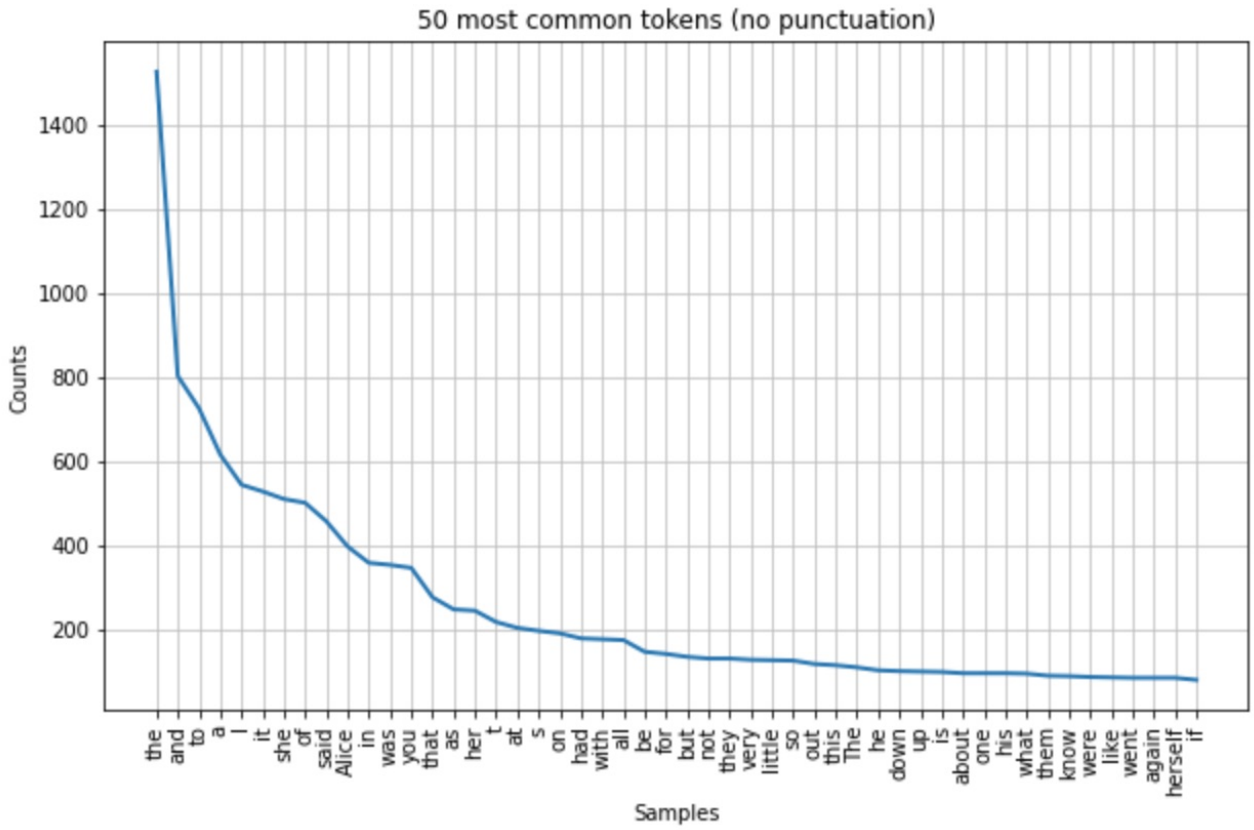
```
1 #import matplotlib.pyplot as plt
2 plt.figure(figsize=(10, 6))
3 fdist = nltk.FreqDist(alice)
4 fdist.plot(50)
```



https://tinyurl.com/imtkupython101

for word, freq in fdist.items() if word.isalpha()

```
1 #import matplotlib.pyplot as plt
2 plt.figure(figsize=(10, 6))
3 fdist_no_punc = nltk.FreqDist(dict((word, freq) for word, freq in fdist.items() if word.isalpha()))
4 fdist_no_punc.plot(50, cumulative=False, title="50 most common tokens (no punctuation)")
```



https://tinyurl.com/imtkupython101

```
nltk.download('stopwords')
stopwords = nltk.corpus.stopwords.words('english')
```

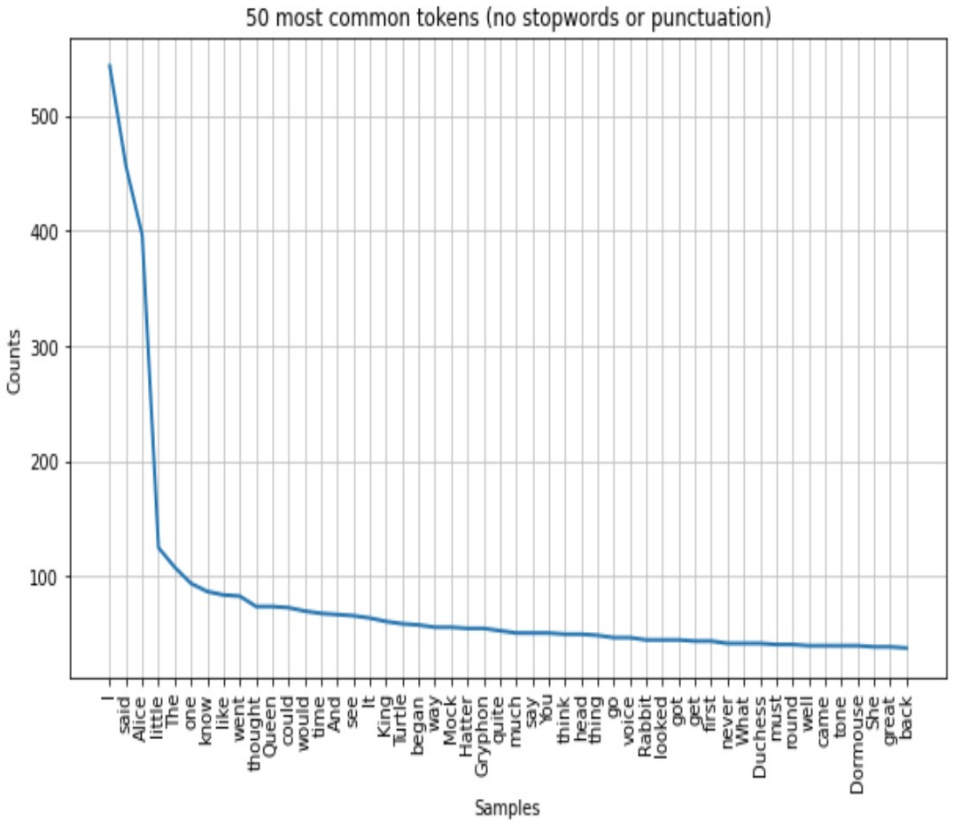
```
1 import nltk
2 nltk.download('stopwords')
3 stopwords = nltk.corpus.stopwords.words('english')
4 stopwords
```

```
'same',
'so',
'than',
'too',
'very',
's',
't',
'can',
'will',
'just',
'don',
"don't",
'should',
"should've",
'now',
```

https://tinyurl.com/imtkupython101

```
for word, freq in fdist.items()
if word not in stopwords and word.isalpha()
```

```
1 #import matplotlib.pyplot as plt
2 plt.figure(figsize=(10, 6))
3 fdist_no_punc_no_stopwords = nltk.FreqDist(dict((word, freq) for word, freq in fdist.items() if word not in stopwords and word.isalpha()))
4 fdist_no_punc_no_stopwords.plot(50, cumulative=False, title="50 most common tokens (no stopwords or punctuation)")
```



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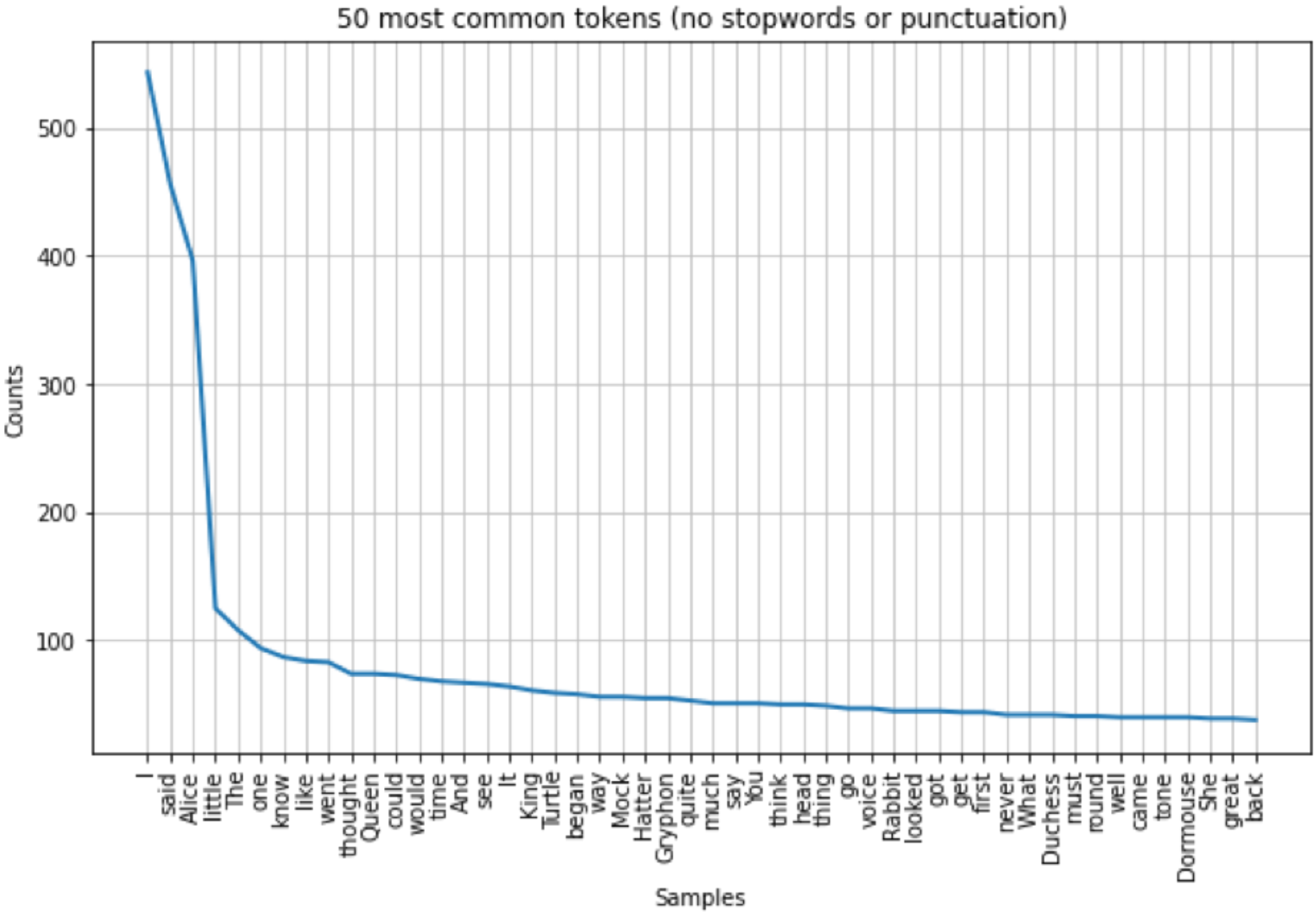
Alice Top 50 Tokens



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BeautifulSoup

```
import requests
from bs4 import BeautifulSoup

url = 'https://www.gutenberg.org/files/11/11-h/11-h.htm'
reqs = requests.get(url)
html_doc = reqs.text

soup = BeautifulSoup(html_doc, 'html.parser')
text = soup.get_text()
```

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tensorflow.keras.preprocessing.text

```
from tensorflow.keras.preprocessing.text import Tokenizer

sentences = [
'i love my dog',
'I, love my cat',
'You love my dog!'
]

tokenizer = Tokenizer(num_words = 100)
tokenizer.fit_on_texts(sentences)
word_index = tokenizer.word_index
print('sentences:', sentences)
print('word index:', word_index)
```

```
sentences: ['i love my dog', 'I, love my cat', 'You love my dog!']
word index: {'love': 1, 'my': 2, 'i': 3, 'dog': 4, 'cat': 5, 'you': 6}
```

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tensorflow.keras.preprocessing.sequence import pad_sequences

```
import tensorflow as tf
from tensorflow import keras

from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences

sentences = [
'I love my dog',
'I love my cat',
'You love my dog!',
'Do you think my dog is amazing?’
]

tokenizer = Tokenizer(num_words = 100, oov_token="<OOV>")
tokenizer.fit_on_texts(sentences)
word_index = tokenizer.word_index
sequences = tokenizer.texts_to_sequences(sentences)
padded = pad_sequences(sequences, maxlen=5)
print("sentences = ", sentences)
print("Word Index = " , word_index)
print("Sequences = " , sequences)
print("Padded Sequences:")
print(padded)
```

https://tinyurl.com/imtkupython101

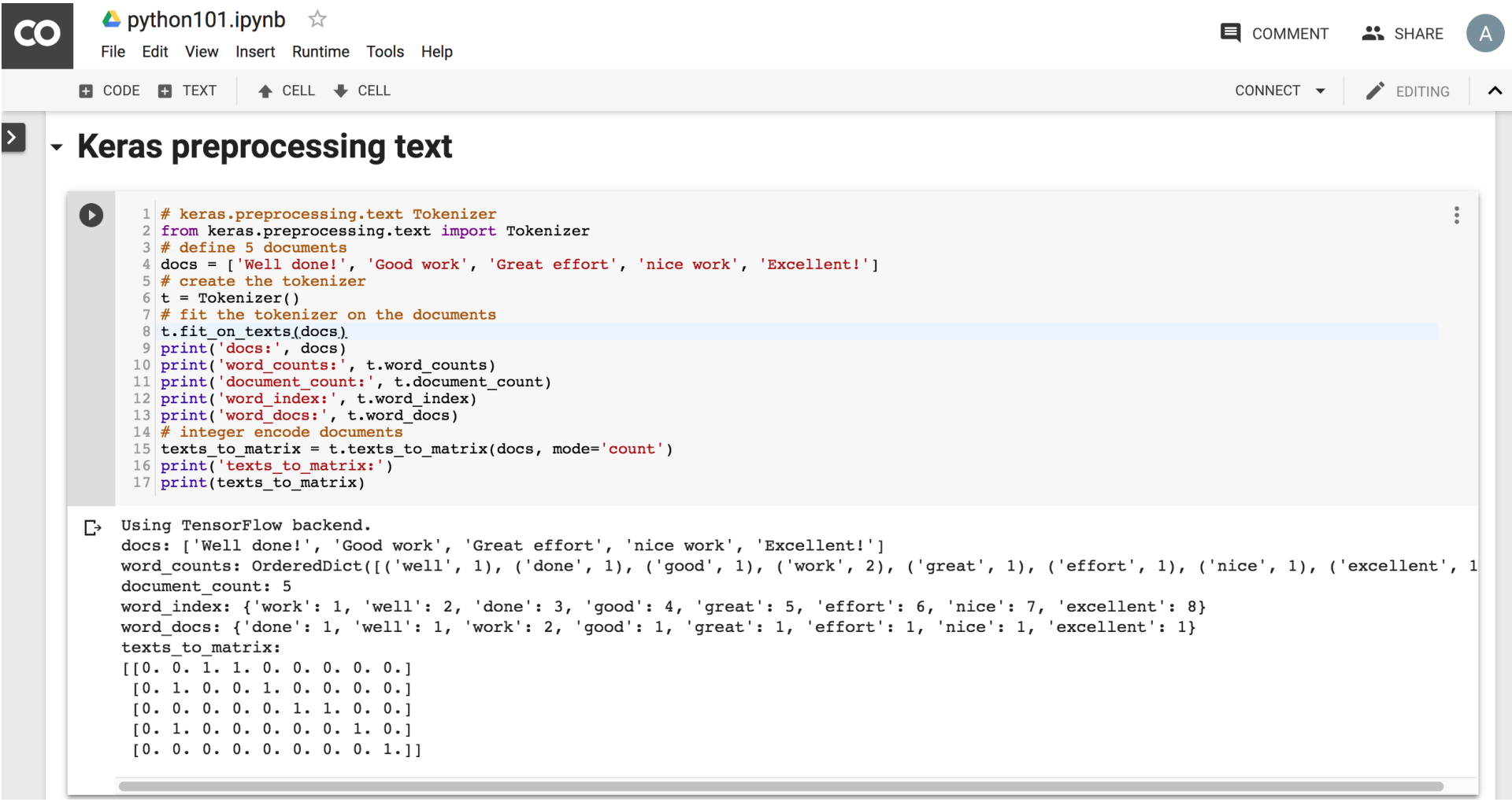
```
tensorflow.keras.preprocessing.sequence
import pad_sequences
```

```
sentences = ['I love my dog', 'I love my
cat', 'You love my dog!', 'Do you think my
dog is amazing?’]

Word Index = {'<OOV>': 1, 'my': 2, 'love': 3,
'dog': 4, 'i': 5, 'you': 6, 'cat': 7, 'do':
8, 'think': 9, 'is': 10, 'amazing': 11}

Sequences = [[5, 3, 2, 4], [5, 3, 2, 7], [6,
3, 2, 4], [8, 6, 9, 2, 4, 10, 11]]

Padded Sequences: [[ 0 5 3 2 4] [ 0 5 3 2 7]
[ 0 6 3 2 4] [ 9 2 4 10 11]]
```

https://tinyurl.com/imtkupython101

Python in Google Colab

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT



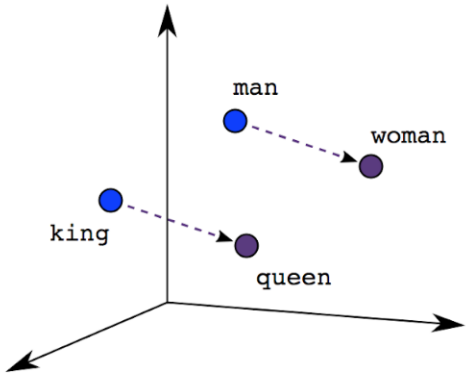
https://tinyurl.com/imtkupython101

One-hot encoding

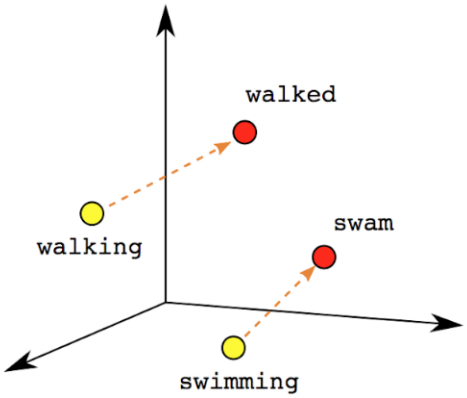
```
                'The mouse ran up the clock' =

The      1   [ [0, 1, 0, 0, 0, 0, 0],
mouse    2     [0, 0, 1, 0, 0, 0, 0],
ran      3     [0, 0, 0, 1, 0, 0, 0],
up       4     [0, 0, 0, 0, 1, 0, 0],
the      1     [0, 1, 0, 0, 0, 0, 0],
clock    5     [0, 0, 0, 0, 0, 1, 0] ]

                [0, 1, 2, 3, 4, 5, 6]
```

Source: https://developers.google.com/machine-learning/guides/text-classification/step-3

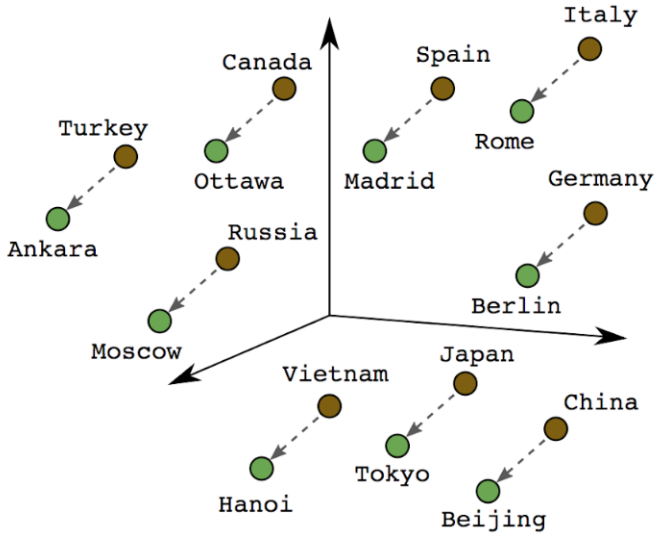
Word embeddings



Male-Female



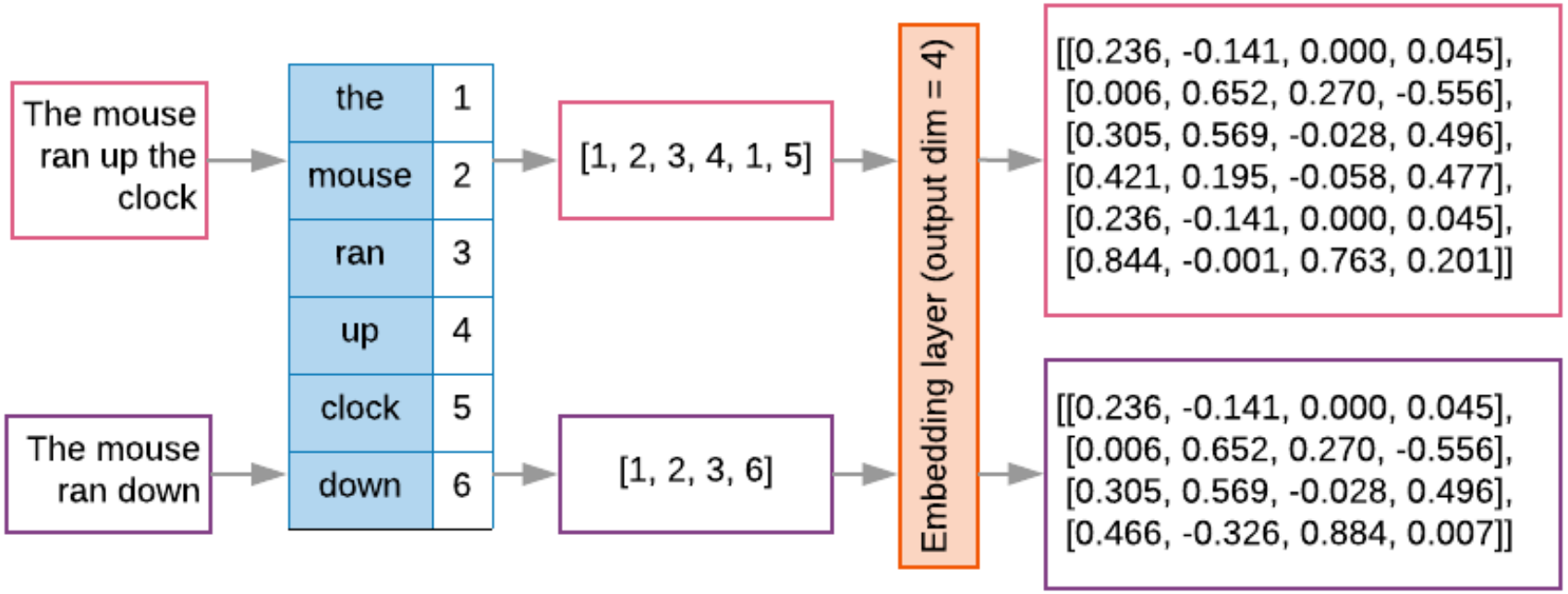
Verb Tense



Country-Capital

Source: https://developers.google.com/machine-learning/guides/text-classification/step-3

Word embeddings



Source: https://developers.google.com/machine-learning/guides/text-classification/step-3

```
t1 = 'The mouse ran up the clock'
t2 = 'The mouse ran down'
s1 = t1.lower().split(' ')
s2 = t2.lower().split(' ')
terms = s1 + s2
sortedset = sorted(set(terms))
print('terms =', terms)
print('sortedset =', sortedset)
```

```
1 t1 = 'The mouse ran up the clock'
2 t2 = 'The mouse ran down'
3 s1 = t1.lower().split(' ')
4 s2 = t2.lower().split(' ')
5 terms = s1 + s2
6 sortedset = sorted(set(terms))
7 print('terms =', terms)
8 print('sortedset =', sortedset)
```

```
terms = ['the', 'mouse', 'ran', 'up', 'the', 'clock', 'the', 'mouse', 'ran', 'down']
sortedset = ['clock', 'down', 'mouse', 'ran', 'the', 'up']
```

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT

```
t1 = 'The mouse ran up the clock'
t2 = 'The mouse ran down'
s1 = t1.lower().split(' ')
s2 = t2.lower().split(' ')
terms = s1 + s2
print(terms)

tfdict = {}
for term in terms:
    if term not in tfdict:
        tfdict[term] = 1
    else:
        tfdict[term] += 1

a = []
for k,v in tfdict.items():
    a.append('{}, {}'.format(k,v))
print(a)
```

```
['the', 'mouse', 'ran', 'up', 'the', 'clock', 'the', 'mouse', 'ran', 'down']
['the, 3', 'mouse, 2', 'ran, 2', 'up, 1', 'clock, 1', 'down, 1']
```

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT

```
sorted_by_value_reverse = sorted(tfdict.items(),
key=lambda kv: kv[1], reverse=True)

sorted_by_value_reverse_dict =
dict(sorted_by_value_reverse)

id2word = {id: word for id, word in
enumerate(sorted_by_value_reverse_dict)}

word2id = dict([(v, k) for (k, v) in
id2word.items()])
```

```
sorted_by_value:  [('up', 1), ('clock', 1), ('down', 1), ('mouse', 2), ('ran', 2), ('the', 3)]
sorted_by_value2:  ['the', 'mouse', 'ran', 'up', 'clock', 'down']
sorted_by_value_reverse:  [('the', 3), ('mouse', 2), ('ran', 2), ('up', 1), ('clock', 1), ('down', 1)]
sorted_by_value_reverse_dict {'the': 3, 'mouse': 2, 'ran': 2, 'up': 1, 'clock': 1, 'down': 1}
id2word {0: 'the', 1: 'mouse', 2: 'ran', 3: 'up', 4: 'clock', 5: 'down'}
word2id {'the': 0, 'mouse': 1, 'ran': 2, 'up': 3, 'clock': 4, 'down': 5}
len_words: 6
sorted_by_key:  [('clock', 1), ('down', 1), ('mouse', 2), ('ran', 2), ('the', 3), ('up', 1)]
the, 3
mouse, 2
ran, 2
up, 1
clock, 1
down, 1
```

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT

```
sorted_by_value = sorted(tfdict.items(), key=lambda kv: kv[1])
print('sorted_by_value: ', sorted_by_value)
sorted_by_value2 = sorted(tfdict, key=tfdict.get, reverse=True)
print('sorted_by_value2: ', sorted_by_value2)
sorted_by_value_reverse = sorted(tfdict.items(), key=lambda kv: kv[1], reverse=True)
print('sorted_by_value_reverse: ', sorted_by_value_reverse)
sorted_by_value_reverse_dict = dict(sorted_by_value_reverse)
print('sorted_by_value_reverse_dict', sorted_by_value_reverse_dict)
id2word = {id: word for id, word in enumerate(sorted_by_value_reverse_dict)}
print('id2word', id2word)
word2id = dict([(v, k) for (k, v) in id2word.items()])
print('word2id', word2id)
print('len_words:', len(word2id))

sorted_by_key = sorted(tfdict.items(), key=lambda kv: kv[0])
print('sorted_by_key: ', sorted_by_key)

tfstring = '\n'.join(a)
print(tfstring)
tf = tfdict.get('mouse')
print(tf)
```

```
sorted_by_value:  [('up', 1), ('clock', 1), ('down', 1), ('mouse', 2), ('ran', 2), ('the', 3)]
sorted_by_value2:  ['the', 'mouse', 'ran', 'up', 'clock', 'down']
sorted_by_value_reverse:  [('the', 3), ('mouse', 2), ('ran', 2), ('up', 1), ('clock', 1), ('down', 1)]
sorted_by_value_reverse_dict {'the': 3, 'mouse': 2, 'ran': 2, 'up': 1, 'clock': 1, 'down': 1}
id2word {0: 'the', 1: 'mouse', 2: 'ran', 3: 'up', 4: 'clock', 5: 'down'}
word2id {'the': 0, 'mouse': 1, 'ran': 2, 'up': 3, 'clock': 4, 'down': 5}
len_words: 6
sorted_by_key:  [('clock', 1), ('down', 1), ('mouse', 2), ('ran', 2), ('the', 3), ('up', 1)]
the, 3
mouse, 2
ran, 2
up, 1
clock, 1
down, 1
```

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT

from keras.preprocessing.text import Tokenizer

```
from keras.preprocessing.text import Tokenizer
# define 5 documents
docs = ['Well done!', 'Good work', 'Great effort', 'nice work', 'Excellent!']
# create the tokenizer
t = Tokenizer()
# fit the tokenizer on the documents
t.fit_on_texts(docs)
print('docs:', docs)
print('word_counts:', t.word_counts)
print('document_count:', t.document_count)
print('word_index:', t.word_index)
print('word_docs:', t.word_docs)
# integer encode documents
texts_to_matrix = t.texts_to_matrix(docs, mode='count')
print('texts_to_matrix:')
print(texts_to_matrix)
```

```
docs: ['Well done!', 'Good work', 'Great effort', 'nice work', 'Excellent!']
word_counts: OrderedDict([('well', 1), ('done', 1), ('good', 1), ('work', 2), ('great', 1), ('effort', 1), ('ni
document_count: 5
word_index: {'work': 1, 'well': 2, 'done': 3, 'good': 4, 'great': 5, 'effort': 6, 'nice': 7, 'excellent': 8}
word_docs: {'done': 1, 'well': 1, 'work': 2, 'good': 1, 'great': 1, 'effort': 1, 'nice': 1, 'excellent': 1}
texts_to_matrix:
[[0. 0. 1. 1. 0. 0. 0. 0. 0.]
 [0. 1. 0. 0. 1. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 1. 1. 0. 0.]
 [0. 1. 0. 0. 0. 0. 0. 1. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 1.]]
```

Source: https://machinelearningmastery.com/prepare-text-data-deep-learning-keras/

from keras.preprocessing.text import Tokenizer

```
from keras.preprocessing.text import Tokenizer
# define 5 documents
docs = ['Well done!', 'Good work', 'Great effort', 'nice
work', 'Excellent!']
# create the tokenizer
t = Tokenizer()
# fit the tokenizer on the documents
t.fit_on_texts(docs)
print('docs:', docs)
print('word_counts:', t.word_counts)
print('document_count:', t.document_count)
print('word_index:', t.word_index)
print('word_docs:', t.word_docs)
# integer encode documents
texts_to_matrix = t.texts_to_matrix(docs, mode='count')
print('texts_to_matrix:')
print(texts_to_matrix)
```

Source: https://machinelearningmastery.com/prepare-text-data-deep-learning-keras/

texts_to_matrix = t.texts_to_matrix(docs, mode='count')

```
docs: ['Well done!', 'Good work', 'Great effort',
'nice work', 'Excellent!']
word_counts: OrderedDict([('well', 1), ('done', 1),
('good', 1), ('work', 2), ('great', 1), ('effort', 1),
('nice', 1), ('excellent', 1)])
document_count: 5
word_index: {'work': 1, 'well': 2, 'done': 3, 'good':
4, 'great': 5, 'effort': 6, 'nice': 7, 'excellent': 8}
word_docs: {'done': 1, 'well': 1, 'work': 2, 'good': 1,
'great': 1, 'effort': 1, 'nice': 1, 'excellent': 1}
texts_to_matrix:
[[0. 0. 1. 1. 0. 0. 0. 0. 0.]
 [0. 1. 0. 0. 1. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 1. 1. 0. 0.]
 [0. 1. 0. 0. 0. 0. 0. 1. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 1.]]
```

Source: https://machinelearningmastery.com/prepare-text-data-deep-learning-keras/

t.texts_to_matrix(docs, mode='tfidf')

```
from keras.preprocessing.text import Tokenizer
# define 5 documents
docs = ['Well done!', 'Good work', 'Great effort', 'nice work',
'Excellent!']
# create the tokenizer
t = Tokenizer()
# fit the tokenizer on the documents
t.fit_on_texts(docs)
print('docs:', docs)
print('word_counts:', t.word_counts)
print('document_count:', t.document_count)
print('word_index:', t.word_index)
print('word_docs:', t.word_docs)
# integer encode documents
texts_to_matrix = t.texts_to_matrix(docs, mode='tfidf')
print('texts_to_matrix:')
print(texts_to_matrix)
```

```
texts_to_matrix:
[[0.         0.         1.25276297 1.25276297 0.         0.
  0.         0.         0.        ]
 [0.         0.98082925 0.         0.         1.25276297 0.
  0.         0.         0.        ]
 [0.         0.         0.         0.         0.         1.25276297
  1.25276297 0.         0.        ]
 [0.         0.98082925 0.         0.         0.         0.
  0.         1.25276297 0.        ]
 [0.         0.         0.         0.         0.         0.
  0.         0.         1.25276297]]
```

Source: https://machinelearningmastery.com/prepare-text-data-deep-learning-keras/

Summary

- Processing Text
- Understanding Text

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