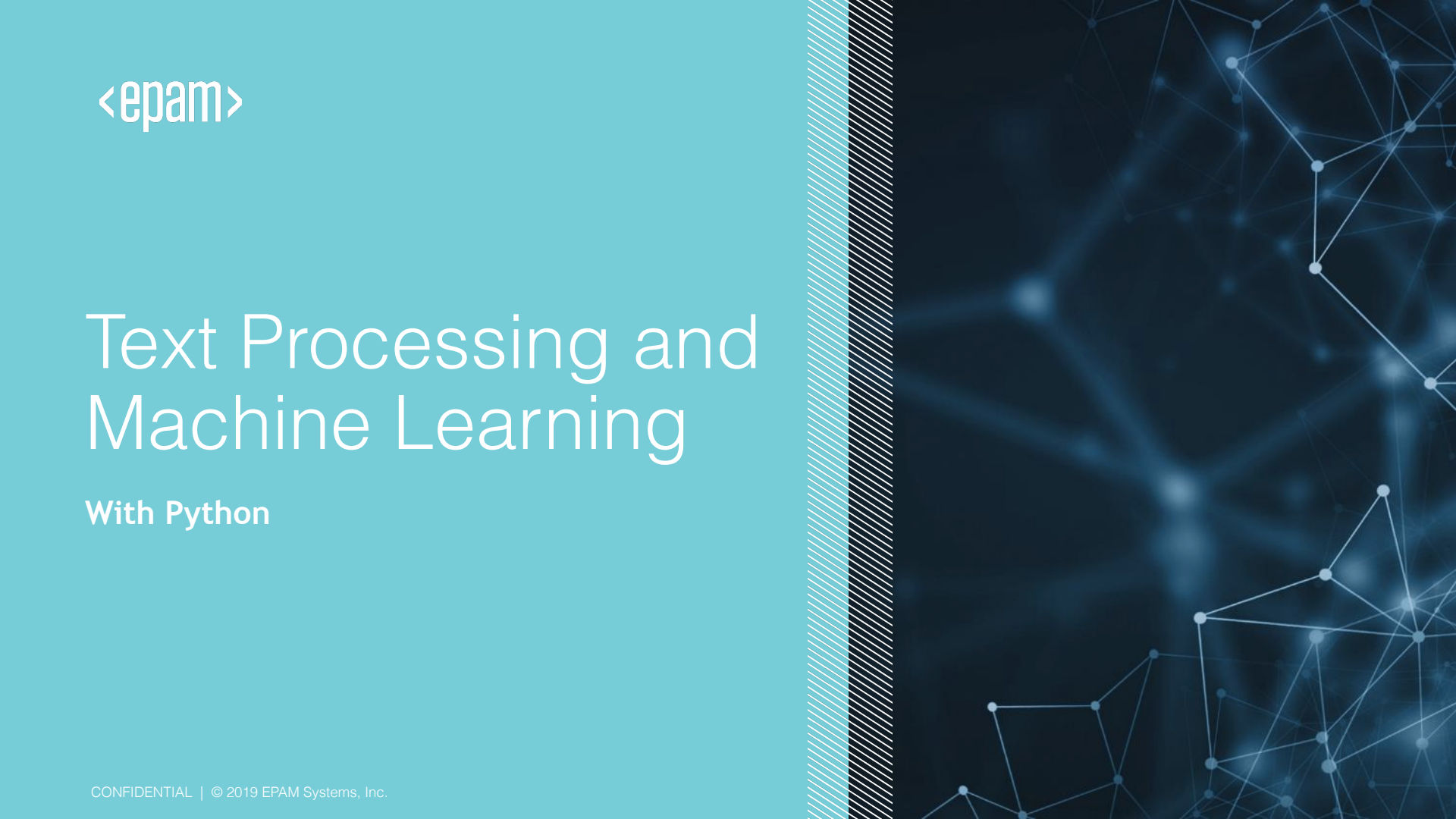

Text Processing and Machine Learning

With Python

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Text Processing

- Refers to the discipline of mechanising the creation, manipulation, or interpretation of text data.

CREATION

- Generating natural language from structured data.
- Auto-generated emails.

MANIPULATION

- Spell checkers
- Text formatters

INTERPRETATION

- Natural-language understanding.
- Sentiment analysis.
- Document classification.

Machine Learning

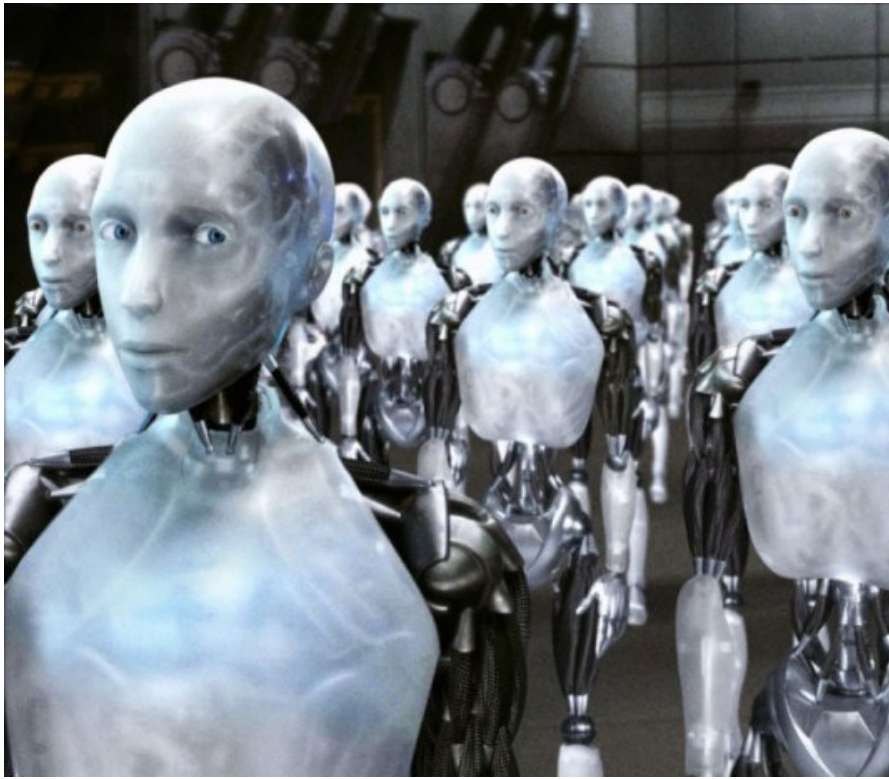
Starting more than half a century ago, scientists became very serious about addressing the question: **“Can we build a model that learns from available data and automatically makes the right decisions and predictions?”**

Machine learning is the science of getting computers to learn and perform. They learn how to perform by given training data, instead of explicitly given set of rules. They learn how to perform and act as same as humans do.

https://sebastianraschka.com/Articles/2014_naive_bayes_1.html

Will A.I. take over the world and kill us?

- A.I. is the intelligence demonstrated by machines.
- Machine learning is an application of artificial intelligence.
- A.I. won’t kill us, unless we want them to do.

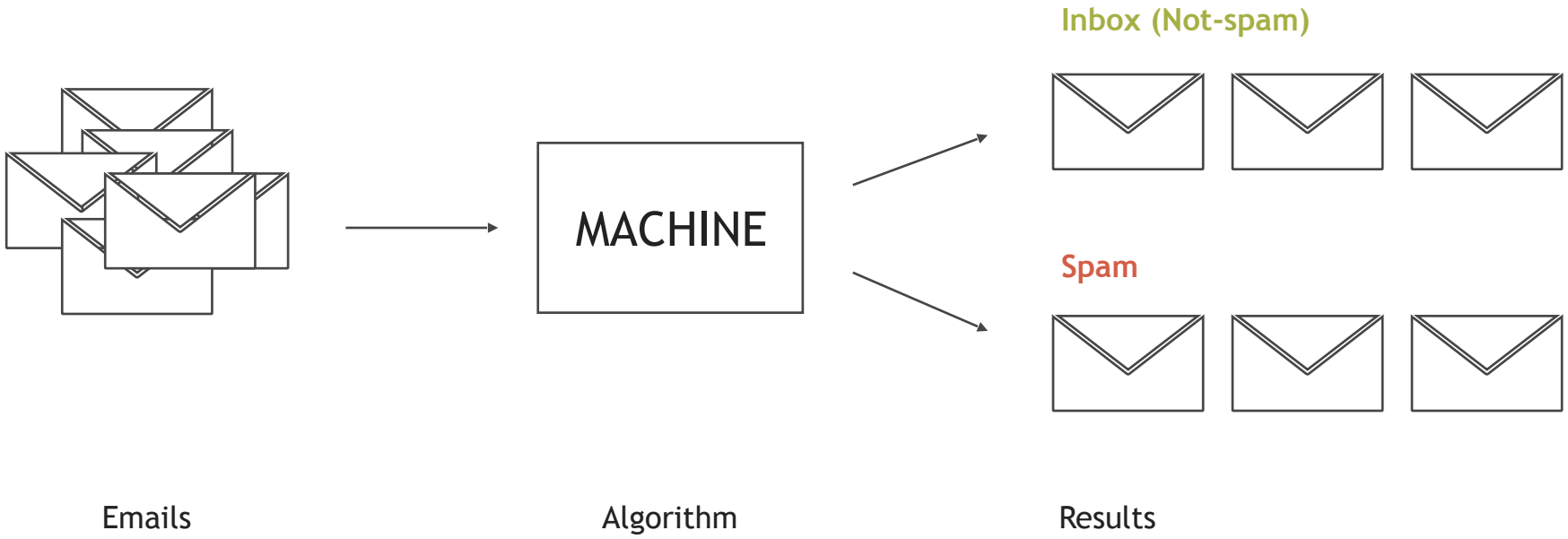


The difference

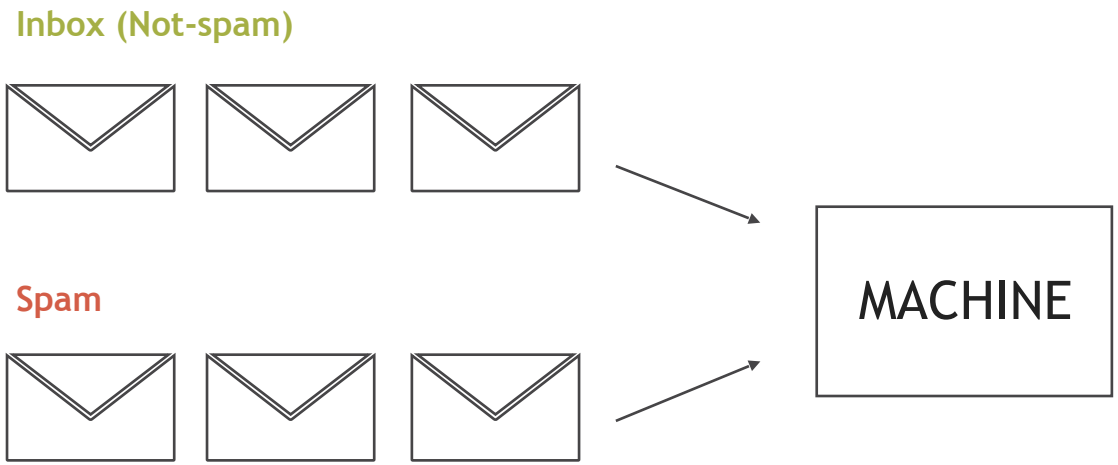
Traditional Approach

Machine Learning

An example application



How they learn



How they perform

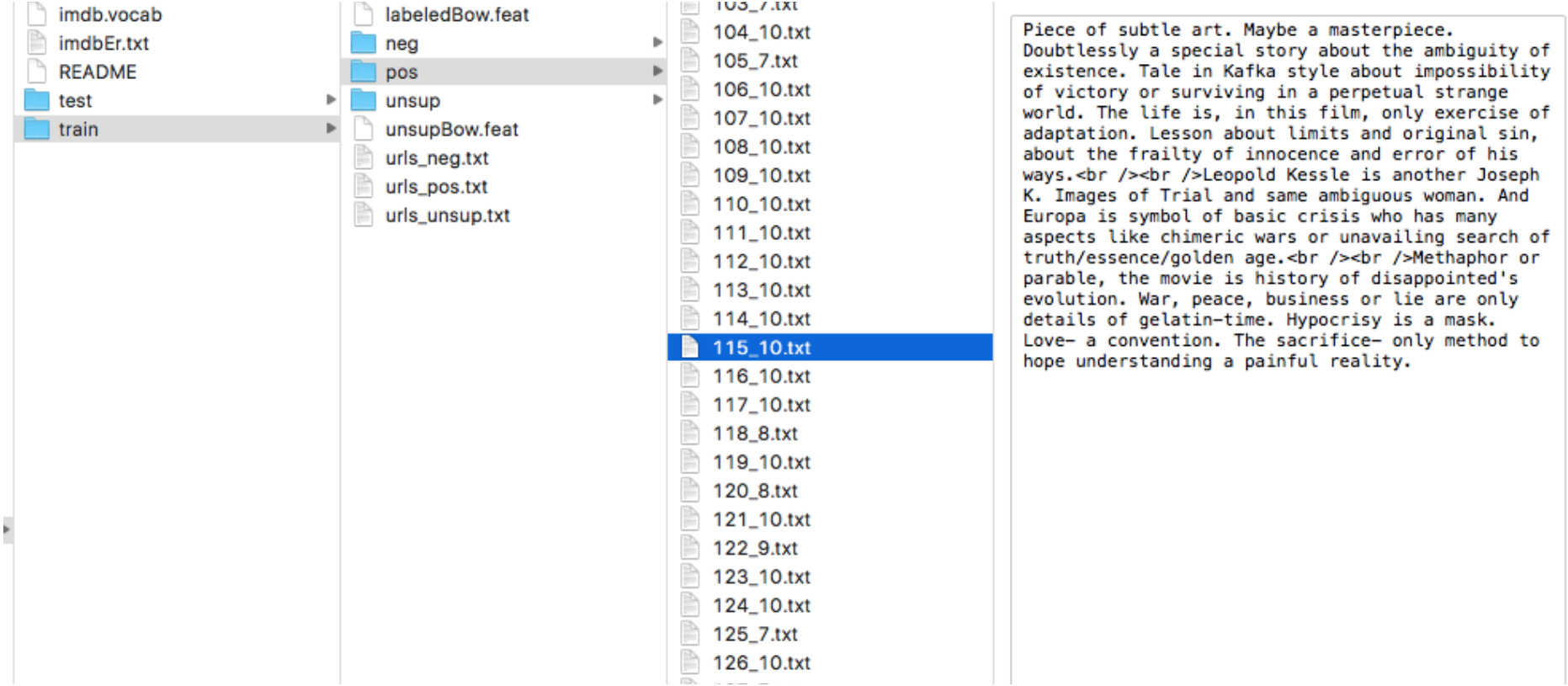
Email

Algorithm

Results

RESULTS CANNOT BE 100% ACCURATE.

Example training set: IMDB reviews

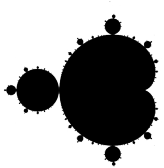


TOOLS

- NLTK
  Natural Language Toolkit

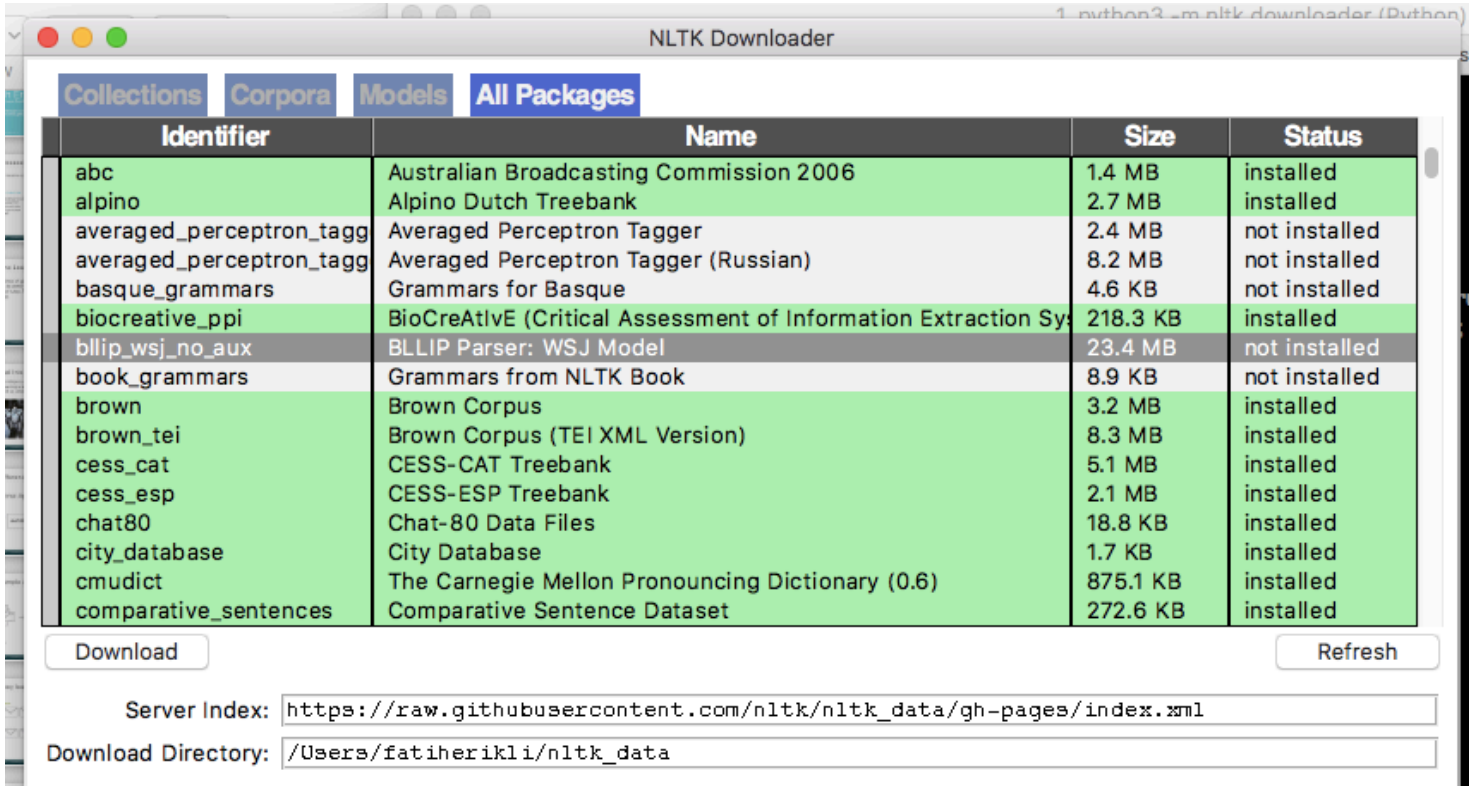
- TextBlob
  TextBlob: Simplified Text Processing

- Jupyter Notebook
  A web application that allows you to create and share documents that contain live code, equations, visualizations and narrative text.

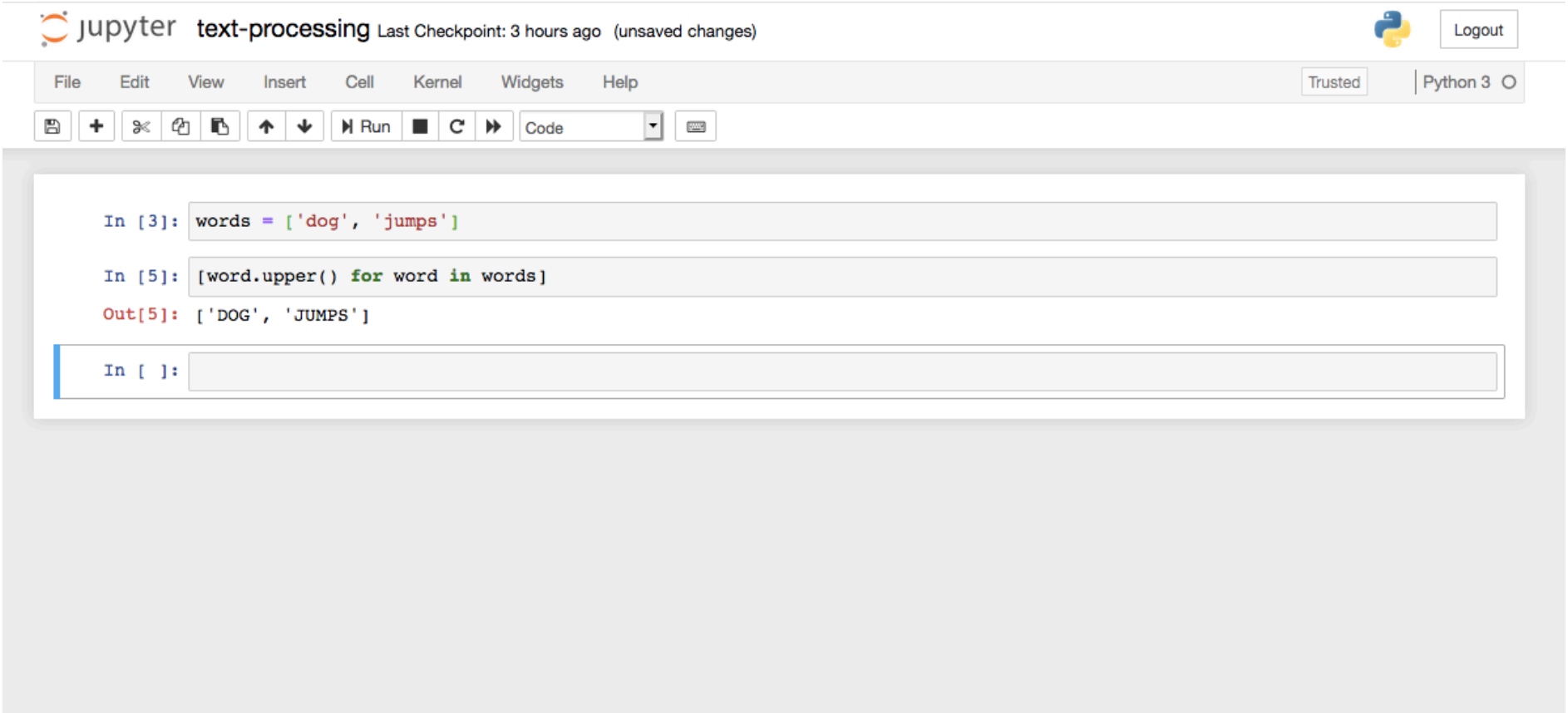


TextBlob

python -m nltk.downloader



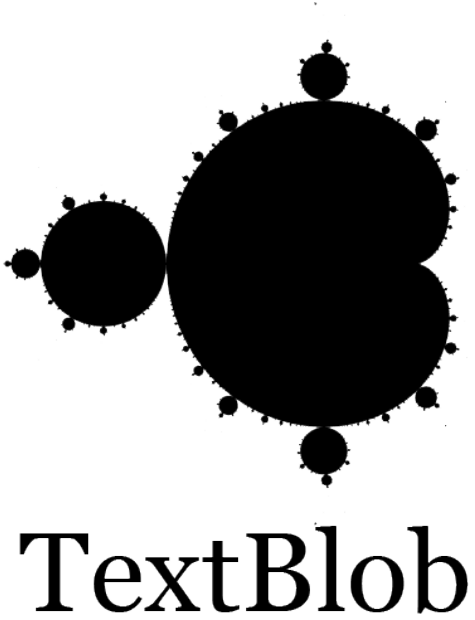
An example notebook



TEXTBLOB: SIMPLIFIED TEXT PROCESSING

Textblob

- Tokenization (Converting texts or words.)
- Builtin classification algorithms
- Sentiment Analysis
- Integration with GoogleTranslate
- Access to NLTK dictionaries and algorithms
- Integration with WordNet database



```
In [4]: from textblob import TextBlob

        blob = TextBlob('''
        The titular threat of The Blob has always struck me as the ultimate movie
        monster: an insatiably hungry, amoeba-like mass able to penetrate
        virtually any safeguard, capable of--as a doomed doctor chillingly
        describes it--"assimilating flesh on contact.
        Snide comparisons to gelatin be damned, it's a concept with the most
        devastating of potential consequences, not unlike the grey goo scenario
        proposed by technological theorists fearful of
        artificial intelligence run rampant.
        ''')

In [6]: blob.words

Out[6]: WordList(['The', 'titular', 'threat', 'of', 'The', 'Blob', 'has', 'always', 'struck', 'me', 'as', 'the', 'ultimate',
        'movie', 'monster', 'an', 'insatiably', 'hungry', 'amoeba-like', 'mass', 'able', 'to', 'penetrate', 'virtually', 'any
        ', 'safeguard', 'capable', 'of', 'as', 'a', 'doomed', 'doctor', 'chillingly', 'describes', 'it', 'assimilating', 'fle
        sh', 'on', 'contact', 'Snide', 'comparisons', 'to', 'gelatin', 'be', 'damned', 'it', "'s", 'a', 'concept', 'with', 't
        he', 'most', 'devastating', 'of', 'potential', 'consequences', 'not', 'unlike', 'the', 'grey', 'goo', 'scenario', 'pr
        oposed', 'by', 'technological', 'theorists', 'fearful', 'of', 'artificial', 'intelligence', 'run', 'rampant'])

In [7]: blob.sentences

Out[7]: [Sentence("
         The titular threat of The Blob has always struck me as the ultimate movie
         monster: an insatiably hungry, amoeba-like mass able to penetrate
         virtually any safeguard, capable of--as a doomed doctor chillingly
         describes it--"assimilating flesh on contact."),
         Sentence("Snide comparisons to gelatin be damned, it's a concept with the most
         devastating of potential consequences, not unlike the grey goo scenario
         proposed by technological theorists fearful of
         artificial intelligence run rampant.")]
```

Tokenization

Clean API to work with the structure of text.

```
In [16]: blob.sentences

Out[16]: [Sentence("
          The titular threat of The Blob has always struck me as the ultimate movie
          monster: an insatiably hungry, amoeba-like mass able to penetrate
          virtually any safeguard, capable of--as a doomed doctor chillingly
          describes it--"assimilating flesh on contact."),
          Sentence("Snide comparisons to gelatin be damned, it's a concept with the most
          devastating of potential consequences, not unlike the grey goo scenario
          proposed by technological theorists fearful of
          artificial intelligence run rampant.")]

In [20]: blob.words[33]

Out[20]: 'describes'

In [21]: blob.words[33].lemmatize("v")

Out[21]: 'describe'

In [ ]:
```

Spelling Correction

Usually about about 70% accurate, the implementation based on Peter Norvig's "How to Write a Spelling Corrector"

```
In [155]: blob = TextBlob("I havv goood speling!")

In [156]: blob.correct()
Out[156]: TextBlob("I have good spelling!")

In [157]: Word('gooood').spellcheck()
Out[157]: [('good', 1.0)]

In [ ]:
```

Sentiment Analysis

Polarity is a value between -1.0 and 1.0,
Subjectivity is between 0.0 and 1.0

```
In [22]: comment = TextBlob('Poland is a beautiful country')

In [23]: comment.sentiment
Out[23]: Sentiment(polarity=0.85, subjectivity=1.0)

In [34]: comment = TextBlob('Poland is a country located in Europe')

In [33]: comment.sentiment
Out[33]: Sentiment(polarity=0.0, subjectivity=0.0)

In [42]: comment = TextBlob("The worst restaurant I have ever seen")

In [43]: comment.sentiment
Out[43]: Sentiment(polarity=-1.0, subjectivity=1.0)

In [ ]:
```

Translation

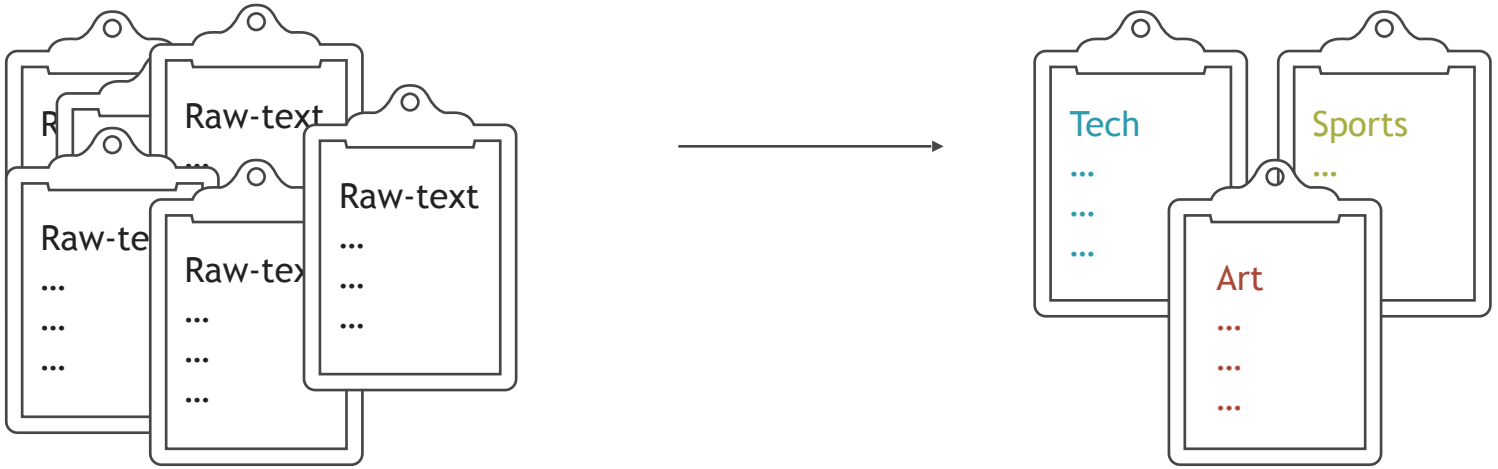
Integration with GoogleTranslate API.

```
In [44]: comment = TextBlob('Poland is a country located in Europe')

In [47]: translated = comment.translate(to='pl')

In [48]: translated
Out[48]: TextBlob("Polska to kraj położony w Europie")

In [49]: translated.detect_language()
Out[49]: 'pl'

In [51]: translated.translate(to='tr')
Out[51]: TextBlob("Polonya Avrupa'da bulunan bir ülkedir")

In [ ]:
```

BUILDING A CLASSIFIER

Text classification

Text classification is the process of assigning tags or categories to text according to its content.



Training Data

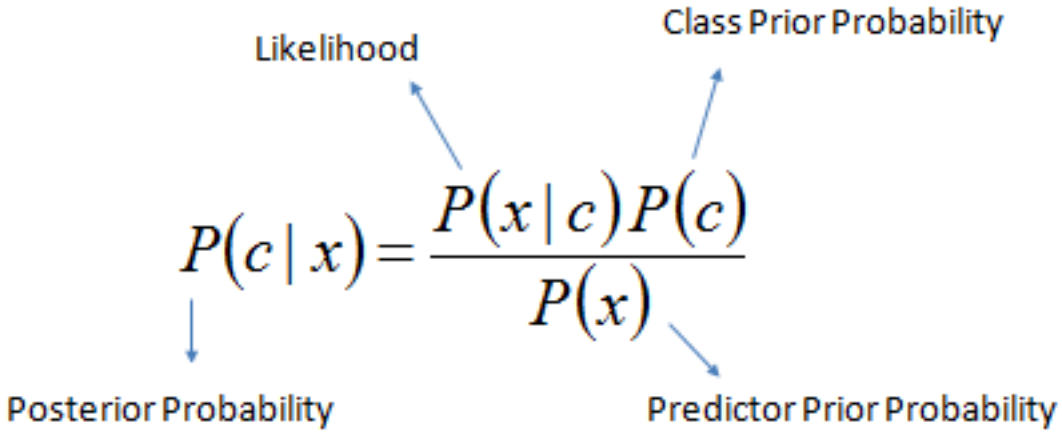
Training data should should contain a raw text and pre-assigned label.
Also having a test data set is important to check classifiers health.

In [56]:
```
train = [
    ('Time is not linear.', 'science'),
    ('There is no such thing as A.I', 'science'),
    ('Science is evidence based process.', 'science'),
    ('The Universe does not "expand"', 'science'),
    ("Python is better than Ruby", 'programming'),
    ('You can\'t measure how good a programming language is.', 'programming'),
    ('C++ is better for programming PC apps than Java', 'programming'),
    ("Semi-colons are pointless in Javascript", 'programming'),
    ('Emacs is better than vim', 'programming'),
    ('Art is for soceity, not for profit.', 'art'),
    ('Picasso was a brilliant artist.', 'art'),
    ('Picasso pioneered cubism.', 'art'),
]
```

In [57]:
```
test = [
    ('Time is relative', 'science'),
    ('Cubism is an avant-garde movement', 'art'),
    ('Python is created by Guido Van Rossum', 'programming')
]
```

Naive Bayes Classification

Naive Bayes is a probabilistic classifier inspired by the Bayes theorem.



$$P(c \mid X) = P(x_1 \mid c) \times P(x_2 \mid c) \times \cdots \times P(x_n \mid c) \times P(c)$$

https://medium.com/datadriveninvestor/classification-algorithms-in-machine-learning-85c0ab65ff4

Naive Bayes Classification

Type	Long	Not Long	Sweet	Not Sweet	Yellow	Not Yellow	**Total**
Banana	400	100	350	150	450	50	500
Orange	0	300	150	150	300	0	300
Other	100	100	150	50	50	150	200
Total	500	500	650	350	800	200	1000

https://www.machinelearningplus.com/predictive-modeling/how-naive-bayes-algorithm-works-with-example-and-full-code/

TextBlob implementation

```
In [58]: from textblob.classifiers import NaiveBayesClassifier

In [59]: classifier = NaiveBayesClassifier(train)

In [60]: classifier.classify('Time is relative')
Out[60]: 'science'

In [61]: classifier.classify('Picasso is a painter')
Out[61]: 'art'

In [64]: probs = classifier.prob_classify('Picasso is a painter')

In [65]: probs.prob('art')
Out[65]: 0.7868710930095634

In [66]: probs.prob('science')
Out[66]: 0.09233965615566112

In [ ]:
```

Feature Engineering

Features are the basic primitives of classification process.
Most of the classifiers use simple feature extractor that indicates which words in the training set are contained in a document.

We can customise that feature extortion behaviour. The process of selecting what features should be taken into account in the classification process is called **feature engineering.**

Feature Engineering

```
In [168]: classifier.show_informative_features()

Most Informative Features
                contains(is) = False              art : progra =      2.5 : 1.0
              contains(Picasso) = False          progra : art    =      2.4 : 1.0
                 contains(than) = False          scienc : progra =      2.2 : 1.0
               contains(better) = False          scienc : progra =      2.2 : 1.0
                   contains(is) = True           progra : art    =      2.0 : 1.0
                  contains(not) = False          progra : scienc =      1.8 : 1.0
           contains(programming) = False          scienc : progra =      1.5 : 1.0
                    contains(a) = True               art : progra =      1.5 : 1.0
                  contains(for) = True               art : progra =      1.5 : 1.0
               contains(cubism) = False          progra : art    =      1.5 : 1.0
```

To get more accurate result, we might want to take only first and last words of the document. To achieve this, we need to create a feature extractor function.

Feature Engineering

```
def end_word_extractor(document):
    tokens = document.split()
    first_word, last_word = tokens[0], tokens[-1]

    return {
        'first({%s})' % first_word: True,
        'last({%s})' % last_word: False,
    }
```

Feature Engineering

```
In [68]: def end_word_extractor(document):
             tokens = document.split()
             first_word, last_word = tokens[0], tokens[-1]
             return {
                 'first({%s})' % first_word: True,
                 'last({%s})' % last_word: False,
             }
```

```
In [69]: classifier = NaiveBayesClassifier(train, feature_extractor=end_word_extrac
```

```
In [76]: probs = classifier.prob_classify('Picasso is an artist.')
```

```
In [77]: probs.prob('art')
Out[77]: 0.9079205257292188
```

```
In [79]:  1 probs = classifier.prob_classify('Picasso is an painter.')
```

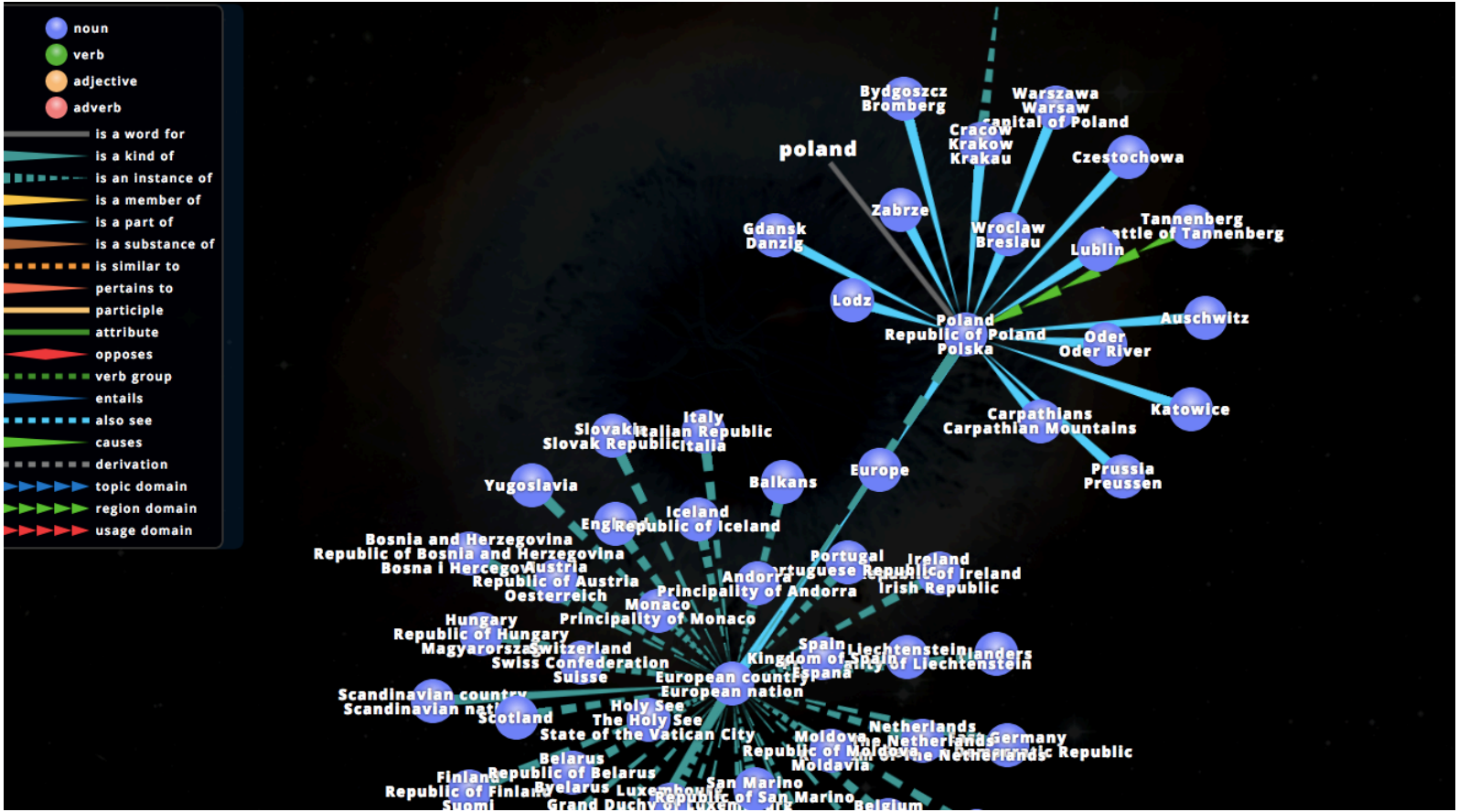
```
In [80]: probs.prob('art')
Out[80]: 0.7065948855989233
```

WORDNET
LEXICAL DATABASE FOR THE ENGLISH LANGUAGE

Wordnet

Wordnet is a graph dataset which each node is connected to each other.
The top node is “Entity” and all of the words branch off from that node.

Lexical nodes can be useful for feature engineering.



https://visuwords.com/poland

Wordnet

Each entity is somehow connected to each other since everything is branched off from “Entity”. Thanks to that feature, we’re able to measure similarity between nodes.

```
In [140]: from textblob import Word

In [144]: poland = Word('poland').synsets[0]

In [150]: hungary = Word('hungary').synsets[0]

In [151]: poland.path_similarity(hungary)
Out[151]: 0.3333333333333333

In [152]: hungary
Out[152]: Synset('hungary.n.01')

In [153]: japan = Word('japan').synsets[0]

In [154]: poland.path_similarity(japan)
Out[154]: 0.09090909090909091
```

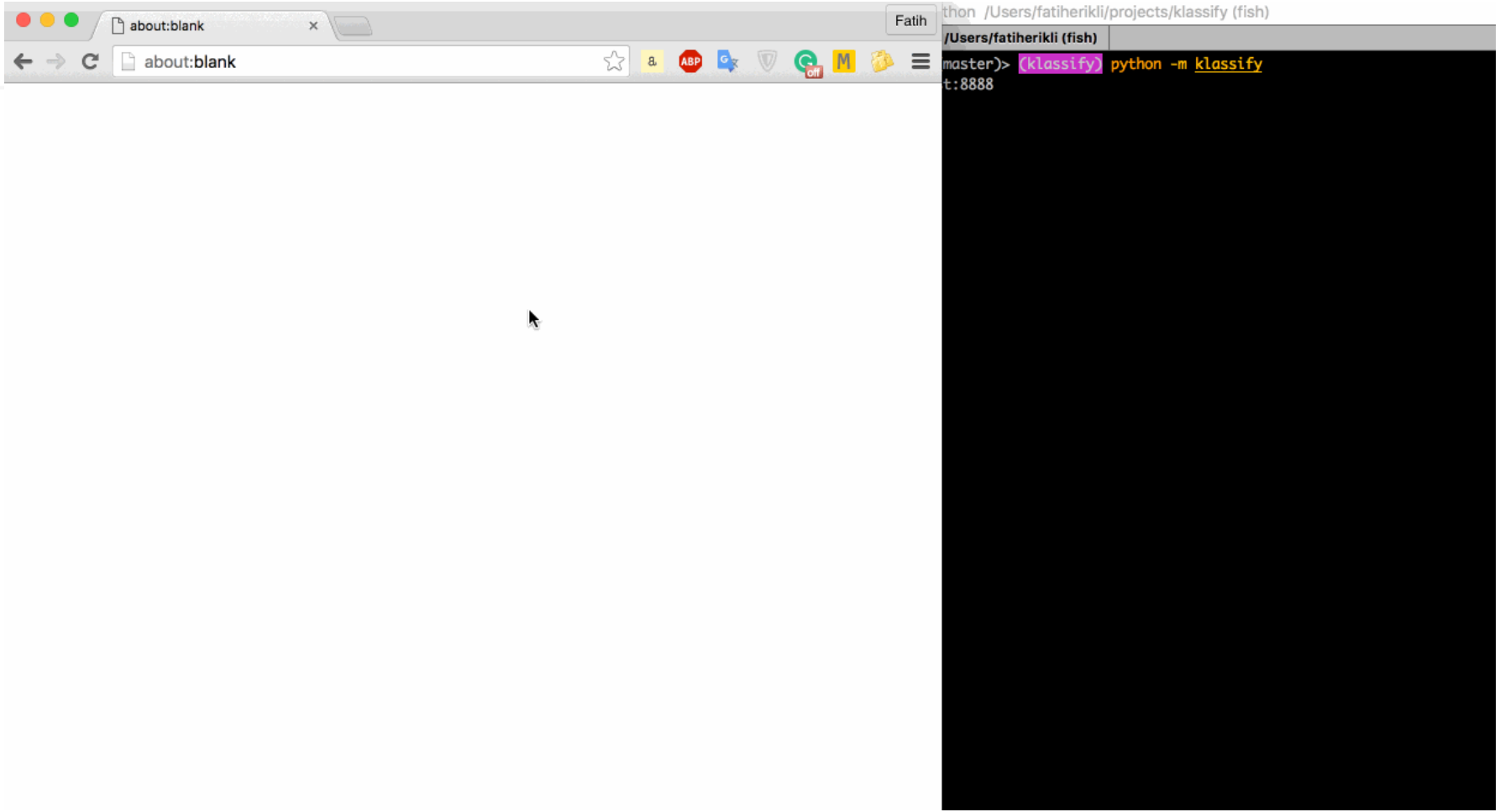
KLASSIFY
TEXT CLASSIFICATION SERVICE - POC

KLASSIFY

Bayesian Text classification service based on Redis. Built on top of Tornado and React.js
https://github.com/fatiherikli/klassify

It can be used for:

- Spam filters
- Web page classification
- News and and topic categorization
- Sentiment Analysis


about:blank
Fatih
about:blank
thon /Users/fatiherikli/projects/klassify (fish)
/Users/fatiherikli (fish)
master)> (klassify) python -m klassify
t:8888

SOURCES

- https://sebastianraschka.com/Articles/2014_naive_bayes_1.html
- https://natureofcode.com/book/chapter-10-neural-networks/
- http://ml-playground.com/
- https://playground.tensorflow.org
- https://keras.io/

QUESTIONS?