GALLOGLY COLLEGE OF ENGINEERING
SCHOOL OF COMPUTER SCIENCE
The UNIVERSITY *of* OKLAHOMA

Text Analysis

Text classification

DATA BITE
A bit on Big Data

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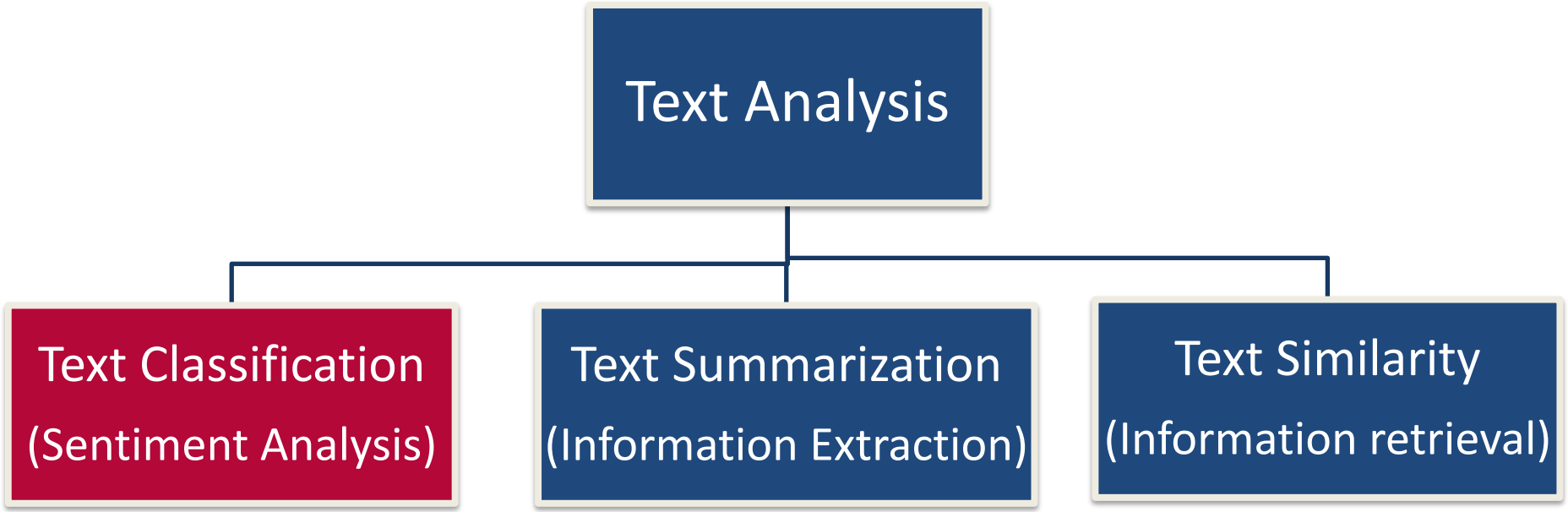
SCAN ME

Overview

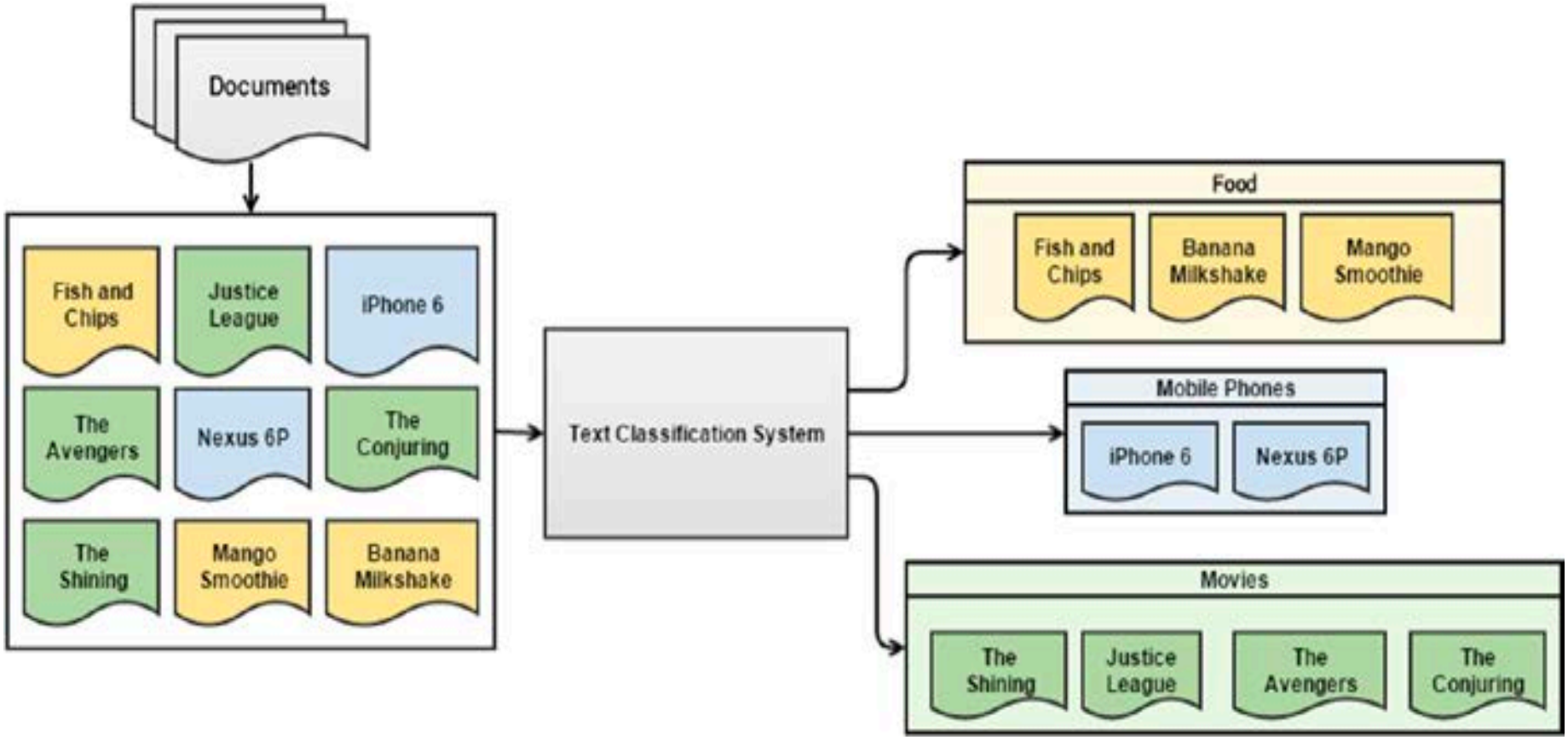
- Text Analysis
- What is Text Classification?
- Machine learning approach
- Types of Text Classification
- Workflow
- Demo

Text Analysis

Analyze complex textual data and extract meaningful patterns and insights from it.



What is Text Classification?



Source: *Text Analytics With Python : A Practical Real-World Approach To Gaining Actionable Insights From Your Data,* **Second Edition**, Dipanjan Sarkar, 2019, Apress L. P. (ISBN 978-1-4842-4353-4) (eBook ISBN 978-1-4842-4354-1) Publisher Website

Machine Learning Approach

Supervised Learning

- Requires labeled training data
- Each data point corresponds to a class or label
- Learns meaningful patterns for each type of class
  - Sentiment analysis
  - Spam filtering
  - Topic labeling

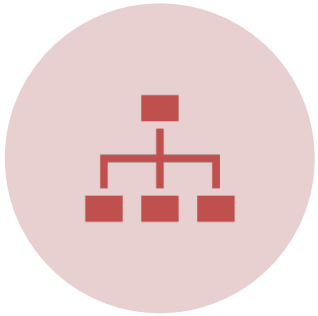
Unsupervised Learning

- Do not require any labeled training data
- Extract meaningful patterns from the data
  - Document Summarization
  - Similarity Analysis
  - Clustering (Useful in Text document categorization)

Types of Classification

BINARY CLASSIFICATION

MULTI-CLASS CLASSIFICATION

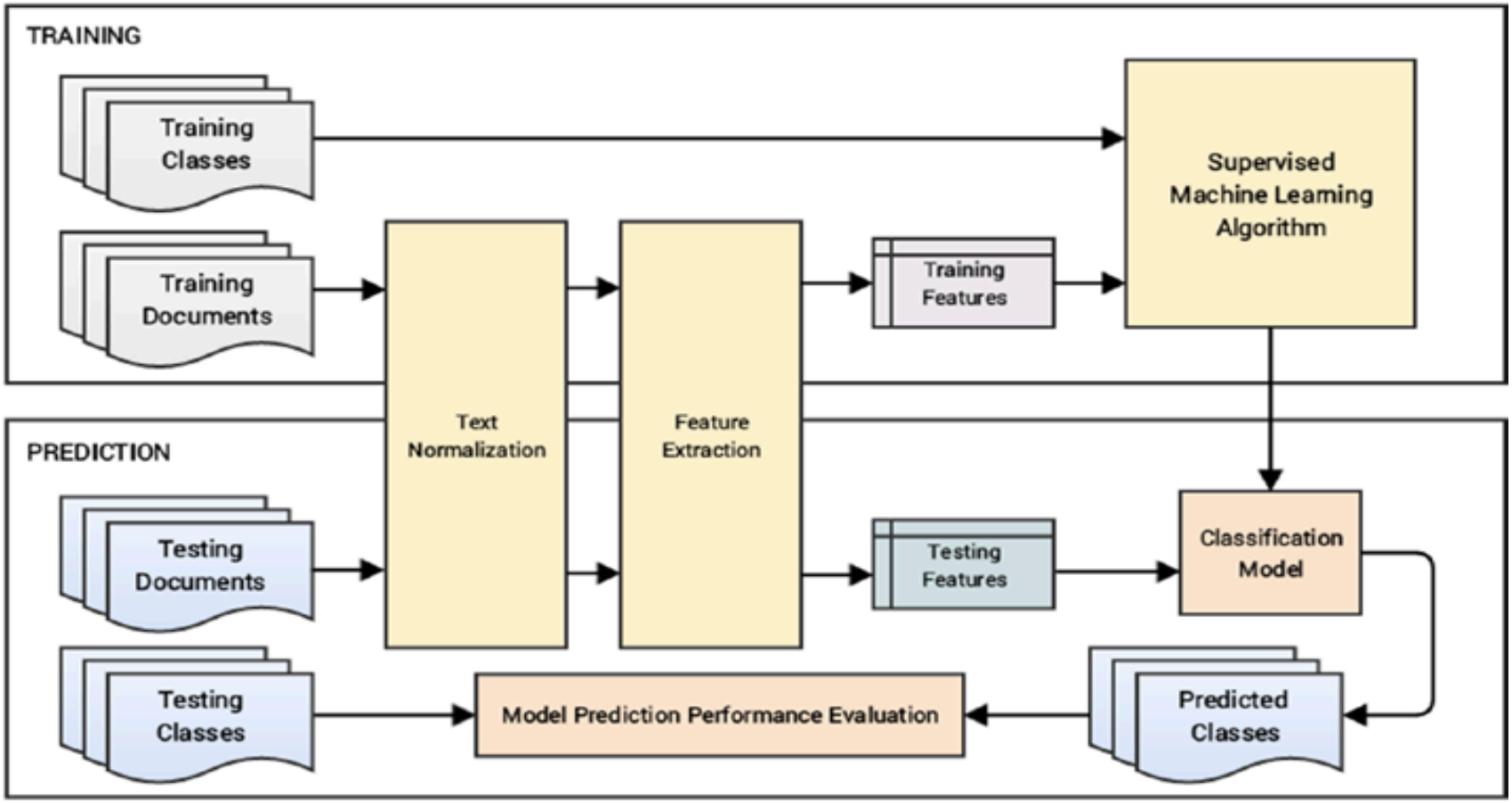


MULTI-LABEL CLASSIFICATION

Text Classification Workflow

- A typical workflow for a text classification system is as follows:
  - Train and test datasets
  - Text Normalization
  - Feature Extraction
  - Model Training
  - Model Prediction

Architecture



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Text Normalization

Tokenization – Segmenting a sentence into words

Named Entity Recognition – like persons, locations or companies

Word vectors – represent the meaning of the word in form of vectors of numbers

Similarity – Comparing words or documents

Bag of Words, TF-IDF, and Advanced word vectorization models

FEATURE EXTRACTION

Bag of Words model

- Convert text document into vectors
- Vector represents the frequency of all the distinct words for specific document
- The frequency of occurrence is the weight of each word

Example

```
from sklearn.feature_extraction.text import CountVectorizer
vectorizer = CountVectorizer(min_df=1, ngram_range=(1,1))
features = vectorizer.fit_transform(corpus)
vectorizer.get_feature_names() ##print the features names


##Corpus is a collection of text:
CORPUS = ['the sky is so beautiful’,
            'sky is blue and sky is beautiful’,
            'the sky is perfectly blue’,
            'i love cream cheese’
            ]
```

Useful link:

https://scikit-learn.org/stable/modules/generated/sklearn.feature_extraction.text.CountVectorizer.html#sklearn.feature_extraction.text.CountVectorizer

TF-IDF Model

- Tf – term frequency
- Idf – inverse document frequency
- TF-IDF is a combination of the above two metrics

Example

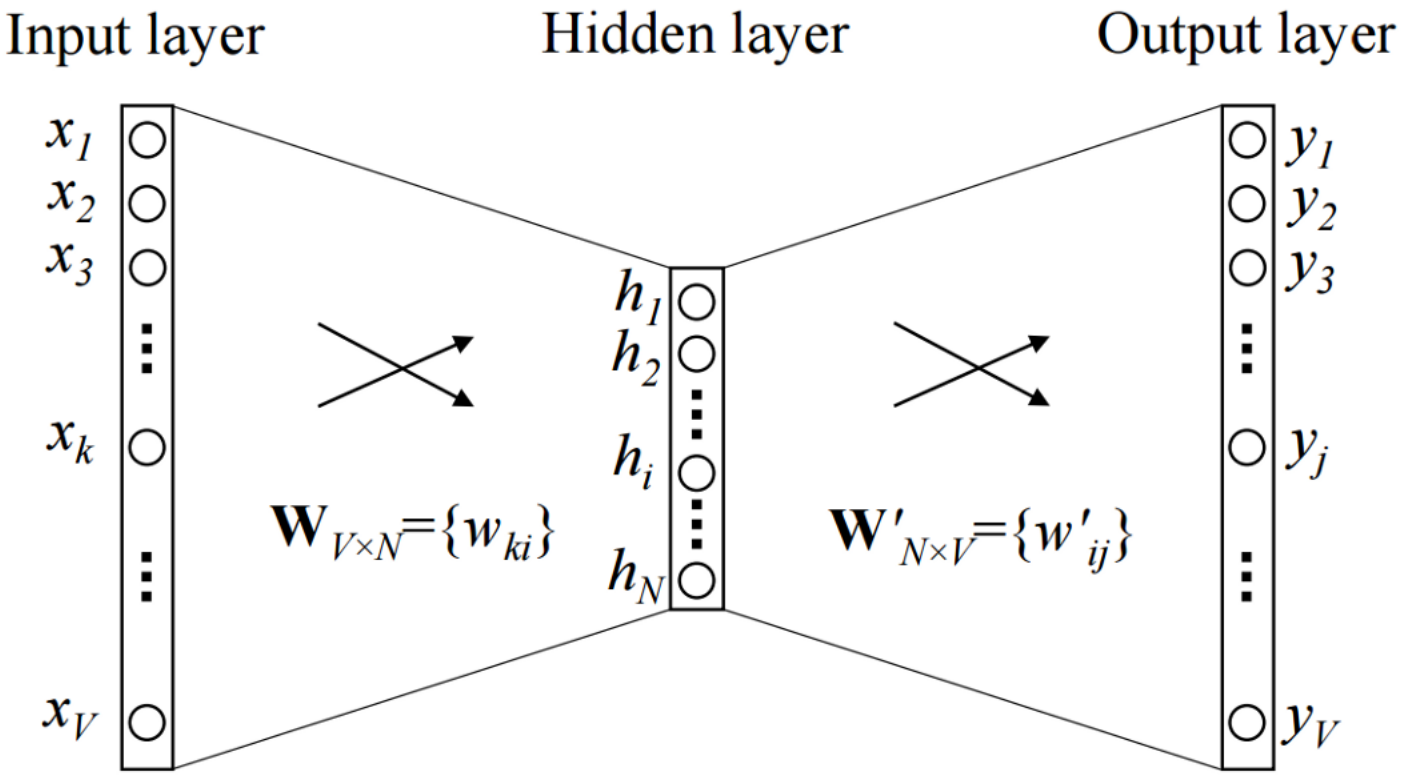
```
from sklearn.feature_extraction.text import
TfidfTransformer

transformer = TfidfTransformer(norm='l2’,
                               smooth_idf=True,
                               use_idf=True)
# fit to data and then transform it
tfidf_matrix =transformer.fit_transform(corpus)
```

Advanced word vectorization models

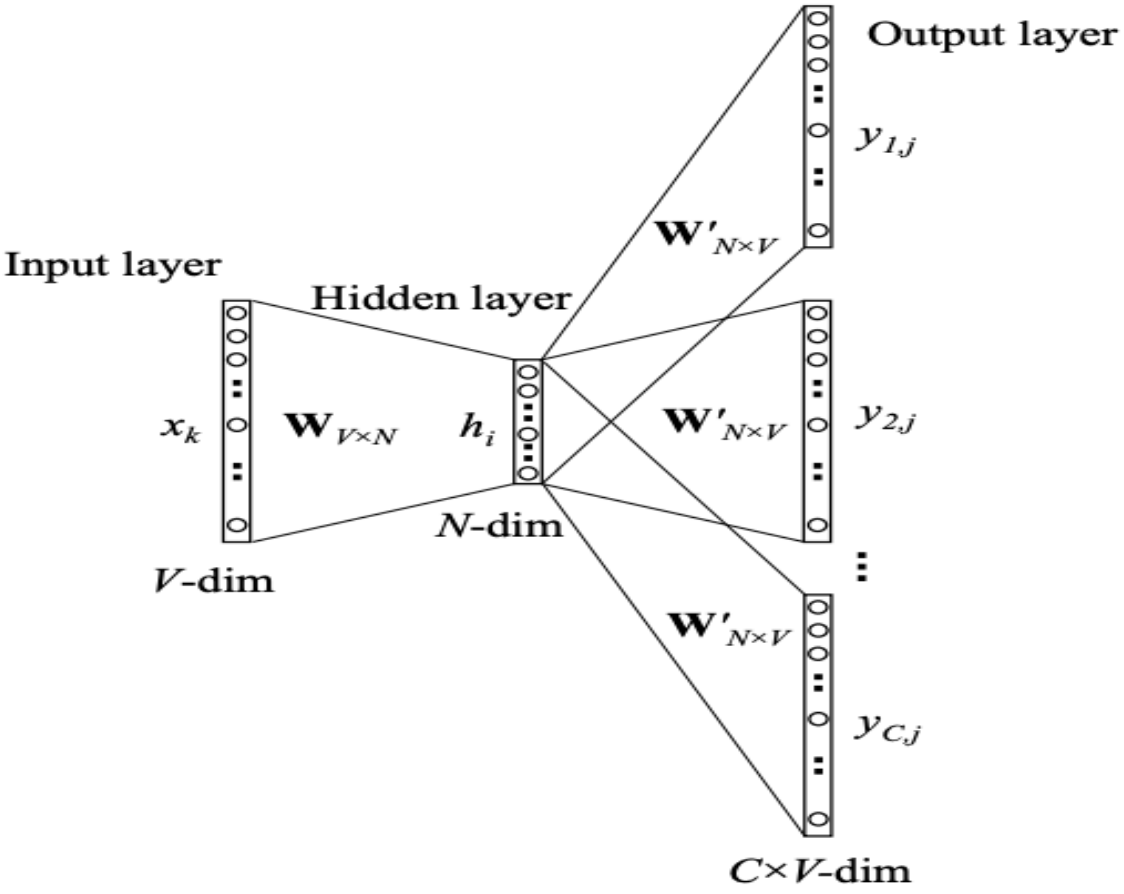
- Word2Vec – learn word embeddings
- It is a neural network-based implementation that learns distributed vector representations of words

Source: Rong, X. (2014). word2vec parameter learning explained. *arXiv preprint arXiv:1411.2738*.

CBOW model


Input layer
Hidden layer
Output layer
x_1
x_2
x_3
x_k
x_V
h_1
h_2
h_i
h_N
y_1
y_2
y_3
y_j
y_V
$\mathbf{W}_{V\times N}=\{w_{ki}\}$
$\mathbf{W}'_{N\times V}=\{w'_{ij}\}$

Skip gram model



Multinomial Naïve Bayes and Support Vector Machines

CLASSIFICATION ALGORITHMS

Multinomial Naïve Bayes

- Scikit-learn library provides MultinomialNB

Support Vector Machines

Supervised learning algorithm

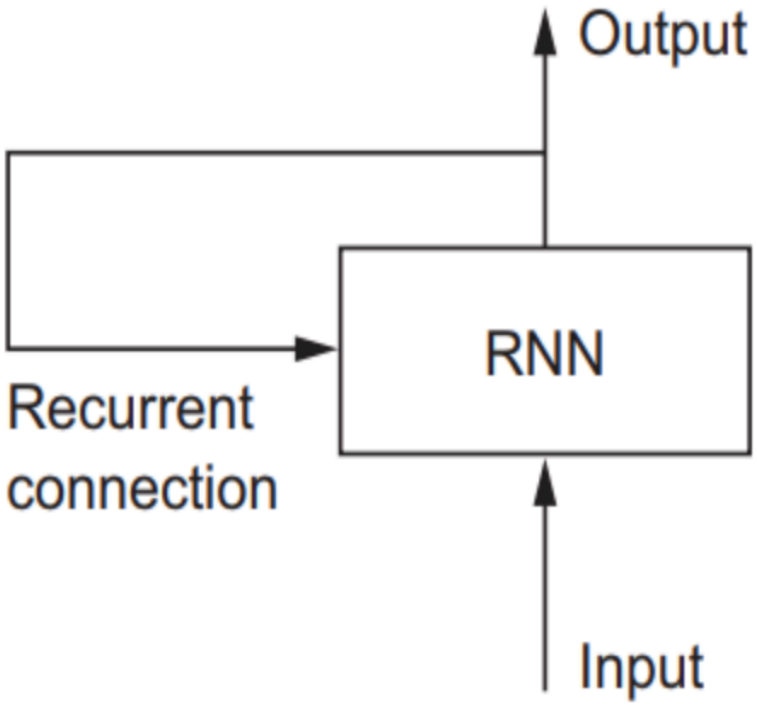
SVM constructs a hyperplane or set of hyperplanes in a high- or infinite-dimensional space, which can be used for classification, regression, or other tasks like outliers detection

Long Short-Term Memory: Allows access to previous information to used at later time

LSTM

RNNs

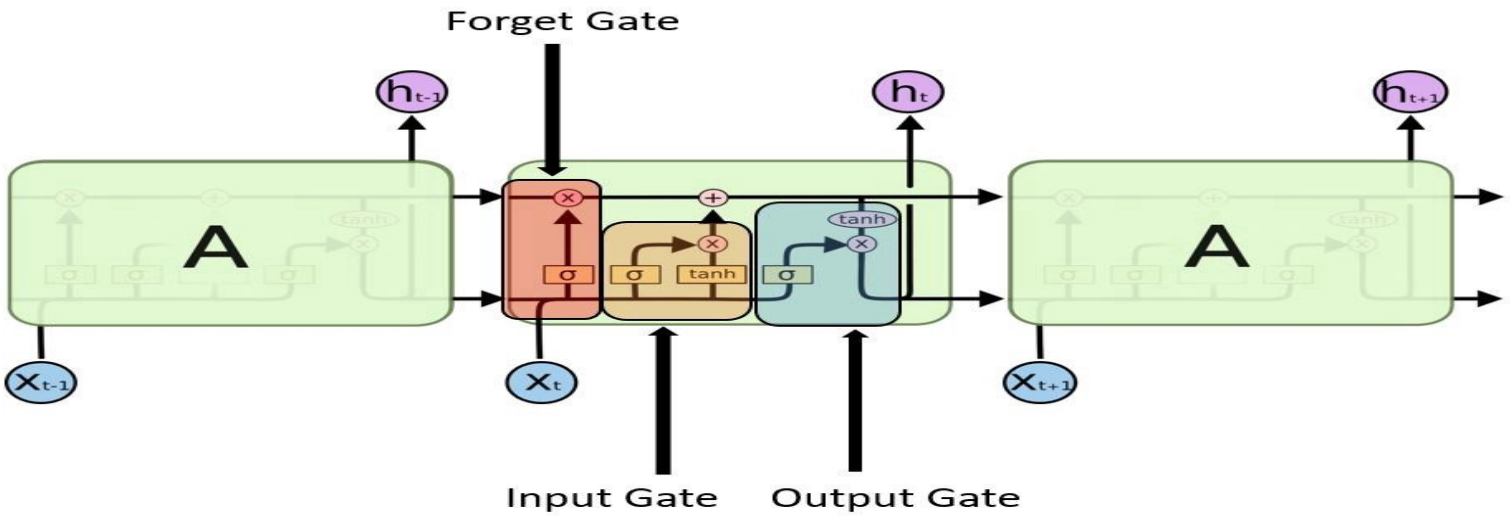
- Recurrent Neural Networks
- Is a generalization of feedforward neural network that has an internal memory
- RNNs can use their internal state (memory) to process sequences of inputs.



Source: https://www.manning.com/books/deep-learning-with-python

LSTMs

- It remembers the previous data



Source: https://towardsdatascience.com/understanding-rnn-and-lstm-f7cdf6dfc14e

Demo

- Implement Feature Extraction using TF-IDF
- Text classification using existing packages in Scikit learn
- Sentiment analysis of imdb dataset using Tensorflow Keras
- Text categorization using Clustering

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Questions?

Thank you!

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