srijan:

RAIT acm Chapter

Approaching Text Summarization using ML and DNN

RAIT-ACM STTP

25 May 2020

About Me

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Data Scientist | Kaggle Competition Expert

Experience Across
Machine Learning, Deep Learning,
Data Ops, Cloud, Algorithms, Optimization

Things to cover

- Introduction to Text Summarization
- Various approaches
- Propose possible solutions
- Create a basic solution
- Code Walkthrough
- Query session

What is Text Summarization?

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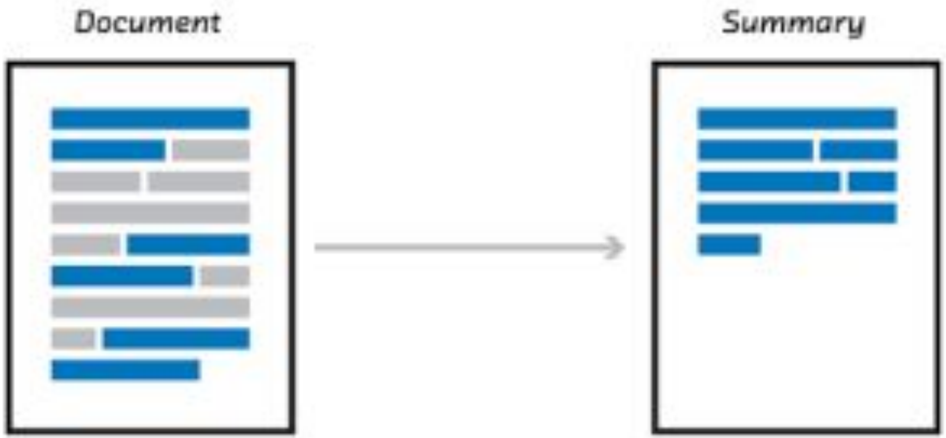
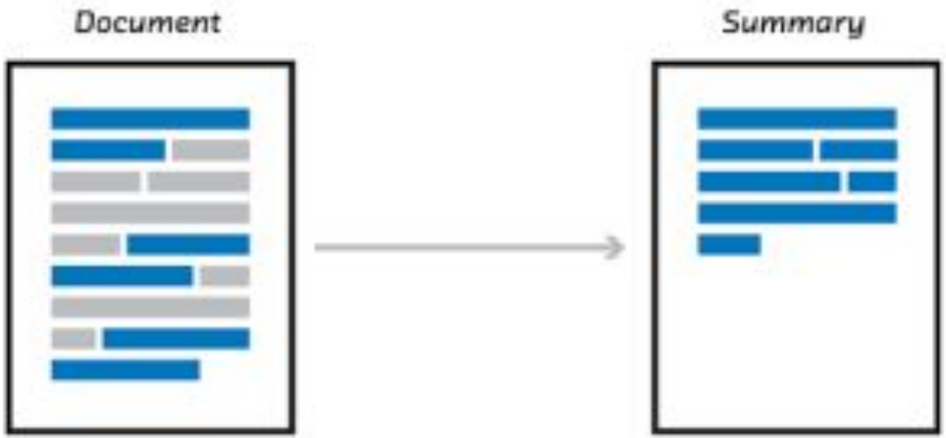


ref: https://medium.com/@ondenyi.eric/extractive-text-summarization-techniques-with-sumy-3d3b127a0a32

What is Text Summarization?

- Text summarization is the process of shortening a set of data computationally, to create a subset (a summary) that represents the most important or relevant information within the original content.[wikipedia]
- Text summarization is the technique for generating a concise and precise summary of voluminous texts while focusing on the sections that convey useful information, and without losing the overall meaning.[floydhub]



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Various approaches for text summarization?

- **Extractive Summarization**

- **Abstractive Summarization**

Various approaches for text summarization?

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- **Extractive Summarization**

Source Text: Peter and Elizabeth took a taxi to attend the night party in the city.

While in the party, Elizabeth collapsed and was rushed to the hospital.

Summary: Peter

- **Abstractive Summarization**

Source Text: Peter and Elizabeth took a taxi to attend the night party in the city.

While in the party, Elizabeth collapsed and was rushed to the hospital.

Summary: Elizabeth was hospitalized after attending a party with Peter.

ref: https://blog.floydhub.com/gentle-introduction-to-text-summarization-in-machine-learning/

Various approaches for text summarization?

- **Extractive Summarization**
  - Extractive summarization means identifying important sections (paragraphs or sentences or even words) of the text and selecting (copy paste) them producing a subset of the text from the original text.

Source Text: Peter and Elizabeth took a taxi to attend the night party in the city.

While in the party, Elizabeth collapsed and was rushed to the hospital.

Summary: Peter

- **Abstractive Summarization**
  - Abstractive summarization is the technique of generating a summary of a text from its main ideas, not by copying verbatim most salient sentences from text.

Source Text: Peter and Elizabeth took a taxi to attend the night party in the city.

While in the party, Elizabeth collapsed and was rushed to the hospital.

Summary: Elizabeth was hospitalized after attending a party with Peter.

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    - Count-based techniques like CountVectorizer, Tf-Idf Vectorizer

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- **What is TF-IDF Vectorizer:**

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$$tf_{i,j} = \frac{n_{i,j}}{\sum_k n_{i,j}}$$

Count vectorization

	for	sat	around	fire	a	the	man	went	out	walk	children
0	0.142857	0.000000	0.000000	0.000000	0.142857	0.142857	0.142857	0.142857	0.142857	0.142857	0.000000
1	0.000000	0.166667	0.166667	0.166667	0.000000	0.333333	0.000000	0.000000	0.000000	0.000000	0.166667

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Inverse Document Frequency (IDF)

$$idf(w) = log(\frac{N}{df_t})$$

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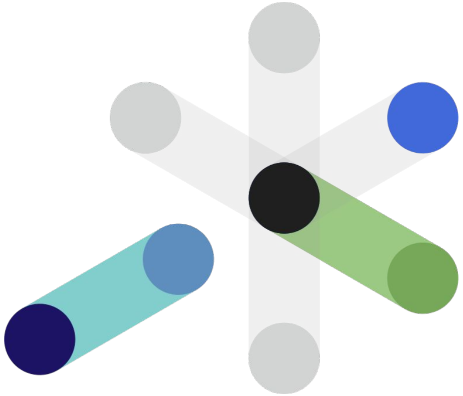
0	0.099021	0.000000	0.000000	0.000000	0.099021	0.0	0.099021	0.099021	0.099021	0.099021	0.000000
1	0.000000	0.115525	0.115525	0.115525	0.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.115525

$$w_{i,j} = tf_{i,j} \times \log\left(\frac{N}{df_i}\right)$$

TF-IDF



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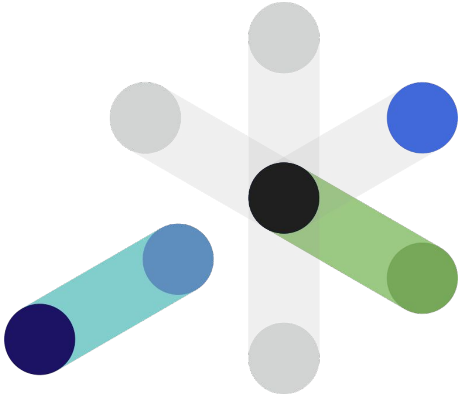
  - For each word in our vocabulary, there will be a learned numerical representation for it.



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  - Both of these techniques learn weights which act as word vector representations.

Approaching Extractive Summarization?

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- **What is CBOW:**

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- **What is CBOW:**
  - CBOW stands for continuous bag-of-words architecture:
    - Task is to predicts the current word from a window of surrounding context words.[wikipedia]
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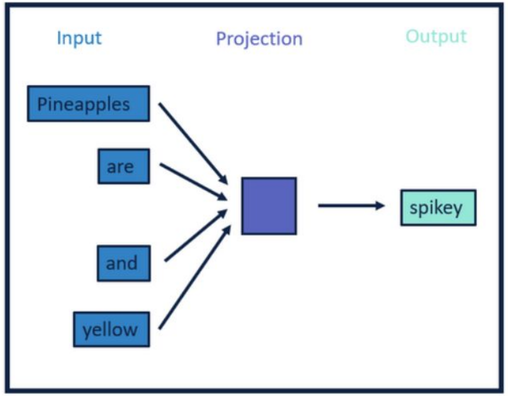

CBOW

Input	Output
Pineapples	Spikey
are	Spikey
and	Spikey
yellow	Spikey

CBOW

ref: https://community.alteryx.com/t5/Data-Science-Blog/Word2vec-for-the-Alteryx-Community/ba-p/305285

Approaching Extractive Summarization?

- **What is SKIP-GRAM:**

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    - The skip-gram architecture weighs nearby context words more heavily than more distant context words.[wikipedia]
    - According to the authors' note, CBOW is faster while skip-gram is slower but does a better job for infrequent words.[wikipedia]

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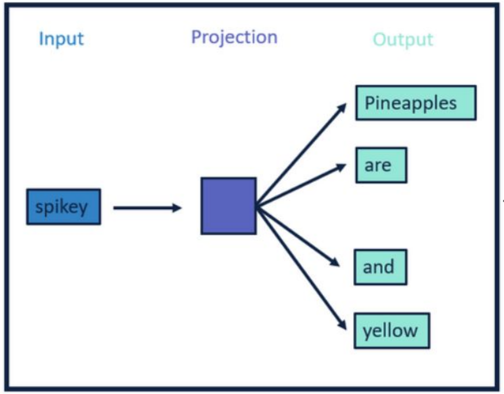

Skip-gram

Input	Output
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Skip-gram

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Approaching Extractive Summarization?

- **Using Word2Vec Embedding**

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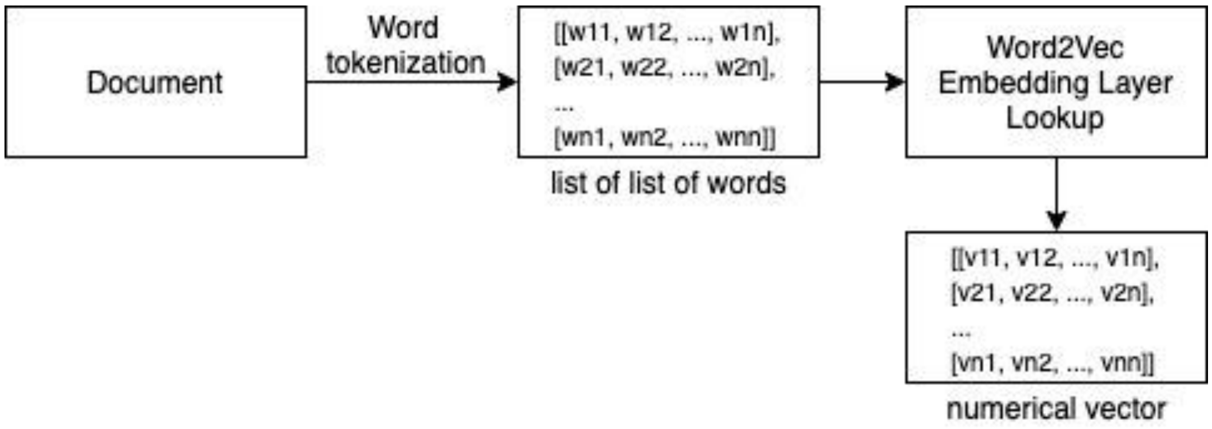
- **Using Word2Vec Embedding**
  - Flow would be something like below one:



Using Word2Vec to convert text data to numerical semantic vector

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  - Pretrained SOTA transformers like BERT (or its variants) to better capture context as well.

Approaching Extractive Summarization?

- **What is BERT:**

Approaching Extractive Summarization?

- **What is BERT:**
  - BERT stands for Bi-directional Encoder Representation from Transformers.
  - It is designed to pre-train deep bidirectional representations from unlabeled text by jointly conditioning on both left and right context.
  - BERT is pre-trained on two NLP tasks:
    - Masked Language Modeling
    - Next Sentence Prediction

Approaching Extractive Summarization?

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- **What is BERT:**
  - BERT stands for Bi-directional Encoder Representation from Transformers.
  - It has two variants mainly:
    - BERT Base: 12 layers (transformer blocks), 12 attention heads, and 110 million parameters
    - BERT Large: 24 layers (transformer blocks), 16 attention heads and, 340 million parameters
  - BERT is pre-trained on two NLP tasks:
    - Masked Language Modeling
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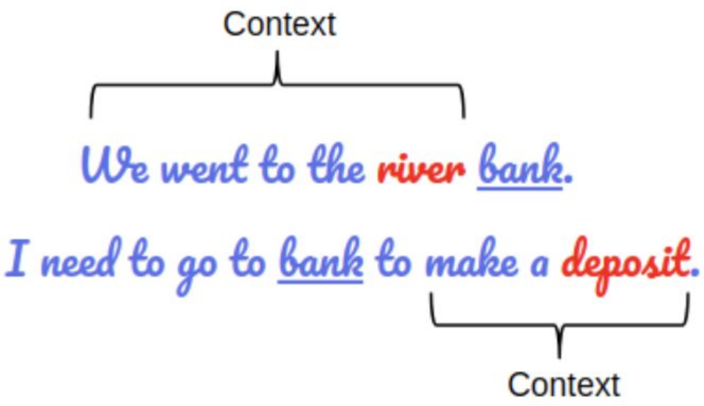

ref: https://www.analyticsvidhya.com/blog/2019/09/demystifying-bert-groundbreaking-nlp-framework/

Approaching Extractive Summarization?

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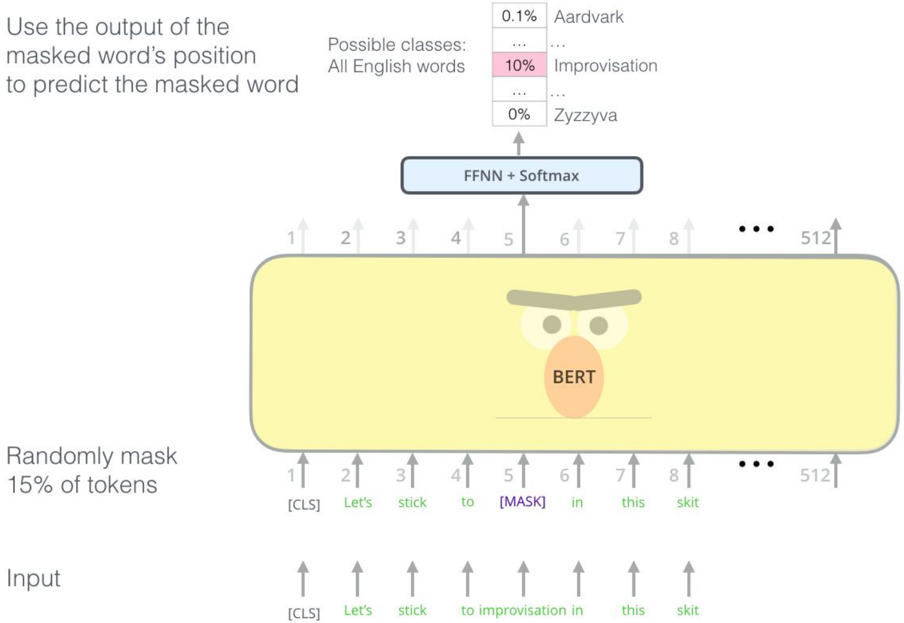

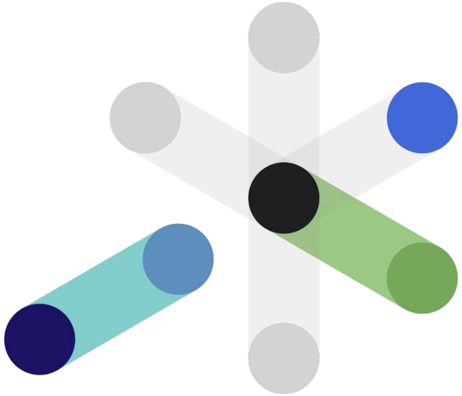

BERT's clever language modeling task masks 15% of words in the input and asks the model to predict the missing word

ref: http://jalammar.github.io/illustrated-bert/

Approaching Extractive Summarization?

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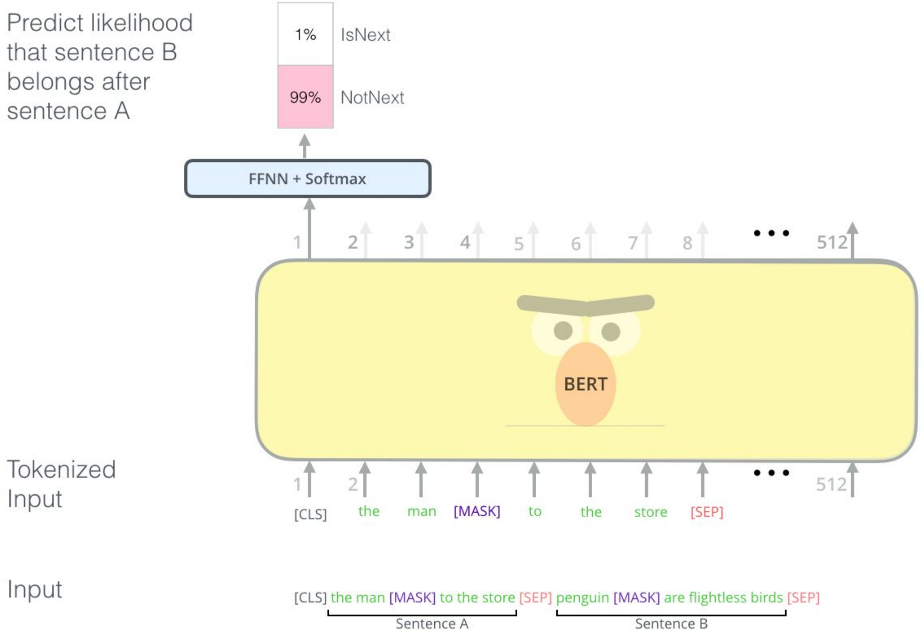
- **What is Next Sentence Prediction:**



The second task BERT is pre-trained on is a two-sentence classification task. The tokenization is oversimplified in this graphic as BERT actually uses WordPieces as tokens rather than words --- so some words are broken down into smaller chunks.

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Approaching Extractive Summarization?

- **Using BERT for feature extraction**

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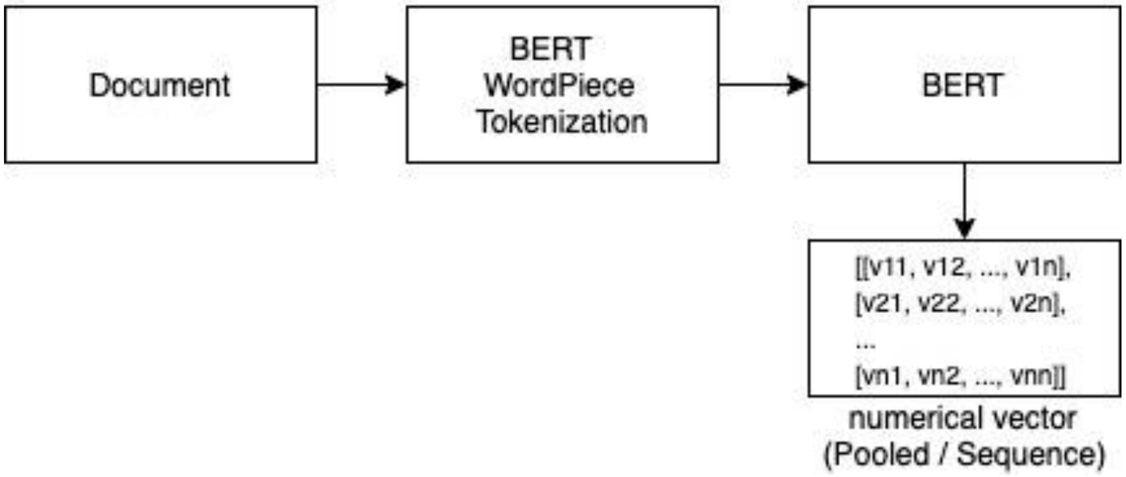

Using BERT to convert text data to numerical vector

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- Use the comparisons to score each sentences and pick the top scored ones as your summary.
- Scoring technique needs to be intelligent enough to properly evaluate what are the information content of a sentence and thus score it accordingly.

Approaching Extractive Summarization?

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Let’s build our basic Solution

Approaching Extractive Summarization?

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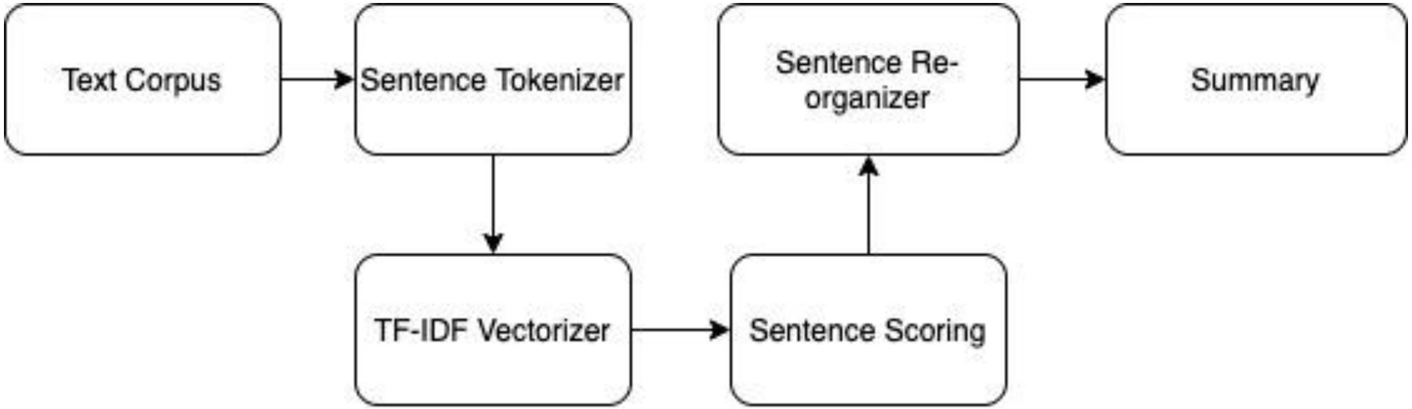

A high level solution for frequency based extractive summarizer

Approaching Extractive Summarization?

- **Sentence scoring using TF-IDF:**

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documentA = 'the man went out for a walk'
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Adding TF-IDF weights to score each sentence

	for	sat	around	fire	a	the	man	went	out	walk	children	score
0	0.099021	0.000000	0.000000	0.000000	0.099021	0.0	0.099021	0.099021	0.099021	0.099021	0.000000	0.594126
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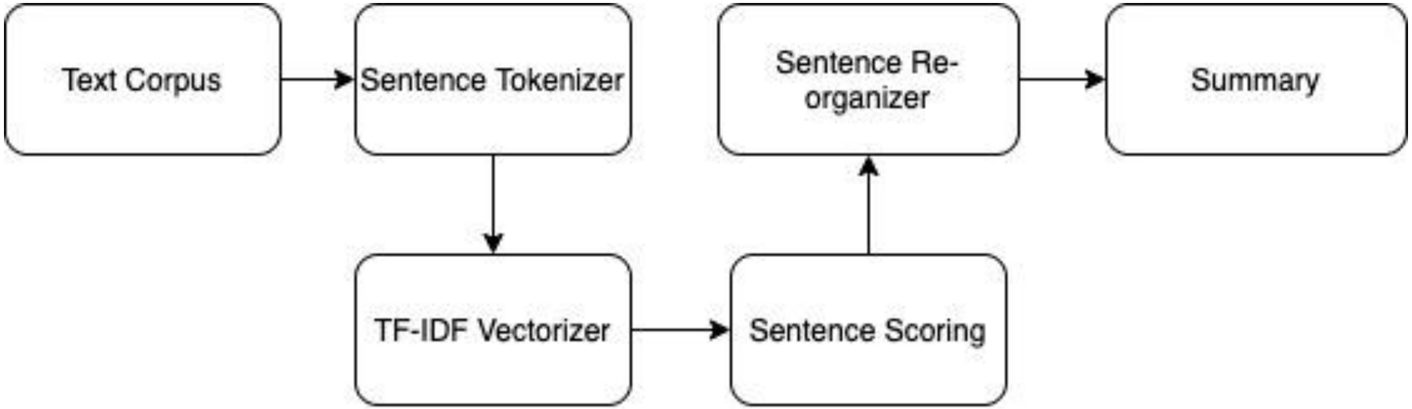

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- **What is Sentence Reorganizer:**

  Text : Stop Words are words which do not contain important significance to be used in Search Queries. Usually, these words are filtered out from search queries because they return a vast amount of unnecessary information. Each programming language will give its own list of stop words to use.

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Sentence Order Indexing : { "Stop Words are words which do not contain important significance to be used in Search Queries": 0,
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Scored Sentences : { “Each programming language will give its own list of stop words to use”: 1.32
,
“Stop Words are words which do not contain important significance to be used in Search Queries”: 0.79,
“Usually, these words are filtered out from search queries because they return a vast amount of unnecessary information”: 0.32 }

Result : Stop Words are words which do not contain important significance to be used in Search Queries. Each programming language will give its own list of stop words to use.

Let’s be practical…….

Fire up your Notebooks

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Any Questions ?

Thank You

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RAIT acm Chapter