Applied Artificial Intelligence

Session 21: Language Model, and RNN for modeling sequences (such as text)

Fall 2018

NC State University
Lecturer: Dr. Behnam Kia

Course Website: https://appliedai.wordpress.ncsu.edu/

Text

- Texts are among the most common types of data that we work on in Machine Learning.

Text

- Machine learning algorithms usually do not take the raw text as inputs, rather text must be transformed to numeric values (numeric vectors). We do so by:

  - Segment text into **characters** and transform each to a vector.

  or

  - Segment text into **words** and transform each to a vector.

  or

  - Segment text into **n-grams of words** and transform each to a vector.

Text

- Segment text into **characters** and transform each to a number or a vector.

- Example:

  I am Groot -> “I” “a” “m” “space” “G” “r” “o” “o” “t”

  And then transform each token to a vector

Text

- Segment text into **words** and transform each to a number or a vector.

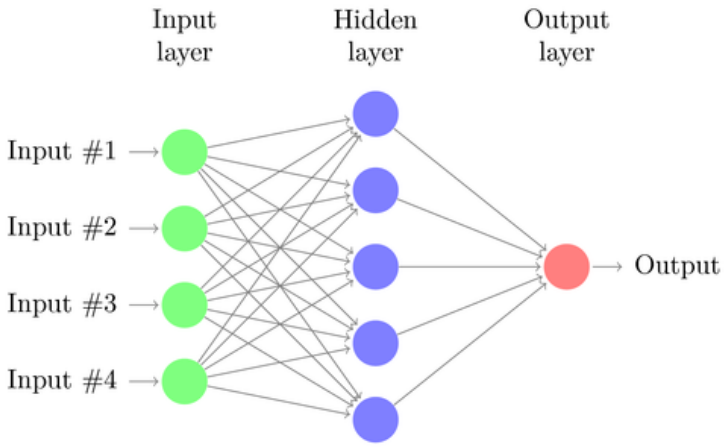
- Example:

  I am Groot -> “I” “am” “Groot”

  And then transform each to a vector

How to model and represent language?

"I" "am" "Groot" ? →



How to transform each token to a vector and represent a sentence with a vector: Method 1: One-hot encoding

Vocabulary={I, am, Groot} ?

One-hot encoding

Vocabulary={I, am, Groot, we, are}

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$$\begin{bmatrix} & \end{bmatrix}$$

One-hot encoding

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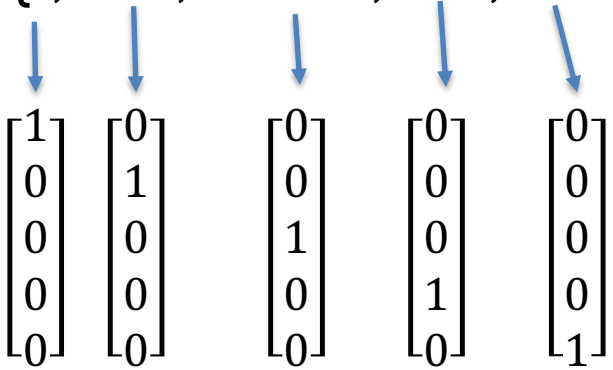

One-hot encoding

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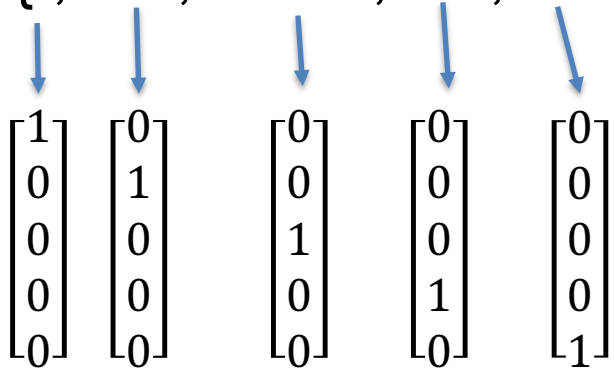


I am Groot. → $\begin{bmatrix}1\\1\\1\\0\\0\end{bmatrix}$

We are Groot. → $\begin{bmatrix}0\\0\\1\\1\\1\end{bmatrix}$

Text

- Texts are among the most common types of data that we work on in Machine Learning.

- Segment text into **n-grams of words** and transform each to a a vector.

- Example for 2-grams:

  I am Groot -> “I” “am” “Groot” “I am” “am Groot”

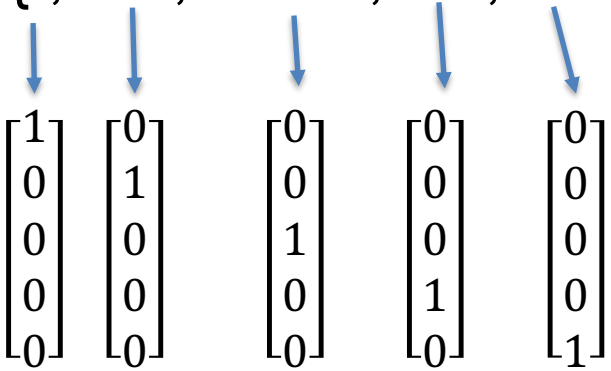
  And then transform each token to a vector

  This representation is called bag-of-2-grams representation of the sentence.

- In most text processing applications words are used as the main tokens.

One-hot encoding: Problems?

Vocabulary={I, am, Groot, we, are}



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One-hot encoding: Problems?

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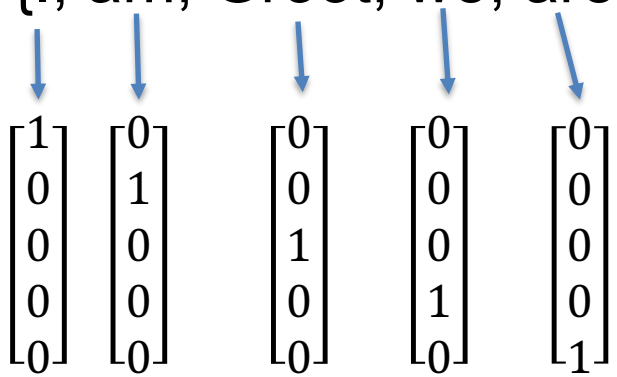

Vocabulary can have 10s of thousands of words.

- Sparse high dimensional vectors.
- Usually hard-coded
- meaningless representation

I am Groot. → $\begin{bmatrix}1\\1\\1\\0\\0\end{bmatrix}$

We are Groot. → $\begin{bmatrix}0\\0\\1\\1\\1\end{bmatrix}$

Word Embedding (word vectorization)

- Each word is represented by a dense, low-dimensional, floating point vectors.
- 256 dimensional, 512 dimensional, or 1024 dimensional.

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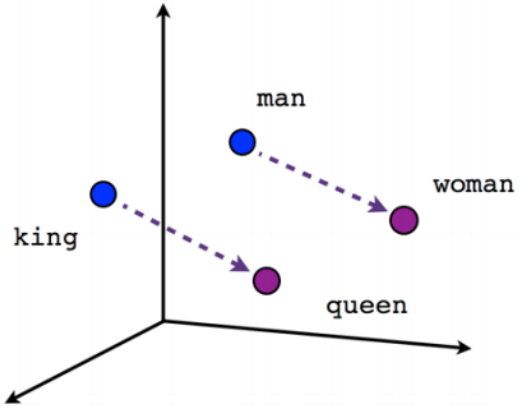
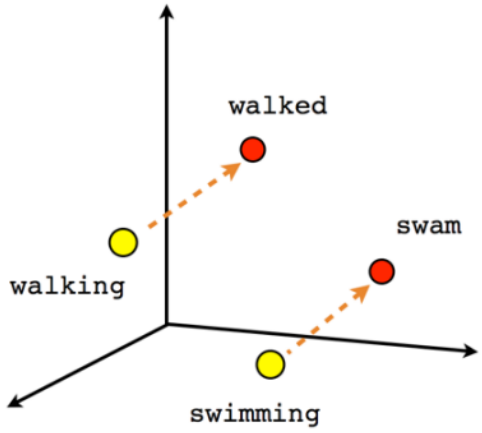
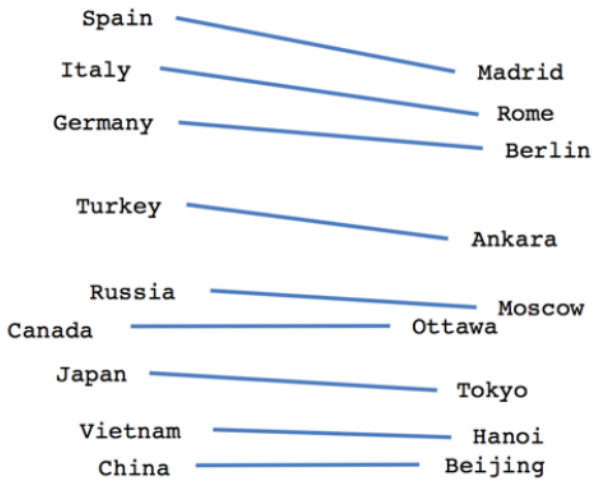


Male-Female



Verb tense

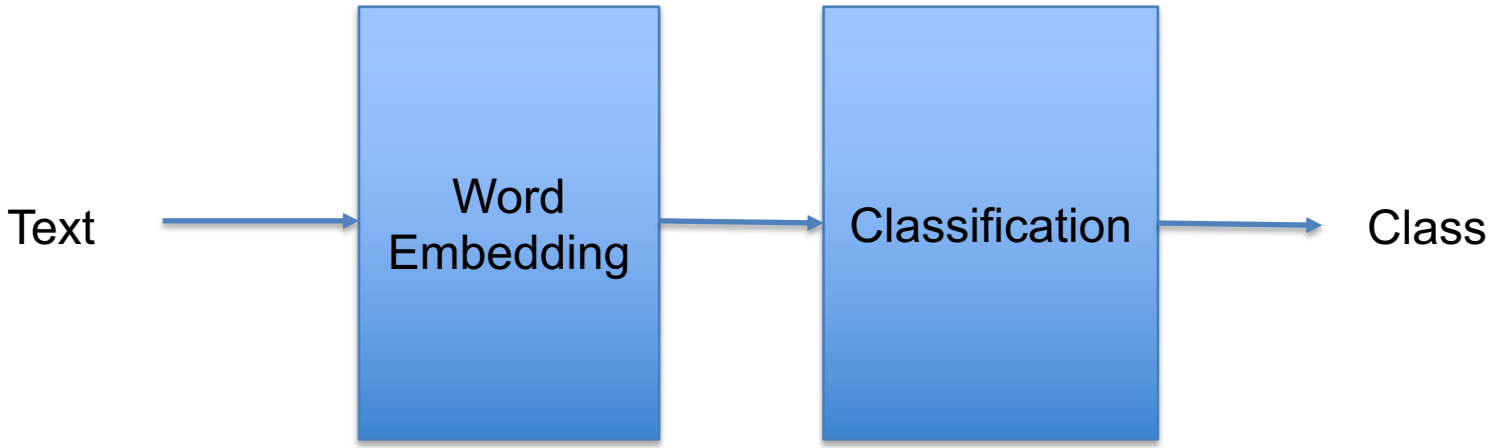


Country-Capital

https://www.tensorflow.org/tutorials/representation/word2vec

How to implement word embedding?

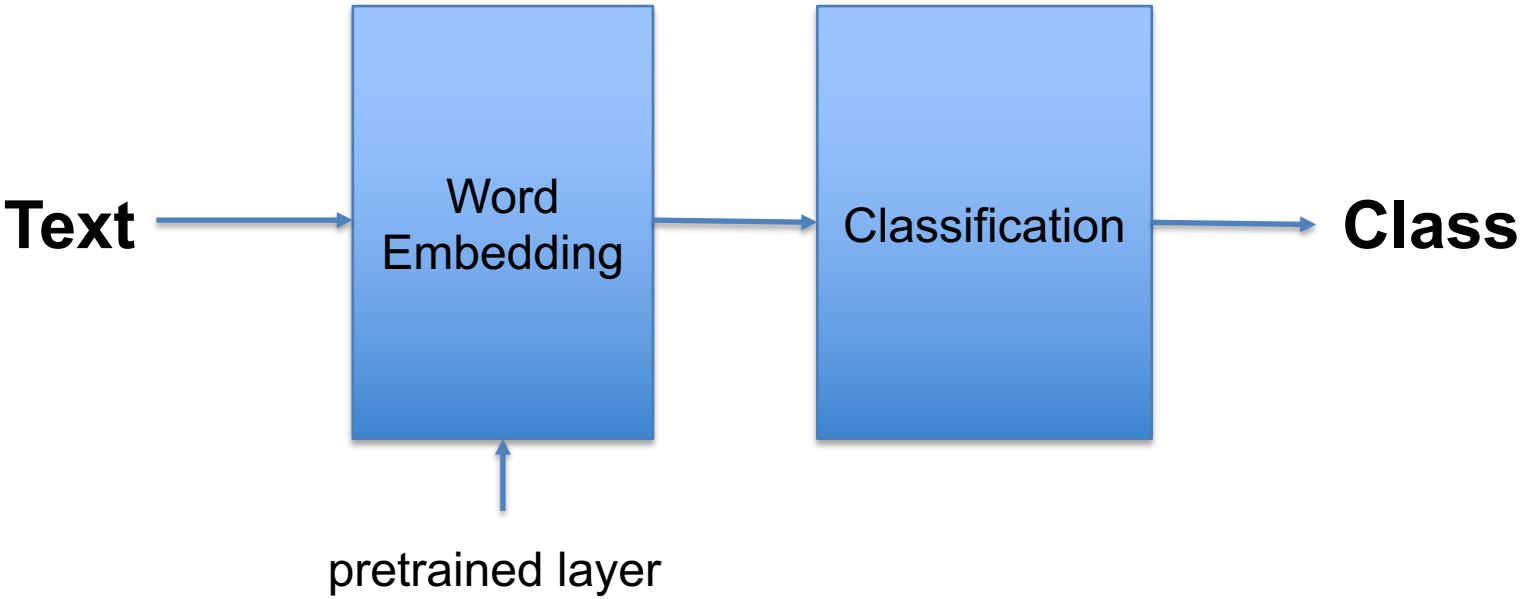
1- Learn jointly with the main task.



How to implement word embedding?

1- Learn jointly with the main task.

2- Load a pretrained word embedding



- Please see the codes: Session 21: Simple RNN for text classification