Part-of-Speech Tagging with Word Embeddings

CS 9875 Final Project

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Outline

Part-of-Speech Tagging

Parts of Speech

- Each word in a sentence carries out a syntactic role: denote an object, denote an action, modify an object, etc.
- This role is mapped to the word using a part-of-speech (PoS) tag

Spelled the Same, Used Differently: Syntactic and Semantic Differences

Words can be different parts of speech (do different things) depending on where they are in the sentence and what is around them

1. Noun-Verb: "spot"
   - "Your nose has a spot on it." (N)
   - "Can you spot him?" (V)
2. Noun-Adjective: "red"
   - "The red I like is that one." (N)
   - "The red car has arrived." (A)

Tagging

Given a sentence, assign a PoS tag to each word in the sentence.

Can you spot the large spot on your nose ?

Tagging

Given a sentence, assign a PoS tag to each word in the sentence.

Can	you	spot	the	large	spot	on	your	nose	?
VB	D	VB	D	Adj	N	PP	D	N	.

Tagging

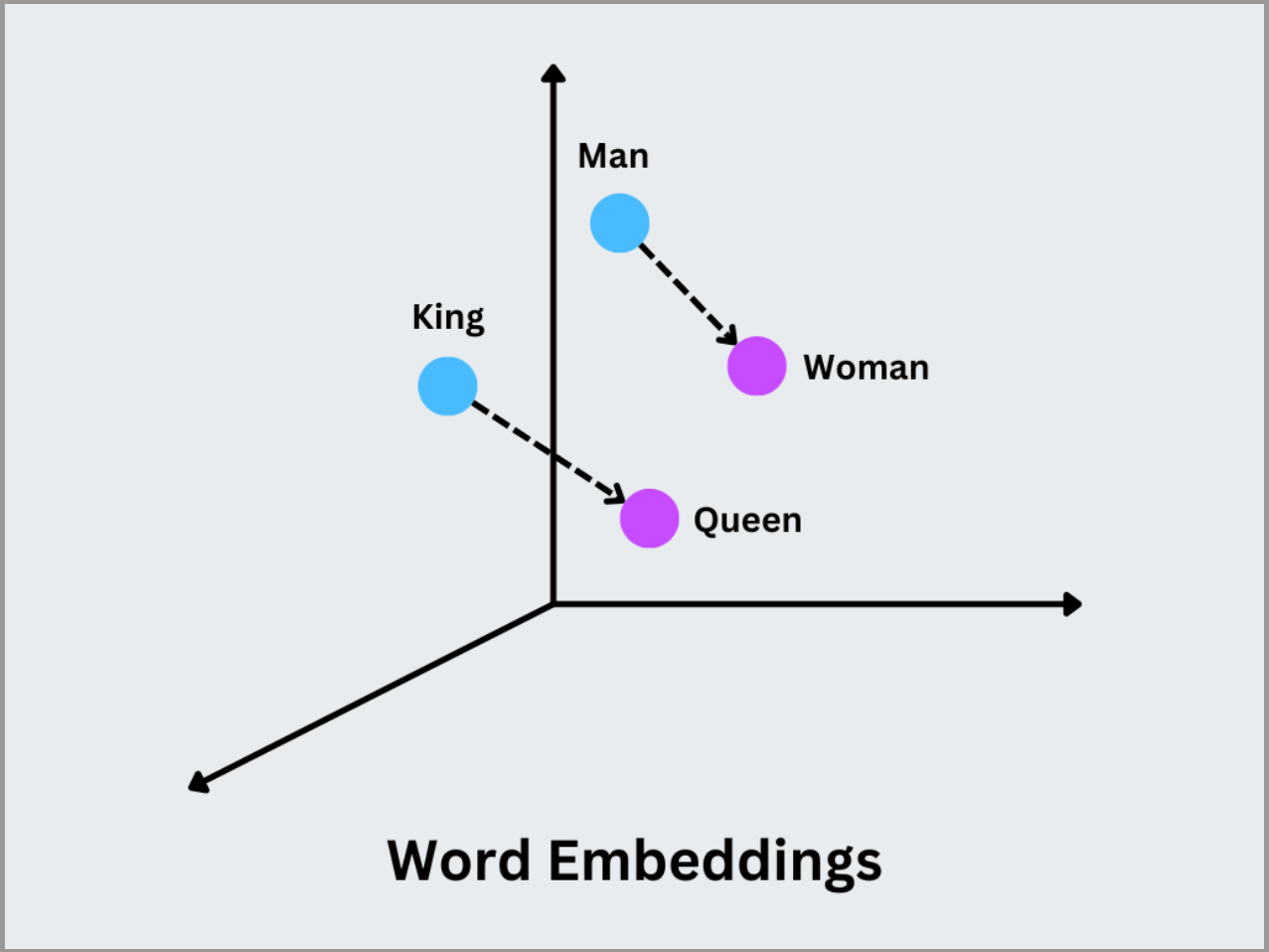
Given a sentence, assign a PoS tag to each word in the sentence.

Can	you	spot	the	large	spot	on	your	nose	?
VB	D	VB	D	Adj	N	PP	D	N	.

What makes PoS tagging different from a standard classification task: context is very important.

Word Embedding Models

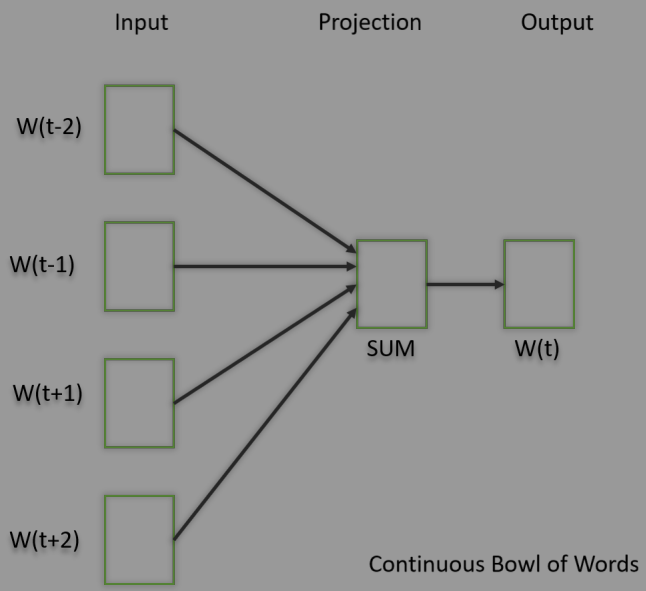
What are word embeddings?



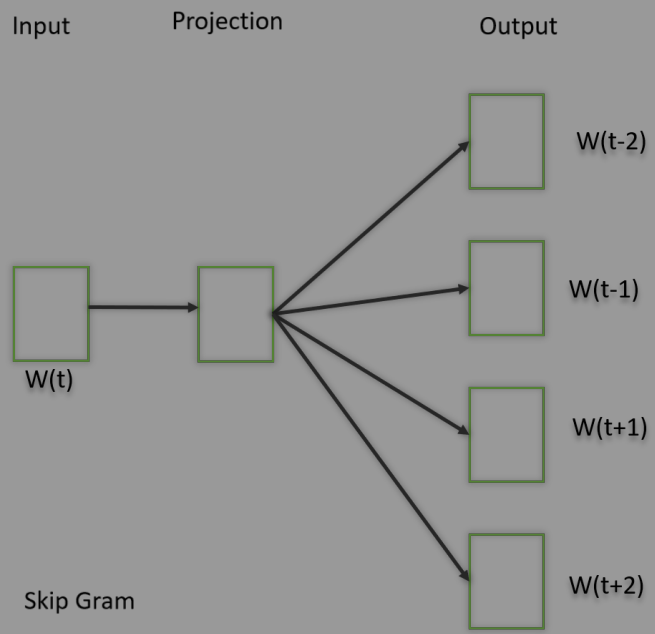
Static Word Embeddings

What are static word embedding models?

Word2Vec



CBOW



Skip Gram

Word2Vec Training Procedures

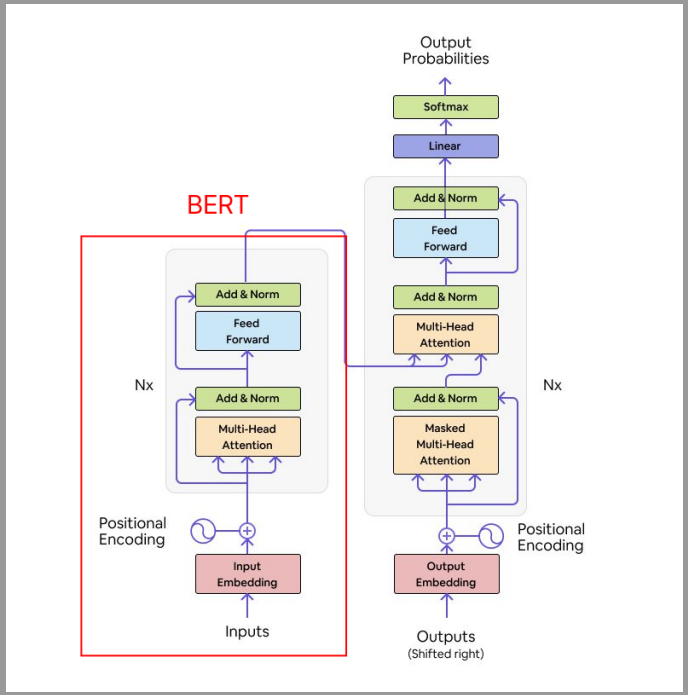
Word2Vec

$$\begin{bmatrix} W_{00} & W_{01} & W_{02} & \dots \\ W_{10} & W_{11} & W_{12} & \dots \\ W_{20} & W_{21} & W_{22} & \dots \\ \dots & \dots & \dots & \dots \end{bmatrix}$$

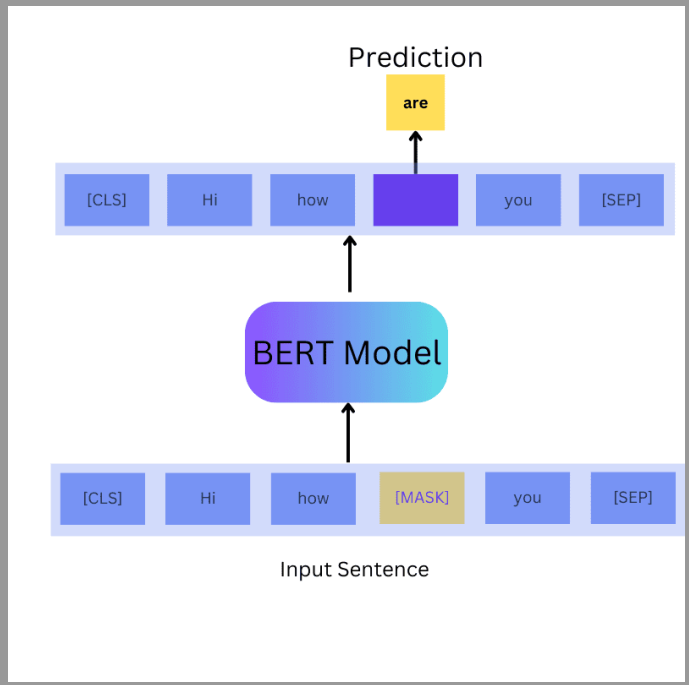
Contextual Word Embeddings

What are contextual word embeddings?

BERT

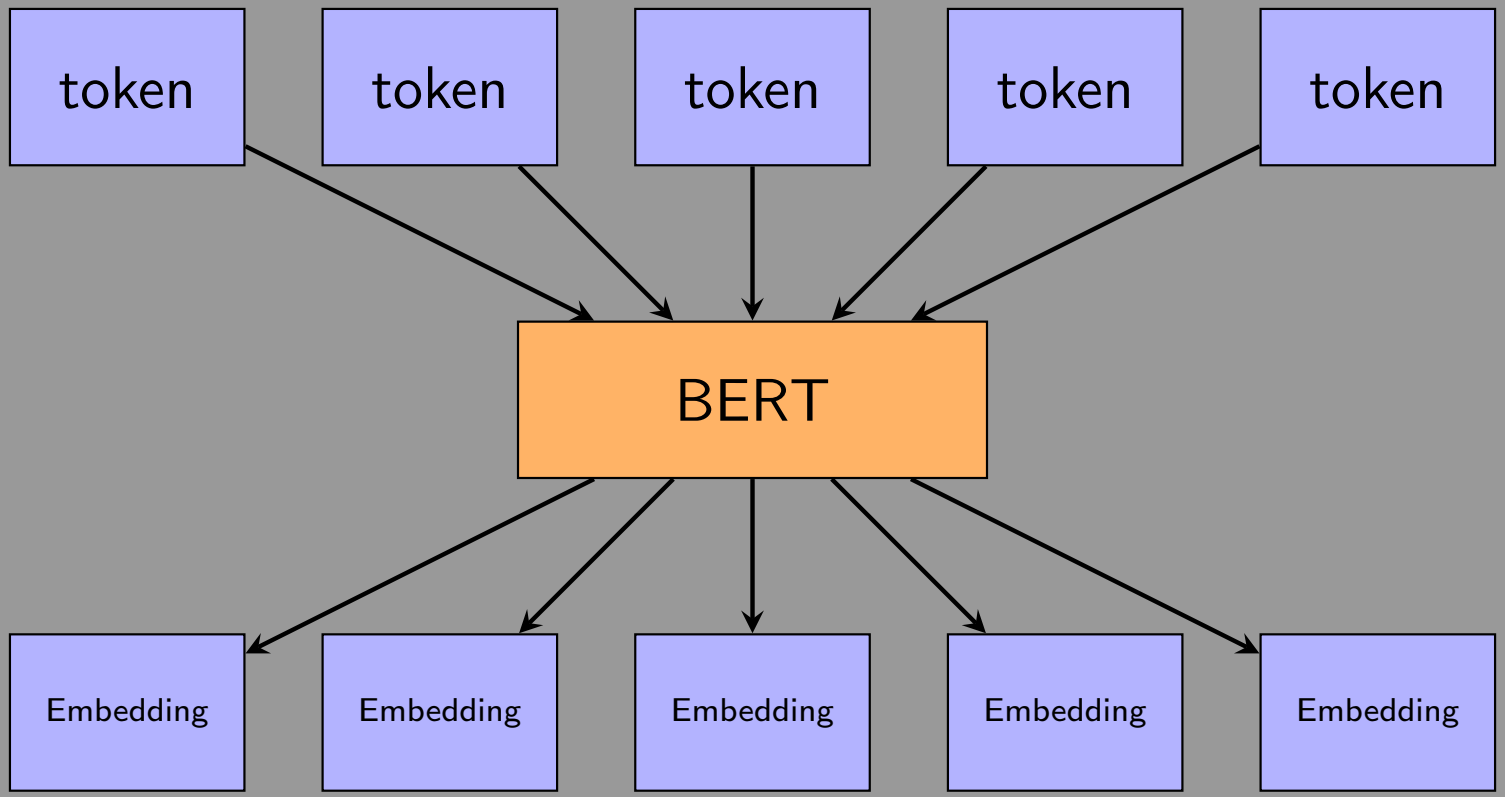


Transformer architecture



MLM

BERT


token
token
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BERT
Embedding
Embedding
Embedding
Embedding
Embedding

How do we use these embeddings?

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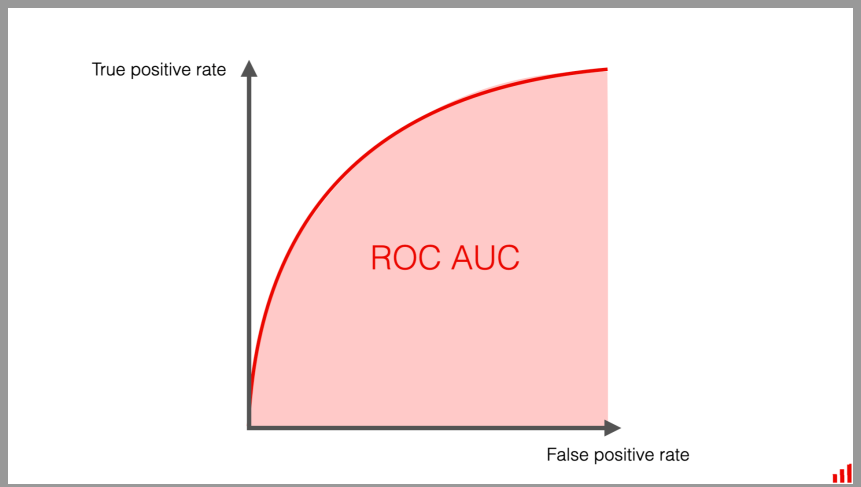
As input for a downstream model: SVM, Boosting, CNN, etc.

Evaluation and Theoretical Analysis

Evaluation Metrics

We will evaluate each of our models using F1 score and AUC-ROC adapted for this multi-class classification problem.



AUC-ROC

Dataset Used

Brown Corpus:

- 1 million tagged words, validated by humans
- American English
- Provided by the Natural Language ToolKit (NLTK)

Theoretical Analysis

We will conduct a theoretical analysis on the word embedding models, and the downstream classifier models.

Anticipated Results

We anticipate achieving near perfect scores in both evaluation metrics using contextual embeddings from BERT and a simple classification model like an SVM.