CSE6060

Statistical Natural Language Processing

Embedding and Chunking

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Embedding

Embeddings translate large sparse vectors into a lower-dimensional space that preserves semantic relationships.

Word embeddings is a technique where individual words of a domain or language are represented as real-valued vectors in a lower dimensional space.

The idea behind all of the word embeddings is to capture with them as much of the semantical/morphological/context/hierarchical/etc, information as possible.

In [1]:

```
from nltk.tokenize import sent_tokenize, word_tokenize
import warnings
import gensim
from gensim.models import Word2Vec
```

In [2]:

```
sample = open("C:/Users/KaviananD/Desktop/dataset/alice_in_wonderland.txt", "r")
s = sample.read()
```

In [3]:

```
# Replaces escape character with space
f = s.replace("\n", " ")
```

In [4]:

```
data = []
# iterate through each sentence in the file
for i in sent_tokenize(f):
    temp = []

    # tokenize the sentence into words
    for j in word_tokenize(i):
        temp.append(j.lower())

    data.append(temp)
```

In [5]:

```
print(data)
```

```
[['project', 'gutenberg', "'s", 'alice', "'s", 'adventures', 'in', 'wonder
land', ',', 'by', 'lewis', 'carroll', 'this', 'ebook', 'is', 'for', 'the',
'use', 'of', 'anyone', 'anywhere', 'at', 'no', 'cost', 'and', 'with', 'alm
ost', 'no', 'restrictions', 'whatsoever', '.'], ['you', 'may', 'copy', 'i
t', ',', 'give', 'it', 'away', 'or', 're-use', 'it', 'under', 'the', 'term
s', 'of', 'the', 'project', 'gutenberg', 'license', 'included', 'with', 't
his', 'ebook', 'or', 'online', 'at', 'www.gutenberg.org', 'title', ':', 'a
lice', "'s", 'adventures', 'in', 'wonderland', 'author', ':', 'lewis', 'ca
rroll', 'posting', 'date', ':', 'june', '25', ',', '2008', '[', 'ebook',
'#', '11', ']', 'release', 'date', ':', 'march', ',', '1994', '[', 'last',
'updated', ':', 'december', '20', ',', '2011', ']', 'language', ':', 'engl
ish', 'character', 'set', 'encoding', ':', 'ascii', '*', '*', '*', 'star
t', 'of', 'this', 'project', 'gutenberg', 'ebook', 'alice', "'s", 'adventu
res', 'in', 'wonderland', '*', '*', '*', 'alice', "'s", 'adventures', 'i
n', 'wonderland', 'lewis', 'carroll', 'the', 'millennium', 'fulcrum', 'edi
tion', '3.0', 'chapter', 'i', '.'], ['down', 'the', 'rabbit-hole', 'alic
e', 'was', 'beginning', 'to', 'get', 'very', 'tired', 'of', 'sitting', 'b
y', 'her', 'sister', 'on', 'the', 'bank', ',', 'and', 'of', 'having', 'not
hing', 'to', 'do', ':', 'once', 'or', 'twice', 'she', 'had', 'peeped', 'in
```

In [6]:

```
# Create CBOW model
model1 = gensim.models.Word2Vec(data, min_count = 1,
                                size = 100, window = 5)
```

CBOW (Continuous Bag of Words)

CBOW model predicts the current word given context words within specific w
indow. The input layer contains the context words and the output layer contains th
e current word. The hidden layer contains the number of dimensions in which we wan
t to represent current word present at the output layer.

In [7]:

```
# Print results
print("Cosine similarity between 'alice' " +
                "and 'wonderland' - CBOW : ",
    model1.similarity('alice', 'wonderland'))

print("Cosine similarity between 'alice' " +
                 "and 'machines' - CBOW : ",
      model1.similarity('alice', 'machines'))
```

```
Cosine similarity between 'alice' and 'wonderland' - CBOW :  0.9828558
Cosine similarity between 'alice' and 'machines' - CBOW :  0.9907339

C:\Users\KaviananD\Anaconda3\envs\tf_gpu_new\lib\site-packages\ipykernel_lau
ncher.py:4: DeprecationWarning: Call to deprecated `similarity` (Method will
be removed in 4.0.0, use self.wv.similarity() instead).
  after removing the cwd from sys.path.
C:\Users\KaviananD\Anaconda3\envs\tf_gpu_new\lib\site-packages\ipykernel_lau
ncher.py:8: DeprecationWarning: Call to deprecated `similarity` (Method will
be removed in 4.0.0, use self.wv.similarity() instead).
```

Skip Gram

Skip gram predicts the surrounding context words within specific window given current word. The input layer contains the current word and the output layer contains the context words. The hidden layer contains the number of dimensions in which we want to represent current word present at the input layer.

In [8]:

```
# Create Skip Gram model
model2 = gensim.models.Word2Vec(data, min_count = 1, size = 100,
                                             window = 5, sg = 1)

# Print results
print("Cosine similarity between 'alice' " +
          "and 'wonderland' - Skip Gram : ",
    model2.similarity('alice', 'wonderland'))

print("Cosine similarity between 'alice' " +
            "and 'machines' - Skip Gram : ",
      model2.similarity('alice', 'machines'))
```

```
Cosine similarity between 'alice' and 'wonderland' - Skip Gram :  0.6691489
Cosine similarity between 'alice' and 'machines' - Skip Gram :  0.8926866

C:\Users\KaviananD\Anaconda3\envs\tf_gpu_new\lib\site-packages\ipykernel_lau
ncher.py:8: DeprecationWarning: Call to deprecated `similarity` (Method will
be removed in 4.0.0, use self.wv.similarity() instead).

C:\Users\KaviananD\Anaconda3\envs\tf_gpu_new\lib\site-packages\ipykernel_lau
ncher.py:12: DeprecationWarning: Call to deprecated `similarity` (Method wil
l be removed in 4.0.0, use self.wv.similarity() instead).
  if sys.path[0] == '':
```

In [9]:

```
import nltk
```

In [10]:

```
from nltk.corpus import brown
model = gensim.models.Word2Vec(brown.sents())
```

In [11]:

```
model.save('model_brown_embedding')
model_3 = gensim.models.Word2Vec.load('model_brown_embedding')
```

In [12]:

```
len(model['universities'])
```

```
C:\Users\KaviananD\Anaconda3\envs\tf_gpu_new\lib\site-packages\ipykernel_lau
ncher.py:1: DeprecationWarning: Call to deprecated `__getitem__` (Method wil
l be removed in 4.0.0, use self.wv.__getitem__() instead).
  """Entry point for launching an IPython kernel.
```

Out[12]:

```
100
```

In [13]:

```
model_3.similarity('university','school') > 0.3
```

```
C:\Users\KaviananD\Anaconda3\envs\tf_gpu_new\lib\site-packages\ipykernel_lau
ncher.py:1: DeprecationWarning: Call to deprecated `similarity` (Method will
be removed in 4.0.0, use self.wv.similarity() instead).
  """Entry point for launching an IPython kernel.
```

Out[13]:

```
True
```

In [14]:

```
model.similarity('university','school') > 0.3
```

```
C:\Users\KaviananD\Anaconda3\envs\tf_gpu_new\lib\site-packages\ipykernel_lau
ncher.py:1: DeprecationWarning: Call to deprecated `similarity` (Method will
be removed in 4.0.0, use self.wv.similarity() instead).
  """Entry point for launching an IPython kernel.
```

Out[14]:

```
True
```

In [15]:

```
1 nltk.download('word2vec_sample')
```

```
[nltk_data] Downloading package word2vec_sample to
[nltk_data]     C:\Users\KaviananD\AppData\Roaming\nltk_data...
[nltk_data]   Package word2vec_sample is already up-to-date!
```

Out[15]:

```
True
```

In [16]:

```
1 model.similarity('woman','man')
```

```
C:\Users\KaviananD\Anaconda3\envs\tf_gpu_new\lib\site-packages\ipykernel_lau
ncher.py:1: DeprecationWarning: Call to deprecated `similarity` (Method will
be removed in 4.0.0, use self.wv.similarity() instead).
  """Entry point for launching an IPython kernel.
```

Out[16]:

```
0.8750772
```

In [18]:

```
1 model.doesnt_match('breakfast cereal dinner lunch'.split())
2
```

```
C:\Users\KaviananD\Anaconda3\envs\tf_gpu_new\lib\site-packages\ipykernel_lau
ncher.py:1: DeprecationWarning: Call to deprecated `doesnt_match` (Method wi
ll be removed in 4.0.0, use self.wv.doesnt_match() instead).
  """Entry point for launching an IPython kernel.
C:\Users\KaviananD\Anaconda3\envs\tf_gpu_new\lib\site-packages\gensim\models
\keyedvectors.py:877: FutureWarning: arrays to stack must be passed as a "se
quence" type such as list or tuple. Support for non-sequence iterables such
as generators is deprecated as of NumPy 1.16 and will raise an error in the
future.
  vectors = vstack(self.word_vec(word, use_norm=True) for word in used_word
s).astype(REAL)
```

Out[18]:

```
'cereal'
```

In [19]:

```
1 model.most_similar(positive=['woman','king'],negative=['man'],topn=1)
```

```
C:\Users\KaviananD\Anaconda3\envs\tf_gpu_new\lib\site-packages\ipykernel_lau
ncher.py:1: DeprecationWarning: Call to deprecated `most_similar` (Method wi
ll be removed in 4.0.0, use self.wv.most_similar() instead).
  """Entry point for launching an IPython kernel.
```

Out[19]:

```
[('sold', 0.9465019106864929)]
```

In [20]:

```
from nltk.data import find
word2vec_sample = str(find('models/word2vec_sample/pruned.word2vec.txt'))
model = gensim.models.KeyedVectors.load_word2vec_format(word2vec_sample, binary=False)
```

In [21]:

```
import numpy as np
labels = []
count = 0
max_count = 50
X = np.zeros(shape=(max_count,len(model['university'])))
```

In [22]:

```
for term in model.vocab:
    X[count] = model[term]
    labels.append(term)
    count+= 1
    if count >= max_count: break
```

In [23]:

```
# It is recommended to use PCA first to reduce to ~50 dimensions
from sklearn.decomposition import PCA
pca = PCA(n_components=50)
X_50 = pca.fit_transform(X)

```

In [24]:

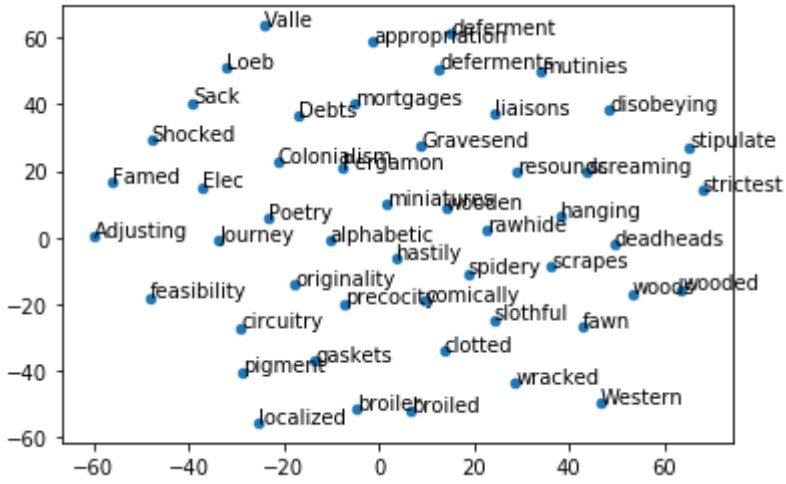
```
# Using TSNE to further reduce to 2 dimensions
from sklearn.manifold import TSNE
model_tsne = TSNE(n_components=2, random_state=0)
Y = model_tsne.fit_transform(X_50)
```

In [25]:

```
# Show the scatter plot
%matplotlib inline
import matplotlib.pyplot as plt
plt.scatter(Y[:,0], Y[:,1], 20)
#Add labels
for label, x, y in zip(labels, Y[:, 0], Y[:, 1]):
    plt.annotate(label, xy = (x,y), xytext = (0, 0), textcoords = 'offset points', size

plt.show()

```



Chunking

Parts of speech Tagging is responsible for reading the text in a language and assigning some specific token (Parts of Speech) to each word.

Chunking is used to add more structure to the sentence by following parts of speech (POS) tagging.

It is also known as shallow parsing. The resulted group of words is called "chunks."

The primary usage of chunking is to make a group of "noun phrases." The parts of speech are combined with regular expressions.

In [26]:

```
import nltk
nltk.download('tagsets')
```

```
[nltk_data] Downloading package tagsets to
[nltk_data]     C:\Users\KaviananD\AppData\Roaming\nltk_data...
[nltk_data]   Package tagsets is already up-to-date!
```

Out[26]:

```
True
```

In [27]:

```
nltk.help.upenn_tagset("NN")
```

```
NN: noun, common, singular or mass
    common-carrier cabbage knuckle-duster Casino afghan shed thermostat
    investment slide humour falloff slick wind hyena override subhumanity
    machinist ...
```

In [28]:

```
import nltk
from nltk import pos_tag
from nltk import RegexpParser
text ="Chunking is used to add more structure to the sentence by following parts of spe
tokens = nltk.word_tokenize(text)
print("\nAfter Split:",tokens)
tokens_tag = pos_tag(tokens)
print("\nAfter Token:",tokens_tag)
patterns= """NP:{<NN.?>*<VBD.?>*<JJ.?>*<CC>?}"""
chunker = RegexpParser(patterns)
print("\nAfter Regex:",chunker)
output = chunker.parse(tokens_tag)
print("\nAfter Chunking",output)
```

```
After Split: ['Chunking', 'is', 'used', 'to', 'add', 'more', 'structure', 't
o', 'the', 'sentence', 'by', 'following', 'parts', 'of', 'speech', '(', 'PO
S', ')', 'tagging', '.']

After Token: [('Chunking', 'NN'), ('is', 'VBZ'), ('used', 'VBN'), ('to', 'T
O'), ('add', 'VB'), ('more', 'JJR'), ('structure', 'NN'), ('to', 'TO'), ('th
e', 'DT'), ('sentence', 'NN'), ('by', 'IN'), ('following', 'VBG'), ('parts',
'NNS'), ('of', 'IN'), ('speech', 'NN'), ('(', '('), ('POS', 'NNP'), (')',
')'), ('tagging', 'NN'), ('.', '.')]

After Regex: chunk.RegexpParser with 1 stages:
RegexpChunkParser with 1 rules:
       <ChunkRule: '<NN.?>*<VBD.?>*<JJ.?>*<CC>?'>

After Chunking (S
  (NP Chunking/NN)
  is/VBZ
  used/VBN
  to/TO
  add/VB
  (NP more/JJR)
  (NP structure/NN)
  to/TO
  the/DT
  (NP sentence/NN)
  by/IN
  following/VBG
  (NP parts/NNS)
  of/IN
  (NP speech/NN)
  (/(
  (NP POS/NNP)
  )/)
  (NP tagging/NN)
  ./.)
```

In [29]:

```
output.draw()
```