StarSpace on Wordplay

August 26, 2018

1 StarSpace on Wordplay lyrics data

Ok so one important thing I've learnt is that StarSpace (SSp) is not straightforward to use. My aim in this file is to understand and successfully apply SSp to some portion of our Wordplay data in order to train some embedding space. I hope I will be able to apply SSp to all our features, and additionally I hope to construct an architecture that allows me to test the embeddings. Perhaps this goal in unrealistic given my current state of knowledge, and this notebook is an attempt to see how far I get.

I was going to create the perfect SSp model for our Wordplay data which would rival our existing algorithms. This goal itself was a huge hindrance, as in its light every confused googling and exploratory code that didn't even run just made me more frustrated and angrier with myself. Why was I not able to accomplish my goal? It took me some time to come to terms with my level of knowledge, and redefine my aim. I needed to take a smaller bite out of this problem, if I was going to make any progress.

This notebook's primary goal is to understand how an SSp model is built to and implement SSp on a Wordplay dataset.

This notebook's secondary goal is then to expand on the basic model and implementation in order to make the SSp model more useful

```
In [1]: # imports
        import pandas as pd
        from pathlib import Path
        import re

        %matplotlib inline
```

1.1 Wordplay data

```
In [4]: PATH = Path("/Users/chrispaul/Desktop/classes/nlp/finalproj")
        list(PATH.iterdir())
        # this notebook runs as long as all supporting files and constructors are placed in th
```

```
Out[4]: [PosixPath('/Users/chrispaul/Desktop/classes/nlp/finalproj/.DS_Store'),
         PosixPath('/Users/chrispaul/Desktop/classes/nlp/finalproj/gitSSp'),
         PosixPath('/Users/chrispaul/Desktop/classes/nlp/finalproj/.ipynb_checkpoints'),
```

```
        PosixPath('/Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace'),
        PosixPath('/Users/chrispaul/Desktop/classes/nlp/finalproj/new_god.csv')]
```

```
In [21]: full_data_raw = pd.read_csv(PATH/'new_god.csv')
```

```
In [22]: full_data_raw.head()
```

Out[22]:

	Song	Artist	song_ID	search_term	lyrics_clean	bpm_raw	artist_trunc	Genre	Year
0	shape of you	ed sheeran	1	shape of you ed sheeran	The club isn't the best place to find a lover...	96	ed sheeran	['Folk Pop', 'Pop']	2017
1	thinking out loud	ed sheeran	5	thinking out loud ed sheeran	When your legs don't work like they used to b...	79	ed sheeran	['Folk Pop', 'Pop']	2014
2	photograph	ed sheeran	16	photograph ed sheeran	Loving can hurt, loving can hurt sometimes Bu...	108	ed sheeran	['Folk Pop', 'Pop']	2014
3	perfect	ed sheeran	49	perfect ed sheeran	I found a love for me Oh darling, just dive r...	95	ed sheeran	['Folk Pop', 'Pop']	2016
4	the a team	ed sheeran	2156	the a team ed sheeran	White lips, pale face Breathing in the snowfl...	85	ed sheeran	['Folk Pop', 'Pop']	2013

```
In [23]: len(full_data_raw)
```

```
Out[23]: 39296
```

This is the core dataset Wordplay runs on. We have around 39k observations total, which each represent a song. Around a song and artist we collect lyric, beat per minute, genre and year of production information.

Immediately one notices `artist_trunc` is a redundant feature. We should disregard it.

```
In [6]: # checking for duplicates

        assert( len(full_data_raw.drop_duplicates()) == len(full_data_raw) )
```

1.2 Primary Goal 1: successfully run StarSpace example

I will attempt to run the AG_news example provided here.

```
In [7]: ! ls

CONTRIBUTING.md             examples
LICENSE.md                  makefile
```

```
PATENTS                       model.o
README.md                     normalize.o
StarSpace on Wordplay.ipynb   parser.o
args.o                        proj.o
classification_ag_news.sh     src
data.o                        starspace
dict.o                        starspace.dSYM
doc_data.o                    starspace.o
doc_parser.o                  utils.o
```

```
In [8]: ! cd Starspace/
        ! pwd
```

```
/bin/sh: line 0: cd: Starspace/: Not a directory
/Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace
```

```
In [9]: ! pwd
```

```
/Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace
```

```
In [10]: ! sh classification_ag_news.sh
```

```
Downloading dataset ag_news
Compiling StarSpace
make: Nothing to be done for `opt'.
Start to train on ag_news data:
Arguments:
lr: 0.01
dim: 10
epoch: 5
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: dot
maxNegSamples: 3
negSearchLimit: 5
thread: 20
minCount: 1
minCountLabel: 1
label: __label__
ngrams: 1
bucket: 2000000
adagrad: 0
trainMode: 0
fileFormat: fastText
```

```
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Start to initialize starspace model.
Build dict from input file : /tmp/starspace/data/ag_news.train
Read 5M words
Number of words in dictionary:  95811
Number of labels in dictionary: 4
Loading data from file : /tmp/starspace/data/ag_news.train
Total number of examples loaded : 120000
Initialized model weights. Model size :
matrix : 95815 10
Training epoch 0: 0.01 0.002
Epoch: 100.0%  lr: 0.008017  loss: 0.006071  eta: <1min   tot: 0h0m2s  (20.0%)007635  eta: <1m
 ---+++               Epoch    0 Train error : 0.00647072 +++---
Training epoch 1: 0.008 0.002
Epoch: 100.0%  lr: 0.006133  loss: 0.004014  eta: <1min   tot: 0h0m4s  (40.0%)4.2%  lr: 0.0076
 ---+++               Epoch    1 Train error : 0.00398943 +++---
Training epoch 2: 0.006 0.002
Epoch: 100.0%  lr: 0.004017  loss: 0.003589  eta: <1min   tot: 0h0m6s  (60.0%)  (42.5%)0h0m4s
 ---+++               Epoch    2 Train error : 0.00340467 +++---
Training epoch 3: 0.004 0.002
Epoch: 100.0%  lr: 0.002033  loss: 0.002712  eta: <1min   tot: 0h0m8s  (80.0%))74.4%  lr: 0.00
 ---+++               Epoch    3 Train error : 0.00298627 +++---
Training epoch 4: 0.002 0.002
Epoch: 100.0%  lr: 0.000017  loss: 0.002686  eta: <1min   tot: 0h0m10s  (100.0%)0%  lr: 0.0011
 ---+++               Epoch    4 Train error : 0.00260718 +++---
Saving model to file : /tmp/starspace/models/ag_news
Saving model in tsv format : /tmp/starspace/models/ag_news.tsv
Start to evaluate trained model:
Arguments:
lr: 0.01
dim: 10
epoch: 5
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: dot
maxNegSamples: 10
negSearchLimit: 50
thread: 10
minCount: 1
minCountLabel: 1
label: __label__
ngrams: 1
bucket: 2000000
adagrad: 1
```

```
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Start to load a trained starspace model.
STARSPACE-2017-2
Initialized model weights. Model size :
matrix : 95815 10
Model loaded.
Loading data from file : /tmp/starspace/data/ag_news.test
Total number of examples loaded : 7600
------Loaded model args:
Arguments:
lr: 0.01
dim: 10
epoch: 5
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: dot
maxNegSamples: 3
negSearchLimit: 5
thread: 10
minCount: 1
minCountLabel: 1
label: __label__
ngrams: 1
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Predictions use 4 known labels.
Evaluation Metrics :
hit@1: 0.917105 hit@10: 1 hit@20: 1 hit@50: 1 mean ranks : 1.10237 Total examples : 7600
```

```
In [12]: # let's see what the embeddings learned are

         PATH_AG = Path("/private/tmp/starspace/models")
         list(PATH_AG.iterdir())
```

```
Out[12]: [PosixPath('/private/tmp/starspace/models/ag_news.tsv'),
          PosixPath('/private/tmp/starspace/models/ag_news')]
```

```
In [13]: AG_emb = pd.read_csv(PATH_AG/'ag_news.tsv', sep='\t')

In [14]: AG_emb.head()

Out[14]:      ,  0.00574184  -0.00380225  0.0204018  0.00871822  0.0220729  -0.016816  \
         0    .    0.105238    -0.005149  -0.052455    0.018976  -0.023077  -0.014826
         1  the    0.023784     0.004734  -0.006258   -0.026205   0.001737   0.007837
         2   to   -0.009514     0.018015   0.006967   -0.000426   0.012733   0.010290
         3  NaN   -0.051777     0.004268   0.010321    0.058306  -0.029463  -0.005299
         4    a   -0.010574    -0.002961  -0.007365   -0.015457  -0.021123  -0.015999

            -0.0184881   0.02238  0.00158177  -0.0071888
         0    0.015565  0.028108   -0.016537    0.068695
         1   -0.007666 -0.007072   -0.016776   -0.054471
         2    0.001564  0.013813    0.009490    0.018243
         3    0.021702 -0.075784    0.015170   -0.090901
         4    0.003005 -0.014996    0.018543    0.013134
```

Great! Starspace ran and it seems that the previous model constructed embeddings of dimension 10. That's the plumbing sorted out.

1.3 Primary Goal 2: Use StarSpace to create embeddings for text followed by one label

I beleive the TagSpace embeddings model is most the most appropriate way to model the Wordplay business need and data. I will take the tag embeddings example from SSp's github page and this research paper as my lead, format the Wordplay data accordingly and create both text and label embeddings using SSp.

I will replace the sentence with the entire lyrics of a song, and add only one label to each observation: the concatenated artist and song title. So the first observation will become

`The club isn't the best place ... in love with the shape of you #ed_sheeran-shape_of_you`

I will limit the number of observations to 500 at first.

1.3.1 constructing the input file

```
In [111]: data1 = full_data_raw[['search_term', 'lyrics_clean']][:500]
          data1.head(2)

Out[111]:                     search_term  \
          0       shape of you ed sheeran
          1  thinking out loud ed sheeran

                                              lyrics_clean
          0   The club isn't the best place to find a lover...
          1   When your legs don't work like they used to b...
```

Punctuation (save for apostrophy) embeddings aren't immediately helpful in the context of Wordplay and its business solution, thus we will trip punctiation and normalize the texts

```
In [174]: def clean(x):
              x = str(x)
              x = x.strip().lower()
              x = x.replace(",","").replace(".","").replace("?","").replace("!","").replace("-
              x = re.sub(' +',' ', x)
              return x

          data1.lyrics_clean = data1.lyrics_clean.apply(clean)
          data1.search_term = data1.search_term.apply(lambda x: '#' + x.replace(' ', "_"))

In [113]: data1.head(2)

Out[113]:                       search_term  \
          0       #shape_of_you_ed_sheeran
          1  #thinking_out_loud_ed_sheeran

                                                lyrics_clean
          0  the club isn't the best place to find a lover ...
          1  when your legs don't work like they used to be...

In [114]: data1['raw'] = data1.lyrics_clean + ' ' + data1.search_term

In [115]: data1.tail(2)

Out[115]:                              search_term  \
          498     #handwritten_demos_shawn_mendes
          499  #act_like_you_love_me_shawn_mendes

                                                lyrics_clean  \
          498  the official lyrics for "handwritten demos" ar...
          499  so you leave tomorrow just sleep the night i p...

                                                          raw
          498  the official lyrics for "handwritten demos" ar...
          499  so you leave tomorrow just sleep the night i p...

In [116]: input_file_1 = data1.raw

In [117]: input_file_1[1]

Out[117]: "when your legs don't work like they used to before and i can't sweep you off of your

In [118]: ! pwd

/Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace


In [119]: input_file_1.to_csv('input1.train', header=None, index=None, mode='a')
```

1.3.2 putting together the model

Following the provided guidance for tagspace modeling and the example shell file above, I wrote a shell script that creates a simple 10 dimentional embedding for both text and search term.

```
In [120]: %time
          ! sh wdpl1.sh

CPU times: user 3 ţs, sys: 1e+03 ns, total: 4 ţs
Wall time: 6.91 ţs
Compiling StarSpace
make: Nothing to be done for `opt'.
Start to train on ag_news data:
Arguments:
lr: 0.01
dim: 10
epoch: 5
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: cosine
maxNegSamples: 3
negSearchLimit: 5
thread: 10
minCount: 1
minCountLabel: 1
label: #
ngrams: 1
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Start to initialize starspace model.
Build dict from input file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input1.t
Read 0M words
Number of words in dictionary:  7931
Number of labels in dictionary: 500
Loading data from file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input1.train
Total number of examples loaded : 510
Initialized model weights. Model size :
matrix : 8431 10
Training epoch 0: 0.01 0.002
Epoch: 98.2%  lr: 0.010000  loss: 0.152674  eta: <1min   tot: 0h0m0s  (19.6%)
 ---+++                Epoch    0 Train error : 0.15630244 +++---
Training epoch 1: 0.008 0.002
```

```
Epoch: 98.2%  lr: 0.008000  loss: 0.038867  eta: <1min   tot: 0h0m0s  (39.6%)
 ---+++                Epoch    1 Train error : 0.05047230 +++---
Training epoch 2: 0.006 0.002
Epoch: 98.2%  lr: 0.006000  loss: 0.014120  eta: <1min   tot: 0h0m0s  (59.6%)
 ---+++                Epoch    2 Train error : 0.01098179 +++---
Training epoch 3: 0.004 0.002
Epoch: 98.2%  lr: 0.004000  loss: 0.003911  eta: <1min   tot: 0h0m0s  (79.6%)
 ---+++                Epoch    3 Train error : 0.00309402 +++---
Training epoch 4: 0.002 0.002
Epoch: 98.2%  lr: 0.002000  loss: 0.001000  eta: <1min   tot: 0h0m0s  (99.6%)
 ---+++                Epoch    4 Train error : 0.00180792 +++---
Saving model to file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay1
Saving model in tsv format : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay1
Finished training
```

```
In [121]: wp1_emb = pd.read_csv('wordplay1.tsv', sep='\t')
```

```
In [122]: wp1_emb.head()
```

Out[122]:

	i	-0.0289933	-0.0477688	0.0144465	0.0322575	-0.0561785	-0.00914634	\
0	you	-0.016684	-0.007199	-0.023151	0.055543	0.045616	-0.046810	
1	the	0.023195	-0.037402	0.000181	0.035587	0.043521	0.042736	
2	me	-0.091708	0.098193	-0.000542	-0.057186	-0.115886	-0.051047	
3	to	-0.007523	0.023796	0.048900	-0.052916	0.094035	-0.050827	
4	and	-0.031491	-0.039310	0.009078	0.034861	0.084509	-0.035038	

	-0.0431827	-0.00666985	-0.0396151	-0.0157005
0	0.029661	0.003988	0.042373	-0.011755
1	-0.067837	0.001842	-0.013847	0.047582
2	0.036369	0.039519	0.008737	0.044722
3	0.008737	-0.039161	-0.030854	-0.000895
4	0.048724	-0.025997	-0.010599	-0.039536

```
In [123]: wp1_emb.tail()
```

Out[123]:

	i	-0.0289933	-0.0477688	0.0144465	\
4230	#prisoner_the_weeknd	0.001285	-0.005031	-0.007681	
4231	#party_monster_the_weeknd	0.004137	-0.014091	-0.012906	
4232	#angel_the_weeknd	-0.021896	-0.017150	0.001063	
4233	#handwritten_demos_shawn_mendes"	0.007524	0.012149	-0.013007	
4234	#act_like_you_love_me_shawn_mendes	-0.002728	-0.000837	-0.002547	

	0.0322575	-0.0561785	-0.00914634	-0.0431827	-0.00666985	-0.0396151	\
4230	-0.007980	-0.011944	0.008554	-0.005743	0.001187	-0.006448	
4231	0.001031	-0.000161	0.008189	-0.006868	-0.007427	0.000739	
4232	0.010375	-0.001157	0.010236	-0.007499	-0.002386	-0.020379	
4233	-0.015691	0.004656	-0.005111	-0.002507	-0.010434	0.002555	
4234	0.004469	-0.000424	-0.000806	0.008899	0.005037	0.003039	

```
      -0.0157005
4230    0.002207
4231   -0.005545
4232    0.007554
4233    0.015898
4234   -0.004517
```

We have successfully placed unigram lyric text and search term on the same embedding space.

1.3.3 Primary goal 2 evaluation

What happens when we feed sample text into model1? Starspace allows users to query the label predictions from a trained model based on some input. This is done via the command line, results in full below. The model is 1.1 Mb large.

```
ChristophersMBP:Starspace chrispaul$ ./query_predict wordplay1 3
Start to load a trained starspace model.
STARSPACE-2017-2
Model loaded.
------Loaded model args:
Arguments:
lr: 0.01
dim: 10
epoch: 5
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: cosine
maxNegSamples: 3
negSearchLimit: 5
thread: 10
minCount: 1
minCountLabel: 1
label: __label__
ngrams: 1
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Predictions use 500 known labels.
Enter some text: when your legs don't
0[0.872863]: #broken_glass_sia
1[0.824216]: #good_intentions_the_chainsmokers
```

```
2[0.805134]: #the_greatest_sia

Enter some text: seventy
0[0.79353]: #understand_shawn_mendes
1[0.781014]: #please_don't_go_mike_posner
2[0.733151]: #thought_of_you_justin_bieber

Enter some text: scared of love
0[0.858134]: #tenerife_sea_ed_sheeran
1[0.784149]: #destiny_sia
2[0.765608]: #down_to_earth_justin_bieber

Enter some text: rockin' the sleeve
0[0.772861]: #something_just_like_this_the_chainsmokers
1[0.715062]: #please_don't_go_mike_posner
2[0.707967]: #i_would_justin_bieber

Enter some text: shape of you
0[0.789852]: #inside_out_the_chainsmokers
1[0.766133]: #the_girl_you_lost_to_cocaine_sia
2[0.745067]: #understand_shawn_mendes
```

The model is unable to predict correct songs for lyrics.
Model tweaking is in order.

1.4 Secondary goal: improve the model

We want a model that accurately picks the song when a string of lyrics are provided. I added trigram capability and tweaked some parameters of the model in wdply2.sh

1.4.1 bigram, dim(10)

model size: 246 Mb

```
In [126]: % time
          ! sh wdpl2.sh

CPU times: user 2 ţs, sys: 1 ţs, total: 3 ţs
Wall time: 5.96 ţs
Compiling StarSpace
make: Nothing to be done for `opt'.
Start to train on ag_news data:
Arguments:
lr: 0.01
dim: 10
epoch: 10
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
```

```
margin: 0.05
similarity: cosine
maxNegSamples: 10
negSearchLimit: 50
thread: 10
minCount: 1
minCountLabel: 1
label: #
ngrams: 2
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Start to initialize starspace model.
Build dict from input file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input1.t
Read 0M words
Number of words in dictionary:  7931
Number of labels in dictionary: 500
Loading data from file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input1.train
Total number of examples loaded : 510
Initialized model weights. Model size :
matrix : 2008431 10
Training epoch 0: 0.01 0.001
Epoch: 98.2%  lr: 0.010000  loss: 0.061980  eta: <1min   tot: 0h0m0s  (9.8%)
 ---+++               Epoch    0 Train error : 0.05855301 +++---
Training epoch 1: 0.009 0.001
Epoch: 98.2%  lr: 0.009000  loss: 0.036111  eta: <1min   tot: 0h0m0s  (19.8%)
 ---+++               Epoch    1 Train error : 0.03582186 +++---
Training epoch 2: 0.008 0.001
Epoch: 98.2%  lr: 0.008000  loss: 0.002271  eta: <1min   tot: 0h0m0s  (29.8%)
 ---+++               Epoch    2 Train error : 0.00215569 +++---
Training epoch 3: 0.007 0.001
Epoch: 98.2%  lr: 0.007000  loss: 0.000258  eta: <1min   tot: 0h0m0s  (39.8%)
 ---+++               Epoch    3 Train error : 0.00049855 +++---
Training epoch 4: 0.006 0.001
Epoch: 98.2%  lr: 0.006000  loss: 0.000001  eta: <1min   tot: 0h0m0s  (49.8%)
 ---+++               Epoch    4 Train error : 0.00012230 +++---
Training epoch 5: 0.005 0.001
Epoch: 98.2%  lr: 0.005000  loss: 0.000012  eta: <1min   tot: 0h0m0s  (59.8%)
 ---+++               Epoch    5 Train error : 0.00004253 +++---
Training epoch 6: 0.004 0.001
Epoch: 98.2%  lr: 0.004000  loss: 0.000010  eta: <1min   tot: 0h0m1s  (69.8%)
 ---+++               Epoch    6 Train error : 0.00004412 +++---
Training epoch 7: 0.003 0.001
Epoch: 98.2%  lr: 0.003000  loss: 0.000060  eta: <1min   tot: 0h0m1s  (79.8%)
```

```
 ---+++                Epoch    7 Train error : 0.00003899 +++---
Training epoch 8: 0.002 0.001
Epoch: 98.2%  lr: 0.002000  loss: 0.000049  eta: <1min   tot: 0h0m1s  (89.8%)
 ---+++                Epoch    8 Train error : 0.00002483 +++---
Training epoch 9: 0.000999999 0.001
Epoch: 98.2%  lr: 0.001000  loss: 0.000027  eta: <1min   tot: 0h0m1s  (99.8%)
 ---+++                Epoch    9 Train error : 0.00004272 +++---
Saving model to file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay2
Saving model in tsv format : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay
Finished training
```

Query results:

```
ChristophersMBP:Starspace chrispaul$ ./query_predict wordplay2 3
Start to load a trained starspace model.
STARSPACE-2017-2
Model loaded.
------Loaded model args:
Arguments:
lr: 0.01
dim: 10
epoch: 10
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: cosine
maxNegSamples: 10
negSearchLimit: 50
thread: 10
minCount: 1
minCountLabel: 1
label: __label__
ngrams: 2
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Predictions use 500 known labels.
Enter some text: when your legs don't
0[0.809341]: #over_now_post_malone
1[0.78122]: #up_justin_bieber
2[0.711541]: #smoke_clouds_james_arthur
```

```
Enter some text: shape of you
0[0.820879]: #shape_of_you_ed_sheeran
1[0.75359]: #thought_of_you_justin_bieber
2[0.735946]: #love_me_like_you_do_justin_bieber

Enter some text: i feel it coming
0[0.979043]: #i_feel_it_coming_the_weeknd
1[0.833373]: #over_now_post_malone
2[0.813325]: #there's_nothing_holdin'_me_back_shawn_mendes

Enter some text: you've been scared of love
0[0.821486]: #swap_it_out_justin_bieber"
1[0.819255]: #i_feel_it_coming_the_weeknd
2[0.814592]: #sweet_design_sia

Enter some text: rockin' the sleeve
0[0.806553]: #tear_in_my_heart_twenty_one
1[0.769888]: #otherside_post_malone
2[0.760887]: #train_wreck_james_arthur

Enter some text: i'm swaggin'
0[0.900865]: #white_iverson_post_malone
1[0.881766]: #honest_shawn_mendes
2[0.738305]: #stitches_shawn_mendes

Enter some text: swaggin'
0[0.88526]: #polarize_twenty_one
1[0.783107]: #rich_&_sad_post_malone
2[0.764396]: #train_wreck_james_arthur

Enter some text: but you know i ain't broke
0[0.762362]: #i_know_what_you_did_last_summer_shawn_mendes"
1[0.748829]: #what_you_need_the_weeknd
2[0.71743]: #lentil_sia

Enter some text: broke
0[0.787075]: #sugar_wraith_post_malone
1[0.69113]: #belong_to_the_world_the_weeknd
2[0.677258]: #lullaby_sia

Enter some text: church shoes
0[0.759928]: #too_young_post_malone
1[0.757443]: #backpack_justin_bieber
2[0.752373]: #stressed_out_twenty_one"

Enter some text: p1 cleaner than your church shoes
0[0.894819]: #starboy_the_weeknd
1[0.875]: #the_birds,_pt._2_the_weeknd"
```

```
2[0.711153]: #break_up_every_night_the_chainsmokers"

Enter some text: white iverson
0[0.813288]: #rich_&_sad_post_malone
1[0.803315]: #polarize_twenty_one
2[0.789332]: #buttons_sia
```

We are getting correct predictions half the time, with more words supplied leading to closer matches. It seems that title matching works only half the time, but certain unique words are being tied to the right artist.

1.4.2 trigram, dim(10)

```
In [127]: ! sh wdpl3.sh

Compiling StarSpace
make: Nothing to be done for `opt'.
Start to train on ag_news data:
Arguments:
lr: 0.01
dim: 10
epoch: 10
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: cosine
maxNegSamples: 10
negSearchLimit: 50
thread: 10
minCount: 1
minCountLabel: 1
label: #
ngrams: 3
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Start to initialize starspace model.
Build dict from input file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input1.t
Read 0M words
Number of words in dictionary:  7931
Number of labels in dictionary: 500
Loading data from file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input1.train
Total number of examples loaded : 510
```

```
Initialized model weights. Model size :
matrix : 2008431 10
Training epoch 0: 0.01 0.001
Epoch: 98.2%  lr: 0.010000  loss: 0.053817  eta: <1min   tot: 0h0m0s  (9.8%)
 ---+++                Epoch    0 Train error : 0.06071814 +++---
Training epoch 1: 0.009 0.001
Epoch: 98.2%  lr: 0.009000  loss: 0.045844  eta: <1min   tot: 0h0m0s  (19.8%)
 ---+++                Epoch    1 Train error : 0.04520454 +++---
Training epoch 2: 0.008 0.001
Epoch: 98.2%  lr: 0.008000  loss: 0.002406  eta: <1min   tot: 0h0m0s  (29.8%)
 ---+++                Epoch    2 Train error : 0.00258707 +++---
Training epoch 3: 0.007 0.001
Epoch: 98.2%  lr: 0.007000  loss: 0.000605  eta: <1min   tot: 0h0m0s  (39.8%)
 ---+++                Epoch    3 Train error : 0.00040577 +++---
Training epoch 4: 0.006 0.001
Epoch: 98.2%  lr: 0.006000  loss: 0.000000  eta: <1min   tot: 0h0m0s  (49.8%)
 ---+++                Epoch    4 Train error : 0.00007581 +++---
Training epoch 5: 0.005 0.001
Epoch: 98.2%  lr: 0.005000  loss: 0.000018  eta: <1min   tot: 0h0m1s  (59.8%)
 ---+++                Epoch    5 Train error : 0.00005712 +++---
Training epoch 6: 0.004 0.001
Epoch: 98.2%  lr: 0.004000  loss: 0.000061  eta: <1min   tot: 0h0m1s  (69.8%)
 ---+++                Epoch    6 Train error : 0.00004869 +++---
Training epoch 7: 0.003 0.001
Epoch: 98.2%  lr: 0.003000  loss: 0.000069  eta: <1min   tot: 0h0m1s  (79.8%)
 ---+++                Epoch    7 Train error : 0.00009256 +++---
Training epoch 8: 0.002 0.001
Epoch: 98.2%  lr: 0.002000  loss: 0.000000  eta: <1min   tot: 0h0m1s  (89.8%)
 ---+++                Epoch    8 Train error : 0.00003042 +++---
Training epoch 9: 0.000999999 0.001
Epoch: 98.2%  lr: 0.001000  loss: 0.000018  eta: <1min   tot: 0h0m1s  (99.8%)
 ---+++                Epoch    9 Train error : 0.00002972 +++---
Saving model to file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay3
Saving model in tsv format : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay3
Finished training
```

Query results:

```
ChristophersMBP:Starspace chrispaul$ ./query_predict wordplay3 3
Start to load a trained starspace model.
STARSPACE-2017-2
Model loaded.
------Loaded model args:
Arguments:
lr: 0.01
dim: 10
epoch: 10
```

```
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: cosine
maxNegSamples: 10
negSearchLimit: 50
thread: 10
minCount: 1
minCountLabel: 1
label: __label__
ngrams: 3
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Predictions use 500 known labels.
Enter some text: when your legs don't work like
0[0.860282]: #don't_say_the_chainsmokers
1[0.749563]: #candy_paint_post_malone"
2[0.719096]: #thinking_out_loud_ed_sheeran

Enter some text: shape of you
0[0.771429]: #kid_in_love_shawn_mendes
1[0.734871]: #privilege_the_weeknd
2[0.72538]: #thought_of_you_justin_bieber

Enter some text: i feel it coming
0[0.877381]: #i_feel_it_coming_the_weeknd
1[0.824538]: #message_man_twenty_one
2[0.794431]: #nancy_mulligan_ed_sheeran"

Enter some text: you've been scared of love
0[0.853353]: #i'll_show_you_justin_bieber
1[0.780176]: #a_lonely_night_the_weeknd
2[0.682456]: #patience_shawn_mendes

Enter some text: rockin' the sleeve
0[0.722859]: #same_old_song_the_weeknd
1[0.696093]: #this_ed_sheeran
2[0.695929]: #pyd_justin_bieber

Enter some text: i'm swaggin'
0[0.770762]: #something_just_like_this_the_chainsmokers
1[0.762157]: #i'm_not_important_to_you_sia
```

```
2[0.700925]: #backpack_justin_bieber

Enter some text: swaggin'
0[0.781288]: #white_iverson_post_malone
1[0.706553]: #i'm_not_important_to_you_sia
2[0.700275]: #the_feeling_justin_bieber

Enter some text: broke
0[0.884333]: #castle_on_the_hill_ed_sheeran"
1[0.812085]: #what's_hatnin'_justin_bieber
2[0.777028]: #buttons_sia

Enter some text: church shoes
0[0.813887]: #waterbed_the_chainsmokers
1[0.791033]: #moon_sia
2[0.756507]: #never_understand_post_malone

Enter some text: p1 cleaner than your church shoes
0[0.756526]: #death_by_chocolate_sia
1[0.728884]: #rockstar_post_malone"
2[0.724995]: #starboy_the_weeknd

Enter some text: white iverson
0[0.881442]: #something_just_like_this_the_chainsmokers
1[0.847419]: #new_man_ed_sheeran"
2[0.82943]: #valerie_the_weeknd
```

These results are worse. Correct song selected only twice.

1.4.3 trigram, dim(32)

model size: 775 MB

```
In [128]: ! sh wdpl4.sh

Compiling StarSpace
make: Nothing to be done for `opt'.
Start to train on ag_news data:
Arguments:
lr: 0.01
dim: 32
epoch: 10
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: cosine
maxNegSamples: 10
negSearchLimit: 50
```

```
thread: 10
minCount: 1
minCountLabel: 1
label: #
ngrams: 3
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Start to initialize starspace model.
Build dict from input file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input1.t
Read 0M words
Number of words in dictionary:  7931
Number of labels in dictionary: 500
Loading data from file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input1.train
Total number of examples loaded : 510
Initialized model weights. Model size :
matrix : 2008431 32
Training epoch 0: 0.01 0.001
Epoch: 98.2%  lr: 0.010000  loss: 0.044895  eta: <1min   tot: 0h0m0s  (9.8%)
 ---+++                Epoch    0 Train error : 0.04231624 +++---
Training epoch 1: 0.009 0.001
Epoch: 98.2%  lr: 0.009000  loss: 0.017358  eta: <1min   tot: 0h0m1s  (19.8%)
 ---+++                Epoch    1 Train error : 0.01802931 +++---
Training epoch 2: 0.008 0.001
Epoch: 98.2%  lr: 0.008000  loss: 0.000200  eta: <1min   tot: 0h0m1s  (29.8%)
 ---+++                Epoch    2 Train error : 0.00046247 +++---
Training epoch 3: 0.007 0.001
Epoch: 98.2%  lr: 0.007000  loss: 0.000126  eta: <1min   tot: 0h0m2s  (39.8%)
 ---+++                Epoch    3 Train error : 0.00021829 +++---
Training epoch 4: 0.006 0.001
Epoch: 98.2%  lr: 0.006000  loss: 0.000034  eta: <1min   tot: 0h0m2s  (49.8%)
 ---+++                Epoch    4 Train error : 0.00002307 +++---
Training epoch 5: 0.005 0.001
Epoch: 98.2%  lr: 0.005000  loss: 0.000000  eta: <1min   tot: 0h0m2s  (59.8%)
 ---+++                Epoch    5 Train error : 0.00001277 +++---
Training epoch 6: 0.004 0.001
Epoch: 98.2%  lr: 0.004000  loss: 0.000026  eta: <1min   tot: 0h0m3s  (69.8%)
 ---+++                Epoch    6 Train error : 0.00001043 +++---
Training epoch 7: 0.003 0.001
Epoch: 98.2%  lr: 0.003000  loss: 0.000020  eta: <1min   tot: 0h0m3s  (79.8%)
 ---+++                Epoch    7 Train error : 0.00001858 +++---
Training epoch 8: 0.002 0.001
Epoch: 98.2%  lr: 0.002000  loss: 0.000019  eta: <1min   tot: 0h0m3s  (89.8%)
 ---+++                Epoch    8 Train error : 0.00002474 +++---
```

```
Training epoch 9: 0.000999999 0.001
Epoch: 98.2%  lr: 0.001000  loss: 0.000068  eta: <1min   tot: 0h0m4s  (99.8%)
 ---+++                Epoch    9 Train error : 0.00001363 +++---
Saving model to file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay4
Saving model in tsv format : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay4
Finished training
```

Query results:

```
ChristophersMBP:Starspace chrispaul$ ./query_predict wordplay4 3
Start to load a trained starspace model.
STARSPACE-2017-2
Model loaded.
------Loaded model args:
Arguments:
lr: 0.01
dim: 32
epoch: 10
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: cosine
maxNegSamples: 10
negSearchLimit: 50
thread: 10
minCount: 1
minCountLabel: 1
label: __label__
ngrams: 3
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Predictions use 500 known labels.
Enter some text: when your legs don't
0[0.597329]: #thinking_out_loud_ed_sheeran
1[0.583392]: #wicked_games_the_weeknd
2[0.529547]: #no_pressure_justin_bieber

Enter some text: shape of you
0[0.846332]: #thought_of_you_justin_bieber
1[0.607232]: #shape_of_you_ed_sheeran
2[0.491238]: #coming_down_the_weeknd
```

```
Enter some text: i feel it coming
0[0.904498]: #i_feel_it_coming_the_weeknd
1[0.46883]: #born_to_be_somebody_justin_bieber
2[0.430913]: #ruin_shawn_mendes

Enter some text: you've been scared of love
0[0.565222]: #i_feel_it_coming_the_weeknd
1[0.525057]: #try_me_the_weeknd
2[0.516499]: #you_know_you_like_it_dj_snake

Enter some text: rockin' the sleeve
0[0.613899]: #last_day_alive_the_chainsmokers
1[0.558823]: #train_wreck_james_arthur
2[0.540408]: #till_dawn_the_weeknd

Enter some text: i'm swaggin'
0[0.779529]: #white_iverson_post_malone
1[0.680836]: #coming_down_the_weeknd
2[0.636568]: #aftertaste_shawn_mendes"

Enter some text: swaggin'
0[0.805887]: #white_iverson_post_malone
1[0.512166]: #happier_ed_sheeran
2[0.501628]: #train_wreck_james_arthur

Enter some text: church shoes
0[0.613486]: #i_took_a_pill_in_ibiza_mike_posner
1[0.598423]: #starboy_the_weeknd
2[0.485587]: #day_too_soon_sia

Enter some text: p1 cleaner than your church shoes
0[0.702307]: #starboy_the_weeknd
1[0.512365]: #i_took_a_pill_in_ibiza_mike_posner
2[0.486779]: #sunshine_sia

Enter some text: white iverson
0[0.62533]: #white_iverson_post_malone
1[0.430297]: #paranoid_post_malone"
2[0.417292]: #let_me_love_the_lonely_james_arthur
```

correct result appears as top selection 7/10 times. Correct result appears in top 2 8/10 times. This model is getting good at predicting unique songs from lyrics, but is already nearly 1GB in size for only 1.25% of our songs data. yikes

1.4.4 trigram, dim(64)

model size: 1.55 GB

```
In [129]: ! sh wdpl5.sh

Compiling StarSpace
make: Nothing to be done for `opt'.
Start to train on ag_news data:
Arguments:
lr: 0.01
dim: 64
epoch: 10
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: cosine
maxNegSamples: 10
negSearchLimit: 50
thread: 10
minCount: 1
minCountLabel: 1
label: #
ngrams: 3
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Start to initialize starspace model.
Build dict from input file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input1.t
Read 0M words
Number of words in dictionary:  7931
Number of labels in dictionary: 500
Loading data from file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input1.train
Total number of examples loaded : 510
Initialized model weights. Model size :
matrix : 2008431 64
Training epoch 0: 0.01 0.001
Epoch: 98.2%  lr: 0.010000  loss: 0.038605  eta: <1min   tot: 0h0m1s  (9.8%)
 ---+++                Epoch    0 Train error : 0.03757801 +++---
Training epoch 1: 0.009 0.001
Epoch: 98.2%  lr: 0.009000  loss: 0.014087  eta: <1min   tot: 0h0m2s  (19.8%)
 ---+++                Epoch    1 Train error : 0.01220230 +++---
Training epoch 2: 0.008 0.001
Epoch: 98.2%  lr: 0.008000  loss: 0.000029  eta: <1min   tot: 0h0m3s  (29.8%)
 ---+++                Epoch    2 Train error : 0.00032709 +++---
Training epoch 3: 0.007 0.001
Epoch: 98.2%  lr: 0.007000  loss: 0.000004  eta: <1min   tot: 0h0m3s  (39.8%)
```

```
 ---+++                Epoch    3 Train error : 0.00009421 +++---
Training epoch 4: 0.006 0.001
Epoch: 98.2%  lr: 0.006000  loss: 0.000000  eta: <1min   tot: 0h0m4s  (49.8%)
 ---+++                Epoch    4 Train error : 0.00001676 +++---
Training epoch 5: 0.005 0.001
Epoch: 98.2%  lr: 0.005000  loss: 0.000000  eta: <1min   tot: 0h0m5s  (59.8%)
 ---+++                Epoch    5 Train error : 0.00000295 +++---
Training epoch 6: 0.004 0.001
Epoch: 98.2%  lr: 0.004000  loss: 0.000000  eta: <1min   tot: 0h0m5s  (69.8%)
 ---+++                Epoch    6 Train error : 0.00002437 +++---
Training epoch 7: 0.003 0.001
Epoch: 98.2%  lr: 0.003000  loss: 0.000000  eta: <1min   tot: 0h0m6s  (79.8%)
 ---+++                Epoch    7 Train error : 0.00000730 +++---
Training epoch 8: 0.002 0.001
Epoch: 98.2%  lr: 0.002000  loss: 0.000000  eta: <1min   tot: 0h0m7s  (89.8%)
 ---+++                Epoch    8 Train error : 0.00000801 +++---
Training epoch 9: 0.000999999 0.001
Epoch: 98.2%  lr: 0.001000  loss: 0.000000  eta: <1min   tot: 0h0m8s  (99.8%)
 ---+++                Epoch    9 Train error : 0.00000667 +++---
Saving model to file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay5
Saving model in tsv format : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay5
Finished training
```

Query results:

```
ChristophersMBP:Starspace chrispaul$ ./query_predict wordplay5 3
Start to load a trained starspace model.
STARSPACE-2017-2
Model loaded.
------Loaded model args:
Arguments:
lr: 0.01
dim: 64
epoch: 10
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: cosine
maxNegSamples: 10
negSearchLimit: 50
thread: 10
minCount: 1
minCountLabel: 1
label: __label__
ngrams: 3
bucket: 2000000
```

```
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Predictions use 500 known labels.
Enter some text: when your legs don't
0[0.628115]: #burn_the_pages_sia
1[0.599703]: #thinking_out_loud_ed_sheeran
2[0.510572]: #love_me_justin_bieber"

Enter some text: when you're legs
0[0.582436]: #the_hills_the_weeknd"
1[0.557637]: #secrets_the_weeknd
2[0.466954]: #little_bird_ed_sheeran

Enter some text: shape of you
0[0.585594]: #get_me_sia
1[0.576874]: #thought_of_you_justin_bieber
2[0.558217]: #true_colors_the_weeknd

Enter some text: i feel it coming
0[0.919123]: #i_feel_it_coming_the_weeknd
1[0.339576]: #fair_game_sia
2[0.318617]: #fairytale_justin_bieber

Enter some text: you've been scared of love
0[0.643806]: #i_feel_it_coming_the_weeknd
1[0.466281]: #children_justin_bieber
2[0.39373]: #xo_/_the_host_the_weeknd

Enter some text: rockin' the sleeve
0[0.466344]: #tenerife_sea_ed_sheeran
1[0.450968]: #butterflies_sia
2[0.428526]: #same_bitches_post_malone

Enter some text: i'm swaggin
0[0.614265]: #coming_down_the_weeknd
1[0.602548]: #inside_out_the_chainsmokers
2[0.540718]: #get_me_sia

Enter some text: swaggin'
0[0.835786]: #white_iverson_post_malone
1[0.429281]: #lay_it_all_on_me_ed_sheeran
2[0.356031]: #happier_ed_sheeran

Enter some text: church shoes
```

```
0[0.628225]: #starboy_the_weeknd
1[0.419632]: #never_understand_post_malone
2[0.41548]: #make_it_rain_ed_sheeran

Enter some text: p1 cleaner than your church shoes
0[0.598233]: #starboy_the_weeknd
1[0.391571]: #sweet_potato_sia
2[0.372494]: #cares_at_the_door_sia

Enter some text: white iverson
0[0.798205]: #white_iverson_post_malone
1[0.431982]: #lay_it_all_on_me_ed_sheeran
2[0.414986]: #yours_truly,_austin_post_post_malone"
```

correct top pick 6/10 times, this seems to be doing worse. Maybe dim(64) is too large an embedding space for this purpose at 500 songs

1.5 Secondary goal 2: add artist, genre, year labels per observation

Let's see what happens when we take our best performing model (trigram, dim(32)) and add extra labels.

I suspect that since all labels are treated equally, many unique song labels will lie between the query and the closest year, genre, artist label. We might not even be able to see any such labels in the nearest 3 labels to the query. Let's see - it might be necessary to construct separate models for these features.

1.5.1 input file 2 creation

```
In [161]: data2 = full_data_raw[['search_term', 'lyrics_clean', 'Artist', 'Genre', 'Year']][:5
          data2.head(2)
```

```
Out[161]:                    search_term  \
          0       shape of you ed sheeran
          1  thinking out loud ed sheeran

                                              lyrics_clean      Artist  \
          0   The club isn't the best place to find a lover...  ed sheeran
          1   When your legs don't work like they used to b...  ed sheeran

                          Genre  Year
          0  ['Folk Pop', 'Pop']  2017
          1  ['Folk Pop', 'Pop']  2014
```

```
In [162]: data2.lyrics_clean = data2.lyrics_clean.apply(clean)
          data2.search_term = data2.search_term.apply(lambda x: '#' + x.replace(' ', "_"))
          data2.Artist = data2.Artist.apply(lambda x: '#' + x.replace(' ', "_"))
          data2.Year = data2.Year.apply(lambda x: '#' + str(x))
          data2.Genre = data2.Genre.apply(lambda x: x.replace("[\'", "#"))
          data2.Genre = data2.Genre.apply(lambda x: x.replace("\']", ""))
```

```
data2.Genre = data2.Genre.apply(lambda x: x.replace("\', \'", "xx#"))
data2.Genre = data2.Genre.apply(lambda x: x.replace(" ", "_"))
data2.Genre = data2.Genre.apply(lambda x: x.replace("xx#", " #"))
```

In [163]:
```
data2.head()
```

Out[163]:

	search_term	lyrics_clean	Artist	Genre	Year
0	#shape_of_you_ed_sheeran	the club isn't the best place to find a lover ...	#ed_sheeran	#Folk_Pop #Pop	#2017
1	#thinking_out_loud_ed_sheeran	when your legs don't work like they used to be...	#ed_sheeran	#Folk_Pop #Pop	#2014
2	#photograph_ed_sheeran	loving can hurt loving can hurt sometimes but ...	#ed_sheeran	#Folk_Pop #Pop	#2014
3	#perfect_ed_sheeran	i found a love for me oh darling just dive rig...	#ed_sheeran	#Folk_Pop #Pop	#2016
4	#the_a_team_ed_sheeran	white lips pale face breathing in the snowflak...	#ed_sheeran	#Folk_Pop #Pop	#2013

In [164]:
```
data2.tail()
```

Out[164]:

	search_term	lyrics_clean	Artist	Genre	Year
495	#the_weight_shawn_mendes	hello everybody how you guys feeling tonight t...	#shawn_mendes	#Folk_Pop #Pop #Pop_Rock	#2015
496	#don't_want_your_love_shawn_mendes	we run about a million miles an hour and i do ...	#shawn_mendes	#Folk_Pop #Pop #Pop_Rock	#2015
497	#lost_shawn_mendes	i walk down the street and all i can see is pe...	#shawn_mendes	#Folk_Pop #Pop #Pop_Rock	#2015
498	#handwritten_demos_shawn_mendes	the official lyrics for "handwritten demos" ar...	#shawn_mendes	#Folk_Pop #Pop #Pop_Rock	#2015
499	#act_like_you_love_me_shawn_mendes	so you leave tomorrow just sleep the night i p...	#shawn_mendes	#Folk_Pop #Pop #Pop_Rock	#2015

```
In [165]: data2.lyrics_clean[0]

Out[165]: "the club isn't the best place to find a lover so the bar is where i go me and my fri

In [166]: data2['raw'] = data2.lyrics_clean + ' ' + data2.search_term + ' ' + data2.Artist + '

In [167]: data2.raw[0]

Out[167]: "the club isn't the best place to find a lover so the bar is where i go me and my fri

In [169]: input_file_2 = data2.raw

          input_file_2.to_csv('input2.train', header=None, index=None, mode='a')
```

1.5.2 trigram, dim(32) on input 2

```
In [171]: ! sh wdpl6.sh

Compiling StarSpace
make: Nothing to be done for `opt'.
Start to train on ag_news data:
Arguments:
lr: 0.01
dim: 32
epoch: 10
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: cosine
maxNegSamples: 10
negSearchLimit: 50
thread: 10
minCount: 1
minCountLabel: 1
label: #
ngrams: 3
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Start to initialize starspace model.
Build dict from input file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input2.t
Read 0M words
Number of words in dictionary:  7931
Number of labels in dictionary: 606
```

```
Loading data from file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input2.train
Total number of examples loaded : 500
Initialized model weights. Model size :
matrix : 2008537 32
Training epoch 0: 0.01 0.001
Epoch: 98.2%  lr: 0.010000  loss: 0.051098  eta: <1min   tot: 0h0m0s  (9.8%)
 ---+++               Epoch    0 Train error : 0.05019714 +++---
Training epoch 1: 0.009 0.001
Epoch: 98.2%  lr: 0.009000  loss: 0.033475  eta: <1min   tot: 0h0m1s  (19.8%)
 ---+++               Epoch    1 Train error : 0.04010218 +++---
Training epoch 2: 0.008 0.001
Epoch: 98.2%  lr: 0.008000  loss: 0.027006  eta: <1min   tot: 0h0m2s  (29.8%)
 ---+++               Epoch    2 Train error : 0.02995434 +++---
Training epoch 3: 0.007 0.001
Epoch: 98.2%  lr: 0.007000  loss: 0.037455  eta: <1min   tot: 0h0m2s  (39.8%)
 ---+++               Epoch    3 Train error : 0.02973104 +++---
Training epoch 4: 0.006 0.001
Epoch: 98.2%  lr: 0.006000  loss: 0.020169  eta: <1min   tot: 0h0m3s  (49.8%)
 ---+++               Epoch    4 Train error : 0.02333216 +++---
Training epoch 5: 0.005 0.001
Epoch: 98.2%  lr: 0.005000  loss: 0.019903  eta: <1min   tot: 0h0m3s  (59.8%)
 ---+++               Epoch    5 Train error : 0.02041424 +++---
Training epoch 6: 0.004 0.001
Epoch: 98.2%  lr: 0.004000  loss: 0.017158  eta: <1min   tot: 0h0m4s  (69.8%)
 ---+++               Epoch    6 Train error : 0.01753144 +++---
Training epoch 7: 0.003 0.001
Epoch: 98.2%  lr: 0.003000  loss: 0.017673  eta: <1min   tot: 0h0m5s  (79.8%)
 ---+++               Epoch    7 Train error : 0.01930143 +++---
Training epoch 8: 0.002 0.001
Epoch: 98.2%  lr: 0.002000  loss: 0.017434  eta: <1min   tot: 0h0m5s  (89.8%)
 ---+++               Epoch    8 Train error : 0.01634584 +++---
Training epoch 9: 0.000999999 0.001
Epoch: 98.2%  lr: 0.001000  loss: 0.015095  eta: <1min   tot: 0h0m6s  (99.8%)
 ---+++               Epoch    9 Train error : 0.01551430 +++---
Saving model to file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay6
Saving model in tsv format : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay6
Finished training
```

query results:

"' ChristophersMBP:Starspace chrispaul$ ./query_predict wordplay6 5 Start to load a trained starspace model. STARSPACE-2017-2 Model loaded. ------Loaded model args: Arguments: lr: 0.01 dim: 32 epoch: 10 maxTrainTime: 8640000 saveEveryEpoch: 0 loss: hinge margin: 0.05 similarity: cosine maxNegSamples: 10 negSearchLimit: 50 thread: 10 minCount: 1 minCountLabel: 1 label: **label** ngrams: 3 bucket: 2000000 adagrad: 1 trainMode: 0 fileFormat: fastText normalizeText: 0 dropoutLHS: 0 dropoutRHS: 0 Predictions use 606 known labels. Enter some text: when your legs don't 0[0.545543]: #can_i_be_him_james_arthur 1[0.518118]: #goner_twenty_one 2[0.504183]: #i'll_show_you_justin_bieber 3[0.500063]: #recov-

ery_james_arthur 4[0.495595]: #the_fall_the_weeknd

Enter some text: shape of you 0[0.637578]: #shape_of_you_ed_sheeran 1[0.613346]: #the_christmas_song_justin_bieber 2[0.541947]: #this_is_what_it_takes_shawn_mendes 3[0.514449]: #u.n.i._ed_sheeran 4[0.507949]: #thought_of_you_justin_bieber

Enter some text: I feel it coming 0[0.754581]: #mark_my_words_justin_bieber 1[0.742582]: #recovery_james_arthur 2[0.717076]: #impossible_james_arthur 3[0.686971]: #i_feel_it_coming_the_weeknd 4[0.678153]: #safe_inside_james_arthur

Enter some text: i feel it coming 0[0.745705]: #mark_my_words_justin_bieber 1[0.738879]: #recovery_james_arthur 2[0.710475]: #impossible_james_arthur 3[0.692685]: #safe_inside_james_arthur 4[0.68346]: #i_feel_it_coming_the_weeknd

Enter some text: you've been scared of love 0[0.683157]: #mark_my_words_justin_bieber 1[0.604954]: #i_feel_it_coming_the_weeknd 2[0.584597]: #valerie_the_weeknd 3[0.559147]: #recovery_james_arthur 4[0.543951]: #baby_justin_bieber

Enter some text: rockin' the sleeve 0[0.614853]: #not_today_twenty_one 1[0.601955]: #sofa_ed_sheeran 2[0.559995]: #kiss_land_the_weeknd 3[0.557646]: #free_the_animal_sia 4[0.546833]: #wanderlust_the_weeknd

Enter some text: i'm swaggin 0[0.567114]: #alive_sia 1[0.510653]: #inside_out_the_chainsmokers 2[0.476584]: #Deep_House 3[0.471518]: #silent_night_justin_bieber 4[0.453057]: #afire_love_ed_sheeran

Enter some text: swaggin' 0[0.713119]: #white_iverson_post_malone 1[0.601568]: #major_lazer_featuring_justin_bieber_and_m 2[0.557987]: #post_malone 3[0.555001]: #sorry_justin_bieber 4[0.547299]: #all_bad_justin_bieber

Enter some text: church shoes 0[0.635485]: #ordinary_life_the_weeknd 1[0.632278]: #lonely_star_the_weeknd 2[0.603001]: #the_weeknd_featuring_daft_punk 3[0.546157]: #omi 4[0.532151]: #gone_the_weeknd

Enter some text: p1 cleaner than your church shoes 0[0.595652]: #lonely_star_the_weeknd 1[0.572356]: #ordinary_life_the_weeknd 2[0.564261]: #one_million_bullets_sia 3[0.552717]: #starboy_the_weeknd 4[0.536313]: #the_weeknd_featuring_daft_punk

Enter some text: white iverson 0[0.781273]: #post_malone 1[0.742281]: #Trap 2[0.698055]: #Cloud_Rap 3[0.643088]: #rich_&_sad_post_malone 4[0.633723]: #leave_post_malone"'

My fears were correct. Most search results only return unique songs in their top 5 predictions as there are a ratio of 5:1 song id labels to any other labels (genre, artist, year).

However, some searches querying very specific vocabulary (such as white iverson) does return the appropriate artist label first, followed by the appropriate genres in position 2 and 3. This is great.

The takeaway from this experiment is that indeed one would need to build seperate models to predict different features for all lyric vocabulary.

1.6 Secondary goal 3: build dedicated genre predictor based on input text

Probably the 'coolest' application of secondary goal 2's insight is to predict what genre of music a person would like to listen to based on input text (not necessarily lyric vocabulary). I will attempt to increase the number of songs we consider to have a breadth of genres represented.

1.6.1 input file 3 creation

```
In [183]: data2 = full_data_raw[['lyrics_clean', 'Genre']]
          data2.head(2)
```

```
Out[183]:                                          lyrics_clean                Genre
          0   The club isn't the best place to find a lover...  ['Folk Pop', 'Pop']
          1   When your legs don't work like they used to b...  ['Folk Pop', 'Pop']

In [184]: data2.lyrics_clean = data2.lyrics_clean.apply(clean)

          data2.Genre = data2.Genre.apply(lambda x: str(x))
          data2.Genre = data2.Genre.apply(lambda x: x.replace("[\'", "#"))
          data2.Genre = data2.Genre.apply(lambda x: x.replace("\']", ""))
          data2.Genre = data2.Genre.apply(lambda x: x.replace("\', \'", "xx#"))
          data2.Genre = data2.Genre.apply(lambda x: x.replace(" ", "_"))
          data2.Genre = data2.Genre.apply(lambda x: x.replace("xx#", " #"))

/Users/chrispaul/anaconda2/envs/nlp/lib/python3.6/site-packages/pandas/core/generic.py:4401: Se
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html
  self[name] = value


In [185]: data2.head()

Out[185]:                                          lyrics_clean           Genre
          0  the club isn't the best place to find a lover ...  #Folk_Pop #Pop
          1  when your legs don't work like they used to be...  #Folk_Pop #Pop
          2  loving can hurt loving can hurt sometimes but ...  #Folk_Pop #Pop
          3  i found a love for me oh darling just dive rig...  #Folk_Pop #Pop
          4  white lips pale face breathing in the snowflak...  #Folk_Pop #Pop

In [186]: data2.tail()

Out[186]:       lyrics_clean                                  Genre
          39291        error                             #Punk_Rock
          39292        error                             #Punk_Rock
          39293        error                             #Punk_Rock
          39294        error                             #Punk_Rock
          39295          nan  #Country #Rock_and_Roll #Rockabilly

In [187]: data2 = data2[data2.lyrics_clean != "error"]

In [188]: len(data2)

Out[188]: 36932

In [189]: data2['raw'] = data2.lyrics_clean + " " + data2.Genre

In [190]: data2.raw[0]

Out[190]: "the club isn't the best place to find a lover so the bar is where i go me and my fri
```

```
In [193]: df1 = data2.sample(frac=0.1, replace=False)
          df2 = data2.sample(frac=0.2, replace=False)
          df3 = data2.sample(frac=0.5, replace=False)

In [195]: input_file_3_1 = df1.raw
          input_file_3_2 = df2.raw
          input_file_3_3 = df3.raw

          input_file_3_1.to_csv('input3_1.train', header=None, index=None, mode='a')
          input_file_3_2.to_csv('input3_2.train', header=None, index=None, mode='a')
          input_file_3_3.to_csv('input3_3.train', header=None, index=None, mode='a')
```

1.6.2 trigram, dim(32) on input 3_3

model size: 740 MB

```
In [197]: ! sh wdpl_G_3.sh
```

```
Compiling StarSpace
make: Nothing to be done for `opt'.
Start to train on ag_news data:
Arguments:
lr: 0.01
dim: 32
epoch: 10
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: cosine
maxNegSamples: 10
negSearchLimit: 50
thread: 10
minCount: 1
minCountLabel: 1
label: #
ngrams: 3
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Start to initialize starspace model.
Build dict from input file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input3_3
Read 5M words
Number of words in dictionary:  88435
Number of labels in dictionary: 572
```

```
Loading data from file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/input3_3.tra
Total number of examples loaded : 18078
Initialized model weights. Model size :
matrix : 2089007 32
Training epoch 0: 0.01 0.001
Epoch: 100.0%  lr: 0.009000  loss: 0.030237  eta: 0h2m  tot: 0h0m19s  (10.0%)
 ---+++               Epoch    0 Train error : 0.03052074 +++---
Training epoch 1: 0.009 0.001
Epoch: 100.0%  lr: 0.008000  loss: 0.016779  eta: 0h2m  tot: 0h0m37s  (20.0%) tot: 0h0m30s  (15
 ---+++               Epoch    1 Train error : 0.01710977 +++---
Training epoch 2: 0.008 0.001
Epoch: 100.0%  lr: 0.007000  loss: 0.011901  eta: 0h1m  tot: 0h0m54s  (30.0%)2m  tot: 0h0m47s
 ---+++               Epoch    2 Train error : 0.01221180 +++---
Training epoch 3: 0.007 0.001
Epoch: 100.0%  lr: 0.006000  loss: 0.010082  eta: 0h1m  tot: 0h1m11s  (40.0%)h1m  tot: 0h1m7s
 ---+++               Epoch    3 Train error : 0.00975063 +++---
Training epoch 4: 0.006 0.001
Epoch: 100.0%  lr: 0.005056  loss: 0.008497  eta: 0h1m  tot: 0h1m27s  (50.0%).9%  lr: 0.005889
 ---+++               Epoch    4 Train error : 0.00864849 +++---
Training epoch 5: 0.005 0.001
Epoch: 100.0%  lr: 0.004000  loss: 0.007861  eta: 0h1m  tot: 0h1m43s  (60.0%)
 ---+++               Epoch    5 Train error : 0.00791969 +++---
Training epoch 6: 0.004 0.001
Epoch: 100.0%  lr: 0.003000  loss: 0.006910  eta: <1min   tot: 0h1m58s  (70.0%)
 ---+++               Epoch    6 Train error : 0.00720129 +++---
Training epoch 7: 0.003 0.001
Epoch: 100.0%  lr: 0.002000  loss: 0.006569  eta: <1min   tot: 0h2m14s  (80.0%)tot: 0h2m5s  (74
 ---+++               Epoch    7 Train error : 0.00662622 +++---
Training epoch 8: 0.002 0.001
Epoch: 100.0%  lr: 0.001000  loss: 0.006067  eta: <1min   tot: 0h2m30s  (90.0%)
 ---+++               Epoch    8 Train error : 0.00624173 +++---
Training epoch 9: 0.000999999 0.001
Epoch: 100.0%  lr: -0.000000  loss: 0.006066  eta: <1min   tot: 0h2m46s  (100.0%)ot: 0h2m41s
 ---+++               Epoch    9 Train error : 0.00595883 +++---
Saving model to file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay_G_3
Saving model in tsv format : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay_
Finished training
```

Query results:

```
ChristophersMBP:Starspace chrispaul$ ./query_predict wordplay_G_3 5
Start to load a trained starspace model.
STARSPACE-2017-2
Model loaded.
------Loaded model args:
Arguments:
lr: 0.01
```

```
dim: 32
epoch: 10
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: cosine
maxNegSamples: 10
negSearchLimit: 50
thread: 10
minCount: 1
minCountLabel: 1
label: __label__
ngrams: 3
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
dropoutRHS: 0
Predictions use 572 known labels.
Enter some text: shape of you
0[0.537096]: #Adult_Contemporary
1[0.515775]: #Classical_Crossover
2[0.504502]: #Blue_Eyed_Soul
3[0.447518]: #Jazz_Fusion
4[0.439413]: #Traditional_Pop_Music

Enter some text: church shoes
0[0.595229]: #Yacht_Rock"
1[0.585303]: #Pop_Standards
2[0.565081]: #Boogie-Woogie
3[0.510275]: #Latin"
4[0.473461]: #Swamp_Rock"

Enter some text: white iverson
0[0.544458]: #College_Rock
1[0.538773]: #Rock_and_Roll"
2[0.536393]: #Comedy_Rock
3[0.530044]: #Jangle_Pop
4[0.527942]: #Western_Swing"

Enter some text: swaggin'
0[0.626325]: #Anti-Folk
1[0.624912]: #Grunge"
2[0.573362]: #Neo-Psychedelia"
3[0.55838]: #College_Rock
```

```
4[0.52458]: #Alternative_Hip_Hop

Enter some text: i feel it coming
0[0.561633]: #Italo_House
1[0.495796]: #Lambada
2[0.444494]: #Dance-Rock
3[0.427253]: #Eurohouse
4[0.420267]: #Surf"

Enter some text: steel horse
0[0.614196]: #Dance-Punk
1[0.578538]: #Blues_Rock
2[0.560555]: #Exotica
3[0.553315]: #Hard_Rock
4[0.506025]: #Glam_Metal

Enter some text: highway to hell
0[0.552641]: #Acoustic
1[0.522208]: #Smooth_Jazz
2[0.503251]: #Garage
3[0.492726]: #Aor
4[0.471313]: #Sophisti-Pop
```

These results aren't good at all. It seems the sheer number of possible genres we have is impeding the algorithm's ability to select the right one (probabilities of the top pick never exceed 62%). Perhaps organizing the genres by meta categories like "rock", "pop", "electronic", "folk", "jazz", etc. would help. Some algorithm tuning would also improve the results.

I will leave the improving of genre prediction to future work.

1.7 Secondary goal 4: attempt to include all songs in the SSp song prediction algorithm

The Wordplay service currently runs on custom algorithms that quite accurately curates a playlist of relevant songs when given input text. I want to expand the scope pf SSp's algorithm to include the entire songs data and compare their performance.

```
In [200]: data2 = full_data_raw[['lyrics_clean', 'search_term']]
          data2.head(2)

Out[200]:                                          lyrics_clean  \
          0   The club isn't the best place to find a lover...
          1   When your legs don't work like they used to b...

                           search_term
          0       shape of you ed sheeran
          1  thinking out loud ed sheeran

In [201]: data2.lyrics_clean = data2.lyrics_clean.apply(clean)
```

```
data2.search_term = data2.search_term.apply(lambda x: str(x))
data2.search_term = data2.search_term.apply(lambda x: '#' + x.replace(' ', "_"))
```

```
/Users/chrispaul/anaconda2/envs/nlp/lib/python3.6/site-packages/pandas/core/generic.py:4401: Se
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html
  self[name] = value
```

```
In [202]: data2.head()
```

Out[202]:

	lyrics_clean	search_term
0	the club isn't the best place to find a lover ...	#shape_of_you_ed_sheeran
1	when your legs don't work like they used to be...	#thinking_out_loud_ed_sheeran
2	loving can hurt loving can hurt sometimes but ...	#photograph_ed_sheeran
3	i found a love for me oh darling just dive rig...	#perfect_ed_sheeran
4	white lips pale face breathing in the snowflak...	#the_a_team_ed_sheeran

```
In [203]: data2['raw'] = data2.lyrics_clean + ' ' + data2.search_term
```

```
/Users/chrispaul/anaconda2/envs/nlp/lib/python3.6/site-packages/ipykernel_launcher.py:1: Settin
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html
  """Entry point for launching an IPython kernel.
```

```
In [205]: data2.tail()
```

Out[205]:

	lyrics_clean	search_term	raw
39291	error	#got_a_lot_to_say_ramones	error #got_a_lot_to_say_ramones
39292	error	#she_talks_to_rainbows_ramones	error #she_talks_to_rainbows_ramones
39293	error	#born_to_die_in_berlin_ramones	
39294	error	#r.a.m.o.n.e.s._ramones	
39295	nan	#nan	

```
          39293  error #born_to_die_in_berlin_ramones
          39294          error #r.a.m.o.n.e.s._ramones
          39295                              nan #nan

In [206]: data2 = data2[data2.lyrics_clean != "error"]

In [207]: len(data2)

Out[207]: 36932

In [208]: data2.raw[0]

Out[208]: "the club isn't the best place to find a lover so the bar is where i go me and my fr

In [209]: input_file_A = data2.raw

In [210]: input_file_A.to_csv('inputA.train', header=None, index=None, mode='a')
```

1.7.1 trigram, dim(32) on input A

model size: 767 MB

```
In [211]: ! sh wdpl_A.sh

Compiling StarSpace
make: Nothing to be done for `opt'.
Start to train on ag_news data:
Arguments:
lr: 0.01
dim: 32
epoch: 10
maxTrainTime: 8640000
saveEveryEpoch: 0
loss: hinge
margin: 0.05
similarity: cosine
maxNegSamples: 10
negSearchLimit: 50
thread: 10
minCount: 1
minCountLabel: 1
label: #
ngrams: 3
bucket: 2000000
adagrad: 1
trainMode: 0
fileFormat: fastText
normalizeText: 0
dropoutLHS: 0
```

```
dropoutRHS: 0
Start to initialize starspace model.
Build dict from input file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/inputA.t
Read 11M words
Number of words in dictionary:  128832
Number of labels in dictionary: 36977
Loading data from file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/inputA.train
Total number of examples loaded : 36930
Initialized model weights. Model size :
matrix : 2165809 32
Training epoch 0: 0.01 0.001
Epoch: 100.0%  lr: 0.009000  loss: 0.035965  eta: 0h6m  tot: 0h0m42s  (10.0%)t: 0h0m3s  (0.7%)
 ---+++               Epoch    0 Train error : 0.03567939 +++---
Training epoch 1: 0.009 0.001
Epoch: 100.0%  lr: 0.008000  loss: 0.003319  eta: 0h4m  tot: 0h1m13s  (20.0%)m  tot: 0h0m59s
 ---+++               Epoch    1 Train error : 0.00324746 +++---
Training epoch 2: 0.008 0.001
Epoch: 100.0%  lr: 0.007000  loss: 0.000255  eta: 0h2m  tot: 0h1m38s  (30.0%)7.0%  lr: 0.00775
 ---+++               Epoch    2 Train error : 0.00018753 +++---
Training epoch 3: 0.007 0.001
Epoch: 100.0%  lr: 0.006000  loss: 0.000075  eta: 0h2m  tot: 0h2m4s  (40.0%)0h2m  tot: 0h1m46s
 ---+++               Epoch    3 Train error : 0.00009280 +++---
Training epoch 4: 0.006 0.001
Epoch: 100.0%  lr: 0.005000  loss: 0.000048  eta: 0h2m  tot: 0h2m29s  (50.0%)6.8%  lr: 0.00569
 ---+++               Epoch    4 Train error : 0.00006345 +++---
Training epoch 5: 0.005 0.001
Epoch: 100.0%  lr: 0.004000  loss: 0.000054  eta: 0h1m  tot: 0h2m54s  (60.0%) lr: 0.004500  los
 ---+++               Epoch    5 Train error : 0.00004797 +++---
Training epoch 6: 0.004 0.001
Epoch: 100.0%  lr: 0.003000  loss: 0.000040  eta: 0h1m  tot: 0h3m19s  (70.0%)8.5%  lr: 0.00361
 ---+++               Epoch    6 Train error : 0.00003503 +++---
Training epoch 7: 0.003 0.001
Epoch: 100.0%  lr: 0.002000  loss: 0.000023  eta: <1min   tot: 0h3m43s  (80.0%)m  tot: 0h3m23s
 ---+++               Epoch    7 Train error : 0.00003080 +++---
Training epoch 8: 0.002 0.001
Epoch: 100.0%  lr: 0.001000  loss: 0.000032  eta: <1min   tot: 0h4m7s  (90.0%)
 ---+++               Epoch    8 Train error : 0.00002829 +++---
Training epoch 9: 0.000999999 0.001
Epoch: 100.0%  lr: -0.000000  loss: 0.000021  eta: <1min   tot: 0h4m32s  (100.0%)00021  eta: <
 ---+++               Epoch    9 Train error : 0.00002192 +++---
Saving model to file : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay_A
Saving model in tsv format : /Users/chrispaul/Desktop/classes/nlp/finalproj/Starspace/wordplay
Finished training
```

Query Results:
Let's see if specific lyrics trace back to the correct song
"your love was handmade" -> ed sheeran, shape of you | "you used to cell phone" -> drake,

hotline bling | "this love toll" -> maroon 5, this love | "sweet dreams disagree travel" -> eurythmics, sweet dreams | "roman cavalry choirs" -> coldplay, viva la vida

```
Enter some text: your love was handmade
0[0.611011]: #interlude_lily_allen
1[0.608823]: #without_love_little_richard
2[0.593795]: #the_grit_don't_quit_e-40
3[0.593452]: #fast_car_jonas_blue
4[0.566742]: #after_dollars,_no_cents_master_p"
5[0.562163]: #stomp_young_buck
6[0.560721]: #through_with_you_maroon_5
7[0.560458]: #compass_rascal_flatts
8[0.559619]: #second_chance_.38_special
9[0.557936]: #world_machine_level_42

Enter some text: you used to cell phone
0[0.699796]: #save_a_prayer_bon_jovi
1[0.636887]: #surrender_tom_petty
2[0.635853]: #the_christmas_song_sarah_mclachlan
3[0.629684]: #he's_a_mighty_good_leader_beck
4[0.605863]: #i_can't_find_smokey_robinson
5[0.605646]: #your_body's_callin'_r._kelly
6[0.600626]: #real_niggaz_jay-z
7[0.594841]: #sleigh_ride_chicago"
8[0.594686]: #forgiveness_sarah_mclachlan
9[0.592229]: #made_for_me_tobymac

Enter some text: this love toll
0[0.754553]: #it's_your_love_tim_mcgraw
1[0.728411]: #this_everyday_love_rascal_flatts
2[0.670507]: #please_u2
3[0.656775]: #ballerina_van_morrison
4[0.62912]: #banned_from_another_club_n.o.r.e.
5[0.605853]: #100_years_jordin_sparks
6[0.603134]: #pusherman_curtis_mayfield
7[0.600518]: #suddenly_billy_ocean
8[0.599851]: #i_just_wanna_love_u_jay_z"
9[0.594478]: #asylum_disturbed

Enter some text: sweet dreams disagree travel
0[0.632433]: #this_ain't_livin'_2pac"
1[0.628782]: #old_man_kensey_r.e.m.
2[0.627102]: #i'll_never_stop_loving_you_britney_spears
3[0.62538]: #swing_trace_adkins
4[0.610122]: #i'm_blowin'_up_kool_moe
5[0.603248]: #tell_me_cathy_dennis
6[0.598248]: #if_she_would_have_been_faithful..._chicago
7[0.596334]: #love_for_sale_bon_jovi"
```