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Stage3 - The Implementation Stage.

This project was implemented using the Python programming language and the Linux operating system.

- Novelty

Users can already find tweets related to their topic by searching for keywords or hashtags related to their topic. However, this project will allow users to find tweets that are both semantically and structurally similar to their tweets, not just related to the topic of those tweets. Users will also be recommended hashtags, such as those of 'intermediate popularity', which users do not include in their tweets, but which are topically related to their tweets.

- Usefulness

This project will allow users to find which tweets and hashtags are similar to their own tweets. Thus, this project aims to bridge different Twitter communities by finding 'hidden' connections between them based on different measures of similarity. This will facillitate communication between previously isolated communities.

- Sample Small Data Snippet (This is a subset 3 tweets out of thousands of tweets used)

211 : RT @KCONTV: Fans dancing in front of the @HondaCenter before the #BTSinAnaheim concert! #TWTinAnaheim #BTS https://t.co/QAVEt0uqYn
212 : RT @BTS_V_sana: 02line(01)ARMY all #ARMY #BTSRT #RT https://
213 : RT @bangtanitl: #BTS was mentioned on Kangnam Style, 170331 https://t.co/uL8yrSGBJB https://t.co/qJ0IINaTrH

- Sample Small Data Output

The word and paragraph vectors, along with the document-term frequency matrix, are huge, so we did not include them in Phase 3 write-up. Additionally, they are only intermediate outputs. The dendrogram of the clustering results is the final output, and a visual and description of it is given below the pipeline description in this section.

- Pipeline Description

Since it would be quite lengthy to include all the code used, only the hierarchical clustering algorithm code has been given at the end of this section. Also, the bipartite graph and Simrank code was completed but are not part of the main pipeline yet, so only a histogram of their output is given; the code is not included.

The rest of the code can be given upon request, and may be included in the final report. The pipeline is briefly described:

The data crawler uses a listener to find new tweets that contain certain keywords or hashtags, collectively called a 'filter'. To find tweets that are related to certain topics but do not necessarily contain the hashtags of those topics, we first gathered tweets containing initial keywords or hashtags (say 5). New keywords, hashtags, and topics were found from in this first iteration of tweets, and were added to the filter. Then, we ran the data crawler again using this new filter, and repeated this multiple times. Essentially, we used previous iterations of keywords or hashtags to find new topics, and we only ran clustering on the tweets found in the final iteration. Each iteration is called a 'generation'.

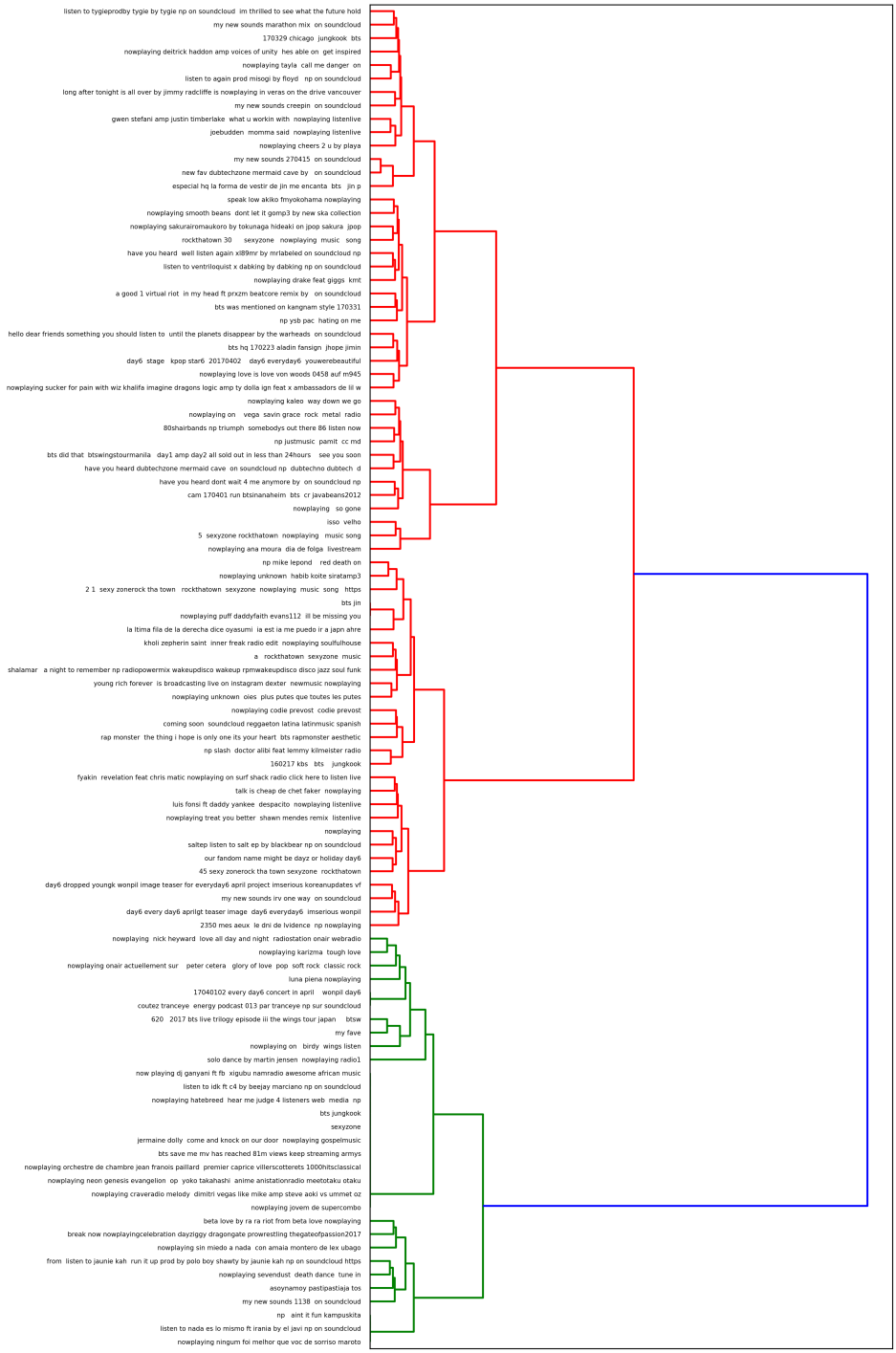
There were two separate methods we used to find new topics: 1)We took the 10 most frequent new, non-trivial keywords hashtags found in this first iteration of tweets and added them to the filter 2) We used LDA to find new topics. IE) Filter in Gen 1: music, concerts Filter in Gen 2: music, concerts, classical, metal Filter in Gen 3: music, concerts, classical, metal, bach

Later, the crawler and topic finding scripts will be deployed to a linux server to be run periodically. This will be implemented by crontab.

The pipeline is described as follows:

- Twitter_streaming.py: Starts up a listener of incoming tweets. Uses the Tweepy library to connect to Twitter Streaming API. Outputs a JSON text file of data
- Tweet_json_to_plain.py: Reads a JSON text file and outputs a file of tweets
- Toptopics.py: Use term frequency and latent dirichlet allocation respectively to find new topics from existing tweets
- IOUtil.py: Reads file of tweets and uses regular expressions to do some preprocessing
- Word2vec.py: Trains word vector and tf-idf weighted sum of word vector to form document vector. Computes similarity between tweets. Outputs word and paragraph vectors
- HierarchicalCluster.py: Clusters the tweets into topics and outputs a dendrogram
- Interesting findings in Dendrogram

Since there were thousands of tweets that were gathered, we created a dendrogram for 100 tweets. There appear to be two main groups, and within the red group, there were 4 main subgroups. This sample shows that our algorithms work. However, since we did not input in meaningful data yet, and since this dendrogram only shows 100 of thousands of tweets, we do not expect this sample to give meaningful results. Later, we will gather better data and perform an analysis.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nowplaying smooth beans dont let it gomp3 by new ska collection
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nowplaying drake feat giggs kmt
a good 1 virtual riot in my head ft prxzm beatcore remix by on soundcloud
bts was mentioned on kangnam style 170331
np ysb pac hating on me
hello dear friends something you should listen to until the planets disappear by the warheads on soundcloud
bts hq 170223 aladin fansign jhope jimin
day6 stage kpop star6 20170402 day6 everyday6 youwerebeautiful
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bts jin
nowplaying puff daddyfaith evans112 ill be missing you
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coming soon soundcloud reggaeton latina latinmusic spanish
rap monster the thing i hope is only one its your heart bts rapmonster aesthetic
np slash doctor alibi feat lemmy kilmeister radio
160217 kbs bts jungkook
fyakin revelation feat chris matic nowplaying on surf shack radio click here to listen live
talk is cheap de chet faker nowplaying
luis fonsi ft daddy yankee despacito nowplaying listenlive
nowplaying treat you better shawn mendes remix listenlive
nowplaying
saltep listen to salt ep by blackbear np on soundcloud
our fandom name might be dayz or holiday day6
45 sexy zonerock tha town sexyzone rockthatown
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nowplaying onair actuellement sur peter cetera glory of love pop soft rock classic rock
luna piena nowplaying
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coutez tranceye energy podcast 013 par tranceye np sur soundcloud
620 2017 bts live trilogy episode iii the wings tour japan btsw
my fave
nowplaying on birdy wings listen
solo dance by martin jensen nowplaying radio1
now playing dj qanyani ft fb xigubu namradio awesome african music
listen to idk ft c4 by beejay marciano np on soundcloud
nowplaying hatebreed hear me judge 4 listeners web media np
bts jungkook
sexyzone
jermaine dolly come and knock on our door nowplaying gospelmusic
bts save me mv has reached 81m views keep streaming armys
nowplaying orchestre de chambre jean franois paillard premier caprice villerscotterets 1000hitsclassical
nowplaying neon genesis evangelion op yoko takahashi anime anistationradio meetotaku otaku
nowplaying craveradio melody dimitri vegas like mike amp steve aoki vs ummet oz
nowplaying jovem de supercombo
beta love by ra ra riot from beta love nowplaying
break now nowplayingcelebration dayziggy dragongate prowrestling thegateofpassion2017
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- Working Code

```
class HierarchicalClusterer(object):
    def __init__(
            self,
            distance_matrix,
            linkage_function,
            minium_clusters=2):
        self.distance_matrix = distance_matrix
        self.linkage_function = linkage_function
        self.minium_clusters = minium_clusters

    def build_clusters(self):
        print 'a'

    def do_link_clustering(self, cluster_id_list, cluster_nodes):

        def small_big(first, second):
             if first < second else (second, first)

        def merge(cluster1,
                  cluster2,
                  distance,
                  cluster_ids,
                  cluster_nodes):
            cluster1, cluster2 = small_big(cluster1, cluster2)
            cluster_ids[cluster1].extend(cluster_ids[cluster2])
            cluster_ids[cluster2] = []
            node = Node()

            if cluster_nodes[cluster1]:
                node.left = cluster_nodes[cluster1]
                cluster_nodes[cluster1].parent = node
            else:
                node.left_instance = cluster1

            if cluster_nodes[cluster2]:
                node.right = cluster_nodes[cluster2]
                cluster_nodes[cluster2].parent = node
            else:
                node.right_instance = cluster2

            node.set_height(distance, distance)
            cluster_nodes[cluster1] = node
```

```
length = self.distance_matrix.shape[0]
cluster_number = self.distance_matrix.shape[0]
distance_list = [
    ClusterPair(first,
    second,
    self.distance_matrix[first][second], 1, 1)
    for first in range(length) for second in range(first +

distance_queue = MyHeap(
    initial=distance_list,
    key=lambda x: x.distance)

while cluster_number - self.minium_clusters > 0:
    pair = distance_queue.pop()
    if not pair:
        break

    if not valid_pair(pair, cluster_id_list):
        continue

    merge(pair.cluster1, pair.cluster2,
     pair.distance, cluster_id_list, cluster_nodes)

    for index in range(length):
        if index != pair.cluster1 \
                and cluster_id_list[index]:
    cluster1, cluster2 = \
        small_big(cluster1, cluster2)

            new_distance = self.linkage_function(
                self.distance_matrix,
                cluster_id_list[smaller],
                cluster_id_list[bigger])

            distance_queue.push(ClusterPair(
                smaller,
                bigger,
                new_distance,
                len(cluster_id_list[smaller]),
                len(cluster_id_list[bigger])))

    cluster_number -= 1
```

- SimRank output (to be integrated into main pipeline later)

This outputs structural similarity scores between tweets. As described in the

'pruning' section of the original SimRank paper (cited in Phase 2), we did not compute distances between tweet that were too far away from one another; thus, score of 0 are not presented in the histogram. Over a hundred thousand tweets were read.

Later, we may use Edit Distance to compute similarity scores and compare the clustering performance on using Edit Distance vs. using Document Vector.

- simrank_tweets.py: contains functions for running SimRank on bipartite graph
- twitter_bipgraph.py: create bipartite graph from tweets and run SimRank on it.