Illinois is famous for being one of the very few states in the country with negative population growth. The objective of your final project is to:

1) Identify the key reasons for the declining population by extracting meaningful insights from unstructured text 2) Provide actionable recommendations on what can be done to r collection of a couple of months' worth of news articles in RCC located at: /project/msca/kadochnikov/news/news_chicago_il.pkl

The news articles are related to either Chicago and / or Illinois.

To complete your assignment, I suggest considering the following steps:

- Clean-up the noise (eliminate articles irrelevant to the analysis)
- Detect major topics
- Identify top reasons for population decline (negative sentiment)
  - Suggest corrective actions
- Demonstrate how the city / state can attract new businesses (positive sentiment)
- Leverage appropriate NLP techniques to identify organizations and people and apply targeted sentiment
  - Why businesses should stay in IL or move into IL? ** Create appropriate visualization to summarize your recommendations (i.e. word cloud chart or bubble chart)
  - Why residents should stay in IL or move into IL? ** Create appropriate visualization to summarize your recommendations (i.e. word cloud chart or bubble chart)

Additional guidance:

- Default sentiment will likely be wrong from any software package and will require significant tweaking
  - Either keyword / dictionary approach or
  - Labeling and classification
- You are encouraged to explore a combination several techniques to identify key topics:
  - Topic modeling (i.e. LSA, LDA and TF-IDF)
  - Classification (hand-label several topics on a sample and then train classifier)
  - Clustering (cluster topics around pre-selected keywords or word vectors)
- Please limit your work to 7 PowerPoint slides. On your slides you will want to provide:
  - Executive Summary
  - Methodology and source data overview
  - Actionable recommendations
- Please submit your actual program codes (i.e. Python Notebook) along with your PowerPoint – as a separate attachment
- Your presentation should be targeted toward business audience and must not contain any code snippets
- You are welcome to use any software packages of your choice to complete the assignment

In [1]:
```
import warnings

warnings.simplefilter('ignore')

import time
import math
import re
from textblob import TextBlob
import pandas as pd

import nltk as nltk
from nltk.stem.wordnet import WordNetLemmatizer

import string


import gensim
from gensim import corpora, models
from gensim.models.ldamulticore import LdaMulticore
import pyLDAvis.gensim
import numpy as np
import pandas as pd
from IPython.display import display
from tqdm import tqdm
from collections import Counter
import ast

import matplotlib.pyplot as plt
import matplotlib.mlab as mlab
import seaborn as sb

from sklearn.feature_extraction.text import CountVectorizer
from textblob import TextBlob
import scipy.stats as stats

from sklearn.decomposition import TruncatedSVD
from sklearn.decomposition import LatentDirichletAllocation
from sklearn.manifold import TSNE

from bokeh.plotting import figure, output_file, show
from bokeh.models import Label
from bokeh.io import output_notebook
output_notebook()

%matplotlib inline
```

(https://bokeh.pydata.org) BokehJS 0.12.16 successfully loaded.

In [74]:
```
import sklearn
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer, HashingVectorizer, TfidfTransformer, TfidfVectorizer
from sklearn.naive_bayes import MultinomialNB
from sklearn.metrics import classification_report, confusion_matrix, accuracy_score
from sklearn.linear_model import LogisticRegression, SGDClassifier
from sklearn import metrics
```

Cleaning

In [2]:
```
df = pd.read_pickle("news_chicago_il.pkl")
```

In [3]:
```
df.head(5)
```

Out[3]:

	crawled_date	language	text	title
0	2020-05-11	english	\nGov. Jay “Fatso” Pritzker called on all Illi...	All In Illinois
1	2020-05-11	english	May 10, 2020 -The Illinois Department of Publi...	The Illinois Department of Public Health Annou...
2	2020-05-11	english	Gloria Lawrence said: May 10, 2020 at 1:31 AM\...	Foto Friday: Alton, Illinois
3	2020-05-11	english	NBA to follow German soccer league model with ...	Chris Broussard on Michael Jordan returning to...
4	2020-05-11	english	Search Minggu, 10 Mei 2020 Pork chops vs. peop...	Pork chops vs. people: Can Americans’ appetite...

In [4]:
```
df.shape
```

Out[4]:
```
(177325, 4)
```

Checking to make sure all articles are in English.

In [5]:
```
df.language.unique()
```

Out[5]: array(['english'], dtype=object)

Dropping columns not needed.

In [6]:
```
df = df.drop(['crawled_date','language'], axis=1)
```

I am making the assumption that articles with the same title have the same content. I will drop duplicates in main dataframe.

In [7]:
```
df = df.drop_duplicates(subset='title').reset_index(drop=True)
len(df)
```

Out[7]: 138258

In [8]:
```
#df contains all duplicate titles

dup_df = pd.read_pickle("news_chicago_il.pkl")
dup_df['duplicate'] = dup_df.duplicated(subset='title', keep='first').reset_index(drop=True)
dup_df = dup_df[dup_df['duplicate'] == True]
len(dup_df)
```

Out[8]: 39067

I want to include the title in case there is important info.

In [9]:
```
df['comb'] = df['title'] + ' ' + df['text']
```

In [10]:
```
words=[]
def stopwords(text):
    words=[w for w in text if w not in stopwords.words('english')]
    return words
```

In [11]:
```
from nltk.corpus import stopwords
#nltk.download('stopwords')
stop = stopwords.words('english')
```

In [12]:
```
#remove stop words

df['comb'] = df['comb'].apply(lambda x: ' '.join([item for item in x.split() if item not in stop]))
```

In [13]:
```
clean=pd.DataFrame(df['comb'])
```

In [14]:
```
#lowercase

clean = pd.DataFrame(clean['comb'].apply(str.lower))
```

In [15]:
```
#remove special chars

clean['text_clean'] = clean['comb'].map(lambda x: re.sub('[^a-zA-Z0-9 @ . , : - _]', '', str(x)))
```

In [16]:
```
#only need to keep clean text
clean=pd.DataFrame(clean['text_clean'])
clean.head()
```

Out[16]:

	text_clean
0	all in illinois gov. jay fatso pritzker called...
1	the illinois department public health announce...
2	foto friday: alton, illinois gloria lawrence s...
3	chris broussard michael jordan returning chica...
4	pork chops vs. people: can americans appetite ...

Only keep articles related to population movement in IL/Chicago.

In [17]:
```
#stemmers

porter = nltk.PorterStemmer()
lancaster = nltk.LancasterStemmer()
```

In [18]:
```
#locations '(USA-IL-Chicago)','Illinois','Chicago'

key_words=['population','migration','exodus','moving','leaving']
in_stems=[porter.stem(c) for c in key_words]
new_stems=[]

for a in range(0, len(clean)):
    words=clean.iloc[a].text_clean
    stems=[porter.stem(t) for t in words.split()]
    if any(s in stems for s in in_stems):
        new_stems.append(a)
    else:
        continue
```

In [19]:
```
clean=clean.iloc[new_stems]
clean=clean.reset_index(drop=True)
len(clean)
```

Out[19]: 26335

I will remove words that I don't feel explain people leaving IL.

In [20]:
```
#remove off-topic sports, animals, and Trump

words_list = ['bears','cubs','bulls','blackhawks','football','baseball','basketball','hockey','sox','Trump','deer','coyote','covi
avirus']
p_stems = [porter.stem(x) for x in words_list]
l_stems = [lancaster.stem(x) for x in words_list]

print(p_stems)
print(l_stems)
```

```
['bear', 'cub', 'bull', 'blackhawk', 'footbal', 'basebal', 'basketbal', 'hockey', 'sox', 'trump', 'deer', 'coyot', 'covid19', 'co
['bear', 'cub', 'bul', 'blackhawk', 'footbal', 'basebal', 'basketbal', 'hockey', 'sox', 'trump', 'deer', 'coyot', 'covid19', 'cov
```

In [21]:
```
porter_stems=[]
for a in range(0, len(clean)):
    words=clean.iloc[a].text_clean
    stems=[porter.stem(t) for t in words.split()]
    if any(s in stems for s in p_stems):
        porter_stems.append(stems)
    else:
        porter_stems.append(None)
```

In [22]:
```
p_articles=[i for i in porter_stems if i is not None]
len(p_articles)
```

Out[22]: 10992

In [23]:
```
clean['contain_stem']=pd.Series(porter_stems)
clean=clean[clean['contain_stem'].isnull()]
clean=clean.reset_index(drop=True)
len(clean)
```

Out[23]: 15343

In [24]:
```
clean_df = clean
clean_df.head()
```

Out[24]:

	text_clean	contain_stem
0	7 chicago officers injured altercation storage...	None
1	real reason nigerian vblogger, ar, tolani baj ...	None
2	families frustrated chicagoarea cemeteries clo...	None
3	illinois tool works inc. nyse:itw ceo buys 998...	None
4	tradition asset management llc decreases stock...	None

TF-IDF

https://stevenloria.com/tf-idf/ (https://stevenloria.com/tf-idf/)

- tf(word, blob) computes "term frequency" which is the number of times a word appears in a document blob, normalized by dividing by the total number of words in blob. We text into words and getting the word counts.
- n_containing(word, bloblist) returns the number of documents containing word. A generator expression is passed to the sum() function.
- idf(word, bloblist) computes "inverse document frequency" which measures how common a word is among all documents in bloblist. The more common a word is, the lower total number of documents to the number of documents containing word, then take the log of that. Add 1 to the divisor to prevent division by zero.
- tfidf(word, blob, bloblist) computes the TF-IDF score. It's the product of tf and idf.

In [25]:
```
bloblist = []
del bloblist[:]

for i  in range(0,len(clean)):
    bloblist.append(TextBlob(clean['text_clean'].iloc[i]))

len(bloblist)
```

Out[25]: 15343

In [26]:
```
def tf(word, blob):
    return blob.words.count(word) / len(blob.words)

def n_containing(word, bloblist):
    return sum(1 for blob in bloblist if word in blob.words)

def idf(word, bloblist):
    return math.log(len(bloblist) / (1 + n_containing(word, bloblist)))

def tfidf(word, blob, bloblist):
    return tf(word, blob) * idf(word, bloblist)
```

In [27]:
```
#top 5

for i, blob in enumerate(bloblist):
    if i == 5:
        break
    print("Top words in news article {}".format(i + 1))
    scores = {word: tfidf(word, blob, bloblist) for word in blob.words}
    sorted_words = sorted(scores.items(), key=lambda x: x[1], reverse=True)
    for word, score in sorted_words[:10]:
        print("\tWord: {}, TF-IDF: {}".format(word, round(score, 5)))
```

```
Top words in news article 1
	Word: altercation, TF-IDF: 0.2734
	Word: officers, TF-IDF: 0.20763
	Word: storage, TF-IDF: 0.17529
	Word: injured, TF-IDF: 0.17139
	Word: male, TF-IDF: 0.09559
	Word: 8:16, TF-IDF: 0.09231
	Word: injuries, TF-IDF: 0.08797
	Word: sfgate, TF-IDF: 0.07939
	Word: authorities, TF-IDF: 0.07871
	Word: stabilized, TF-IDF: 0.07703
Top words in news article 2
	Word: tolani, TF-IDF: 0.57696
	Word: baj, TF-IDF: 0.46157
	Word: nigerian, TF-IDF: 0.40387
	Word: nigeria, TF-IDF: 0.39694
	Word: vblogger, TF-IDF: 0.37676
	Word: ar, TF-IDF: 0.35146
	Word: lagos, TF-IDF: 0.32829
	Word: real, TF-IDF: 0.13276
	Word: reason, TF-IDF: 0.12651
	Word: entrepreneurer, TF-IDF: 0.12135
Top words in news article 3
	Word: mothers, TF-IDF: 0.13321
	Word: gates, TF-IDF: 0.11302
	Word: cemeteries, TF-IDF: 0.10206
	Word: cemetery, TF-IDF: 0.06834
	Word: families, TF-IDF: 0.06452
	Word: harris, TF-IDF: 0.05731
	Word: stood, TF-IDF: 0.05213
	Word: console, TF-IDF: 0.05155
	Word: smith, TF-IDF: 0.04858
	Word: visitors, TF-IDF: 0.04773
Top words in news article 4
	Word: tool, TF-IDF: 0.11619
	Word: works, TF-IDF: 0.09095
	Word: illinois, TF-IDF: 0.0348
	Word: rating, TF-IDF: 0.03263
	Word: stock, TF-IDF: 0.02461
	Word: acquired, TF-IDF: 0.02397
	Word: quarter, TF-IDF: 0.02174
	Word: itw, TF-IDF: 0.02147
	Word: ratio, TF-IDF: 0.02017
	Word: price, TF-IDF: 0.01997
Top words in news article 5
	Word: tool, TF-IDF: 0.09723
	Word: works, TF-IDF: 0.07673
	Word: shares, TF-IDF: 0.04231
	Word: stock, TF-IDF: 0.03807
	Word: illinois, TF-IDF: 0.02912
	Word: quarter, TF-IDF: 0.02775
	Word: rating, TF-IDF: 0.02467
	Word: industrial, TF-IDF: 0.0235
	Word: itw, TF-IDF: 0.02214
	Word: products, TF-IDF: 0.01995
```

LDA

In [28]:
```
df2list = clean['text_clean'].tolist()
df2list[:1]
```

Out[28]:
```
['7 chicago officers injured altercation storage center  sfgate 7 chicago officers injured altercation storage center published 8
ven chicago police officers injured altercation saturday storage center citys near south side, authorities said. officers called s
causing disturbance lobby. he allegedly refused leave property, prompting altercation officers. one officer hospitalized injuries
ted scene minor injuries. police said male wasnt injured taken custody. authorities said charges pending. most popular']
```

In [29]:
```
doc_complete = []
stop = set(stopwords.words('english'))
exclude = set(string.punctuation)
lemma = WordNetLemmatizer()
def clean(doc):
    stop_free = " ".join([i for i in doc.lower().split() if i not in stop])
    punc_free = ''.join(ch for ch in stop_free if ch not in exclude)
    normalized = " ".join(lemma.lemmatize(word) for word in punc_free.split())
    return normalized

doc_clean = [clean(doc).split() for doc in doc_complete]
```

In [30]:
```
news_clean = [clean(doc).split() for doc in df2list]
```

In [31]:
```
len(news_clean)
```

Out[31]: 15343

In [32]:
```
print(*news_clean[:1], sep='\n\n')
```

```
['7', 'chicago', 'officer', 'injured', 'altercation', 'storage', 'center', 'sfgate', '7', 'chicago', 'officer', 'injured', 'alterc
'816', 'pdt', 'sunday', 'may', '10', '2020', 'chicago', 'ap', 'seven', 'chicago', 'police', 'officer', 'injured', 'altercation',
ar', 'south', 'side', 'authority', 'said', 'officer', 'called', 'storage', 'facility', 'around', '11', 'am', 'report', 'male', 'ca
y', 'refused', 'leave', 'property', 'prompting', 'altercation', 'officer', 'one', 'officer', 'hospitalized', 'injury', 'shoulder'
reated', 'scene', 'minor', 'injury', 'police', 'said', 'male', 'wasnt', 'injured', 'taken', 'custody', 'authority', 'said', 'charg
```

In [33]:
```
dictionary = corpora.Dictionary(news_clean)

#convert 2 corpus

doc_term_matrix = [dictionary.doc2bow(doc) for doc in news_clean]
```

In [34]:
```
#3 topic model
numtopics = 3

%time ldamodel = LdaMulticore(doc_term_matrix, num_topics=numtopics, id2word = dictionary, passes=50)
```

```
Wall time: 13min 6s
```

In [35]:
```
print(*ldamodel.print_topics(num_topics=numtopics, num_words=3), sep='\n')
```

```
(0, '0.009*"illinois" + 0.008*"state" + 0.006*"chicago"')
(1, '0.017*"chicago" + 0.007*"said" + 0.005*"one"')
(2, '0.034*"share" + 0.023*"company" + 0.022*"stock"')
```

In [36]:
```
print(*ldamodel.print_topics(num_topics=numtopics, num_words=5), sep='\n\n')
```

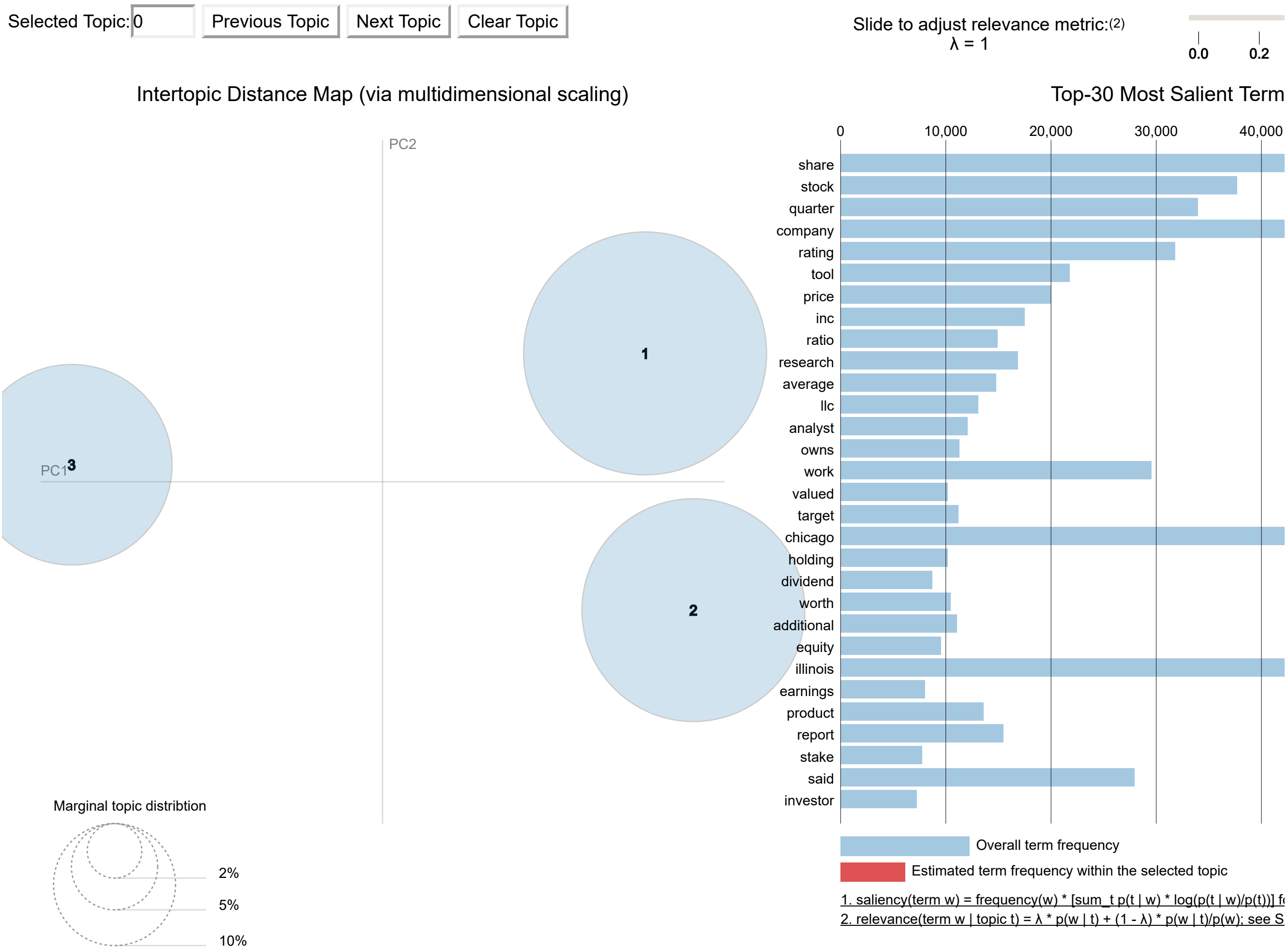
```
(0, '0.009*"illinois" + 0.008*"state" + 0.006*"chicago" + 0.005*"said" + 0.004*"year"')

(1, '0.017*"chicago" + 0.007*"said" + 0.005*"one" + 0.004*"police" + 0.004*"time"')

(2, '0.034*"share" + 0.023*"company" + 0.022*"stock" + 0.020*"quarter" + 0.019*"rating"')
```

In [37]:
```
print(*ldamodel.print_topics(num_topics=numtopics, num_words=10), sep='\n\n')
```

```
(0, '0.009*"illinois" + 0.008*"state" + 0.006*"chicago" + 0.005*"said" + 0.004*"year" + 0.004*"new" + 0.003*"also" + 0.003*"time"

(1, '0.017*"chicago" + 0.007*"said" + 0.005*"one" + 0.004*"police" + 0.004*"time" + 0.003*"year" + 0.003*"like" + 0.003*"city" + 0

(2, '0.034*"share" + 0.023*"company" + 0.022*"stock" + 0.020*"quarter" + 0.019*"rating" + 0.013*"illinois" + 0.012*"tool" + 0.012*
```

In [38]:
```
lda_display = pyLDAvis.gensim.prepare(ldamodel, doc_term_matrix, dictionary, sort_topics=False, mds='mmds')
pyLDAvis.display(lda_display)
```

Out[38]:



In [39]:
```
#10 topic model
numtopics = 10

%time ldamodel = LdaMulticore(doc_term_matrix, num_topics=numtopics, id2word = dictionary, passes=50)
```

```
Wall time: 14min 49s
```

In [40]:
```
print(*ldamodel.print_topics(num_topics=numtopics, num_words=3), sep='\n\n')
```

```
(0, '0.018*"chicago" + 0.010*"said" + 0.007*"police"')

(1, '0.016*"illinois" + 0.014*"state" + 0.011*"said"')

(2, '0.037*"share" + 0.024*"stock" + 0.024*"company"')

(3, '0.010*"share" + 0.009*"year" + 0.006*"intel"')

(4, '0.015*"chicago" + 0.007*"music" + 0.006*"art"')

(5, '0.041*"illinois" + 0.041*"tool" + 0.039*"work"')

(6, '0.008*"illinois" + 0.007*"information" + 0.006*"court"')

(7, '0.017*"chicago" + 0.008*"city" + 0.008*"illinois"')

(8, '0.007*"chicago" + 0.005*"work" + 0.005*"school"')

(9, '0.014*"chicago" + 0.005*"food" + 0.005*"new"')
```

In [41]:
```
print(*ldamodel.print_topics(num_topics=numtopics, num_words=5), sep='\n\n')
```

```
(0, '0.018*"chicago" + 0.010*"said" + 0.007*"police" + 0.006*"one" + 0.005*"officer"')

(1, '0.016*"illinois" + 0.014*"state" + 0.011*"said" + 0.006*"year" + 0.005*"new"')

(2, '0.037*"share" + 0.024*"stock" + 0.024*"company" + 0.021*"quarter" + 0.020*"rating"')

(3, '0.010*"share" + 0.009*"year" + 0.006*"intel" + 0.006*"index" + 0.005*"november"')

(4, '0.015*"chicago" + 0.007*"music" + 0.006*"art" + 0.005*"pm" + 0.005*"back"')

(5, '0.041*"illinois" + 0.041*"tool" + 0.039*"work" + 0.030*"share" + 0.024*"company"')

(6, '0.008*"illinois" + 0.007*"information" + 0.006*"court" + 0.006*"customer" + 0.006*"experience"')

(7, '0.017*"chicago" + 0.008*"city" + 0.008*"illinois" + 0.007*"area" + 0.006*"building"')

(8, '0.007*"chicago" + 0.005*"work" + 0.005*"school" + 0.005*"student" + 0.005*"health"')

(9, '0.014*"chicago" + 0.005*"food" + 0.005*"new" + 0.005*"one" + 0.004*"year"')
```

I tried to do coherence scores but I was unable to run the code in a reasonable amount of time.

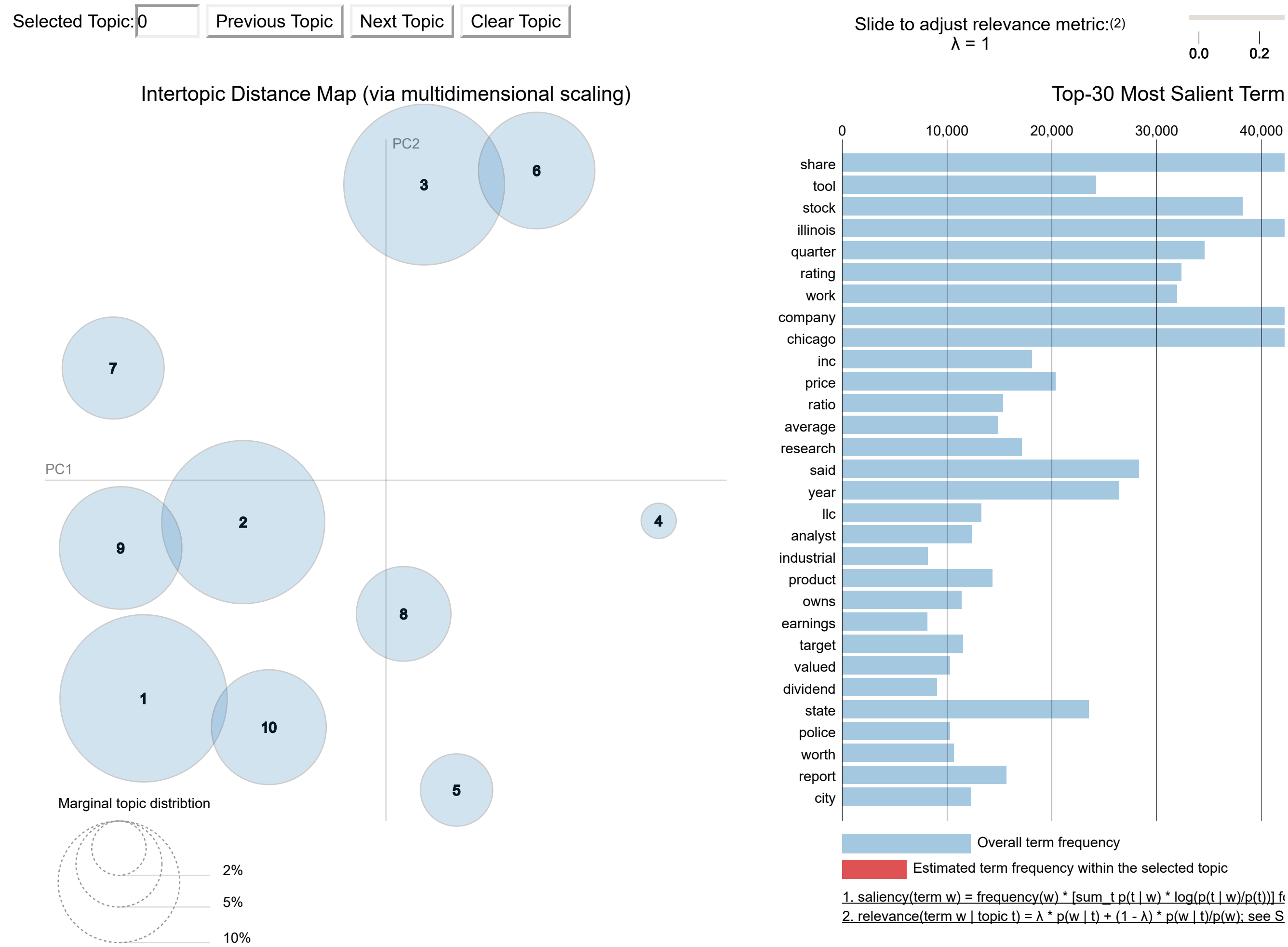
I am choosing the 10-topic model for now because it had the best outcome.

In [42]:
```
print(*ldamodel.print_topics(num_topics=numtopics, num_words=10), sep='\n\n')
```

```
(0, '0.018*"chicago" + 0.010*"said" + 0.007*"police" + 0.006*"one" + 0.005*"officer" + 0.004*"time" + 0.004*"two" + 0.004*"season

(1, '0.016*"illinois" + 0.014*"state" + 0.011*"said" + 0.006*"year" + 0.005*"new" + 0.005*"people" + 0.005*"chicago" + 0.004*"law

(2, '0.037*"share" + 0.024*"stock" + 0.024*"company" + 0.021*"quarter" + 0.020*"rating" + 0.011*"price" + 0.009*"research" + 0.00

(3, '0.010*"share" + 0.009*"year" + 0.006*"intel" + 0.006*"index" + 0.005*"november" + 0.005*"million" + 0.005*"lilly" + 0.004*"a

(4, '0.015*"chicago" + 0.007*"music" + 0.006*"art" + 0.005*"pm" + 0.005*"back" + 0.005*"get" + 0.004*"show" + 0.004*"flight" + 0.

(5, '0.041*"illinois" + 0.041*"tool" + 0.039*"work" + 0.030*"share" + 0.024*"company" + 0.020*"stock" + 0.019*"quarter" + 0.018*"

(6, '0.008*"illinois" + 0.007*"information" + 0.006*"court" + 0.006*"customer" + 0.006*"experience" + 0.006*"job" + 0.005*"team" 
e"')

(7, '0.017*"chicago" + 0.008*"city" + 0.008*"illinois" + 0.007*"area" + 0.006*"building" + 0.006*"said" + 0.005*"home" + 0.005*"w

(8, '0.007*"chicago" + 0.005*"work" + 0.005*"school" + 0.005*"student" + 0.005*"health" + 0.004*"time" + 0.004*"need" + 0.004*"pr

(9, '0.014*"chicago" + 0.005*"food" + 0.005*"new" + 0.005*"one" + 0.004*"year" + 0.004*"restaurant" + 0.004*"time" + 0.004*"like"
```

In [43]:
```
lda_display = pyLDAvis.gensim.prepare(ldamodel, doc_term_matrix, dictionary, sort_topics=False, mds='mmds')
pyLDAvis.display(lda_display)
```

Out[43]:



In [44]:
```
#max_topics = 15
#lda_models = []
#n_topics = []

#for i in range(1, max_topics):
#    n_topics.append(i+1)
#    %time model = LdaMulticore(doc_term_matrix, num_topics=i+1, id2word = dictionary, passes=50)
#    lda_models.append(model)
```

In [45]:
```
#coherence_scores = []

#for model in lda_models:
#    coherencemodel = CoherenceModel(model=model, texts=news_clean, dictionary=dictionary, coherence='c_v')
#    coherence_scores.append(coherencemodel.get_coherence())
```

In [46]:
```
#fig, ax = plt.subplots(figsize=(10,6))
#sns.lineplot(x=n_topics, y=coherence_scores, ax=ax)
#ax.set(xlabel='# of Topics', ylabel='Coherence Score')
```

LSA

In [47]:
```
n_topics = 10
```

In [48]:
```
reindexed_data = clean_df['text_clean']
reindexed_data.head(3)
```

Out[48]:
```
0    7 chicago officers injured altercation storage...
1    real reason nigerian vblogger, ar, tolani baj ...
2    families frustrated chicagoarea cemeteries clo...
Name: text_clean, dtype: object
```

In [49]:
```
from sklearn.feature_extraction.text import TfidfVectorizer

vectorizer = TfidfVectorizer(stop_words='english',
max_features= 1000, # keep top 1000 terms
max_df = 0.5,
smooth_idf=True)

X = vectorizer.fit_transform(reindexed_data)

X.shape # check shape of the document-term matrix
```

Out[49]:
```
(15343, 1000)
```

In [50]:
```
from sklearn.decomposition import TruncatedSVD

# SVD represent documents and terms in vectors
svd_model = TruncatedSVD(n_components=10, algorithm='randomized', n_iter=100, random_state=122)

svd_model.fit(X)

len(svd_model.components_)
```

Out[50]:
```
10
```

In [51]:
```
terms = vectorizer.get_feature_names()

for i, comp in enumerate(svd_model.components_):
    terms_comp = zip(terms, comp)
    sorted_terms = sorted(terms_comp, key= lambda x:x[1], reverse=True)[:7]
    print("Topic "+str(i)+": ")
    for t in sorted_terms:
        print(t[0])
```

```
Topic 0:
shares
stock
quarter
tool
rating
works
illinois
Topic 1:
said
illinois
state
police
people
time
like
Topic 2:
tool
works
illinois
itw
industrial
products
oem
Topic 3:
police
said
officers
state
illinois
man
county
Topic 4:
police
tool
man
officers
works
season
said
Topic 5:
experience
customer
police
service
work
job
customers
Topic 6:
snow
weather
city
area
winter
saturday
lake
Topic 7:
owensillinois
marijuana
snow
cannabis
weather
season
sales
Topic 8:
marijuana
said
cannabis
recreational
city
sales
people
Topic 9:
owensillinois
students
school
rating
industrial
schools
food
```

In [52]:
```
#import umap as umap

#X_topics = svd_model.fit_transform(X)
#embedding = umap.UMAP(n_neighbors=150, min_dist=0.5, random_state=12).fit_transform(X_topics)

#plt.figure(figsize=(7,5))
#plt.scatter(embedding[:, 0], embedding[:, 1],
#c = dataset.target,
#s = 10, # size
#edgecolor='none')
#plt.show()
```

Sentiment Analysis (Hand-labeled)

I want to include stopwords so the sentences are still human readable.

In [93]:
```
sa_df=pd.DataFrame(df['comb'])

sa_df.head()
```

Out[93]:

	comb
0	All In Illinois Gov. Jay “Fatso” Pritzker call...
1	The Illinois Department Public Health Announce...
2	Foto Friday: Alton, Illinois Gloria Lawrence s...
3	Chris Broussard Michael Jordan returning Chica...
4	Pork chops vs. people: Can Americans’ appetite...

In [94]:
```
#lowercase

sa_df = pd.DataFrame(sa_df.comb.apply(str.lower))
```

In [95]:
```
#remove special chars

sa_df['text_clean'] = sa_df['comb'].map(lambda x: re.sub('[^a-zA-Z0-9 @ . , : - _]', '', str(x)))
```

In [96]:
```
#only need to keep clean text
sa_df=pd.DataFrame(sa_df['text_clean'])
sa_df.head()
```

Out[96]:

	text_clean
0	all in illinois gov. jay fatso pritzker called...
1	the illinois department public health announce...
2	foto friday: alton, illinois gloria lawrence s...
3	chris broussard michael jordan returning chica...
4	pork chops vs. people: can americans appetite ...

Only keep articles related to population movement in IL/Chicago.

In [97]:
```
#stemmers

porter = nltk.PorterStemmer()
lancaster = nltk.LancasterStemmer()
```

In [99]:
```
#locations '(USA-IL-Chicago)','Illinois','Chicago'

key_words=['population','migration','exodus','moving','leaving']
in_stems=[porter.stem(c) for c in key_words]
new_stems=[]

for a in range(0, len(sa_df)):
    words=sa_df.iloc[a].text_clean
    stems=[porter.stem(t) for t in words.split()]
    if any(s in stems for s in in_stems):
        new_stems.append(a)
    else:
        continue
```

In [100]:
```
sa_df=sa_df.iloc[new_stems]
sa_df=sa_df.reset_index(drop=True)
len(sa_df)
```

Out[100]: 26335

I will remove words that I don't feel explain people leaving IL.

In [101]:
```
#remove off-topic sports, animals, and Trump

words_list = ['bears','cubs','bulls','blackhawks','football','baseball','basketball','hockey','sox','Trump','deer','coyote','covi
avirus']
p_stems = [porter.stem(x) for x in words_list]
l_stems = [lancaster.stem(x) for x in words_list]

print(p_stems)
print(l_stems)
```

```
['bear', 'cub', 'bull', 'blackhawk', 'footbal', 'basebal', 'basketbal', 'hockey', 'sox', 'trump', 'deer', 'coyot', 'covid19', 'cov
['bear', 'cub', 'bul', 'blackhawk', 'footbal', 'basebal', 'basketbal', 'hockey', 'sox', 'trump', 'deer', 'coyot', 'covid19', 'cov
```

In [102]:
```
porter_stems=[]
for a in range(0, len(sa_df)):
    words=sa_df.iloc[a].text_clean
    stems=[porter.stem(t) for t in words.split()]
    if any(s in stems for s in p_stems):
        porter_stems.append(stems)
    else:
        porter_stems.append(None)
```

In [103]:
```
p_articles=[i for i in porter_stems if i is not None]
len(p_articles)
```

Out[103]: 10992

In [105]:
```
sa_df['contain_stem']=pd.Series(porter_stems)
sa_df=sa_df[sa_df['contain_stem'].isnull()]
sa_df=sa_df.reset_index(drop=True)
len(sa_df)
```

Out[105]: 15343

In [106]:
```
sa_df.head()
```

Out[106]:

	text_clean	contain_stem
0	7 chicago officers injured altercation storage...	None
1	real reason nigerian vblogger, ar, tolani baj ...	None
2	families frustrated chicagoarea cemeteries clo...	None
3	illinois tool works inc. nyse:itw ceo buys 998...	None
4	tradition asset management llc decreases stock...	None

In [107]:
```
#every sentence becomes it's own observavtion
class_sentences=[]
for n in range(len(sa_df)):
    sentences=nltk.sent_tokenize(sa_df.iloc[n].text_clean)
    for m in sentences:
        class_sentences.append(m)
```

In [108]:
```
#remove non-sentences
class_sentences=[o for o in class_sentences if len(o) > 10]
len(class_sentences)
```

Out[108]: 414089

In [109]:
```
sentences=pd.DataFrame(columns=['Sentence'], data=class_sentences)
```

In [110]:
```
sentences['Class']=""
```

In [111]:
```
sentences.head(10)
```

Out[111]:

	Sentence	Class
0	7 chicago officers injured altercation storage...	
1	officers called storage facility around 11 a.m...	
2	he allegedly refused leave property, prompting...	
3	one officer hospitalized injuries shoulder kne...	
4	six officers treated scene minor injuries.	
5	police said male wasnt injured taken custody.	
6	authorities said charges pending.	
7	most popular	
8	real reason nigerian vblogger, ar, tolani baj ...	
9	real names, tolani shobajo the post real reaso...	

In [112]:
```
sentences_test, sentences_train = train_test_split(sentences, test_size=200, random_state=1)
print(sentences_train.shape)
print(sentences_test.shape)
```

```
(200, 2)
(413889, 2)
```

I'm going to hand label some of the data. Negative=0, Neutral=1, Positive=2

I choose to hand label because sentiment analysis tools (like the tweets one) are notoriously bad at predicting on data that isn't apples-to-apples. For example, it'd be a bad idea news articles. A car chase makes for a good movie, but it is not so great if it's happening in your neighborhood.

In [113]:
```
train_labels=sentences_train.to_csv('train_labels.csv')
```

Reading the file back after I label.

In [116]:
```
sentences_train=pd.read_csv('train_labels.csv')
sentences_train=sentences_train.drop(['Unnamed: 0'], axis=1)
sentences_train.head(10)
```

Out[116]:

	Sentence	Class
0	posted march 7, 2019.	1
1	jsonline.comstorynewsloc almilwaukee20191206re...	1
2	the 60yearold joined paper intern 32 years ago...	2
3	the deputy treated noncritical leg injuries ho...	1
4	to its i leave, maray said.	1
5	this represents 4.28 annualized dividend divid...	2
6	take hofmann tower, national landmark, fall 20...	1
7	illinois tool works makes 2.5 fenimore asset m...	2
8	i dont got speculating im getting cannabis i s...	2
9	zacks investment research cut fair isaac stron...	1

I ran Naive Bayes and XGB for the hand-labeled data and only got 57% and 55% accuracy.

I don't think I labeled enough data for this to work.

I will try to do auto labeling.

Sentiment Analysis (auto)

In [253]:
```
from collections import defaultdict

all_reviews = sa_df['text_clean']
all_sent_values = []
all_sentiments = []
```

In [254]:
```
from nltk.sentiment.vader import SentimentIntensityAnalyzer
def sentiment_value(paragraph):
    analyser = SentimentIntensityAnalyzer()
    result = analyser.polarity_scores(paragraph)
    score = result['compound']
    return round(score,1)
```

In [256]:
```
for i in range(0,len(sa_df)):
    all_sent_values.append(sentiment_value(all_reviews[i]))
```

In [280]:
```
SENTIMENT_VALUE = []
SENTIMENT = []
for i in range(0,len(sa_df)):
    sent = all_sent_values[i]
    if (sent<=1 and sent>0.2):
        SENTIMENT.append('Positive')
        SENTIMENT_VALUE.append(2)
    elif (sent<-0.2 and sent>=-1):
        SENTIMENT.append('Negative')
        SENTIMENT_VALUE.append(0)
    else:
        SENTIMENT.append('Neutral')
        SENTIMENT_VALUE.append(1)
```

In [281]:
```
len(all_sent_values)
```

Out[281]:
```
20254
```

In [282]:
```
temp_data = sa_df[0:]
```

In [283]:
```
temp_data['SENTIMENT_VALUE'] = SENTIMENT_VALUE
temp_data['SENTIMENT'] = SENTIMENT
```

In [284]:
```
temp_data.head()
```

Out[284]:

	text_clean
0	7 chicago officers injured altercation storage center sfgate 7 chicago officers injured altercation storage center published 8:16 pdt, sunday, may 10, 2020 chicago ap seven chicago police office...
1	real reason nigerian vblogger, ar, tolani baj moved chicago lagos real reason nigerian vblogger, ar, tolani baj moved chicago lagos published daily times mon, 11 may 2020 nigerian entrepreneurer, ...
2	families frustrated chicagoarea cemeteries close visitors mothers day dozens chicagoarea families unable pay respects lost loved ones mothers day say cemeteries closed gates visitors without expla...
3	illinois tool works inc. nyse:itw ceo buys 998,046.00 stock illinois tool works inc. nyse:itw ceo ernest scott santi purchased 6,300 shares illinois tool works stock transaction dated wednesday, m...
4	tradition asset management llc decreases stock holdings illinois tool works inc. nyse:itw tradition asset management llc lowered stake illinois tool works inc. nyse:itw 1.8 1st quarter, according ...

In [285]:
```
le = preprocessing.LabelEncoder()
```

In [286]:
```
le.fit(clean_df.text_clean)
```

Out[286]:
```
LabelEncoder()
```

In [287]:
```
le.transform(clean_df['text_clean'])
```

Out[287]:
```
array([  500, 12215,  6095, ...,  5765,  5277, 14633])
```

Classification

In [288]:
```
X = temp_data.text_clean
y = temp_data.SENTIMENT_VALUE

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state = 8)
```

In [289]:
```
print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

```
(10740,)
(4603,)
(10740,)
(4603,)
```

In [290]:
```
y_test.value_counts()
```

Out[290]:
```
2    3479
0     922
1     202
Name: SENTIMENT_VALUE, dtype: int64
```

Naive Bayes

In [291]:
```
nb = Pipeline([('vect', CountVectorizer()),
               ('tfidf', TfidfTransformer()),
               ('clf', MultinomialNB()),
              ])
nb.fit(X_train, y_train)
```

Out[291]:
```
Pipeline(memory=None,
         steps=[('vect',
                 CountVectorizer(analyzer='word', binary=False,
                                 decode_error='strict',
                                 dtype=<class 'numpy.int64'>, encoding='utf-8',
                                 input='content', lowercase=True, max_df=1.0,
                                 max_features=None, min_df=1,
                                 ngram_range=(1, 1), preprocessor=None,
                                 stop_words=None, strip_accents=None,
                                 token_pattern='(?u)\\b\\w\\w+\\b',
                                 tokenizer=None, vocabulary=None)),
                ('tfidf',
                 TfidfTransformer(norm='l2', smooth_idf=True,
                                  sublinear_tf=False, use_idf=True)),
                ('clf',
                 MultinomialNB(alpha=1.0, class_prior=None, fit_prior=True))],
         verbose=False)
```

In [298]:
```
%%time

y_pred_nb = nb.predict(X_test)

print('accuracy %s' % accuracy_score(y_pred_nb, y_test))
```

```
accuracy 0.7558114273300022
Wall time: 1.42 s
```

Logistic Regression

In [293]:
```
lr = Pipeline([('vect', CountVectorizer()),
               ('tfidf', TfidfTransformer()),
               ('clf', LogisticRegression()),
              ])
lr.fit(X_train, y_train)
```

Out[293]:
```
Pipeline(memory=None,
         steps=[('vect',
                 CountVectorizer(analyzer='word', binary=False,
                                 decode_error='strict',
                                 dtype=<class 'numpy.int64'>, encoding='utf-8',
                                 input='content', lowercase=True, max_df=1.0,
                                 max_features=None, min_df=1,
                                 ngram_range=(1, 1), preprocessor=None,
                                 stop_words=None, strip_accents=None,
                                 token_pattern='(?u)\\b\\w\\w+\\b',
                                 tokenizer=None, vocabulary=None)),
                ('tfidf',
                 TfidfTransformer(norm='l2', smooth_idf=True,
                                  sublinear_tf=False, use_idf=True)),
                ('clf',
                 LogisticRegression(C=1.0, class_weight=None, dual=False,
                                    fit_intercept=True, intercept_scaling=1,
                                    l1_ratio=None, max_iter=100,
                                    multi_class='warn', n_jobs=None,
                                    penalty='l2', random_state=None,
                                    solver='warn', tol=0.0001, verbose=0,
                                    warm_start=False))],
         verbose=False)
```

In [299]:
```
%%time

y_pred_lr = lr.predict(X_test)

print('accuracy %s' % accuracy_score(y_pred_lr, y_test))
```

```
accuracy 0.7592874212470129
Wall time: 1.48 s
```

XGBClassifier

In [295]:
```
from xgboost import XGBClassifier
```

In [296]:
```
xgb = Pipeline([('vect', CountVectorizer()),
               ('tfidf', TfidfTransformer()),
               ('clf', XGBClassifier()),
              ])
xgb.fit(X_train, y_train)
```

Out[296]:
```
Pipeline(memory=None,
         steps=[('vect',
                 CountVectorizer(analyzer='word', binary=False,
                                 decode_error='strict',
                                 dtype=<class 'numpy.int64'>, encoding='utf-8',
                                 input='content', lowercase=True, max_df=1.0,
                                 max_features=None, min_df=1,
                                 ngram_range=(1, 1), preprocessor=None,
                                 stop_words=None, strip_accents=None,
                                 token_pattern='(?u)\\b\\w\\w+\\b',
                                 tokenizer=None, vocabulary=Non...
                 XGBClassifier(base_score=0.5, booster='gbtree',
                               colsample_bylevel=1, colsample_bynode=1,
                               colsample_bytree=1, gamma=0, learning_rate=0.1,
                               max_delta_step=0, max_depth=3,
                               min_child_weight=1, missing=None,
                               n_estimators=100, n_jobs=1, nthread=None,
                               objective='multi:softprob', random_state=0,
                               reg_alpha=0, reg_lambda=1, scale_pos_weight=1,
                               seed=None, silent=None, subsample=1,
                               verbosity=1))],
         verbose=False)
```

In [300]:
```
%%time

y_pred_xgb = xgb.predict(X_test)

print('accuracy %s' % accuracy_score(y_pred_xgb, y_test))
```

```
accuracy 0.7571149250488811
Wall time: 1.78 s
```

LR is the winner with 0.759 accuracy.

Word Cloud - General

In [301]:
```
sent_df = X_test.to_frame()
sent_df['prediction']=y_pred_lr.tolist()
```

In [302]:
```
#Negative=0, Neutral=1, Positive=2
sent_df['prediction'].value_counts()
```

Out[302]:
```
2    4502
0     101
Name: prediction, dtype: int64
```

In [304]:
```
sent_df.head()
```

Out[304]:

3688	chicago fire 811 review: where we end up in: one chicago shows , reviews , tv one thing i love chicago fire fact tackles realworld issues. it never fails mak
10916	chicago 2019: 2020 subaru legacy preview: subaru announced next week, showing allnew 2020 legacy chicago auto show. to promote announcement, ja teaser images. the ex...
7746	illinois marijuana sales top 34 million february illinois marijuana sales top 34 million february illinois marijuana sales top 34 million february on mar 6, 202
9867	chubb ltd nyse:cb shares purchased chicago trust co na chicago trust co na increased holdings shares chubb ltd nyse:cb 3.3 first quarter, according rece commission...
14173	new jersey music festival, illinois motorcycles, georgia shrimp fleet, missouri park day, , more travel the scoop travelwriter, columnist, author janet groene

In [308]:
```
pos_sentences=sent_df[sent_df['prediction']==2]
pos_text=pos_sentences["text_clean"].tolist()
pos_text[0:2]
```

Out[308]:
```
['chicago fire 811 review: where we end up in: one chicago shows , reviews , tv one thing i love chicago fire fact tackles realwor
mportant things life. this episode particular focused cancer firefighters importance coming together midst conflict. never take l
icago fire where we end up episode 811  pictured: lr david eigenberg christopher herrmann, taylor kinney kelly severide, joe minos
theres one thing i could tell firehouse 20, its dont wanna mess firehouse 51 . because push comes shove, boden always gonna 51s ba
as things firefighters 51 everyone 20 werent bad enough, 51 stay firehouse 20 fumigated bedbugs. stand out scene chicago fire wher
rosende blake gallo  photo by: adrian burrowsnbc blake gallo running chicago halfmarathon firefighter gear everything. it inspirin
ers. i couldnt even run halfmarathon normal clothes, let alone heavy firefighter gear. but gallo really caring person, doesnt real
e blake gallo. while i still really miss otis, i really love blake gallo. i think hes great addition firehouse 51. hes definitely
lake gallo might one new favorite characters. i mean, whats love him best lines captain delaney: you may based 51, youre chief who
ites gallo: two dates were already moving together watch chicago fire wednesdays 98c nbc advertisements',
 'chicago 2019: 2020 subaru legacy preview: subaru announced next week, showing allnew 2020 legacy chicago auto show. to promote a
ple teaser images. the exterior looks evolution current shape, complete headlights 2018 legacy. previous spy photos hint larger gr
a interior appears subaru going premium look. theres also large tablet screen houses number functions driver passenger. we make ph
2020 legacy move modular platform underpins new ascent, forester, impreza. source: subaru view full article']
```

In [310]:
```
neg_sentences=sent_df[sent_df['prediction']==0]
neg_text=neg_sentences["text_clean"].tolist()
neg_text[0:2]
```

Out[310]:
```
['illinois marijuana sales top 34 million february illinois marijuana sales top 34 million february illinois marijuana sales top 3
nowicki capitol news illinois springfield  legal marijuana sales state remained strong february, nearly 35 million spent marijuana
alization. customers spent 34.8 million 831,600 items 29day period. of that, 25.6 million spent illinois residents, outofstaters s
vernors office. the numbers include taxes collected. these numbers show continues strong demand across state equitycentric cannabi
aid toi hutchinson, senior cannabis advisor gov. jb pritzker. as adult use cannabis industry continues grow, number opportunities
ommunities suffered failed war drugs. the numbers slightly january, saw 39.2 million sales 31day span. that generated 7.3 million
1 million retail sales taxes shared state local governments. tax numbers february yet available. the states share cannabis tax rev
35 percent state general fund, 20 percent substance abuse programs, 10 percent budget stabilization fund, 8 percent local governme
tion public health data collection. another 25 percent goes special fund community development projects areas high arrest poverty
s. the state also accepting applications new licenses part programs initial rollout. aspiring craft growers, cannabis infusers tra
ture 5 p.m. march 16. the applications available departments website https:www2.illinois.govsitesagrplantspagesadultusecannabis.as
cants, companies majority stake live disproportionately impacted areas, arrested offenses eligible expungement legalization progra
category. those applicants receive additional points application eligible receive technical assistance, grants, lowinterest loans
 'is injury personal injury illinois personal injury  january 14, 2020 if somebody know injured, different terms may hear. one ter
ding difference two phrases important. the term personal injury used civil law define claims victims peoples negligence file recei
odily injury. the defendant chicago personal injury claim person whose actions caused harm another party. the plaintiff claims per
injury claim not injuries person suffers personal injuries far civil lawsuits concerned. a bodily injury occur someone fault anoth
harmed, nobody blame. other times, person may something causes injury, leaving unable pursue compensation another party. four elem
ts must proven order personal injury case successful. duty care . a defendant must duty exercise reasonable care plaintiff. for ex
cident, driver likely duty operate vehicle care avoid accidents others. in slip fall case, business owners property owners general
here. breach duty . the second element proving negligence showing breach persons duty care. for example, driver fails stop stop si
property owner breaches duty care fail clean spills floor timely manner. even defendant intend cause harm plaintiff, could still h
ion . the third element cases showing breach persons duty care contributed injury plaintiff sustained. following example above, pe
injuries, causation case. however, run stop sign, strike another vehicle, cause injuries, causation would present. damages . final
uries personal injury claim valid. some common types damages may warrant personal injury claim include medical costs, lost income
if unsure whether personal injury claim, please seek assistance qualified personal injury attorney. most individuals experience re
an attorney able guide onto best path forward case. a skilled personal injury attorney work obtain maximum compensation settlement
rm receive free confidential consultation experienced injury attorney. first name ']
```

In [311]:
```
pos_sentences.to_pickle('pos_sentences.pickle')
neg_sentences.to_pickle('neg_sentences.pickle')
```

In [313]:
```
stop = set(stopwords.words('english'))
extra_stops=['chicago', 'illinois', 'city', 'said', 'say', 'year']
stop.update(extra_stops)
exclude = set(string.punctuation)
lemma = WordNetLemmatizer()
```

In [315]:
```
def clean(doc):
    stop_free = " ".join([i for i in doc.lower().split() if i not in stop])
    punc_free = ''.join(ch for ch in stop_free if ch not in exclude)
    normalized = " ".join(lemma.lemmatize(word) for word in punc_free.split())
    return normalized
```

In [316]:
```
pos_clean = [clean(doc).split() for doc in pos_text]
```

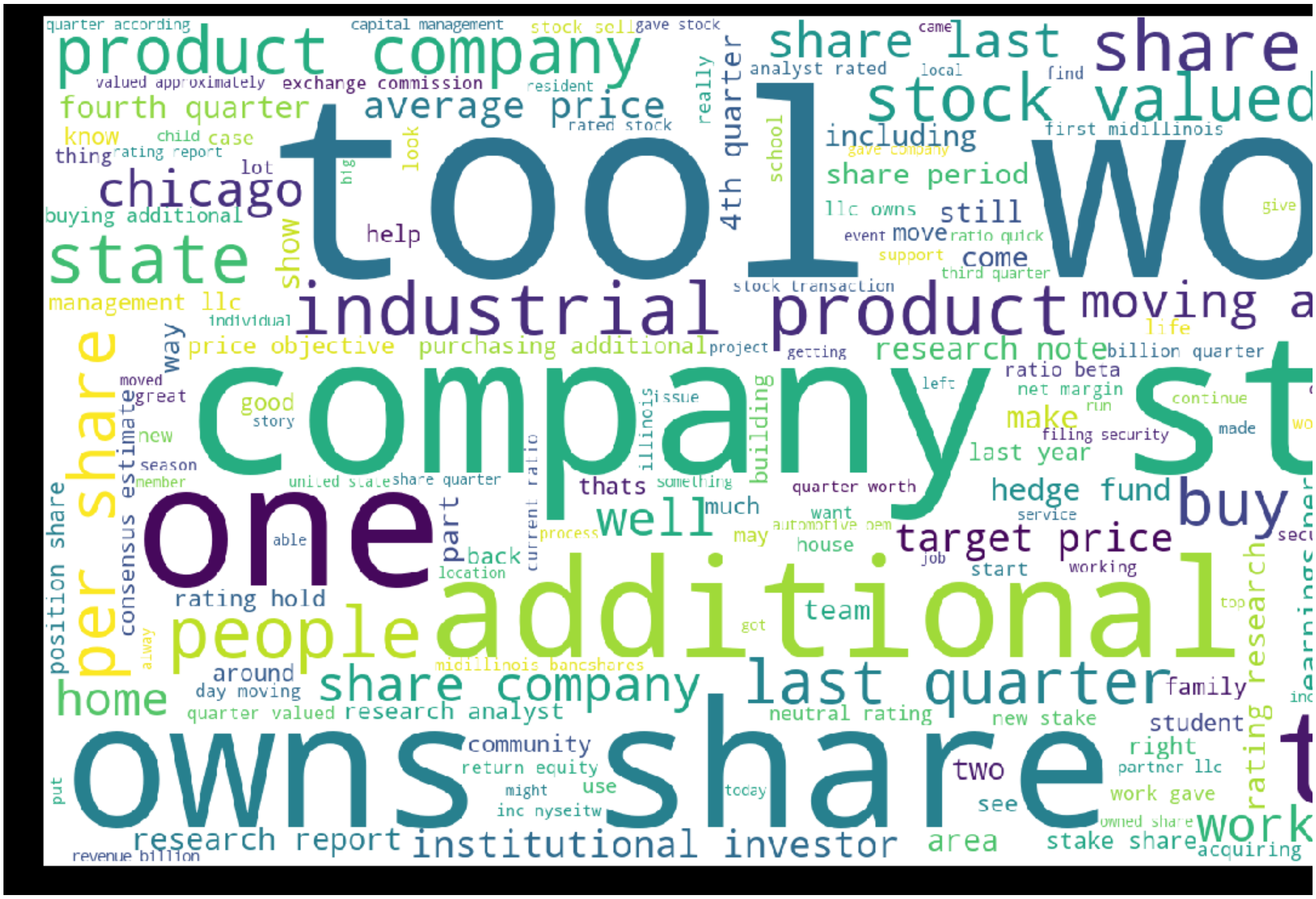
In [317]:
```
neg_clean = [clean(doc).split() for doc in neg_text]
```

In [319]:
```
pos_words=[]
for u in range(len(pos_clean)):
    words=pos_clean[u]
    for v in words:
        pos_words.append(v)

pos_string=" ".join(pos_words)
```

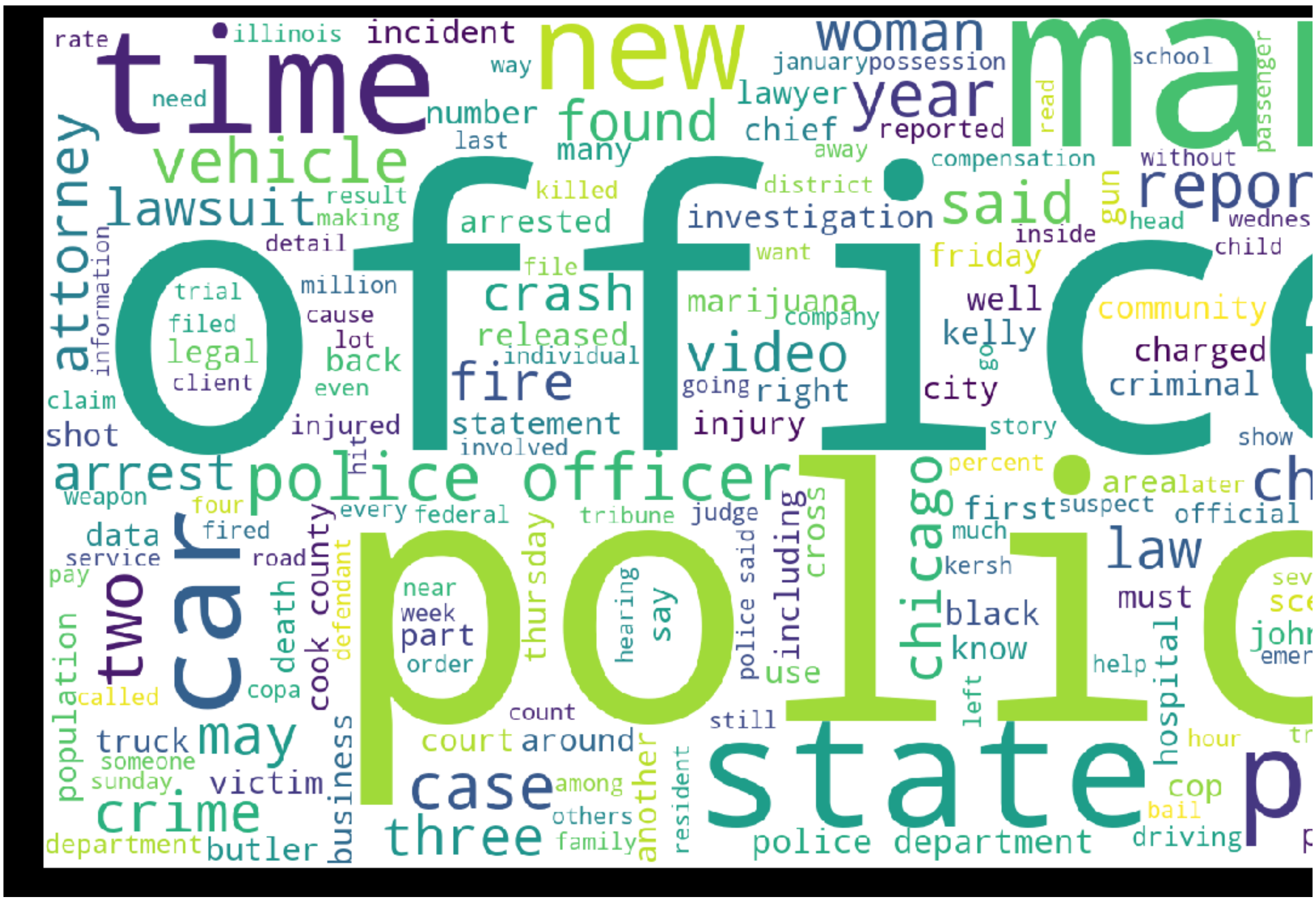
In [321]:
```
neg_words=[]
for w in range(len(neg_clean)):
    words=neg_clean[w]
    for x in words:
        neg_words.append(x)

neg_string=" ".join(neg_words)
```

In [322]:
```
pos_text_file = open("positive.txt", "w")
pos_text_file.write(pos_string)
pos_text_file.close()
with open('negative.txt', 'w', encoding='utf-8') as neg_text_file:
    neg_text_file.write(neg_string)
```

In [332]:
```
# Create stopword list:
stopwords = set(STOPWORDS)
#stopwords.update(["drink", "now", "wine", "flavor", "flavors"])

file_content=open ("positive.txt").read()

# Generate a word cloud image
wordcloud = WordCloud(stopwords=stopwords, background_color="white", width=1600, height=800).generate(file_content)

# Display the generated image:
# the matplotlib way:
plt.figure( figsize=(20,10), facecolor='k')
plt.imshow(wordcloud)
plt.axis("off")
plt.tight_layout(pad=0)
plt.show()
```



In [333]:
```
# Create stopword list:
stopwords = set(STOPWORDS)
#stopwords.update(["drink", "now", "wine", "flavor", "flavors"])

file_content=open ("negative.txt").read()

# Generate a word cloud image
wordcloud = WordCloud(stopwords=stopwords, background_color="white", width=1600, height=800).generate(file_content)

# Display the generated image:
# the matplotlib way:
plt.figure( figsize=(20,10), facecolor='k')
plt.imshow(wordcloud)
plt.axis("off")
plt.tight_layout(pad=0)
plt.show()
```



Name + Entity

In [334]:
```
text=clean_df['text_clean'].str.cat(sep=', ')
```

In [335]:
```
text=str(text)
```

In [336]:
```
entities = []
labels = []

for sent in nltk.sent_tokenize(text):
    for chunk in nltk.ne_chunk(nltk.pos_tag(nltk.word_tokenize(sent)), binary = False):
        if hasattr(chunk, 'label'):
            entities.append(' '.join(c[0] for c in chunk)) #Add space as between multi-token entities
            labels.append(chunk.label())

entities_labels = list(set(zip(entities, labels))) #unique entities
```

In [337]:
```
entities_df = pd.DataFrame(entities_labels)
entities_df.columns = ["Entities", "Labels"]
entities_df.head(20)
```

Out[337]:

	Entities	Labels
0	u.s.	GPE
1	mr. madox	PERSON
2	u.s.soviet	GPE
3	mr. kelly	PERSON
4	mr. ron	PERSON
5	john j.	PERSON
6	neighborhoods.com	ORGANIZATION
7	south	LOCATION
8	clinton	PERSON
9	trip.com	ORGANIZATION
10	mr. hamad	PERSON
11	m.b.a.	ORGANIZATION
12	d.c.	ORGANIZATION
13	russian	GPE
14	harry.harry	PERSON
15	mr. kersh	PERSON
16	mr. worsley	PERSON
17	u.n.	ORGANIZATION
18	mcdunnah.mcdunnah	PERSON
19	mr. robot	PERSON

In [340]:
```
Person=entities_df[entities_df['Labels']=='PERSON']
```

In [356]:
```
#there aren't any people mentioned more than once
Person['Entities'].value_counts().sort_values(ascending=False)
```

Out[356]:
```
clinton          1
calif.           1
mr. mcgill       1
it.pitt          1
harry            1
                ..
mr. t.           1
mr. mumbower     1
mr. smollett     1
mr. madox        1
mr. hieronymus   1
Name: Entities, Length: 66, dtype: int64
```

In [346]:
```
Org=entities_df[entities_df['Labels']=='ORGANIZATION']
```

In [347]:
```
#there aren't any orgs mentioned more than once
Org['Entities'].value_counts().sort_values(ascending=False)
```

Out[347]:
```
amazon.com            1
u.n.                  1
neighborhoods.com     1
l.a.                  1
n.w.a.                1
s.a.                  1
u.s.a.                1
better.com            1
d.c.                  1
mlb.com               1
u.s.                  1
trip.com              1
telegraphherald.com   1
parted.the            1
m.b.a.                1
u.s                   1
___                   1
Name: Entities, dtype: int64
```

In [365]:
```
in_terms = Org['Entities'].tolist()
in_stems=[porter.stem(c) for c in in_terms]
in_index=[]
out_index=[]
for a in range(0, len(clean_df)):
    words=clean_df.iloc[a].text_clean
    stems=[porter.stem(t) for t in words.split()]
    #if any of the keywords are in the title (stems), put those stems in the list
    if any(s in stems for s in in_stems):
        in_index.append(a)
    #if none of the keywords are present insert a Null value
    else:
        out_index.append(a)
```

Companies

In [388]:
```
companies=clean_df.iloc[in_index]
companies.head(20)
```

Out[388]:

7	jushi announces beginning adultuse cannabis sales illinois dispensary normal, illinois new adultuse customers can only shop online overthephone instore p instore, on...
10	pope francis names father louis tylka archdiocese chicago coadjutor bishop peoria pope francis names father louis tylka archdiocese chicago coadjutor bish washingtonpope fran...
28	how south holland, illinois helping residents protect properties flooding south hollands flood assistance rebate program powerful incentive proactive flooding outside...
33	top 10 haunted hot spots illinois ghost stories halloween anymore. nearly every town ghost stories, obscure others however, theres locations well known pa haunted. ...
34	former illinois congressman runs iowa u.s. house seat clinton a former u.s. congressman illinois one five republicans seeking partys nomination iowas 2nd co...
59	investors give nod worstrated illinois with revenue growing photographer: scott olsongetty images photographer: scott olsongetty images as governor j.b. pr office, ...
72	goodbye, new york, california illinois. hello where 1 4 goodbye, new york, california illinois. hello where bloomberg opinion new york, california illinois hemo
83	chicago public schools although ex president george bush said popular quote no child left behind , hat happening chicago public schools exactly opposite. school...
85	fiat chrysler temporarily idle jeep cherokee plant illinois print fca fca invested 350 million belvidere plant, starting 2016, produce cherokee, moved toledo, oh
86	activist, 23, named vacant chicagoarea state house post illinois news activist, 23, named vacant chicagoarea state house post a 23yearold community activ appoi...
94	sangamon among 93 illinois counties declining populations sangamon saw population decrease 2,419, 1.2 percent, last decade, according new analysis wi bureau data. san...
98	ushlleading chicago stuns fighting saints last minute comeback local sports telegraphherald.com the chicago steel scored twice final minute regulation time s...
114	lexington betty barbecue opens saturday one eleven food hall eater chicago plus 2 lexington betty barbecue opens saturday one eleven food hall eater chic opens...
121	iowaillinoiswisconsin news brief iowaillinoiswisconsin telegraphherald.com new hampshire general oversee wisconsin national guard changes madison, wis changes wis...
122	fiat idling illinois jeep plant third time six months bloomberg fiat chrysler automobiles nv pause production jeep sport utility vehicle factory third time six mon
135	show review: the almost use inner light create emotional show experience chicago cait mcmahon the almosts if i believed you tour brought southern weath crowd fear call...
144	400 illinois national guard soldiers say goodbye deployment ceremony pam maxey, texico, tears streaming face embraced son, spec. drake hess, last tues southern illinoi...
150	chicago home price growth flat, sp corelogic caseshiller indices show crains chicago business home price growth stalled last fall chicago area. the regions perce...
159	amazon buys pinnacle, saving 1,416 jobs chicago rockford airport amazon amazon buys pinnacle, saving 1,416 jobs chicago rockford airport amazon print taking pinna...
165	todd smith withdraws partner chicago based personal injury trial law firm power rogers smith llp out state todd smith withdraws partner chicago based perso ...

In [373]:
```
companies.shape
```

Out[373]: (2050, 2)

In [392]:
```
company_sentences=[]
for nn in range(len(companies)):
    c_sentences=nltk.sent_tokenize(companies.iloc[nn].text_clean)
    for mm in c_sentences:
        company_sentences.append(mm)
```

In [393]:
```
company_sentences=pd.DataFrame(columns=['Sentence'], data=company_sentences)
company_sentences['Class']=""
company_sentences.shape
```

Out[393]: (81609, 2)

In [422]:
```
company_sentences.head()
```

Out[422]:

0	jushi announces beginning adultuse cannabis sales illinois dispensary normal, illinois new adultuse customers can only shop online overthephone instore pick
1	as previously announced, jushis illinois dispensaries operate companys beyond hello brand.
2	on monday, may 11, 2020 9:00 a.m., beyond hello bloomingtonnormal begin serving adultuse customers jushis newly launched online shopping experience w instore...
3	medical patients continue shop instore well place orders online overthephone either curbside instore pickup.
4	jim cacioppo, jushis chairman chief executive officer commented, on day two years ago, beyond hello opened first dispensary bristol, pennsylvania.

Residents

In [504]:
```
in_terms = Person['Entities'].tolist()
in_stems=[porter.stem(c) for c in in_terms]
in_index=[]
out_index=[]
for a in range(0, len(clean_df)):
    words=clean_df.iloc[a].text_clean
    stems=[porter.stem(t) for t in words.split()]
    #if any of the keywords are in the title (stems), put those stems in the list
    if any(s in stems for s in in_stems):
        in_index.append(a)
    #if none of the keywords are present insert a Null value
    else:
        out_index.append(a)
```

In [505]:
```
residents=clean_df.iloc[in_index]
residents.head(20)
```

Out[505]:

2	families frustrated chicagoarea cemeteries close visitors mothers day dozens chicagoarea families unable pay respects lost loved ones mothers day say ce expla...
7	jushi announces beginning adultuse cannabis sales illinois dispensary normal, illinois new adultuse customers can only shop online overthephone instore p instore, on...
10	pope francis names father louis tylka archdiocese chicago coadjutor bishop peoria pope francis names father louis tylka archdiocese chicago coadjutor bish washingtonpope fran...
24	comment chicago fire department history mike mc my dad mentioned driver ss1 article click download this entry posted may 7, 2020, 3:30 pm filed fire depa entry...
28	how south holland, illinois helping residents protect properties flooding south hollands flood assistance rebate program powerful incentive proactive flooding outside...
33	top 10 haunted hot spots illinois ghost stories halloween anymore. nearly every town ghost stories, obscure others however, theres locations well known pa haunted. ...
34	former illinois congressman runs iowa u.s. house seat clinton a former u.s. congressman illinois one five republicans seeking partys nomination iowas 2nd co...
59	investors give nod worstrated illinois with revenue growing photographer: scott olsongetty images photographer: scott olsongetty images as governor j.b. pr office, ...
72	goodbye, new york, california illinois. hello where 1 4 goodbye, new york, california illinois. hello where bloomberg opinion new york, california illinois hemo
83	chicago public schools although ex president george bush said popular quote no child left behind , hat happening chicago public schools exactly opposite. school...
84	multiple chicago police employees under investigation for alleged coverup of eddie johnson drinking and driving incident mayor lori lightfoot. lori lightfoot sp
85	fiat chrysler temporarily idle jeep cherokee plant illinois print fca fca invested 350 million belvidere plant, starting 2016, produce cherokee, moved toledo, oh
86	activist, 23, named vacant chicagoarea state house post illinois news activist, 23, named vacant chicagoarea state house post a 23yearold community activ appoi...
94	sangamon among 93 illinois counties declining populations sangamon saw population decrease 2,419, 1.2 percent, last decade, according new analysis wi bureau data. san...
97	what are the discharge dates for chicago pd then james compeau went sort scored touchdown 16 seconds board chop deficit 166 halftime. rb james todd ir backfield eight...
114	lexington betty barbecue opens saturday one eleven food hall eater chicago plus 2 lexington betty barbecue opens saturday one eleven food hall eater chic opens...
121	iowaillinoiswisconsin news brief iowaillinoiswisconsin telegraphherald.com new hampshire general oversee wisconsin national guard changes madison, wis changes wis...
122	fiat idling illinois jeep plant third time six months bloomberg fiat chrysler automobiles nv pause production jeep sport utility vehicle factory third time six mon
135	show review: the almost use inner light create emotional show experience chicago cait mcmahon the almosts if i believed you tour brought southern weathe crowd fear call...
144	400 illinois national guard soldiers say goodbye deployment ceremony pam maxey, texico, tears streaming face embraced son, spec. drake hess, last tues southern illinoi...

In [506]:
```
residents.shape
```

Out[506]: (2549, 2)

In [508]:
```
residents_sentences=[]
for nn in range(len(residents)):
    r_sentences=nltk.sent_tokenize(residents.iloc[nn].text_clean)
    for mm in r_sentences:
        residents_sentences.append(mm)
```

In [509]:
```
residents_sentences=pd.DataFrame(columns=['Sentence'], data=residents_sentences)
residents_sentences['Class']=""
residents_sentences.shape
```

Out[509]: (101901, 2)

In [510]:
```
residents_sentences.head()
```

Out[510]:

0	families frustrated chicagoarea cemeteries close visitors mothers day dozens chicagoarea families unable pay respects lost loved ones mothers day say cem
1	but number families met locked gates sunday.they might earth, closest get mothers, said gregory harris.for harris, cemetery one place go honor mother doroth
2	they looking forward seeing moms, harris said.he said small group frustrated people jumped gates leave flowers mothers gravesides.there gentlemen went wa
3	they want see loved one i understood that.when got there, 20 people so, standing out, wanting get inside.
4	they knowledge well, said registered nurse glendra smith.for smith, familys first mothers day without mom, anna pennington, passed away less two months ag

Sentiment Analysis - Company

In [448]:
```
all_reviews = company_sentences['Sentence']
all_sent_values = []
all_sentiments = []
```

In [449]:
```
from nltk.sentiment.vader import SentimentIntensityAnalyzer
def sentiment_value(paragraph):
    analyser = SentimentIntensityAnalyzer()
    result = analyser.polarity_scores(paragraph)
    score = result['compound']
    return round(score,1)
```

In [450]:
```
for i in range(0,len(all_reviews)):
    all_sent_values.append(sentiment_value(all_reviews[i]))
```

In [463]:
```
SENTIMENT_VALUE = []
SENTIMENT = []
for i in range(0,len(all_reviews)):
    sent = all_sent_values[i]
    if (sent<=1 and sent>0.2):
        SENTIMENT.append('Positive')
        SENTIMENT_VALUE.append(2)
    elif (sent<-0.2 and sent>=-1):
        SENTIMENT.append('Negative')
        SENTIMENT_VALUE.append(0)
    else:
        SENTIMENT.append('Neutral')
        SENTIMENT_VALUE.append(1)
```

In [465]:
```
temp_data = company_sentences['Sentence'].to_frame()
```

In [466]:
```
temp_data['SENTIMENT_VALUE'] = SENTIMENT_VALUE
temp_data['SENTIMENT'] = SENTIMENT
```

In [467]:
```
temp_data.head()
```

Out[467]:

0	jushi announces beginning adultuse cannabis sales illinois dispensary normal, illinois new adultuse customers can only shop online overthephone instore pick patients can shop instore, on...
1	as previously announced, jushis illinois dispensaries operate companys beyond hello brand.
2	on monday, may 11, 2020 9:00 a.m., beyond hello bloomingtonnormal begin serving adultuse customers jushis newly launched online shopping experience www.beyondhello.com overthephone orders instore...
3	medical patients continue shop instore well place orders online overthephone either curbside instore pickup.
4	jim cacioppo, jushis chairman chief executive officer commented, on day two years ago, beyond hello opened first dispensary bristol, pennsylvania.

Classification - Company

In [468]:
```
X = temp_data.Sentence
y = temp_data.SENTIMENT_VALUE

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state = 8)
```

In [469]:
```
print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

```
(57126,)
(24483,)
(57126,)
(24483,)
```

In [470]:
```
y_test.value_counts()
```

Out[470]:
```
1    11637
2     8460
0     4386
Name: SENTIMENT_VALUE, dtype: int64
```

In [471]:
```
#train LR classifier
lr = Pipeline([('vect', CountVectorizer()),
               ('tfidf', TfidfTransformer()),
               ('clf', LogisticRegression()),
              ])
lr.fit(X_train, y_train)
```

Out[471]:
```
Pipeline(memory=None,
         steps=[('vect',
                 CountVectorizer(analyzer='word', binary=False,
                                 decode_error='strict',
                                 dtype=<class 'numpy.int64'>, encoding='utf-8',
                                 input='content', lowercase=True, max_df=1.0,
                                 max_features=None, min_df=1,
                                 ngram_range=(1, 1), preprocessor=None,
                                 stop_words=None, strip_accents=None,
                                 token_pattern='(?u)\\b\\w\\w+\\b',
                                 tokenizer=None, vocabulary=None)),
                ('tfidf',
                 TfidfTransformer(norm='l2', smooth_idf=True,
                                  sublinear_tf=False, use_idf=True)),
                ('clf',
                 LogisticRegression(C=1.0, class_weight=None, dual=False,
                                    fit_intercept=True, intercept_scaling=1,
                                    l1_ratio=None, max_iter=100,
                                    multi_class='warn', n_jobs=None,
                                    penalty='l2', random_state=None,
                                    solver='warn', tol=0.0001, verbose=0,
                                    warm_start=False))],
         verbose=False)
```

In [472]:
```
%%time

y_pred_lr = lr.predict(X_test)

print('accuracy %s' % accuracy_score(y_pred_lr, y_test))
```

```
accuracy 0.8206919086713229
Wall time: 387 ms
```

Word Cloud - Company

In [474]:
```
sent_df = X_test.to_frame()
sent_df['prediction']=y_pred_lr.tolist()
```

In [475]:
```
#Negative=0, Neutral=1, Positive=2
sent_df['prediction'].value_counts()
```

Out[475]:
```
1    13929
2     7530
0     3024
Name: prediction, dtype: int64
```

In [476]:
```
sent_df.head()
```

Out[476]:

	Sentence	prediction
59288	merriman shawnee mission, ksarizona state transfer arizona state swims backstroke freestyle events.	1
36004	students may noticed changes food businesses around columbias morningside campus.	1
54078	wadlow died july 15, 1940 buried coffin measuring 10 feet, 9 inches long, 32 inches wide 30 inches deep.	1
9838	naturally, someone drunk enough volunteer.	0
40523	with valets versatile wall bedsmurphy beds, comfort lost.	0

In [480]:
```
pos_sentences=sent_df[sent_df['prediction']==2]
pos_text=pos_sentences["Sentence"].tolist()
pos_text[0:2]
```

Out[480]:
```
['but trade deals created equal, people benefit readily them.',
 'restaurants facing higher costs food labor, increasing competition limits ability raise prices.']
```

In [481]:
```
neg_sentences=sent_df[sent_df['prediction']==0]
neg_text=neg_sentences["Sentence"].tolist()
neg_text[0:2]
```

Out[481]:
```
['naturally, someone drunk enough volunteer.',
 'with valets versatile wall bedsmurphy beds, comfort lost.']
```

In [482]:
```
pos_sentences.to_pickle('pos_sentences.pickle')
neg_sentences.to_pickle('neg_sentences.pickle')
```

In [485]:
```
def clean(doc):
    stop_free = " ".join([i for i in doc.lower().split() if i not in stop])
    punc_free = ''.join(ch for ch in stop_free if ch not in exclude)
    normalized = " ".join(lemma.lemmatize(word) for word in punc_free.split())
    return normalized
```

In [486]:
```
pos_clean = [clean(doc).split() for doc in pos_text]
```

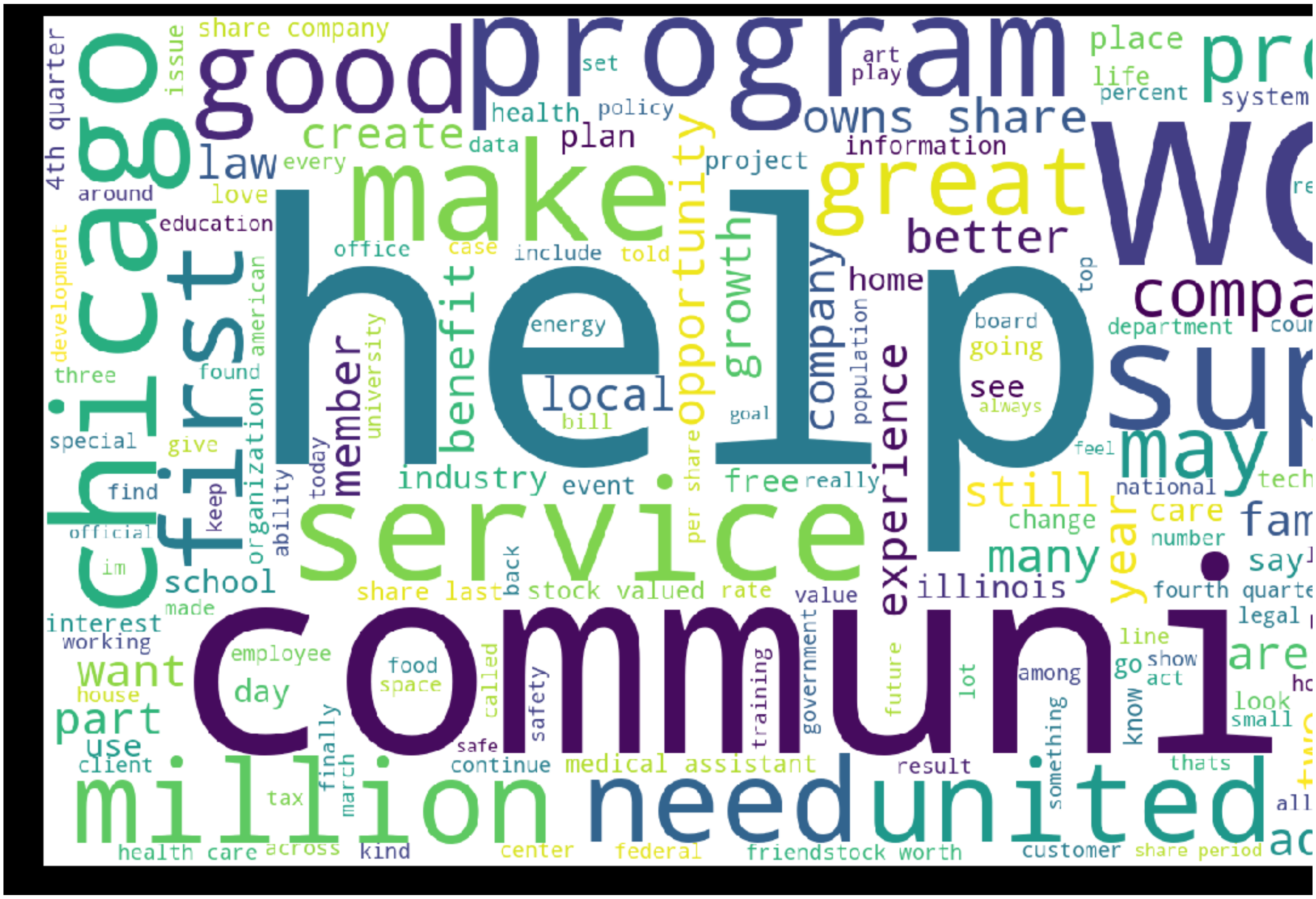
In [487]:
```
neg_clean = [clean(doc).split() for doc in neg_text]
```

In [488]:
```
pos_words=[]
for u in range(len(pos_clean)):
    words=pos_clean[u]
    for v in words:
        pos_words.append(v)

pos_string=" ".join(pos_words)
```

In [489]:
```
neg_words=[]
for w in range(len(neg_clean)):
    words=neg_clean[w]
    for x in words:
        neg_words.append(x)

neg_string=" ".join(neg_words)
```

In [490]:
```
pos_text_file = open("positive_company.txt", "w")
pos_text_file.write(pos_string)
pos_text_file.close()
with open('negative_company.txt', 'w', encoding='utf-8') as neg_text_file:
    neg_text_file.write(neg_string)
```

In [498]:
```
# Create stopword list:
stopwords = set(STOPWORDS)
stopwords.update(["state", "new", "one",'well','time','said','people','business'])

file_content=open ("positive_company.txt").read()

# Generate a word cloud image
wordcloud = WordCloud(stopwords=stopwords, background_color="white", width=1600, height=800).generate(file_content)

# Display the generated image:
# the matplotlib way:
plt.figure( figsize=(20,10), facecolor='k')
plt.imshow(wordcloud)
plt.axis("off")
plt.tight_layout(pad=0)
plt.show()
```



In [499]:
```
# Create stopword list:
stopwords = set(STOPWORDS)
stopwords.update(["state",'people','one'])

file_content=open ("negative_company.txt").read()

# Generate a word cloud image
wordcloud = WordCloud(stopwords=stopwords, background_color="white", width=1600, height=800).generate(file_content)

# Display the generated image:
# the matplotlib way:
plt.figure( figsize=(20,10), facecolor='k')
plt.imshow(wordcloud)
plt.axis("off")
plt.tight_layout(pad=0)
plt.show()
```

Sentiment Analysis - Resident

In [511]:
```
all_reviews = residents_sentences['Sentence']
all_sent_values = []
all_sentiments = []
```

In [512]:
```
from nltk.sentiment.vader import SentimentIntensityAnalyzer
def sentiment_value(paragraph):
    analyser = SentimentIntensityAnalyzer()
    result = analyser.polarity_scores(paragraph)
    score = result['compound']
    return round(score,1)
```

In [513]:
```
for i in range(0,len(all_reviews)):
    all_sent_values.append(sentiment_value(all_reviews[i]))
```

In [514]:
```
SENTIMENT_VALUE = []
SENTIMENT = []
for i in range(0,len(all_reviews)):
    sent = all_sent_values[i]
    if (sent<=1 and sent>0.2):
        SENTIMENT.append('Positive')
        SENTIMENT_VALUE.append(2)
    elif (sent<-0.2 and sent>=-1):
        SENTIMENT.append('Negative')
        SENTIMENT_VALUE.append(0)
    else:
        SENTIMENT.append('Neutral')
        SENTIMENT_VALUE.append(1)
```

In [519]:
```
temp_data = residents_sentences['Sentence'].to_frame()
```

In [520]:
```
temp_data['SENTIMENT_VALUE'] = SENTIMENT_VALUE
temp_data['SENTIMENT'] = SENTIMENT
```

In [521]:
```
temp_data.head()
```

Out[521]:

0	families frustrated chicagoarea cemeteries close visitors mothers day dozens chicagoarea families unable pay respects lost loved ones mothers day say cem gates visitors without expla...
1	but number families met locked gates sunday.they might earth, closest get mothers, said gregory harris.for harris, cemetery one place go honor mother doroth cars families stood outside...
2	they looking forward seeing moms, harris said.he said small group frustrated people jumped gates leave flowers mothers gravesides.there gentlemen went wa
3	they want see loved one i understood that.when got there, 20 people so, standing out, wanting get inside.
4	they knowledge well, said registered nurse glendra smith.for smith, familys first mothers day without mom, anna pennington, passed away less two months ag cedar park, i tears welli...

Classification - Resident

In [522]:
```
X = temp_data.Sentence
y = temp_data.SENTIMENT_VALUE

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state = 8)
```

In [523]:
```
print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

```
(71330,)
(30571,)
(71330,)
(30571,)
```

In [524]:
```
y_test.value_counts()
```

Out[524]:
```
1    14658
2    10339
0     5574
Name: SENTIMENT_VALUE, dtype: int64
```

In [525]:
```
#train LR classifier
lr = Pipeline([('vect', CountVectorizer()),
               ('tfidf', TfidfTransformer()),
               ('clf', LogisticRegression()),
              ])
lr.fit(X_train, y_train)
```

Out[525]:
```
Pipeline(memory=None,
         steps=[('vect',
                 CountVectorizer(analyzer='word', binary=False,
                                 decode_error='strict',
                                 dtype=<class 'numpy.int64'>, encoding='utf-8',
                                 input='content', lowercase=True, max_df=1.0,
                                 max_features=None, min_df=1,
                                 ngram_range=(1, 1), preprocessor=None,
                                 stop_words=None, strip_accents=None,
                                 token_pattern='(?u)\\b\\w\\w+\\b',
                                 tokenizer=None, vocabulary=None)),
                ('tfidf',
                 TfidfTransformer(norm='l2', smooth_idf=True,
                                  sublinear_tf=False, use_idf=True)),
                ('clf',
                 LogisticRegression(C=1.0, class_weight=None, dual=False,
                                    fit_intercept=True, intercept_scaling=1,
                                    l1_ratio=None, max_iter=100,
                                    multi_class='warn', n_jobs=None,
                                    penalty='l2', random_state=None,
                                    solver='warn', tol=0.0001, verbose=0,
                                    warm_start=False))],
         verbose=False)
```

In [526]:
```
%%time

y_pred_lr = lr.predict(X_test)

print('accuracy %s' % accuracy_score(y_pred_lr, y_test))
```

```
accuracy 0.8265676621634883
Wall time: 518 ms
```

Word Cloud - Resident

In [527]:
```
sent_df = X_test.to_frame()
sent_df['prediction']=y_pred_lr.tolist()
```

In [528]:
```
#Negative=0, Neutral=1, Positive=2
sent_df['prediction'].value_counts()
```

Out[528]:
```
1    17208
2     9472
0     3891
Name: prediction, dtype: int64
```

In [529]:
```
sent_df.head()
```

Out[529]:

87432	people ineligible commission include: lobbyists persons appointed, running elected position state, federal, local government paid consultant campaign re a...
70774	casey leins may 14, 2019 these places best america educating students levels.
30872	i get really upset people object pipelines oil still transported rail, aziz said.
85930	ethics reform the republicans best hope minimize losses, jackson said.
80641	as aide schmitz, goncher served liaison constituents state agencies.

In [530]:
```
pos_sentences=sent_df[sent_df['prediction']==2]
pos_text=pos_sentences["Sentence"].tolist()
pos_text[0:2]
```

Out[530]:
```
['people ineligible commission include: lobbyists persons appointed, running elected position state, federal, local government pa
cal candidate political action committee individual ownership interest entity state, local federal contract appointed elected off
 'casey leins may 14, 2019 these places best america educating students levels.']
```

In [531]:
```
neg_sentences=sent_df[sent_df['prediction']==0]
neg_text=neg_sentences["Sentence"].tolist()
neg_text[0:2]
```

Out[531]:
```
['i get really upset people object pipelines oil still transported rail, aziz said.',
 'johnson, married, initially blamed failure take blood pressure medication said drinks dinner earlier evening.']
```

In [532]:
```
pos_sentences.to_pickle('pos_sentences.pickle')
neg_sentences.to_pickle('neg_sentences.pickle')
```

In [533]:
```
def clean(doc):
    stop_free = " ".join([i for i in doc.lower().split() if i not in stop])
    punc_free = ''.join(ch for ch in stop_free if ch not in exclude)
    normalized = " ".join(lemma.lemmatize(word) for word in punc_free.split())
    return normalized
```

In [534]:
```
pos_clean = [clean(doc).split() for doc in pos_text]
```

In [535]:
```
neg_clean = [clean(doc).split() for doc in neg_text]
```

In [536]:
```
pos_words=[]
for u in range(len(pos_clean)):
    words=pos_clean[u]
    for v in words:
        pos_words.append(v)

pos_string=" ".join(pos_words)
```

In [537]:
```
neg_words=[]
for w in range(len(neg_clean)):
    words=neg_clean[w]
    for x in words:
        neg_words.append(x)

neg_string=" ".join(neg_words)
```

In [538]:
```
pos_text_file = open("positive_resident.txt", "w")
pos_text_file.write(pos_string)
pos_text_file.close()
with open('negative_resident.txt', 'w', encoding='utf-8') as neg_text_file:
    neg_text_file.write(neg_string)
```

In [545]:
```
# Create stopword list:
stopwords = set(STOPWORDS)
stopwords.update(['people','new','one','state','well','said','time','business','make'])

file_content=open ("positive_resident.txt").read()

# Generate a word cloud image
wordcloud = WordCloud(stopwords=stopwords, background_color="white", width=1600, height=800).generate(file_content)

# Display the generated image:
# the matplotlib way:
plt.figure( figsize=(20,10), facecolor='k')
plt.imshow(wordcloud)
plt.axis("off")
plt.tight_layout(pad=0)
plt.show()
```

In [548]:
```
# Create stopword list:
stopwords = set(STOPWORDS)
stopwords.update(["state",'people','one','said','new'])

file_content=open ("negative_resident.txt").read()

# Generate a word cloud image
wordcloud = WordCloud(stopwords=stopwords, background_color="white", width=1600, height=800).generate(file_content)

# Display the generated image:
# the matplotlib way:
plt.figure( figsize=(20,10), facecolor='k')
plt.imshow(wordcloud)
plt.axis("off")
plt.tight_layout(pad=0)
plt.show()
```