In [1]:

```
# Topic Modeling
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### @Status : In-Progress
```

In [2]:

```
### Import Relevant Libraries
import os
import pandas as pd
import numpy as np
import collections
import datetime as dt
import requests
import json
import re
import time

import matplotlib.pyplot as plt
import matplotlib.cm as cm
%matplotlib inline
import seaborn as sns
sns.set_style('whitegrid')
from scipy.stats import norm
from IPython.display import display, Image



import string
import re
import nltk
from nltk.util import ngrams
from nltk import pos_tag,word_tokenize
from nltk.corpus import stopwords
from nltk.tokenize import WhitespaceTokenizer
from nltk.stem import WordNetLemmatizer,PorterStemmer
from wordcloud import WordCloud, STOPWORDS, ImageColorGenerator
from textblob import TextBlob

from sklearn.ensemble import RandomForestClassifier
from sklearn.preprocessing import StandardScaler
from sklearn import metrics
from sklearn.metrics import accuracy_score
from sklearn.metrics import classification_report, confusion_matrix
from sklearn.feature_extraction.text import TfidfVectorizer, CountVectorizer
from sklearn.decomposition import LatentDirichletAllocation as LDA
from sklearn.decomposition import NMF
```

In [3]:

```
### Build a get_date function to convert date format
#### Build a data_creation function to read json data into pandas dataframe

def get_date(created):
    return dt.datetime.fromtimestamp(created)

def data_creation(subreddit) :
    with open('submissions_'+subreddit+'.json') as f:
        data = json.loads("[" +
            f.read().replace("}\n{", "},\n{") +
        "]")
    data =pd.DataFrame(data)
    reddit_data = data[['author','over_18','title','selftext','num_comments', 's
core', 'full_link','created_utc']]
    reddit_data = reddit_data.dropna()
    _timestamp = reddit_data["created_utc"].apply(get_date)
    reddit_data = reddit_data.assign(timestamp = _timestamp)
    reddit_data['over_18'] = reddit_data['over_18'].astype('str')
    reddit_data['subreddit']= subreddit
    # Build column have title + selftext
    reddit_data['title_with_selftext']= reddit_data['title'] +" " + reddit_data[
'selftext']

    # Do one more extra cleaning : keep updating this part
    reddit_data=reddit_data[~reddit_data['title_with_selftext'].isin([ '[removed
]', '[deleted]',''])]
    subreddit = reddit_data
    return subreddit

def empty_words_clean(text):
    text = text.replace('[removed]','')
    text= text.replace('[deleted]','')
    text= text.replace('\n','')
    return (text)
```

In [4]:

```
pd.set_option('display.max_columns', 500)
pd.set_option('display.max_rows', 500)
```

In [5]:

```
### Dataframing 4 subreddit Datasets
SuicideWatch_df = data_creation('SuicideWatch')
depressed_df = data_creation('depressed')
happy_df = data_creation('happy')
selfimprovement_df = data_creation('selfimprovement')

### Concat all 4 dataframes into one merged file
all_subreddit_df = pd.concat([SuicideWatch_df,depressed_df,happy_df,selfimprovem
ent_df])
```

In [6]:

```
### 0.Data Preparation
```

In [7]:

```
#### Text Preprocessing by following pipeline :
### Raw text => Tokeninze/lowercase => Remove stop words => Remove non-alphabeti
c characters =>
### Remove Extra Punctuations => Lemmatization => Build Custom Stop words dictio
nary
```

In [8]:

```
# Build function that takes a word and returns true if it consists only of non-a
lphabetic characters
def alpha_filter(w):
    pattern = re.compile('^[^a-z]+$')
    if (pattern.match(w)):
        return True
    else:
        return False

# Build data preparation function including all the necessary 7 steps :
def clean_words(text):
    # lower text & tokenizing
    text = text.replace('\n',' ')
    text = text.replace('[removed]',' ')
    text= text.replace('[deleted]', '')
    text =text.lower()

    ### Updated cleaning-pipeline :
    text = re.sub(r'[^a-zA-Z0-9 ]',r' ',text) #remove anything that is not a let
ter or number first
    text = [word for word in text.split(" ")]

    # remove stop words
    nltk_stopwords = set(stopwords.words('english'))
    review_lower_stop = [x for x in text if not x in nltk_stopwords]
    # remove extra punctuations
    review_lower_stop_pun = [y for y in review_lower_stop if not alpha_filter(y)
]

    review_lower_stop_pun_extra = [''.join(x for x in par if x not in string.pun
ctuation) for par in review_lower_stop_pun]
    # Lemmatization
    porter = WordNetLemmatizer()
    review_lower_stop_pun_extra_lemmatized = []
    for a in review_lower_stop_pun_extra :
        review_lower_stop_pun_extra_lemmatized.append(porter.lemmatize(a))
    # buid custom stop words dictionary
    cachedStopWords = set(stopwords.words("english"))

    ####Keep Updating custom stop words
    cachedStopWords.update(('nt', 'wo', 're', 'im', 'yall','u','ca','ive', 'wan'
,'na','gon','nov','x200b','amp',\
                            'wwwyoutubecomwatch','http','vbjkbl5olvm8','lt', 'br', '
gt', 'amp','tsp','tbsp','nbsp'))
    review_lower_stop_pun_extra_lemmatized_stop = [x for x in review_lower_stop_
pun_extra_lemmatized\
                                                    if not x in cachedStopWords]
    text = " ".join(review_lower_stop_pun_extra_lemmatized_stop)
    return (text)

def detect_polarity(text):
    return TextBlob(text).sentiment.polarity
```

In [9]:

```
##Data Sampling
```

In [10]:

```
### Because of relatively huge dataset, we need to perform random sampling of 30
% for now

all_subreddit_df_list = all_subreddit_df.sample(frac=0.3, replace=True, random_s
tate=1)
```

In [11]:

```
all_subreddit_df_list["title_with_selftext_clean"] = all_subreddit_df_list["titl
e_with_selftext"].apply(lambda x: clean_words(x))
```

In [12]:

```
all_subreddit_df_list['polarity'] = all_subreddit_df_list['title_with_selftext_c
lean'].apply(detect_polarity)
```

In [13]:

```
all_subreddit_df_list.head(3)
```

Out[13]:

	author	over_18	title	selftext	num_comments	score	
12970	sudrawkid	False	Can't properly stick up for myself and feel weak.	Hey everyone! I guess I should just outright g...	2	4	https://ww
5192	PinkyIsSnug	False	Gonna kill myself very very soon. I've really ...	I joined this school with high hopes. hopes th...	5	1	https://ww
2357	ReasonableBrother3	False	GET RID OF DEPRESSION	[removed]	0	1	https://ww

In [14]:

```
### Final check of cleaning pipeline's output/reliability
```

In [15]:

```
all_subreddit_df_list.title.head(1).tolist()
```

Out[15]:

```
["Can't properly stick up for myself and feel weak."]
```

```
In [16]:
```

```
all_subreddit_df_list.selftext.head(1).tolist()
```

```
Out[16]:
```

```
["Hey everyone! I guess I should just outright get into it. As a per
son I tend to be very meek and mild mannered, often apologizing for
things that are literally not my fault at all. Because of this I thi
nk people tend to walk on me a bit and truth be told, I let them. I
hate confrontation and it gives me the worst anxiety. However my iss
ues is that I hold all my anger and frustration in that once I spot
someone even weaker than I am I let it out on them and hard. (exampl
e: an acquaintance of mine was saying some not so nice but not serio
us stuff about me behind my back. I knew I could handle a confrontat
ion with him and so I went IN to the point where I said some things
that were unnecessarily mean.)\n\n I can't find that balance, and no
w my job is making my feelings of weakness even worse. I work in ret
ail (I know it's horrid) but I am great customer service person, I'm
very friendly and smile and all that but the sheer abuse I take from
asshole customers on the daily is enough to make me want to cry when
I get home. They are just so rude to me and I let them...and I know
at work I can't exactly clap back but I mean I really just let them
walk all over me, to the point where it almost seems like they know
I'm powerless and often tell a manager that I'm a bad worker (despit
e the fact I'm probably one of the best customer service people we h
ave at work). \n\nIs there anyway to appropriately defend myself in
situations so I can stop bottling up my anger and unleashing it on t
hose who don't deserve it. I feel so weak willed at times it's reall
y crushing me and I feel awful after I eventually snap. Please help,
thank you."]
```

In [17]:

```
all_subreddit_df_list.title_with_selftext_clean.head(1).tolist()
```

Out[17]:

```
['properly stick feel weak  hey everyone  guess outright get  person
tend meek mild mannered  often apologizing thing literally fault  th
ink people tend walk bit truth told  let  hate confrontation give wo
rst anxiety  however issue hold anger frustration spot someone even
weaker let hard   example  acquaintance mine saying nice serious stu
ff behind back  knew could handle confrontation went point said thin
g unnecessarily mean     find balance  job making feeling weakness e
ven worse  work retail  know horrid  great customer service person
friendly smile sheer abuse take asshole customer daily enough make w
ant cry get home  rude let   know work exactly clap back mean really
let walk  point almost seems like know powerless often tell manager
bad worker  despite fact probably one best customer service people w
ork     anyway appropriately defend situation stop bottling anger un
leashing deserve  feel weak willed time really crushing feel awful e
ventually snap  please help  thank ']
```

In [18]:

```
#Descriptive statistics & dataframe  info
```

In [19]:

```
all_subreddit_df_list.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 47828 entries, 12970 to 43513
Data columns (total 13 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   author                      47828 non-null  object
 1   over_18                     47828 non-null  object
 2   title                       47828 non-null  object
 3   selftext                    47828 non-null  object
 4   num_comments                47828 non-null  int64
 5   score                       47828 non-null  int64
 6   full_link                   47828 non-null  object
 7   created_utc                 47828 non-null  int64
 8   timestamp                   47828 non-null  datetime64[ns]
 9   subreddit                   47828 non-null  object
 10  title_with_selftext         47828 non-null  object
 11  title_with_selftext_clean   47828 non-null  object
 12  polarity                    47828 non-null  float64
dtypes: datetime64[ns](1), float64(1), int64(3), object(8)
memory usage: 5.1+ MB
```

In [20]:

```
all_subreddit_df_list.describe()
```

Out[20]:

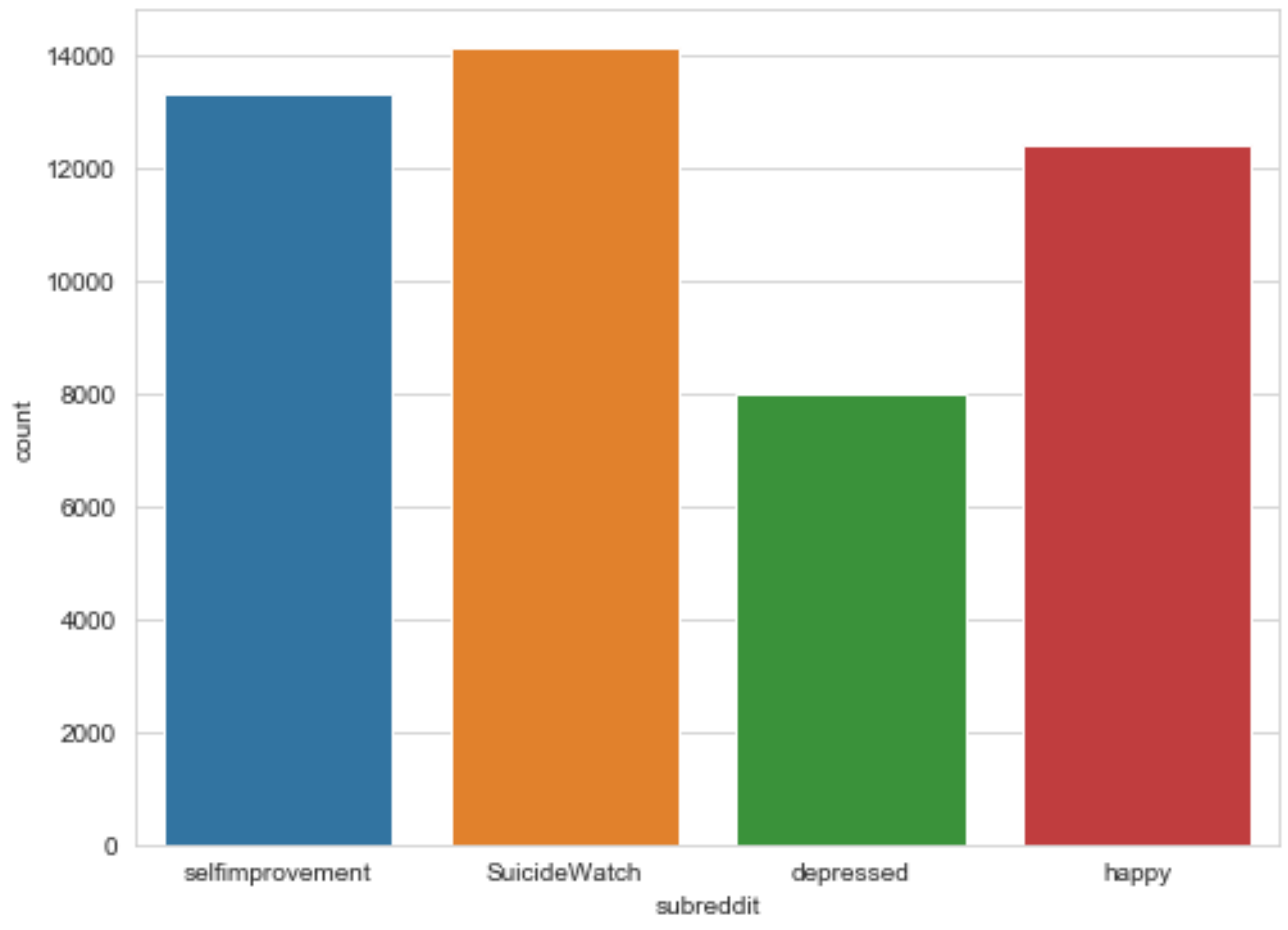
	num_comments	score	created_utc	polarity
count	47828.000000	47828.000000	4.782800e+04	47828.000000
mean	6.214289	65.042590	1.557714e+09	0.076999
std	28.489875	966.074055	3.417972e+07	0.254898
min	0.000000	0.000000	1.304697e+09	-1.000000
25%	1.000000	1.000000	1.538144e+09	-0.038462
50%	2.000000	1.000000	1.570949e+09	0.039981
75%	5.000000	3.000000	1.584263e+09	0.194731
max	1825.000000	81714.000000	1.590173e+09	1.000000

In [21]:

```
# Build Bar plot for all 4 subreddit distribution
plt.figure(figsize=(8,6))
sns.countplot(x='subreddit',data=all_subreddit_df_list)
```

Out[21]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1a344ed910>
```

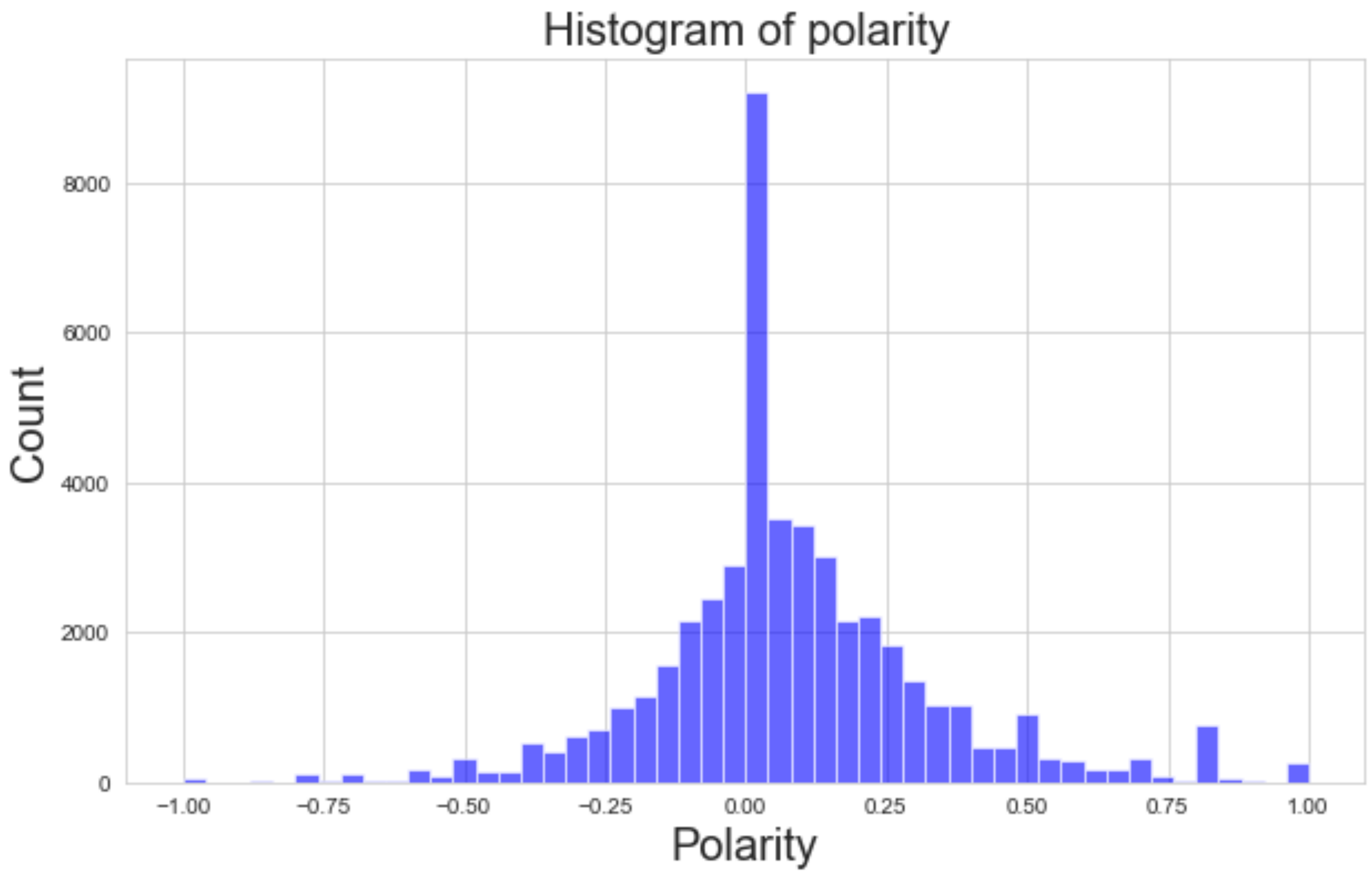


In [22]:

```
## Polarity (Sentiment) distribution of all 4 subreddit - Symmetric/ not skewed
```

In [23]:

```
num_bins = 50
plt.figure(figsize=(10,6))
n, bins, patches = plt.hist(all_subreddit_df_list.polarity, num_bins, facecolor=
'blue', alpha=0.6)
plt.xlabel('Polarity',fontsize =20)
plt.ylabel('Count',fontsize =20)
plt.title('Histogram of polarity',fontsize =20)
plt.show()
```



Topic Modeling : NMF

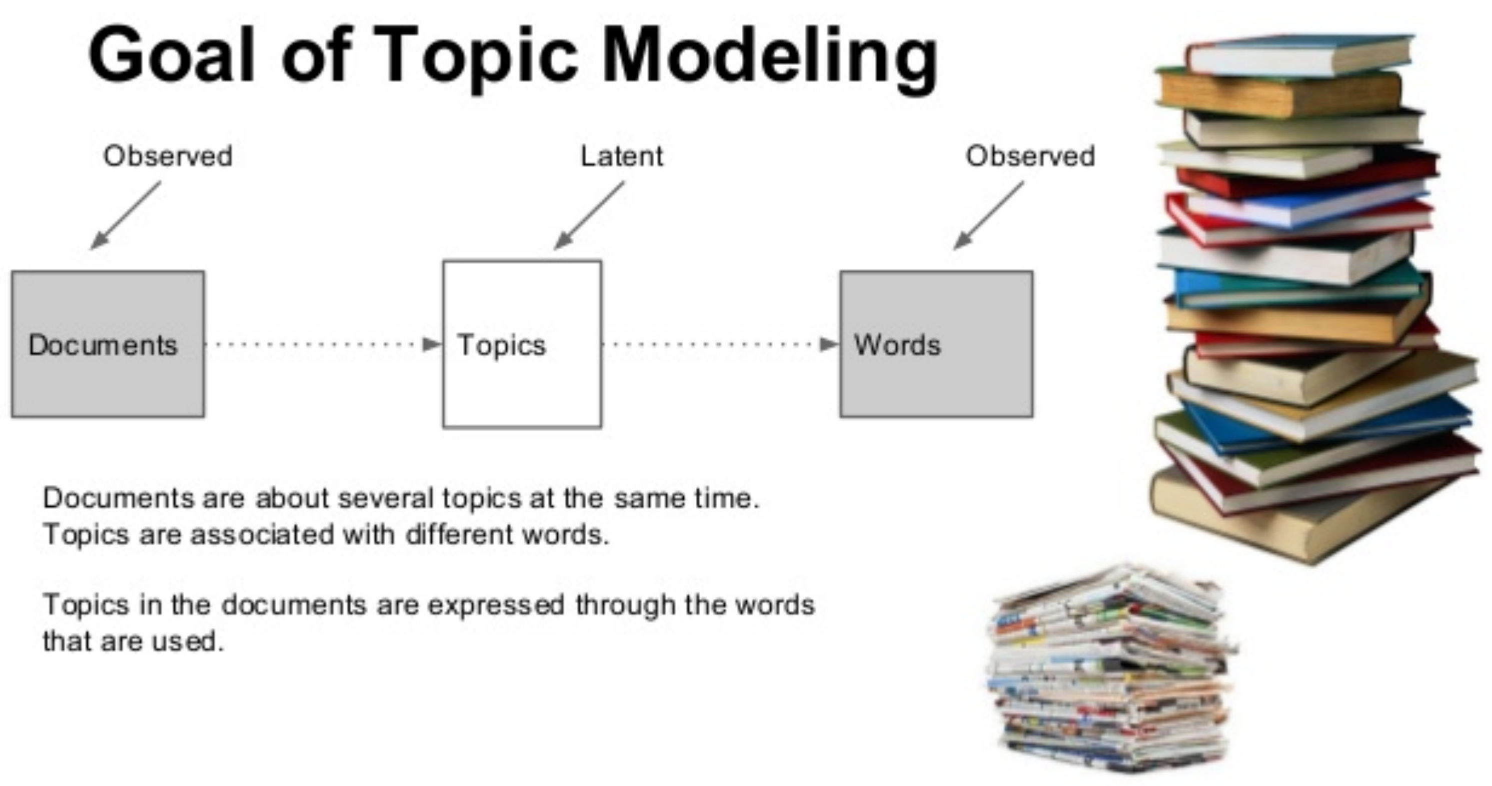
A type of statistical model for discovering the abstract "topics" that occur in a collection of documents. A document typically concerns multiple topics in different proportions; thus, in a document that is 10% about cats and 90% about dogs, there would probably be about 9 times more dog words than cat words.

The "topics" produced by topic modeling techniques are clusters of similar words.

A topic model captures this intuition in a mathematical framework, which allows examining a set of documents and discovering, based on the statistics of the words in each, what the topics might be and what each document's balance of topics is.

In [24]:

```python
display(Image(filename='topic_modeling.png'))
```



Documents are about several topics at the same time.
Topics are associated with different words.

Topics in the documents are expressed through the words that are used.

# Non-Negative Matrix Factorization (NMF) is an 'unsupervised' and the state of the art 'feature extraction' technique so there are no labeling of topics that the model will be trained on.

Simply, NMF is useful when there are many attributes and the attributes are ambiguous or have weak predictability (*especially like the dataset we have). By combining attributes, NMF can produce meaningful patterns, topics, or themes.

In a text document, the same word can occur in different places with different meanings. For example, "hike" can be applied to the outdoors or to interest rates. By combining attributes, NMF introduces context, which is essential for predictive power:

"hike" + "mountain" -> "outdoor sports" (Topic 1)

"hike" + "interest" -> "interest rates" (Topic 2)

The way it works is that,NMF provides two matrices of topics that are factorized from Document-Term Matrix. One of two matrices is Document-Topic Matrix and the other is Topic-Term Matrix.

NMF decomposes (or factorizes) high-dimensional word vectors into a lower-dimensional representation. These lower-dimensional vectors are non-negative which also means their "coefficients" are non-negative.

In our analysis, the high-dimensional vectors are going to be "TF-IDF" weights. *(term frequency-inverse document frequency : is a statistical measure that evaluates how relevant a word is to a document in a collection of documents. This is done by multiplying two metrics: how many times a word appears in a document, and the inverse document frequency of the word across a set of documents.)

But it can be anything including word vectors or a simple raw count of the words and tf-idf weights out of the text works well and is computationally not very expensive (i.e runs fast).

So, NMF is a deterministic algorithm which arrives at a single representation of the corpus and it arrives at its representation of a corpus in terms of something resembling “latent topics”.

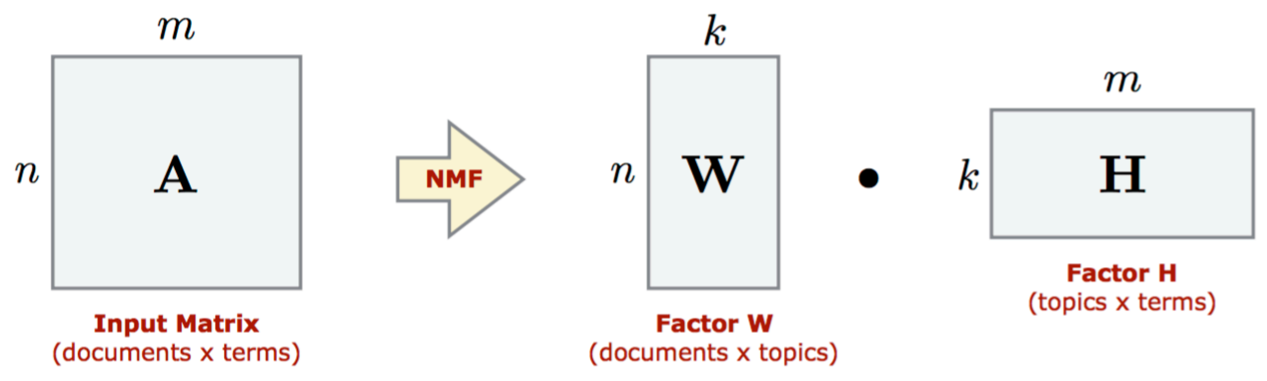
In [25]:

```
### n : 47828, k:4, m :5000 (N unique features : We assigned it as 5000, from 9k
)
### 47828 x9000 -> Factorize (47828 x4 ) X (4 x 5000)
```

In [26]:

```
display(Image(filename='nmf.png'))
```

- **Input:** Document-term matrix **A**; Number of topics k.
- **Output:** Two k-dimensional factors **W** and **H** approximating **A**.



Although there are some variants, popular way of measuring how good the approximation is the frobenius norm (the sum of element-wise squared distance errors). Formalizing this, we obtain the following objective

In [27]:

```
display(Image(filename='objective.png'))
```

$$minimize \, \|X - WH\|_F^2 \; w.r.t. \, W, H \; s.t. \, W, H \geq 0$$

NMF decomposes a data matrix A into the product of two lower rank matrices W and H so that A is approximately equal to W times H. NMF uses an iterative procedure to modify the initial values of W and H so that the product approaches A. The procedure terminates when the approximation error converges or the specified number of iterations is reached.

In [28]:

```
### Build NMF Model
```

In [29]:

```
# get topics with their terms and weights
def get_topics_terms_weights(weights, feature_names):
    feature_names = np.array(feature_names)
    sorted_indices = np.array([list(row[::-1]) for row in np.argsort(np.abs(weig
hts))])
    sorted_weights = np.array([list(wt[index]) for wt, index in zip(weights, sor
ted_indices)])
    sorted_terms = np.array([list(feature_names[row]) for row in sorted_indices]
)
    topics = [np.vstack((terms.T, term_weights.T)).T for terms, term_weights in 
zip(sorted_terms, sorted_weights)]
    return topics

# prints components of all the topics  obtained from topic modeling
def print_topics_udf(topics, total_topics=4,
                     weight_threshold=0.0001,
                     display_weights=False,
                     num_terms=None):

    for index in range(total_topics):
        topic = topics[index]
        topic = [(term, float(wt))
                 for term, wt in topic]
        #print(topic)
        topic = [(word, round(wt,2))
                 for word, wt in topic
                 if abs(wt) >= weight_threshold]

        if display_weights:
            print('Topic'+str(index)+' with weights : ')
            print(topic[:num_terms]) if num_terms else topic
            print('\n')
        else:
            print('Topic #'+str(index)+' without weights : ')
            tw = [term for term, wt in topic]
            print(tw[:num_terms]) if num_terms else tw
```

In [63]:

```
def tfidf_nmf_function (dataframe, no_top_words, number) :
# Store only text contents
    data_text = dataframe[['title_with_selftext_clean']]
    data_text['index'] = dataframe.index
    # Assign to 'documents' which has texts and index of each
    documents = data_text
    ## Vectorization
    # NMF is able to use tf-idf - vectorize the corpus
    tfidf_vectorizer = TfidfVectorizer(max_df=0.80, min_df=10, max_features=6000
,ngram_range=(1, 2)
                                      ,stop_words='english', token_pattern = r'\b[^
\d\w]+\b')

    ## min_df = 10 : ignore words that appear in less than 10 of the subreddits
    ##  max_df=0.80 : model to ignore words that appear in more than 80% of the
subreddits
    ## max_features=6000 : After processing we have a little over 9k(9688) uniqu
e words
    ### so we'll set the max_features to only include the top 6k
    #### by term frequency across the articles for further feature reduction.
    ##  ngram_range=(1, 2) : tf-idf weights for n-grams (bigrams, trigrams etc.)
.
    ### To do that we'll set the n_gram range to (1, 2)
    #### which will include unigrams and bigrams.


    # calculate the feature matrix
    tfidf = tfidf_vectorizer.fit_transform(dataframe['title_with_selftext_clean'
])
    print( "Created %d X %d TF-IDF-normalized document-term matrix" % (tfidf.sha
pe[0], tfidf.shape[1]) )
    tfidf_feature_names = tfidf_vectorizer.get_feature_names()


    print ( "in the corpus of N documents, total of N unique features :")
    display(tfidf.shape)
    tfidf_feature_names = tfidf_vectorizer.get_feature_names()
    print("Length of unique features are : ", len(tfidf_vectorizer.get_feature_n
ames()))

    # Run NMF
    nmf = NMF(n_components=number, random_state=1, alpha=.3, l1_ratio=.5, init='
nndsvd')

    ### Regularization ?
    ####will lower the variance from the model - More robust decision on data as
 it minimize overfitting
    ##  'nndsvd'  :Nonnegative Double Singular Value Decomposition which works b
est on sparse data like we have here
    ##  As in ElasticNet, we control the combination of L1 (Lasso) and L2 (Ridge
) with the l1_ratio (ρ) parameter
    ###between 0< - <1  and the intensity of the regularization with the alpha (
α) parameter

    nmf_z = nmf.fit_transform(tfidf)
    nmf_weights = nmf.components_
    nmf_feature_names = tfidf_vectorizer.get_feature_names()


    for topic_idx, topic in enumerate(nmf.components_):
            print("Topic %d:" % (topic_idx))
            print(", ".join([tfidf_feature_names[i]
                        for i in topic.argsort()[:-no_top_words - 1:-1]]) ,"\n")

    topics = get_topics_terms_weights(nmf_weights, nmf_feature_names)
    print_topics_udf(topics, total_topics=4, num_terms=30, display_weights=True)


    TopicNumber=[]
    for i in range(len(nmf_z)):
        h=nmf_z[i].tolist().index(nmf_z[i].max())
        TopicNumber.append(h)
    documents['topic_nmf']=TopicNumber
    dataframe['topic_nmf'] =TopicNumber
    sns.countplot(x='topic_nmf', data=documents)
```

In [ ]:

```

```

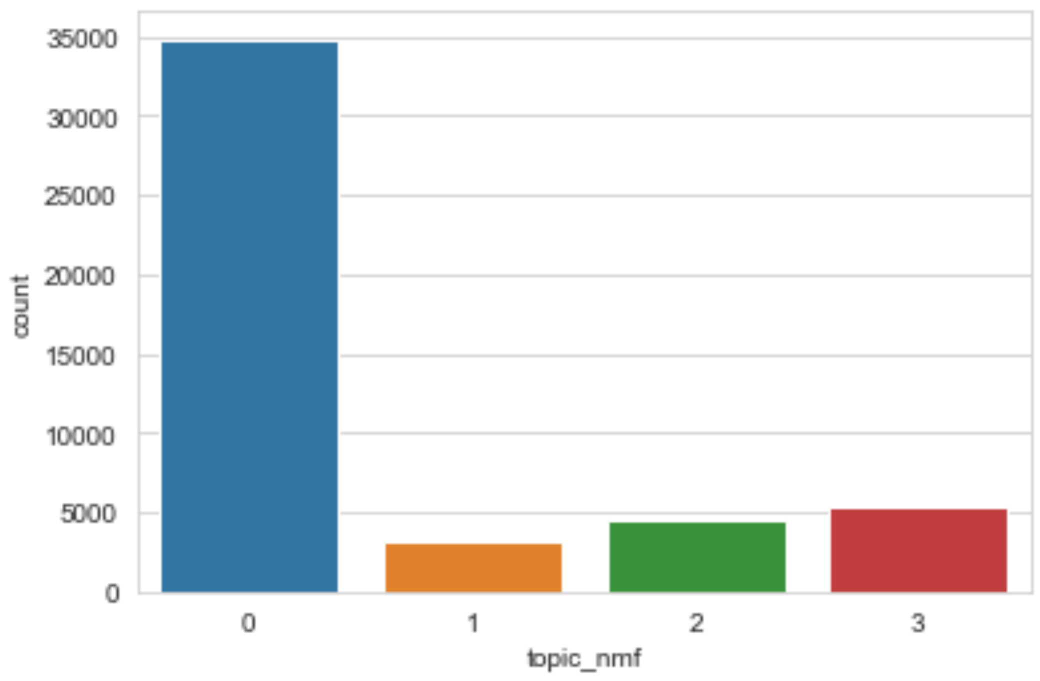
In [64]:

```
### We are having better results with NMF (over TF-IDF matrix) than with LDA.
### The top keywords of the topics NFM finds are more related and meaningful to
the context of my corpus,
###which are posts of many subjects shared internally in my organization.
```

In [65]:

```
#def nmf_function (tfidf, model, feature_names, no_top_words) :
#nmf_function (tfidf,nmf, tfidf_feature_names, 20)
#visualization topic distribution
tfidf_nmf_function(all_subreddit_df_list,30 ,4)
```

```
/Users/Jay/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launc
her.py:4: SettingWithCopyWarning:
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: https://pandas.pydata.org/pand
as-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-co
py
  after removing the cwd from sys.path.

Created 47828 X 6000 TF-IDF-normalized document-term matrix
in the corpus of N documents, total of N unique features :

(47828, 6000)

Length of unique features are :  6000
Topic 0:
life, time, year, friend, know, people, thing, day, really, think, l
ike, help, going, work, make, got, good, school, love, job, need, th
ought, way, better, self, month, say, lot, family, person

Topic 1:
happy, make happy, make, today, finally, feel happy, year, day, love
, birthday, happy life, dog, really happy, happy happy, want happy,
smile, family, happiness, happy birthday, christmas, picture, little
, video, place, happy new, new, happy today, got, baby, girl

Topic 2:
feel, like, feel like, feeling, know, make feel, really, make, peopl
e, dont, sad, anymore, know feel, want, depressed, like feel, thing,
like shit, shit, hate, want feel, good, bad, life feel, talk, think,
felt, feeling like, better, feel better

Topic 3:
want, die, want die, kill, fucking, anymore, dont, hate, live, know,
end, life, tired, pain, want kill, wish, care, dont want, hurt, fuck
, want live, wanna, alive, suicide, want end, shit, stop, death, die
want, scared

Topic0 with weights :
[('life', 2.68), ('time', 2.48), ('year', 2.34), ('friend', 2.2), ('
know', 2.09), ('people', 2.02), ('thing', 2.0), ('day', 1.92), ('rea
lly', 1.83), ('think', 1.51), ('like', 1.51), ('help', 1.48), ('goin
g', 1.38), ('work', 1.37), ('make', 1.33), ('got', 1.3), ('good', 1.
29), ('school', 1.26), ('love', 1.24), ('job', 1.22), ('need', 1.2),
('thought', 1.17), ('way', 1.16), ('better', 1.09), ('self', 1.05),
('month', 1.04), ('say', 1.0), ('lot', 0.98), ('family', 0.95), ('pe
rson', 0.94)]


Topic1 with weights :
[('happy', 8.94), ('make happy', 1.74), ('make', 1.15), ('today', 0.
32), ('finally', 0.3), ('feel happy', 0.27), ('year', 0.25), ('day',
0.24), ('love', 0.23), ('birthday', 0.19), ('happy life', 0.18), ('d
og', 0.18), ('really happy', 0.17), ('happy happy', 0.16), ('want ha
ppy', 0.14), ('smile', 0.14), ('family', 0.13), ('happiness', 0.13),
('happy birthday', 0.12), ('christmas', 0.1), ('picture', 0.1), ('li
ttle', 0.1), ('video', 0.1), ('place', 0.09), ('happy new', 0.09), (
'new', 0.09), ('happy today', 0.09), ('got', 0.09), ('baby', 0.09),
('girl', 0.09)]


Topic2 with weights :
[('feel', 7.26), ('like', 5.57), ('feel like', 4.96), ('feeling', 0.
83), ('know', 0.78), ('make feel', 0.65), ('really', 0.55), ('make',
0.51), ('people', 0.43), ('dont', 0.41), ('sad', 0.4), ('anymore', 0
.38), ('know feel', 0.32), ('want', 0.31), ('depressed', 0.31), ('li
ke feel', 0.3), ('thing', 0.29), ('like shit', 0.29), ('shit', 0.29)
, ('hate', 0.27), ('want feel', 0.27), ('good', 0.27), ('bad', 0.26)
, ('life feel', 0.26), ('talk', 0.26), ('think', 0.25), ('felt', 0.2
5), ('feeling like', 0.25), ('better', 0.24), ('feel better', 0.23)]


Topic3 with weights :
[('want', 6.51), ('die', 3.54), ('want die', 2.24), ('kill', 2.1), (
'fucking', 1.89), ('anymore', 1.68), ('dont', 1.35), ('hate', 1.13),
('live', 1.07), ('know', 1.02), ('end', 0.89), ('life', 0.88), ('tir
ed', 0.86), ('pain', 0.74), ('want kill', 0.71), ('wish', 0.7), ('ca
re', 0.69), ('dont want', 0.64), ('hurt', 0.62), ('fuck', 0.6), ('wa
nt live', 0.59), ('wanna', 0.56), ('alive', 0.52), ('suicide', 0.52)
, ('want end', 0.52), ('shit', 0.51), ('stop', 0.49), ('death', 0.46
), ('die want', 0.43), ('scared', 0.42)]



/Users/Jay/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launc
her.py:59: SettingWithCopyWarning:
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: https://pandas.pydata.org/pand
as-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-co
py
```

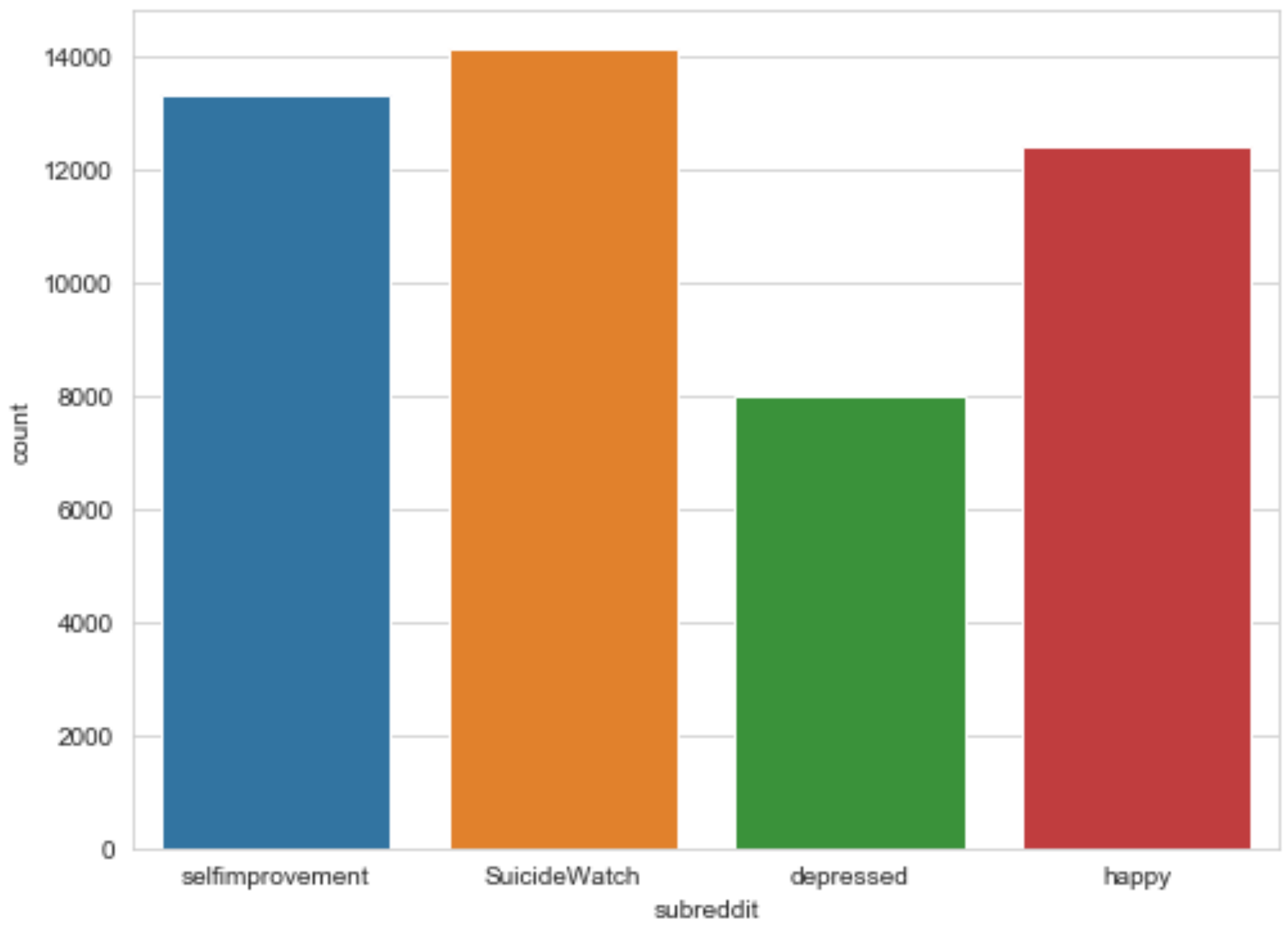


In [66]:

```
# Compare the Bar plot for all 4 subreddit distribution with above Topic modelin
g distribution
plt.figure(figsize=(8,6))
sns.countplot(x='subreddit',data=all_subreddit_df_list)
```

Out[66]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1a429630d0>
```



In [67]:

```
from collections import Counter
print(Counter(all_subreddit_df_list.topic_nmf))
```

```
Counter({0: 34804, 3: 5328, 2: 4577, 1: 3119})
```

In [68]:

```
topic0_gr = all_subreddit_df_list[all_subreddit_df_list['topic_nmf'] ==0]
topic1_gr = all_subreddit_df_list[all_subreddit_df_list['topic_nmf'] ==1]
topic2_gr = all_subreddit_df_list[all_subreddit_df_list['topic_nmf'] ==2]
topic3_gr = all_subreddit_df_list[all_subreddit_df_list['topic_nmf'] ==3]
```

In [69]:

```
print(Counter(all_subreddit_df_list.subreddit))
```

```
Counter({'SuicideWatch': 14124, 'selfimprovement': 13298, 'happy': 1
2411, 'depressed': 7995})
```

In [70]:

```
print(Counter(topic0_gr.subreddit))
```

```
Counter({'selfimprovement': 11471, 'happy': 9255, 'SuicideWatch': 85
39, 'depressed': 5539})
```

In [71]:

```
print(Counter(topic1_gr.subreddit))
```

```
Counter({'happy': 2605, 'depressed': 197, 'SuicideWatch': 176, 'self
improvement': 141})
```

In [72]:

```
print(Counter(topic2_gr.subreddit))
```

```
Counter({'SuicideWatch': 1554, 'depressed': 1397, 'selfimprovement':
1188, 'happy': 438})
```

In [73]:

```
print(Counter(topic3_gr.subreddit))
```

```
Counter({'SuicideWatch': 3855, 'depressed': 862, 'selfimprovement':
498, 'happy': 113})
```

In [74]:

```
#Build a Weight-Term Dictionary DataFrame
```

In [78]:

```
tfidf_vectorizer = TfidfVectorizer(max_df=0.80, min_df=10, max_features=6000,ngr
am_range=(1, 2)
                                   ,stop_words='english', token_pattern = r'\b[^
\d\W]+\b')
tfidf = tfidf_vectorizer.fit_transform(all_subreddit_df_list['title_with_selftex
t_clean'])
nmf = NMF(n_components=4, random_state=1, alpha=.3, l1_ratio=.5, init='nndsvd')
nmf_output = nmf.fit_transform(tfidf)
nmf_feature_names = tfidf_vectorizer.get_feature_names()
nmf_weights = nmf.components_
feature_names = np.array(nmf_feature_names)
sorted_indices = np.array([list(row[::-1]) for row in np.argsort(np.abs(nmf_weig
hts))])
sorted_weights = np.array([list(wt[index]) for wt, index in zip(nmf_weights, sor
ted_indices)])
sorted_terms = np.array([list(feature_names[row]) for row in sorted_indices])
topics = get_topics_terms_weights(nmf_weights, nmf_feature_names)


weight_term_df=pd.DataFrame(nmf_weights).transpose()
weight_term_df['term']=nmf_feature_names
weight_term_df['max']=weight_term_df.max(axis=1)
weight_term_df =weight_term_df.set_axis(['Topic 0', 'Topic 1', 'Topic 2', 'Topic
3', 'term', 'max'], axis=1, inplace=False)
```

In [146]:

```
pd.set_option('display.max_columns', 500)
pd.set_option('display.max_rows', 6000)
weight_term_df.head(10)
```

Out[146]:

	Topic 0	Topic 1	Topic 2	Topic 3	term	max
0	0.001754	0.0	0.0	0.00000	abandon	0.001754
1	0.028738	0.0	0.0	0.00000	abandoned	0.028738
2	0.000000	0.0	0.0	0.00000	abandonment	0.000000
3	0.103248	0.0	0.0	0.00000	ability	0.103248
4	0.571750	0.0	0.0	0.03155	able	0.571750
5	0.000000	0.0	0.0	0.00000	able afford	0.000000
6	0.000000	0.0	0.0	0.00000	able help	0.000000
7	0.013640	0.0	0.0	0.00000	able make	0.013640
8	0.012170	0.0	0.0	0.00000	able talk	0.012170
9	0.000852	0.0	0.0	0.00000	able work	0.000852

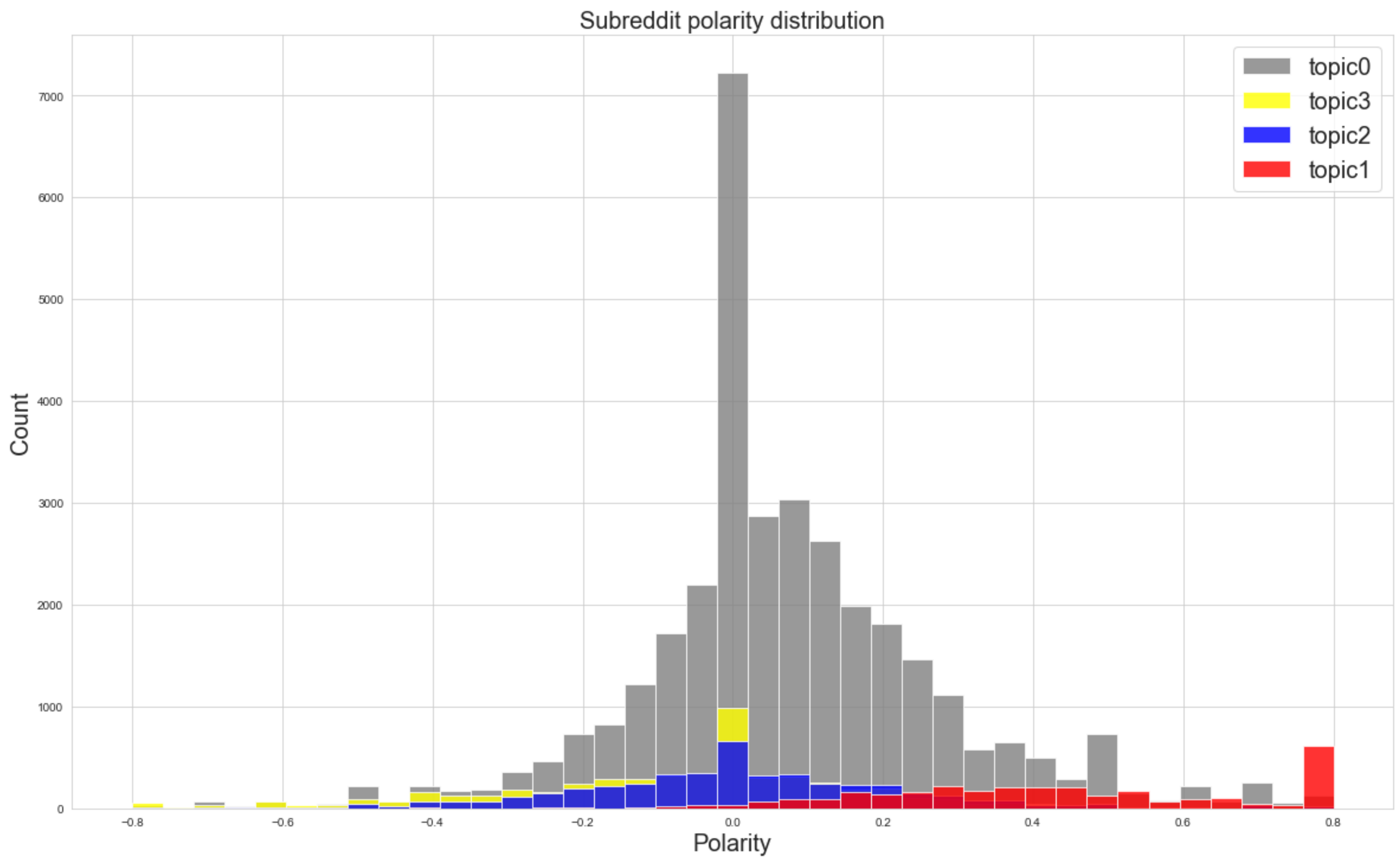
In [80]:

```
print_topics_udf(topics, total_topics=4, num_terms=30, display_weights=True)
```

```
Topic0 with weights :
[('life', 2.68), ('time', 2.48), ('year', 2.34), ('friend', 2.2), ('
know', 2.09), ('people', 2.02), ('thing', 2.0), ('day', 1.92), ('rea
lly', 1.83), ('think', 1.51), ('like', 1.51), ('help', 1.48), ('goin
g', 1.38), ('work', 1.37), ('make', 1.33), ('got', 1.3), ('good', 1.
29), ('school', 1.26), ('love', 1.24), ('job', 1.22), ('need', 1.2),
('thought', 1.17), ('way', 1.16), ('better', 1.09), ('self', 1.05),
('month', 1.04), ('say', 1.0), ('lot', 0.98), ('family', 0.95), ('pe
rson', 0.94)]


Topic1 with weights :
[('happy', 8.94), ('make happy', 1.74), ('make', 1.15), ('today', 0.
32), ('finally', 0.3), ('feel happy', 0.27), ('year', 0.25), ('day',
0.24), ('love', 0.23), ('birthday', 0.19), ('happy life', 0.18), ('d
og', 0.18), ('really happy', 0.17), ('happy happy', 0.16), ('want ha
ppy', 0.14), ('smile', 0.14), ('family', 0.13), ('happiness', 0.13),
('happy birthday', 0.12), ('christmas', 0.1), ('picture', 0.1), ('li
ttle', 0.1), ('video', 0.1), ('place', 0.09), ('happy new', 0.09), (
'new', 0.09), ('happy today', 0.09), ('got', 0.09), ('baby', 0.09),
('girl', 0.09)]


Topic2 with weights :
[('feel', 7.26), ('like', 5.57), ('feel like', 4.96), ('feeling', 0.
83), ('know', 0.78), ('make feel', 0.65), ('really', 0.55), ('make',
0.51), ('people', 0.43), ('dont', 0.41), ('sad', 0.4), ('anymore', 0
.38), ('know feel', 0.32), ('want', 0.31), ('depressed', 0.31), ('li
ke feel', 0.3), ('thing', 0.29), ('like shit', 0.29), ('shit', 0.29)
, ('hate', 0.27), ('want feel', 0.27), ('good', 0.27), ('bad', 0.26)
, ('life feel', 0.26), ('talk', 0.26), ('think', 0.25), ('felt', 0.2
5), ('feeling like', 0.25), ('better', 0.24), ('feel better', 0.23)]


Topic3 with weights :
[('want', 6.51), ('die', 3.54), ('want die', 2.24), ('kill', 2.1), (
'fucking', 1.89), ('anymore', 1.68), ('dont', 1.35), ('hate', 1.13),
('live', 1.07), ('know', 1.02), ('end', 0.89), ('life', 0.88), ('tir
ed', 0.86), ('pain', 0.74), ('want kill', 0.71), ('wish', 0.7), ('ca
re', 0.69), ('dont want', 0.64), ('hurt', 0.62), ('fuck', 0.6), ('wa
nt live', 0.59), ('wanna', 0.56), ('alive', 0.52), ('suicide', 0.52)
, ('want end', 0.52), ('shit', 0.51), ('stop', 0.49), ('death', 0.46
), ('die want', 0.43), ('scared', 0.42)]
```

In [81]:

```
from matplotlib import pyplot
plt.figure(figsize=(20,12))
bins = np.linspace(-.8, .8, 40)

pyplot.hist(topic0_gr['polarity'], bins, alpha=0.8, label='topic0',color='grey')
pyplot.hist(topic3_gr['polarity'], bins, alpha=0.8, label='topic3',color='yellow
')
pyplot.hist(topic2_gr['polarity'], bins, alpha=0.8, label='topic2',color='blue')
pyplot.hist(topic1_gr['polarity'], bins, alpha=0.8, label='topic1',color='red')

plt.xlabel('Polarity',fontsize =20)
plt.ylabel('Count',fontsize =20)
pyplot.legend(loc='upper right',fontsize=20)
plt.title('Subreddit polarity distribution',fontsize =20)

pyplot.show()
```



In [82]:

```
### Give term-weight example of each topic cluster's highest weighted words
```

In [83]:

```
##Topic 0
```

In [84]:

```
weight_term_df[weight_term_df['term']=='life']
```

Out[84]:

	Topic 0	Topic 1	Topic 2	Topic 3	term	max
2802	2.680113	0.059391	0.047689	0.881764	life	2.680113

In [85]:

```
##Topic 1
```

In [86]:

```
weight_term_df[weight_term_df['term']=='happy']
```

Out[86]:

	Topic 0	Topic 1	Topic 2	Topic 3	term	max
2146	0.21013	8.944098	0.0	0.0	happy	8.944098

In [87]:

```
##Topic 2
```

In [88]:

```
weight_term_df[weight_term_df['term']=='feel']
```

Out[88]:

	Topic 0	Topic 1	Topic 2	Topic 3	term	max
1579	0.732116	0.044509	7.262632	0.125261	feel	7.262632

In [89]:

```
##Topic 3
```

```
In [90]:
```

```
weight_term_df[weight_term_df['term']=='die']
```

```
Out[90]:
```

	Topic 0	Topic 1	Topic 2	Topic 3	term	max
1145	0.0	0.0	0.0	3.53933	die	3.53933

```
In [ ]:
```

```
## Some exceptional examples : can be one of the most important weight term in b
oth Topic 0 and Topic 2
```

```
In [139]:
```

```
weight_term_df[weight_term_df['term']=='like']
```

```
Out[139]:
```

	Topic 0	Topic 1	Topic 2	Topic 3	term	max
2890	1.510057	0.0	5.573123	0.059722	like	5.573123

```
In [ ]:
```

```

```

Final check-up for Topic 3 (Latent Suicidal Ideation & Life TopicGroup) documents examples

In [118]:

```
all_subreddit_df_list[all_subreddit_df_list['topic_nmf']==3].tail(5)
```

Out[118]:

	author	over_18	title	selftext	num_comments	score	
10174	myLuciferislonelyx	False	me again	I’m so fucking unwell and my life is completel...	2	1	https://www.re
11794	anon-lizard	False	Struggling with chronic, intrusive, and obsess...	I have been seeking treatment for my depressio...	1	1	https://www.re
45726	lss3745	False	Divorce after 8 years	My will be ex wife's words keep ringing in my ...	0	1	https://www.re
31796	supahardpimp	False	help	What do you do when your mental health has tak...	0	2	https://www.re
32880	[deleted]	False	Can someone help me kill myself	[deleted]	2	1	https://www.re

In [119]:

```
all_subreddit_df_list[all_subreddit_df_list['topic_nmf']==3].title.tail(5).tolis
t()
```

Out[119]:

```
['me again',
 'Struggling with chronic, intrusive, and obsessive suicidal ideatio
ns',
 'Divorce after 8 years',
 'help',
 'Can someone help me kill myself']
```

In [121]:

```
all_subreddit_df_list[all_subreddit_df_list['topic_nmf']==3].selftext.tail(5).to
list()
```

```
Out[121]:

['I’m so fucking unwell and my life is completely falling apart arou
nd me, and doing anything is a chore, my body hurts, I know fine wel
l I’m fighting with myself, in my head everyday when it’s calling me
and shaming me all day long, it’s me, I do it to myself but it won’t
stop, and every time it speaks it hurts so bad, I’m a lost cause I h
onestly fucking hate myself I’m ready to fucking die honest to god I
wish someone would just put a fucking gun to my head because I’m too
fucking pathetic to do it myself. \n\nYes I have told this to my car
e manager and my mother and my friends. People care, which makes thi
s all harder my mother would be devastated, but not a single one of
them understand how much pain I am in, everyone’s telling me to put
all this work in, I’ve been fighting with myself for 8 years and now
I am fucking DONE',
 'I have been seeking treatment for my depression and suicidal ideat
ions and have been diagnosed with treatment resistant depression. Pa
rt of me knows I shouldn’t want to die and that I should want to liv
e. The other part of me wants to end my suffering. I don’t want anyo
ne to question if they did enough. Everyone is doing everything they
can. It’s me who is fucked up. My therapist is trying his best but I
can tell my thoughts are frustrating him. \n\nShould I just do it? I
t seems easier to give up. The only point in life is living and I’m
barely doing that. \n\nI know how I would do it. I want to write my
suicide letter. \n\nThose suicide hotlines are bullshit so please do
n’t suggest I try those. Last time I did, she told me to try essenti
al oils lol',
 'My will be ex wife\'s words keep ringing in my head. She told me a
ll this a few weeks back and I can\'t get over it.\n\n"I don\'t love
you anymore like you love me, and I don\'t want to be with you"\n\n"
No, I never want to hear from you again. When this is over I hope I
never even think of you again."\n\n"Counseling for us is a waste of
time, I hate you and that won\'t change."\n\nI just simply don\'t kn
ow how I can go on knowing that someone that I care for so deeply ca
n hold such contempt and hatred for me.',
 'What do you do when your mental health has taken over your life? I
know I shouldn’t kill myself but I have no other options I can’t fun
ction or maintain any relationships I can barely keep my job but I j
ust want to stop showing up and slowly starve and die idk. I find th
ings I want to do but I know nothing will make me feel anything so I
don’t try. Conversations with my boyfriend have become so dry I wond
er if he’s as bored of me as I am. I don’t even know what to do how
can I live with this depression it hurts constantly I can’t control
my mood swings and I depend on meds for what? They aren’t helping an
ything clearly. I just want someone to take care of me so I can heal
but that’s just not realistic.',
 '[deleted]']
```

In [120]:

```
all_subreddit_df_list[all_subreddit_df_list['topic_nmf']==3].title_with_selftext
_clean.tail(5).tolist()
```

Out[120]:

```
['fucking unwell life completely falling apart around  anything chor
e  body hurt  know fine well fighting  head everyday calling shaming
day long   stop  every time speaks hurt bad  lost cause honestly fuc
king hate ready fucking die honest god wish someone would put fuckin
g gun head fucking pathetic    yes told care manager mother friend 
people care  make harder mother would devastated  single one underst
and much pain  everyone telling put work  fighting year fucking done
',
 'struggling chronic  intrusive  obsessive suicidal ideation seeking
treatment depression suicidal ideation diagnosed treatment resistant
depression  part know want die want live  part want end suffering  w
ant anyone question enough  everyone everything  fucked  therapist t
rying best tell thought frustrating     seems easier give  point lif
e living barely    know would  want write suicide letter    suicide 
hotlines bullshit please suggest try  last time  told try essential 
oil lol',
 'divorce year ex wife word keep ringing head  told week back get 
love anymore like love  want     never want hear  hope never even th
ink     counseling waste time  hate change    simply know go knowing
someone care deeply hold contempt hatred ',
 'help mental health taken life  know kill option function maintain 
relationship barely keep job want stop showing slowly starve die idk
find thing want know nothing make feel anything try  conversation bo
yfriend become dry wonder bored  even know live depression hurt cons
tantly control mood swing depend med  helping anything clearly  want
someone take care heal realistic ',
 'someone help kill ']
```

In [ ]:

```

```

In [ ]:

```

```

In [91]:

```
## so basically using this coefficient of each term and  document scores
## we can decompose each document into a weighted sum of topics
```

DataFrame after Topic Modeling -> This dataframe will be used for BERT: classification modeling

In [135]:

```
all_subreddit_df_list.tail(1)
```

Out[135]:

	author	over_18	title	selftext	num_comments	score	
43513	qourkening	False	Borrowed time	It never got easier for me, all the people tha...	0	1	https://www.reddit.com/r/

In [137]:

```
all_subreddit_df_list.title_with_selftext.tail(1).tolist()
```

Out[137]:

```
['Borrowed time It never got easier for me, all the people that have
tried to help me make me feel worse, I\'ve held on far longer than I
ever expected and it went back to people hating me. Couple of full c
ircles in my life\n\nI cant even talk to the "professionals" anymore
, the anxiety is teamed up with the depression again. I am delusiona
l to think posting on reddit would help me, when I cant even use my
phone anymore. \n\nNo one ever cares about us on the level we need,
believing all those lies created nothing but more trauma and wasted
time. I know it was all my fault, and I am fucking sorry']
```

In [ ]:

```

```