In [1]:
```python
# Importing Neccessary Libraries
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings('ignore')
```

In [2]:
```python
import re
import nltk
import string
import nlp_utils
import contractions
from nltk.corpus import stopwords
from nltk.stem import WordNetLemmatizer
from nltk.tokenize import word_tokenize,sent_tokenize
from nltk.stem import PorterStemmer, LancasterStemmer, SnowballStemmer
```

In [3]:
```python
df=pd.read_csv('Toxic.csv')
# Reading train dataset.
```

In [4]:
```python
df
# Loading dataset.
```

Out[4]:

	id	comment_text	toxic	severe_toxic	obscene	threat	insult	identity_hate
0	0000997932d777bf	Explanation\nWhy the edits made under my usern...	0	0	0	0	0	0
1	000103f0d9cfb60f	D'aww! He matches this background colour I'm s...	0	0	0	0	0	0
2	000113f07ec002fd	Hey man, I'm really not trying to edit war. It...	0	0	0	0	0	0
3	0001b41b1c6bb37e	"\nMore\nI can't make any real suggestions on ...	0	0	0	0	0	0
4	0001d958c54c6e35	You, sir, are my hero. Any chance you remember...	0	0	0	0	0	0
...	...	...	...	...	...	...	...	...
159566	ffe987279560d7ff	":::::And for the second time of asking, when ...	0	0	0	0	0	0
159567	ffea4adeee384e90	You should be ashamed of yourself \n\nThat is ...	0	0	0	0	0	0
159568	ffee36eab5c267c9	Spitzer \n\nUmm, theres no actual article for ...	0	0	0	0	0	0
159569	fff125370e4aaaf3	And it looks like it was actually you who put ...	0	0	0	0	0	0
159570	fff46fc426af1f9a	"\nAnd ... I really don't think you understand...	0	0	0	0	0	0

159571 rows × 8 columns

In [5]:
```python
df.info()
# Information about the dataset
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 159571 entries, 0 to 159570
Data columns (total 8 columns):
 #   Column         Non-Null Count   Dtype
---  ------         --------------   -----
 0   id             159571 non-null  object
 1   comment_text   159571 non-null  object
 2   toxic          159571 non-null  int64
 3   severe_toxic   159571 non-null  int64
 4   obscene        159571 non-null  int64
 5   threat         159571 non-null  int64
 6   insult         159571 non-null  int64
 7   identity_hate  159571 non-null  int64
dtypes: int64(6), object(2)
memory usage: 9.7+ MB
```

In [6]:
```python
df.isnull().sum()
# There are no null values.
```

Out[6]:
```
id               0
comment_text     0
toxic            0
severe_toxic     0
obscene          0
threat           0
insult           0
identity_hate    0
dtype: int64
```

In [7]:
```python
df['toxic'].value_counts()
# Counts of toxic and non toxic sentences.
```

Out[7]:
```
0    144277
1     15294
Name: toxic, dtype: int64
```

In [8]:
```python
df['severe_toxic'].value_counts()
# Counts of severe_toxic and non severe_toxic sentences.
```

Out[8]:
```
0    157976
1      1595
Name: severe_toxic, dtype: int64
```

In [9]:
```python
df['obscene'].value_counts()
# Counts of obscene and non obscene sentences.
```

Out[9]:
```
0    151122
1      8449
Name: obscene, dtype: int64
```

In [10]:
```python
df['threat'].value_counts()
# Counts of threat and non threatening sentences.
```

Out[10]:
```
0    159093
1       478
Name: threat, dtype: int64
```

In [11]:
```python
df['insult'].value_counts()
# Counts of insult and non insulting sentences.
```

Out[11]:
```
0    151694
1      7877
Name: insult, dtype: int64
```

In [12]:
```python
df['identity_hate'].value_counts()
# Counts of toxic and non identity_hate sentences.
```

Out[12]:
```
0    158166
1      1405
Name: identity_hate, dtype: int64
```

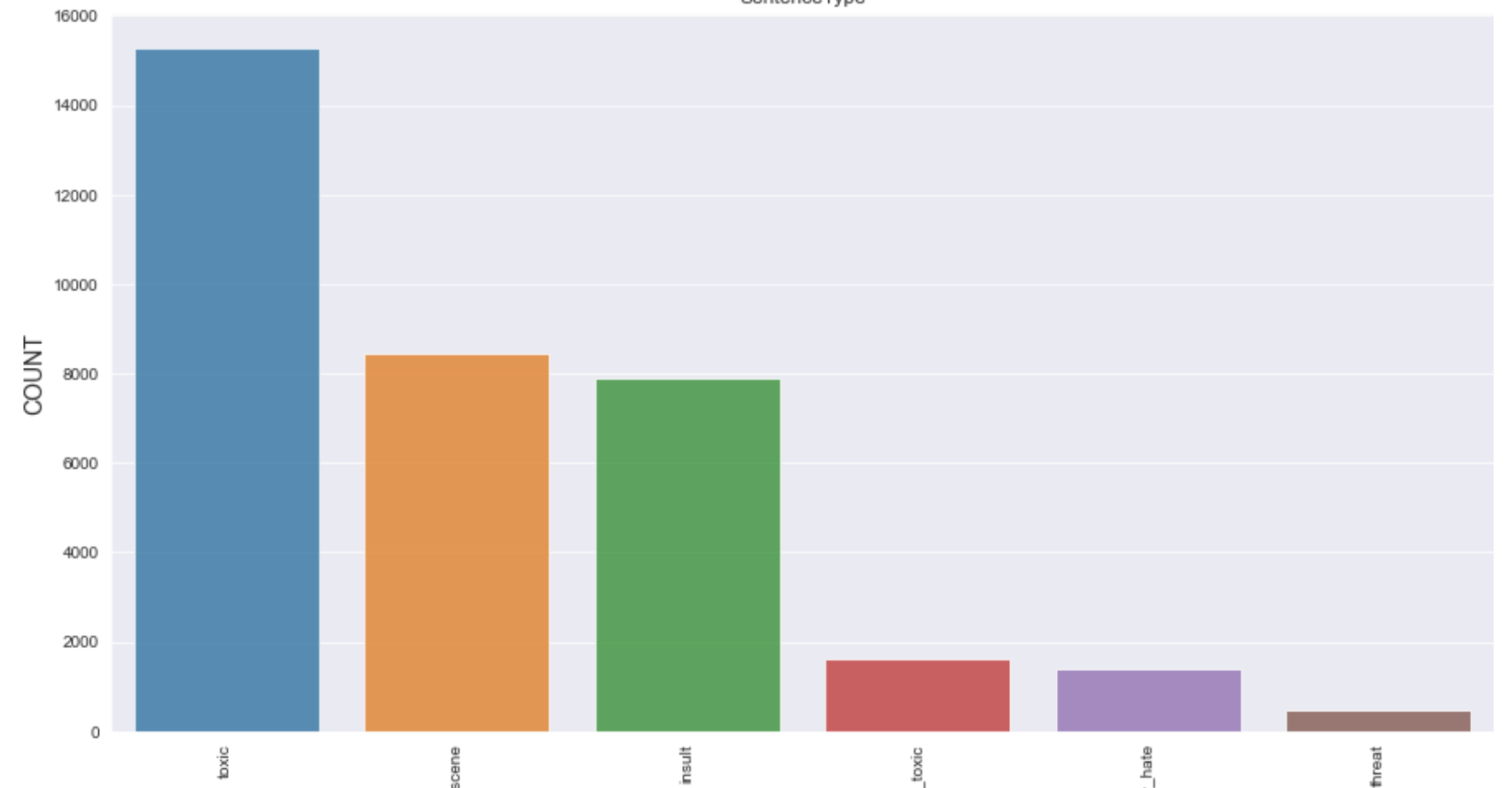
Data Visualization

In [13]:
```python
sentencetype_graph=df.iloc[:,2:].sum()
# Using only numeric columns.
```

In [14]:
```python
sentencetype_graph
```

Out[14]:
```
toxic            15294
severe_toxic      1595
obscene           8449
threat             478
insult            7877
identity_hate     1405
dtype: int64
```

In [15]:
```python
sns.set_style("darkgrid")
ls=sentencetype_graph.sort_values(ascending=False)
plt.figure(figsize=(15,8))
temp =sns.barplot(ls.index, ls.values, alpha=0.8)
plt.title('SentenceType')
plt.ylabel('COUNT', fontsize=14)
plt.xlabel('All Sentence Types', fontsize=15)
temp.set_xticklabels(rotation=90,labels=ls.index,fontsize=10)
plt.show()
```



In [16]:
```python
# There are a many toxic sentences followed by obscene sentences and very few threatening sentences as seen abo
```

Text Pre-processing

In [17]:
```python
# df['comment_text'][10]
```

In [18]:
```python
import re
import string
```

In [19]:
```python
alphanumeric = lambda x: re.sub('\w*\d\w*', ' ', x)
punc_lower = lambda x: re.sub('[%s]' % re.escape(string.punctuation), ' ', x.lower())
remove_n = lambda x: re.sub("\n", " ", x)
remove_non_ascii = lambda x: re.sub(r'[^\x00-\x7f]',r' ', x)
df['comment_text'] = df['comment_text'].map(alphanumeric).map(punc_lower).map(remove_n).map(remove_non_ascii)
# Removing special characters
```

In [20]:
```python
df['comment_text'][10]
```

Out[20]:
```
'  fair use rationale for image wonju jpg  thanks for uploading image wonju jpg  i notice the image page specif
ies that the image is being used under fair use but there is no explanation or rationale as to why its use in w
ikipedia articles constitutes fair use  in addition to the boilerplate fair use template  you must also write o
ut on the image description page a specific explanation or rationale for why using this image in each article i
s consistent with fair use   please go to the image description page and edit it to include a fair use rational
e  if you have uploaded other fair use media  consider checking that you have specified the fair use rationale
on those pages too  you can find a list of  image  pages you have edited by clicking on the   my contributions
  link  it is located at the very top of any wikipedia page when you are logged in   and then selecting   image
  from the dropdown box  note that any fair use images uploaded after   may    and lacking such an explanatio
n will be deleted one week after they have been uploaded  as described on criteria for speedy deletion  if you
have any questions please ask them at the media copyright questions page  thank you   talk   contribs      unsp
ecified source for image wonju jpg  thanks for uploading image wonju jpg  i noticed that the file s description
page currently doesn t specify who created the content  so the copyright status is unclear  if you did not crea
te this file yourself  then you will need to specify the owner of the copyright  if you obtained it from a webs
ite  then a link to the website from which it was taken  together with a restatement of that website s terms of
use of its content  is usually sufficient information  however  if the copyright holder is different from the w
ebsite s publisher  then their copyright should also be acknowledged   as well as adding the source  please add
a proper copyright licensing tag if the file doesn t have one already  if you created took the picture  audio
or video then the  tag can be used to release it under the gfdl  if you believe the media meets the criteria at
wikipedia fair use  use a tag such as  or one of the other tags listed at wikipedia image copyright tags fair u
se  see wikipedia image copyright tags for the full list of copyright tags that you can use  if you have uploa
ded other files  consider checking that you have specified their source and tagged them  too  you can find a li
st of files you have uploaded by following   this link   unsourced and untagged images may be deleted one week
after they have been tagged  as described on criteria for speedy deletion  if the image is copyrighted under a
non free license  per wikipedia fair use  then the image will be deleted  hours after   if you have any questi
ons please ask them at the media copyright questions page  thank you   talk   contribs      '
```

In [21]:
```python
Insulting_comment_df=df.loc[:,['id','comment_text','insult']]
# Creating insult dataframe
```

In [22]:
```python
IdentityHate_comment_df=df.loc[:,['id','comment_text','identity_hate']]
# Creating identityhate dataframe
```

In [23]:
```python
Obscene_comment_df=df.loc[:,['id','comment_text','obscene']]
# Creating obscene comment dataframe
```

In [24]:
```python
Threatening_comment_df=df.loc[:,['id','comment_text','threat']]
# Creating threatening dataframe
```

In [25]:
```python
Severetoxic_comment_df=df.loc[:,['id','comment_text','severe_toxic']]
# Creating severtoxic dataframe
```

In [26]:
```python
Toxic_comment_df=df.loc[:,['id','comment_text','toxic']]
# Creating toxic dataframe
```

In [27]:
```python
# Subset datasets.
```

In [28]:
```python
Severetoxic_comment_df
```

Out[28]:

	id	comment_text	severe_toxic
0	0000997932d777bf	explanation why the edits made under my userna...	0
1	000103f0d9cfb60f	d aww he matches this background colour i m s...	0
2	000113f07ec002fd	hey man i m really not trying to edit war it...	0
3	0001b41b1c6bb37e	more i can t make any real suggestions on im...	0
4	0001d958c54c6e35	you sir are my hero any chance you remember...	0
...	...	...	...
159566	ffe987279560d7ff	and for the second time of asking when ...	0
159567	ffea4adeee384e90	you should be ashamed of yourself that is a ...	0
159568	ffee36eab5c267c9	spitzer umm theres no actual article for pr...	0
159569	fff125370e4aaaf3	and it looks like it was actually you who put ...	0
159570	fff46fc426af1f9a	and i really don t think you understand ...	0

159571 rows × 3 columns

In [29]:
```python
Threatening_comment_df
```

Out[29]:

	id	comment_text	threat
0	0000997932d777bf	explanation why the edits made under my userna...	0
1	000103f0d9cfb60f	d aww he matches this background colour i m s...	0
2	000113f07ec002fd	hey man i m really not trying to edit war it...	0
3	0001b41b1c6bb37e	more i can t make any real suggestions on im...	0
4	0001d958c54c6e35	you sir are my hero any chance you remember...	0
...	...	...	...
159566	ffe987279560d7ff	and for the second time of asking when ...	0
159567	ffea4adeee384e90	you should be ashamed of yourself that is a ...	0
159568	ffee36eab5c267c9	spitzer umm theres no actual article for pr...	0
159569	fff125370e4aaaf3	and it looks like it was actually you who put ...	0
159570	fff46fc426af1f9a	and i really don t think you understand ...	0

159571 rows × 3 columns

In [30]:
```python
Obscene_comment_df
```

Out[30]:

	id	comment_text	obscene
0	0000997932d777bf	explanation why the edits made under my userna...	0
1	000103f0d9cfb60f	d aww he matches this background colour i m s...	0
2	000113f07ec002fd	hey man i m really not trying to edit war it...	0
3	0001b41b1c6bb37e	more i can t make any real suggestions on im...	0
4	0001d958c54c6e35	you sir are my hero any chance you remember...	0
...	...	...	...
159566	ffe987279560d7ff	and for the second time of asking when ...	0
159567	ffea4adeee384e90	you should be ashamed of yourself that is a ...	0
159568	ffee36eab5c267c9	spitzer umm theres no actual article for pr...	0
159569	fff125370e4aaaf3	and it looks like it was actually you who put ...	0
159570	fff46fc426af1f9a	and i really don t think you understand ...	0

159571 rows × 3 columns

In [31]:
```python
Toxic_comment_df
```

Out[31]:

	id	comment_text	toxic
0	0000997932d777bf	explanation why the edits made under my userna...	0
1	000103f0d9cfb60f	d aww he matches this background colour i m s...	0
2	000113f07ec002fd	hey man i m really not trying to edit war it...	0
3	0001b41b1c6bb37e	more i can t make any real suggestions on im...	0
4	0001d958c54c6e35	you sir are my hero any chance you remember...	0
...	...	...	...
159566	ffe987279560d7ff	and for the second time of asking when ...	0
159567	ffea4adeee384e90	you should be ashamed of yourself that is a ...	0
159568	ffee36eab5c267c9	spitzer umm theres no actual article for pr...	0
159569	fff125370e4aaaf3	and it looks like it was actually you who put ...	0
159570	fff46fc426af1f9a	and i really don t think you understand ...	0

159571 rows × 3 columns

In [32]:
```python
IdentityHate_comment_df
```

Out[32]:

	id	comment_text	identity_hate
0	0000997932d777bf	explanation why the edits made under my userna...	0
1	000103f0d9cfb60f	d aww he matches this background colour i m s...	0
2	000113f07ec002fd	hey man i m really not trying to edit war it...	0
3	0001b41b1c6bb37e	more i can t make any real suggestions on im...	0
4	0001d958c54c6e35	you sir are my hero any chance you remember...	0
...	...	...	...
159566	ffe987279560d7ff	and for the second time of asking when ...	0
159567	ffea4adeee384e90	you should be ashamed of yourself that is a ...	0
159568	ffee36eab5c267c9	spitzer umm theres no actual article for pr...	0
159569	fff125370e4aaaf3	and it looks like it was actually you who put ...	0
159570	fff46fc426af1f9a	and i really don t think you understand ...	0

159571 rows × 3 columns

In [33]:
```python
Insulting_comment_df
```

Out[33]:

	id	comment_text	insult
0	0000997932d777bf	explanation why the edits made under my userna...	0
1	000103f0d9cfb60f	d aww he matches this background colour i m s...	0
2	000113f07ec002fd	hey man i m really not trying to edit war it...	0
3	0001b41b1c6bb37e	more i can t make any real suggestions on im...	0
4	0001d958c54c6e35	you sir are my hero any chance you remember...	0
...	...	...	...
159566	ffe987279560d7ff	and for the second time of asking when ...	0
159567	ffea4adeee384e90	you should be ashamed of yourself that is a ...	0
159568	ffee36eab5c267c9	spitzer umm theres no actual article for pr...	0
159569	fff125370e4aaaf3	and it looks like it was actually you who put ...	0
159570	fff46fc426af1f9a	and i really don t think you understand ...	0

159571 rows × 3 columns

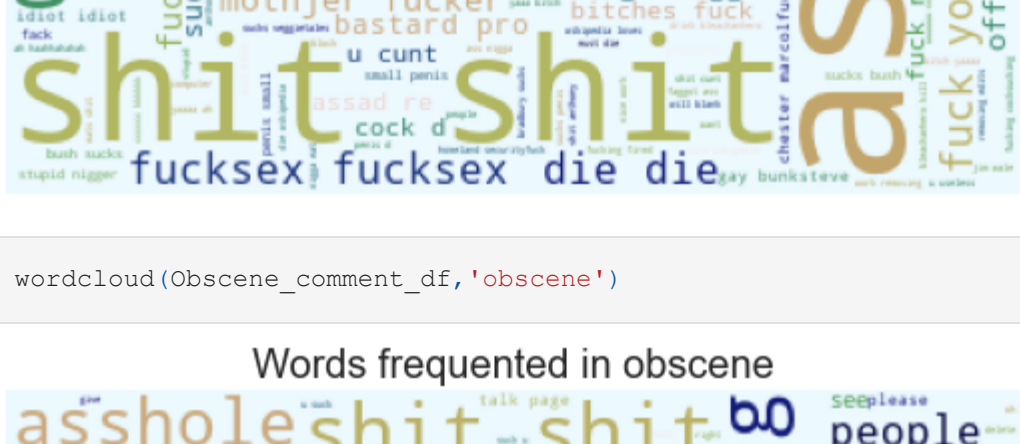
In [ ]:

In [34]:
```python
import wordcloud
from PIL import Image
from wordcloud import WordCloud, STOPWORDS, ImageColorGenerator

from nltk.corpus import stopwords
```

In [35]:
```python
def wordcloud(df, label):

    subset=df[df[label]==1]
    text=subset.comment_text.values
    wc= WordCloud(background_color="#ECF9FF",max_words=3000)

    wc.generate(" ".join(text))

    plt.figure(figsize=(20,20))
    plt.subplot(221)
    plt.axis("off")
    plt.title("Words frequented in {}".format(label), fontsize=20)
    plt.imshow(wc.recolor(colormap= 'gist_earth' , random_state=244), alpha=0.98)
# Visualising the subset datasets using wordcloud
```

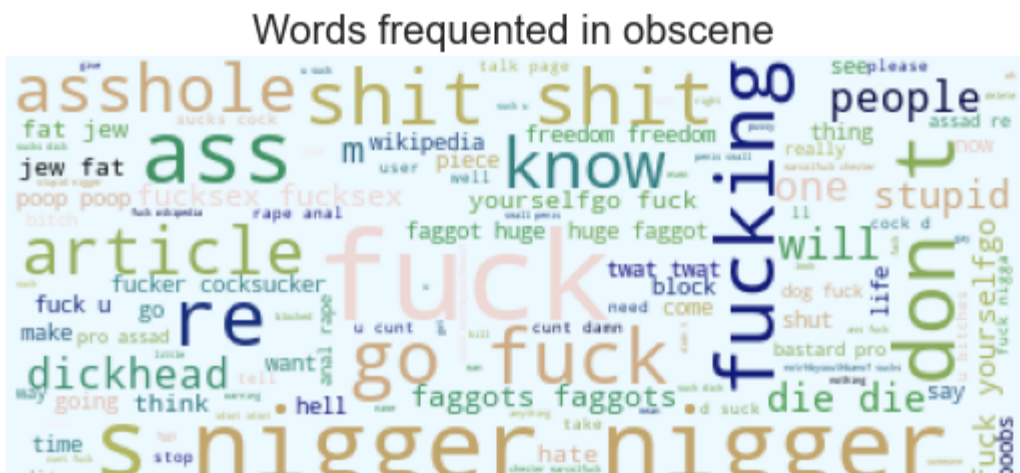
In [36]:
```python
wordcloud(Severetoxic_comment_df,'severe_toxic')
```

Words frequented in severe_toxic



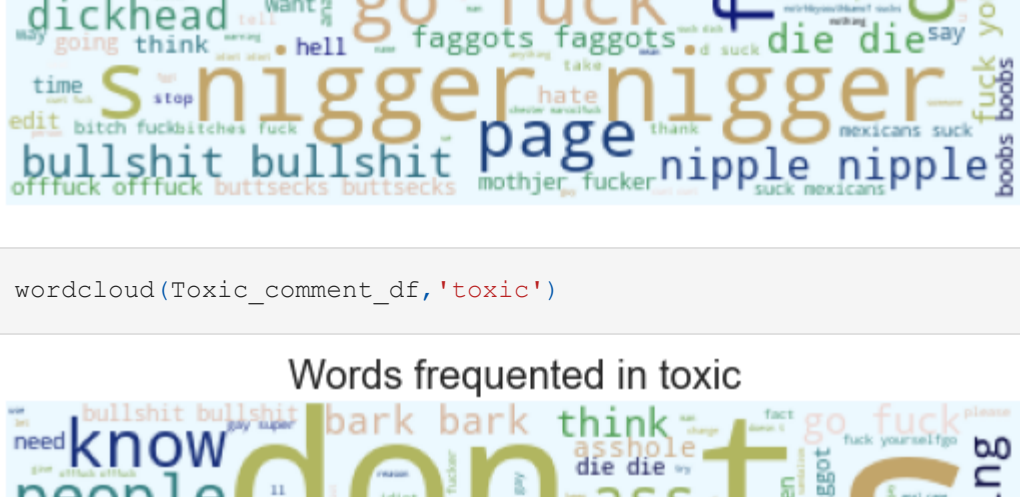
In [37]:
```python
wordcloud(Obscene_comment_df,'obscene')
```

Words frequented in obscene



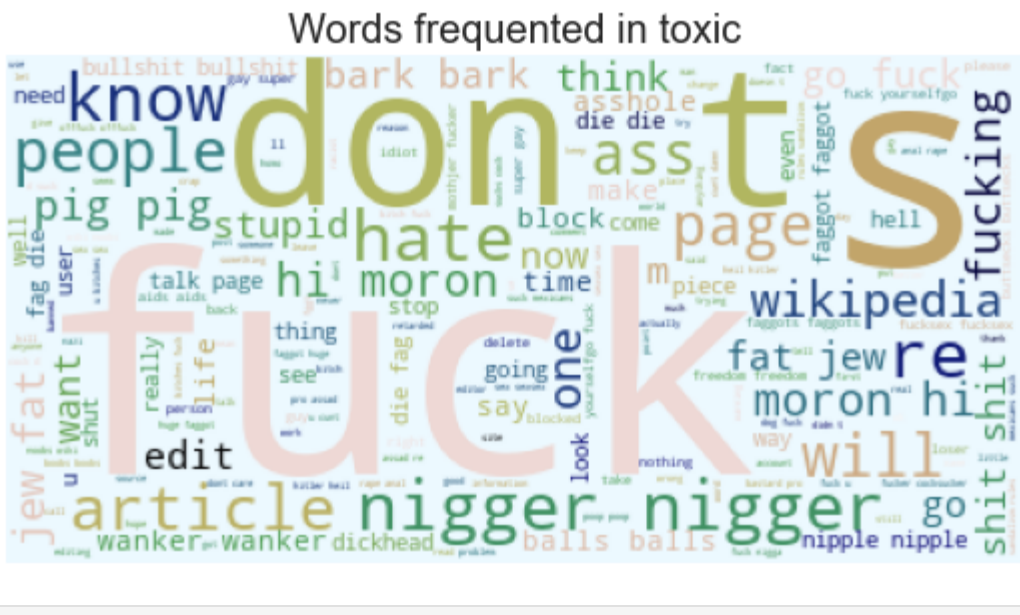
In [38]:
```python
wordcloud(Toxic_comment_df,'toxic')
```

Words frequented in toxic



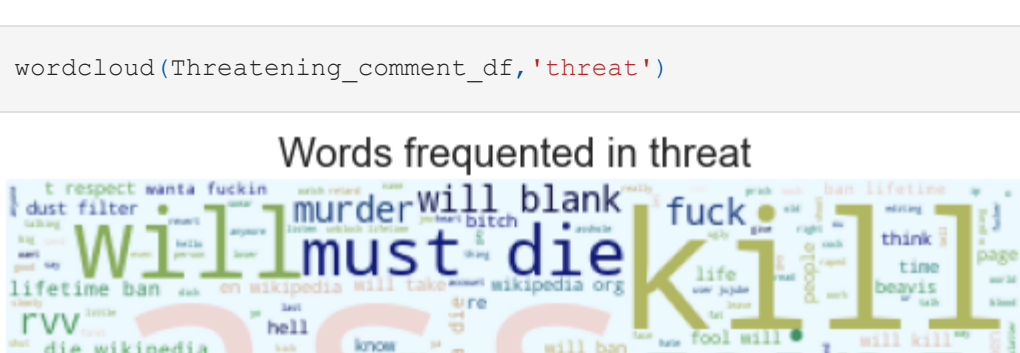
In [39]:
```python
wordcloud(Threatening_comment_df,'threat')
```

Words frequented in threat



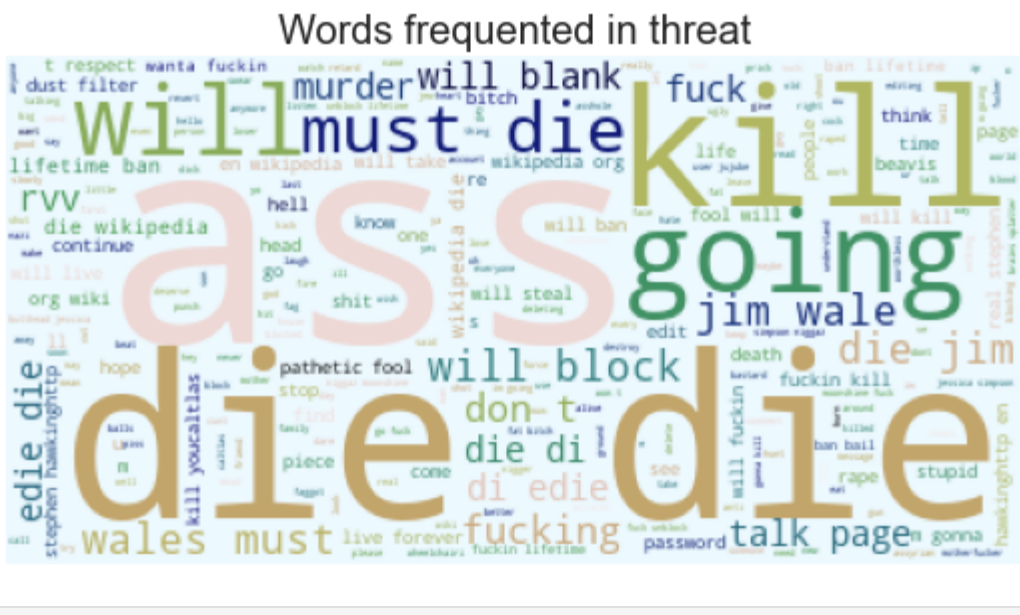
In [40]:
```python
wordcloud(Insulting_comment_df,'insult')
```

Words frequented in insult



In [41]:
```python
wordcloud(IdentityHate_comment_df,'identity_hate')
```

Words frequented in identity_hate



Balancing the target column in the dataset

In [42]:
```python
Toxic_comment_balanced_1 = Toxic_comment_df[Toxic_comment_df['toxic'] == 1].iloc[0:5000,:]
# Selecting only 5000 toxic comments
```

In [43]:
```python
Toxic_comment_balanced_0 = Toxic_comment_df[Toxic_comment_df['toxic'] == 0].iloc[0:5000,:]
# Selecting only 5000 non toxic comments
```

In [44]:
```python
Toxic_comment_balanced_1.shape
# Shape of Toxic_comment_balanced_1
```

Out[44]: (5000, 3)

In [45]:
```python
Toxic_comment_balanced_0.shape
# Shape of Toxic_comment_balanced_0
```

Out[45]: (5000, 3)

In [46]:
```python
Toxic_comment_balanced_1['toxic'].value_counts()
# Value_counts of Toxic_comment_balanced_1
```

Out[46]:
```
1    5000
Name: toxic, dtype: int64
```

In [47]:
```python
Toxic_comment_balanced_0['toxic'].value_counts()
# Value_counts of Toxic_comment_balanced_0
```

Out[47]:
```
0    5000
Name: toxic, dtype: int64
```

In [48]:
```python
Toxic_comment_balanced=pd.concat([Toxic_comment_balanced_1,Toxic_comment_balanced_0])
## concatenating toxic and non toxic comments
```

In [49]:
```python
Toxic_comment_balanced['toxic'].value_counts()
# Balanced column
```

Out[49]:
```
1    5000
0    5000
Name: toxic, dtype: int64
```

Repeating the steps for other subset datasets

In [50]:
```python
Severetoxic_comment_df['severe_toxic'].value_counts()
# value counts of Severetoxic_comment_df
```

Out[50]:
```
0    157976
1      1595
Name: severe_toxic, dtype: int64
```

In [51]:
```python
Severetoxic_comment_df_1 = Severetoxic_comment_df[Severetoxic_comment_df['severe_toxic'] == 1].iloc[0:1595,:]
# selecting 1595 values of Severetoxic_comment_df_1
```

In [52]:
```python
Severetoxic_comment_df_0 = Severetoxic_comment_df[Severetoxic_comment_df['severe_toxic'] == 0].iloc[0:1595,:]
# selecting 1595 values of Severetoxic_comment_df_0
```

In [53]:
```python
Severe_toxic_comment_balanced=pd.concat([Severetoxic_comment_df_1,Severetoxic_comment_df_0])
# Concatenating Severetoxic_comment_df_1 and Severetoxic_comment_df_0
```

In [54]:
```python
Severe_toxic_comment_balanced['severe_toxic'].value_counts()
# Final value counts of the Severetoxic_comment_balanced
```

Out[54]:
```
1    1595
0    1595
Name: severe_toxic, dtype: int64
```

Repeating the same for obscene comment data frame

In [55]:
```python
Obscene_comment_df['obscene'].value_counts()
# Value counts of the obscene_comment_df
```

Out[55]:
```
0    151122
1      8449
Name: obscene, dtype: int64
```

In [56]:
```python
Obscene_comment_df_1 = Obscene_comment_df[Obscene_comment_df['obscene'] == 1].iloc[0:5000,:]
```

In [57]:
```python
Obscene_comment_df_0 = Obscene_comment_df[Obscene_comment_df['obscene'] == 0].iloc[0:5000,:]
```

In [58]:
```python
Obscene_comment_balanced = pd.concat([Obscene_comment_df_1,Obscene_comment_df_0])
```

In [59]:
```python
Obscene_comment_balanced['obscene'].value_counts()
```

Out[59]:
```
1    5000
0    5000
Name: obscene, dtype: int64
```

In [60]:
```python
### Repeating the same for Threatening comment data frame
```

In [61]:
```python
Threatening_comment_df
```

Out[61]:

	id	comment_text	threat
0	0000997932d777bf	explanation why the edits made under my userna...	0
1	000103f0d9cfb60f	d aww he matches this background colour i m s...	0
2	000113f07ec002fd	hey man i m really not trying to edit war it...	0
3	0001b41b1c6bb37e	more i can t make any real suggestions on im...	0
4	0001d958c54c6e35	you sir are my hero any chance you remember...	0
...	...	...	...
159566	ffe987279560d7ff	and for the second time of asking when ...	0
159567	ffea4adeee384e90	you should be ashamed of yourself that is a ...	0
159568	ffee36eab5c267c9	spitzer umm theres no actual article for pr...	0
159569	fff125370e4aaaf3	and it looks like it was actually you who put ...	0
159570	fff46fc426af1f9a	and i really don t think you understand ...	0

159571 rows × 3 columns

In [62]:
```python
Threatening_comment_df['threat'].value_counts()
```

Out[62]:
```
0    159093
1       478
Name: threat, dtype: int64
```

In [63]:
```python
Threatening_comment_df_1 = Threatening_comment_df[Threatening_comment_df['threat'] == 1].iloc[0:478,:]
```

In [64]:
```python
Threatening_comment_df_0 = Threatening_comment_df[Threatening_comment_df['threat'] == 0].iloc[0:478,:]
```

In [65]:
```python
Threatening_comment_balanced = pd.concat([Threatening_comment_df_1,Threatening_comment_df_0])
```

In [66]:
```python
Threatening_comment_balanced['threat'].value_counts()
```

Out[66]:
```
1    478
0    478
Name: threat, dtype: int64
```

In [67]:
```python
Threatening_comment_balanced
```

Out[67]:

	id	comment_text	threat
79	003217c3eb469ba9	hi i am back again last warning stop undoin...	1
176	006b94add72ed61c	i think that your a fagget get a oife and burn...	1
600	0199d6af27b715f3	i m also a sock puppet of this account supri...	1
802	02230885017a50c5	fuck you smith please have me notified when ...	1
1017	02c6e41e4b317ac3	wouldn t be the first time bitch fuck you i l...	1
...	...	...	...
475	01389dc7e054bfe5	hello if you re interested we could re...	0
476	013ad5246f4b953b	f k all rides at worlds of fun i hate all ...	0
477	013bd808a6d3d69b	as to job for you sure thing as soon as i ...	0
478	013c1a43411c5f9a	oh ok i just wanted to see what people though...	0
479	013d17a8b342f501	wrong the capital is podgorica as it has alwa...	0

956 rows × 3 columns

In [68]:
```python
### Repeating the same for Insulting_comment_data frame
```

In [69]:
```python
Insulting_comment_df['insult'].value_counts()
```

Out[69]:
```
0    151694
1      7877
Name: insult, dtype: int64
```

In [70]:
```python
Insulting_comment_df_1 = Insulting_comment_df[Insulting_comment_df['insult'] == 1].iloc[0:5000,:]
```

In [71]:
```python
Insulting_comment_df_0 = Insulting_comment_df[Insulting_comment_df['insult'] == 0].iloc[0:5000,:]
```

In [72]:
```python
Insulting_comment_balanced = pd.concat([Insulting_comment_df_1,Insulting_comment_df_0])
```

In [73]:
```python
Insulting_comment_balanced['insult'].value_counts()
```

Out[73]:
```
1    5000
0    5000
Name: insult, dtype: int64
```

In [74]:
```python
### Repeating the same for IdentityHate_comment_df
```

In [75]:
```python
IdentityHate_comment_df['identity_hate'].value_counts()
```

Out[75]:
```
0    158166
1      1405
Name: identity_hate, dtype: int64
```

In [76]:
```python
IdentityHate_comment_df_1 = IdentityHate_comment_df[IdentityHate_comment_df['identity_hate'] == 1].iloc[0:1405,
```

In [77]:
```python
IdentityHate_comment_df_0 = IdentityHate_comment_df[IdentityHate_comment_df['identity_hate'] == 0].iloc[0:1405,
```

In [78]:
```python
IdentityHate_comment_balanced = pd.concat([IdentityHate_comment_df_1,IdentityHate_comment_df_0])
```

In [79]:
```python
IdentityHate_comment_balanced['identity_hate'].value_counts()
```

Out[79]:
```
1    1405
0    1405
Name: identity_hate, dtype: int64
```

Machine learning

In [80]:
```python
from sklearn import preprocessing
from sklearn.feature_selection import SelectFromModel

from sklearn.model_selection import train_test_split, KFold, cross_val_score
from sklearn.metrics import f1_score, precision_score, recall_score, precision_recall_curve, fbeta_score, confu
from sklearn.metrics import roc_auc_score, roc_curve

from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import MultinomialNB, BernoulliNB
from sklearn.svm import LinearSVC
from sklearn.ensemble import RandomForestClassifier

from sklearn.feature_extraction.text import CountVectorizer, TfidfVectorizer
from nltk import ngrams,bigrams,trigrams
```

In [81]:

```python
def cv_tf_train_test(dataframe,label,vectorizer,ngram):

    # Split the data into X and y data sets
    X = dataframe.comment_text
    y = dataframe[label]

    # Split our data into training and test data
    X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=50)

    # Using vectorizer and removing stopwords
    cv1 = vectorizer(ngram_range=(ngram), stop_words='english')

    # Transforming x-train and x-test
    X_train_cv1 = cv1.fit_transform(X_train)
    X_test_cv1  = cv1.transform(X_test)

    ## Machine learning models

    ## Logistic regression
    lr = LogisticRegression()
    lr.fit(X_train_cv1, y_train)

    ## k-nearest neighbours
    knn = KNeighborsClassifier(n_neighbors=5)
    knn.fit(X_train_cv1, y_train)

    ## Naive Bayes
    bnb = BernoulliNB()
    bnb.fit(X_train_cv1, y_train)

    ## Multinomial naive bayes
    mnb = MultinomialNB()
    mnb.fit(X_train_cv1, y_train)

    ## Support vector machine
    svm_model = LinearSVC()
    svm_model.fit(X_train_cv1, y_train)

    ## Random Forest
    randomforest = RandomForestClassifier(n_estimators=100, random_state=50)
    randomforest.fit(X_train_cv1, y_train)

    f1_score_data = {'F1 Score':[f1_score(lr.predict(X_test_cv1), y_test), f1_score(knn.predict(X_test_cv1), y_
                                 f1_score(bnb.predict(X_test_cv1), y_test), f1_score(mnb.predict(X_test_cv1), y_
                                 f1_score(svm_model.predict(X_test_cv1), y_test), f1_score(randomforest.predict
    ## Saving f1 score results into a dataframe
    df_f1 = pd.DataFrame(f1_score_data, index=['Log Regression','KNN', 'BernoulliNB', 'MultinomialNB', 'SVM', '

    return df_f1
```

In [ ]:

In [ ]:

In [ ]:

In [ ]:

Evaluating model performance using evaluation metrics.

In [82]:

```python
severe_toxic_comment_cv = cv_tf_train_test(Severe_toxic_comment_balanced, 'severe_toxic', TfidfVectorizer, (1,1
severe_toxic_comment_cv.rename(columns={'F1 Score': 'F1 Score(severe_toxic)'}, inplace=True)
severe_toxic_comment_cv
# Multinomial NB has higher F1 score
```

Out[82]:

	F1 Score(severe_toxic)
Log Regression	0.940282
KNN	0.860192
BernoulliNB	0.790738
MultinomialNB	0.932377
SVM	0.937901
Random Forest	0.941176

In [ ]:

In [83]:

```python
obscene_comment_cv = cv_tf_train_test(Obscene_comment_balanced, 'obscene', TfidfVectorizer, (1,1))
obscene_comment_cv.rename(columns={'F1 Score': 'F1 Score(obscene)'}, inplace=True)
obscene_comment_cv
# Random Forest has higher F1 score
```

Out[83]:

	F1 Score(obscene)
Log Regression	0.901183
KNN	0.625341
BernoulliNB	0.766640
MultinomialNB	0.887496
SVM	0.915613
Random Forest	0.884261

In [84]:

```python
threat_comment_cv = cv_tf_train_test(Threatening_comment_balanced, 'threat', TfidfVectorizer, (1,1))
threat_comment_cv.rename(columns={'F1 Score': 'F1 Score(threat)'}, inplace=True)
threat_comment_cv
# Random Forest has higher F1 score
```

Out[84]:

	F1 Score(threat)
Log Regression	0.897338
KNN	0.852459
BernoulliNB	0.745205
MultinomialNB	0.902098
SVM	0.894737
Random Forest	0.923077

In [85]:

```python
insult_comment_cv = cv_tf_train_test(Insulting_comment_balanced, 'insult', TfidfVectorizer, (1,1))
insult_comment_cv.rename(columns={'F1 Score': 'F1 Score(insult)'}, inplace=True)
insult_comment_cv
# SVM has higher F1 score
```

Out[85]:

	F1 Score(insult)
Log Regression	0.901851
KNN	0.320661
BernoulliNB	0.776986
MultinomialNB	0.896299
SVM	0.906218
Random Forest	0.890821

In [86]:

```python
identity_hatecomment_cv = cv_tf_train_test(IdentityHate_comment_balanced, 'identity_hate', TfidfVectorizer, (1,
identity_hatecomment_cv.rename(columns={'F1 Score': 'F1 Score(identity_hate)'}, inplace=True)
identity_hatecomment_cv
# MultinomialNB has higher F1 score
```

Out[86]:

	F1 Score(identity_hate)
Log Regression	0.905707
KNN	0.820046
BernoulliNB	0.776699
MultinomialNB	0.903302
SVM	0.896806
Random Forest	0.888087

In [87]:

```python
X = Toxic_comment_balanced.comment_text
y = Toxic_comment_balanced['toxic']

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=42)

# Initiate a Tfidf vectorizer
tfv = TfidfVectorizer(ngram_range=(1,1), stop_words='english')

X_train_fit = tfv.fit_transform(X_train)
X_test_fit = tfv.transform(X_test)
randomforest = RandomForestClassifier(n_estimators=100, random_state=50)

randomforest.fit(X_train_fit, y_train)
randomforest.predict(X_test_fit)
```

Out[87]:

```
array([0, 1, 1, ..., 1, 1, 1], dtype=int64)
```

In [88]:

```python
## Testing the model to check if the given text is toxic or not.
```

In [89]:

```python
comment1 = ['i killed an insect and ate it']
comment1_vect = tfv.transform(comment1)
randomforest.predict_proba(comment1_vect)[:,1]
## As seen below the above comment is 73 percent toxic
```

Out[89]:

```
array([0.73519444])
```

In [90]:

```python
comment2 = ['Is this sentence a good one']
comment2_vect = tfv.transform(comment2)
randomforest.predict_proba(comment2_vect)[:,1]
## As seen below the above comment is 0.08 percent toxic which says the comment is not toxic
```

Out[90]:

```
array([0.08770635])
```

In [91]:

```python
comment2 = ['truth will prevail']
comment2_vect = tfv.transform(comment2)
randomforest.predict_proba(comment2_vect)[:,1]
## The above comment is 46 percent toxic.
```

Out[91]:

```
array([0.46238997])
```

In [ ]: