Sentiment Analysis with Tweepy

Set up environment

In [ ]:

```
!pip install tweepy==4.9.0
```

In [ ]:

```
!pip install textblob
```

In [ ]:

```
!pip install wordcloud
```

In [2]:

```
import tweepy
import pandas as pd
import re
from nltk.sentiment.vader import SentimentIntensityAnalyzer
from textblob import TextBlob
import nltk
nltk.download('vader_lexicon')

import numpy as np
from PIL import Image
from wordcloud import WordCloud, STOPWORDS
import matplotlib.pyplot as plt
```

```
[nltk_data] Downloading package vader_lexicon to
[nltk_data]     C:\Users\Aniket\AppData\Roaming\nltk_data...
[nltk_data]   Package vader_lexicon is already up-to-date!
```

Twitter Authentication

In [3]:

```
client = tweepy.Client(bearer_token='AAAAAAAAAAAAAAAAAAAAAOVMjwEAAAAAz3YAf8h62laWvirfBC
```

Get recent public tweets on a keyword

In [4]:

```
# Pull tweets from twitter

query = '#apple -is:retweet lang:en'
paginator = tweepy.Paginator(
    client.search_recent_tweets,
    query=query,
    max_results=100,
    limit=10
)
tweet_list = []

#flatten() - return a copy of the array collapsed into one dimensional.
for tweet in paginator.flatten():
    tweet_list.append(tweet)
    print(tweet)
```

```
Somehow I see this being true - Tim Cook Says He's Ready To Pull Twit
ter From App Store Once President Xi Gives The Order https://t.co/Vkn
IoSczyR (https://t.co/VknIoSczyR) via @TheBabylonBee #Apple @tim_cook
@elonmusk #Twitter #AppleVsTwitter #ChinaControlsApple
The #apple Watch Action Button’s sole purpose is to do your bidding h
ttps://t.co/QS2lpwyxNg (https://t.co/QS2lpwyxNg)
4) Instead of #Global pasteboard #developers can create private UIPas
teboards which can only be accessed by certain selected applications.

#Apple #ios #Data #security #DataSecurity #infosecurity #infosec #bug
bounty #community #cyber #CyberSec
November saw the release of patches from the likes of #Apple’s #iOS,
#Google #Chrome, 3Firefox, &amp;amp; #Microsoft #Windows to fix multiple
#security #vulnerabilities. Some of these issues are pretty severe, &
amp; several have already been exploited by attackers. https://t.co/M
qxFmQkJxm (https://t.co/MqxFmQkJxm)
If you use #Apple products you are a fool. Apple is in bed with commu
nist tyrants-Xi and Joe Biden. They are watching everything you say &
amp; do &amp;amp; think. They will be initiating social credit surveillan
```

In [5]:

```
#Creating new dataframe and new features
tweet_list_df = pd.DataFrame(tweet_list)
tweet_list_df = pd.DataFrame(tweet_list_df['text'])
tweet_list_df.head(5)
```

Out[5]:

	text
0	Somehow I see this being true - Tim Cook Says ...
1	The #apple Watch Action Button’s sole purpose ...
2	4) Instead of #Global pasteboard #developers c...
3	November saw the release of patches from the I...
4	If you use #Apple products you are a fool. App...

In [6]:

```
tweet_list_df.tail()
```

Out[6]:

	text
995	Chef's Dish on Why Apple is Good Fall or Holid...
996	App Store Awards celebrate the \n👏best apps an...
997	Elon Musk has accused Apple Inc of threatening...
998	@juanchepeguezo @elonmusk @tim_cook @nayibbuke...
999	GG @Seihuko_, on SoSkills app 🚀\n\nDownload li...

In [7]:

```
tweet_list_df.shape
```

Out[7]:

```
(1000, 1)
```

In [8]:

```
tweet_list_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 1 columns):
 #   Column  Non-Null Count  Dtype 
---  ------  --------------  ----- 
 0   text    1000 non-null   object
dtypes: object(1)
memory usage: 7.9+ KB
```

In [9]:

```
tweet_list_df.dtypes
```

Out[9]:

```
text    object
dtype: object
```

In [10]:

```
np.sum(tweet_list_df.isnull().any(axis=1))
```

Out[10]:

```
0
```

Data preprocessing

In [11]:

```
def preprocess_tweet(sen):
    '''Cleans text data up, leaving only 2 or more char long non-stepwords composed of 
    in lowercase'''

    sentence = sen.lower()

    # Remove RT
    sentence = re.sub('RT @\w+: '," ", sentence)

    # Remove special characters
    sentence = re.sub("(@[A-Za-z0-9]+)|([^0-9A-Za-z \t])|(\w+:\/\/\S+)"," ", sentence)

    # Single character removal
    sentence = re.sub(r"\s+[a-zA-Z]\s+", ' ', sentence)  # When we remove apostrophe fr

    # Remove multiple spaces
    sentence = re.sub(r'\s+', ' ', sentence)  # Next, we remove all the single characte

    return sentence
```

In [12]:

```
cleaned_tweets = []

for tweet in tweet_list_df['text']:
  cleaned_tweet = preprocess_tweet(tweet)
  cleaned_tweets.append(cleaned_tweet)
```

In [13]:

```
tweet_list_df['cleaned'] = pd.DataFrame(cleaned_tweets)
tweet_list_df.head(5)
```

Out[13]:

	text	cleaned
0	Somehow I see this being true - Tim Cook Says ...	somehow see this being true tim cook says he r...
1	The #apple Watch Action Button’s sole purpose ...	the apple watch action button sole purpose is ...
2	4) Instead of #Global pasteboard #developers c...	4 instead of global pasteboard developers can ...
3	November saw the release of patches from the l...	november saw the release of patches from the l...
4	If you use #Apple products you are a fool. App...	if you use apple products you are fool apple i...

In [14]:

```
tweet_list_df.tail(6)
```

Out[14]:

	text	cleaned
994	#ElonMusk has declared war on Apple, and the #...	elonmusk has declared war on apple and the te...
995	Chef's Dish on Why Apple is Good Fall or Holid...	chef dish on why apple is good fall or holiday...
996	App Store Awards celebrate the \n👏best apps an...	app store awards celebrate the best apps and g...
997	Elon Musk has accused Apple Inc of threatening...	elon musk has accused apple inc of threatening...
998	@juanchepeguezo @elonmusk @tim_cook @nayibbuke...	cook apple could die very soon
999	GG @Seihuko_, on SoSkills app 🚀\n\nDownload li...	gg on soskills app download links apple androi...

Removing Stopwords

In [15]:

```
stopwordlist = ['a', 'about', 'above', 'after', 'again', 'ain', 'all', 'am', 'an',
             'and','any','are', 'as', 'at', 'be', 'because', 'been', 'before',
             'being', 'below', 'between','both', 'by', 'can', 'd', 'did', 'do',
             'does', 'doing', 'down', 'during', 'each','few', 'for', 'from',
             'further', 'had', 'has', 'have', 'having', 'he', 'her', 'here',
             'hers', 'herself', 'him', 'himself', 'his', 'how', 'i', 'if', 'in',
             'into','is', 'it', 'its', 'itself', 'just', 'll', 'm', 'ma',
             'me', 'more', 'most','my', 'myself', 'now', 'o', 'of', 'on', 'once',
             'only', 'or', 'other', 'our', 'ours','ourselves', 'out', 'own', 're','s',
             't', 'than', 'that', "thatll", 'the', 'their', 'theirs', 'them',
             'themselves', 'then', 'there', 'these', 'they', 'this', 'those',
             'through', 'to', 'too','under', 'until', 'up', 've', 'very', 'was',
             'we', 'were', 'what', 'when', 'where','which','while', 'who', 'whom',
             'why', 'will', 'with', 'won', 'y', 'you', "youd","youll", "youre",
             "youve", 'your', 'yours', 'yourself', 'yourselves']
```

In [16]:

```
STOPWORDS = set(stopwordlist)
def cleaning_stopwords(text):
    return " ".join([word for word in str(text).split() if word not in STOPWORDS])
tweet_list_df['cleaned'] = tweet_list_df['cleaned'].apply(lambda text: cleaning_stopwor
tweet_list_df['cleaned'].head()
```

Out[16]:

```
0    somehow see true tim cook says ready pull twit...
1       apple watch action button sole purpose bidding
2    4 instead global pasteboard developers create ...
3    november saw release patches likes apple ios g...
4    use apple products fool apple bed communist ty...
Name: cleaned, dtype: object
```

Applying Stemming

In [17]:

```
import nltk
st = nltk.PorterStemmer()
def stemming_on_text(data):
    text = [st.stem(word) for word in data]
    return data
tweet_list_df['cleaned']= tweet_list_df['cleaned'].apply(lambda x: stemming_on_text(x))
tweet_list_df['cleaned'].head()
```

Out[17]:

```
0    somehow see true tim cook says ready pull twit...
1       apple watch action button sole purpose bidding
2    4 instead global pasteboard developers create ...
3    november saw release patches likes apple ios g...
4    use apple products fool apple bed communist ty...
Name: cleaned, dtype: object
```

Generate Sentiment Labels

In [18]:

```
#Calculating Negative, Positive, Neutral and Compound values

tweet_list_df[['polarity', 'subjectivity']] = tweet_list_df['cleaned'].apply(lambda Tex
for index, row in tweet_list_df['cleaned'].iteritems():
    score = SentimentIntensityAnalyzer().polarity_scores(row)
    neg = score['neg']
    neu = score['neu']
    pos = score['pos']
    comp = score['compound']

    if comp <= -0.05:
        tweet_list_df.loc[index, 'sentiment'] = "negative"
    elif comp >= 0.05:
        tweet_list_df.loc[index, 'sentiment'] = "positive"
    else:
        tweet_list_df.loc[index, 'sentiment'] = "neutral"
    tweet_list_df.loc[index, 'neg'] = neg
    tweet_list_df.loc[index, 'neu'] = neu
    tweet_list_df.loc[index, 'pos'] = pos
    tweet_list_df.loc[index, 'compound'] = comp

print(tweet_list_df.head(5))
tweet_list_df.tail()
```

```
                                                text  \
0  Somehow I see this being true - Tim Cook Says ...
1  The #apple Watch Action Button’s sole purpose ...
2  4) Instead of #Global pasteboard #developers c...
3  November saw the release of patches from the l...
4  If you use #Apple products you are a fool. App...

                                             cleaned  polarity  subjectiv
ity  \
0  somehow see true tim cook says ready pull twit...  0.275000      0.575
000
1     apple watch action button sole purpose bidding  0.050000      0.175
000
2  4 instead global pasteboard developers create ...  0.071429      0.315
476
3  november saw release patches likes apple ios g...  0.083333      0.333
333
4  use apple products fool apple bed communist ty...  0.016667      0.033
333

  sentiment    neg    neu    pos  compound
0  positive  0.000  0.782  0.218    0.6486
1   neutral  0.000  1.000  0.000    0.0000
2  positive  0.000  0.742  0.258    0.6808
3  negative  0.292  0.483  0.225   -0.3612
4  negative  0.163  0.752  0.085   -0.3400
```

Out[18]:

	text	cleaned	polarity	subjectivity	sentiment	neg	neu	pos	cc
995	Chef's Dish on Why Apple is Good Fall or Holid...	chef dish apple good fall holiday ingredient p...	0.700000	0.600000	positive	0.000	0.781	0.219	
996	App Store Awards celebrate the \n👏 best apps an...	app store awards celebrate best apps games 202...	0.500000	0.350000	positive	0.000	0.451	0.549	
997	Elon Musk has accused Apple Inc of threatening...	elon musk accused apple inc threatening block ...	0.033333	0.066667	negative	0.286	0.714	0.000	
998	@juanchepeguezo @elonmusk @tim_cook @nayibbuke...	cook apple could die soon	0.000000	0.000000	negative	0.494	0.506	0.000	
999	GG @Seihuko_, on SoSkills app 🚀\n\nDownload li...	gg soskills app download links apple android i...	0.000000	0.000000	positive	0.000	0.833	0.167	

Sentiment Visualisation

In [19]:

```
#Creating new data frames for all sentiments (positive, negative and neutral)

tweet_list_df_negative = tweet_list_df[tweet_list_df["sentiment"]=="negative"]
tweet_list_df_positive = tweet_list_df[tweet_list_df["sentiment"]=="positive"]
tweet_list_df_neutral = tweet_list_df[tweet_list_df["sentiment"]=="neutral"]
```

Donut Charts

In [20]:

```
#Function for count_values_in single columns

def count_values_in_column(data,feature):
    total=data.loc[:,feature].value_counts(dropna=False)
    percentage=round(data.loc[:,feature].value_counts(dropna=False,normalize=True)*100,
    return pd.concat([total,percentage],axis=1,keys=['Total','Percentage'])
```

In [17]:

```
#Count_values for sentiment
count_values_in_column(tweet_list_df,"sentiment")
```

Out[17]:

	Total	Percentage
positive	495	49.5
neutral	285	28.5
negative	220	22.0

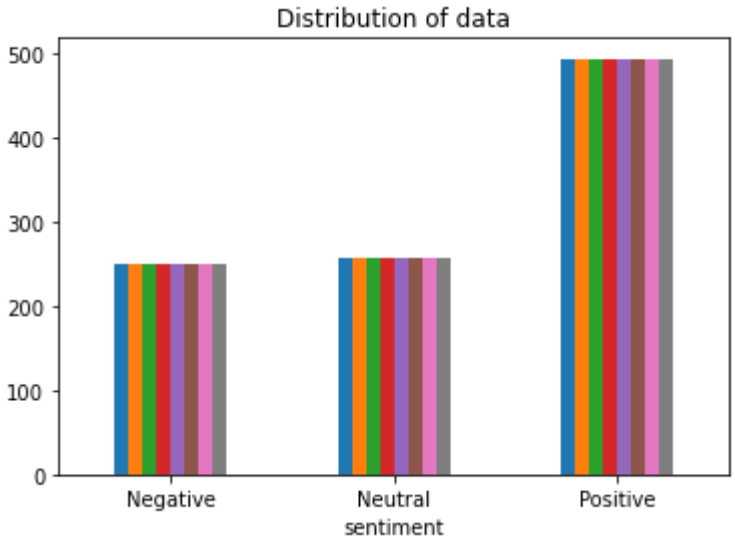
In [18]:

```
# create data for Pie Chart
pichart = count_values_in_column(tweet_list_df,"sentiment")

names= pichart.index
size=pichart["Percentage"]

my_circle=plt.Circle( (0,0), 0.7, color='white')
plt.pie(size, labels=names, colors=['green','blue','red'])
p=plt.gcf()
p.gca().add_artist(my_circle)
plt.show()
```

Distribution of data

In [21]:

```
ax = tweet_list_df.groupby('sentiment').count().plot(kind='bar', title='Distribution of
ax.set_xticklabels(['Negative','Neutral','Positive'], rotation=0)
# Storing data in lists.
text, sentiment = list(tweet_list_df['text']), list(tweet_list_df['sentiment'])
```

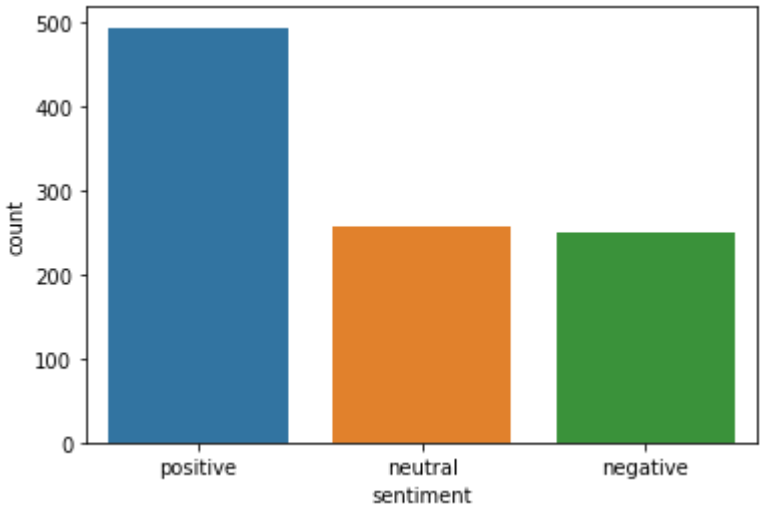


In [22]:

```
import seaborn as sns
sns.countplot(x='sentiment', data=tweet_list_df)
```

Out[22]:

```
<AxesSubplot:xlabel='sentiment', ylabel='count'>
```



Word Clouds

In [23]:

```
#Function to Create Wordcloud

def create_wordcloud(text):
    mask = np.array(Image.open("cloud.png"))
    stopwords = set(STOPWORDS)
    wc = WordCloud(background_color="white",
                   mask = mask,
                   max_words=100,
                   stopwords=stopwords,
                   repeat=True)
    wc.generate(str(text))
    wc.to_file("c1_wordcloud.png")
    print("Word Cloud Saved Successfully")
    path="c1_wordcloud.png"
    display(Image.open(path))
```

In [24]:

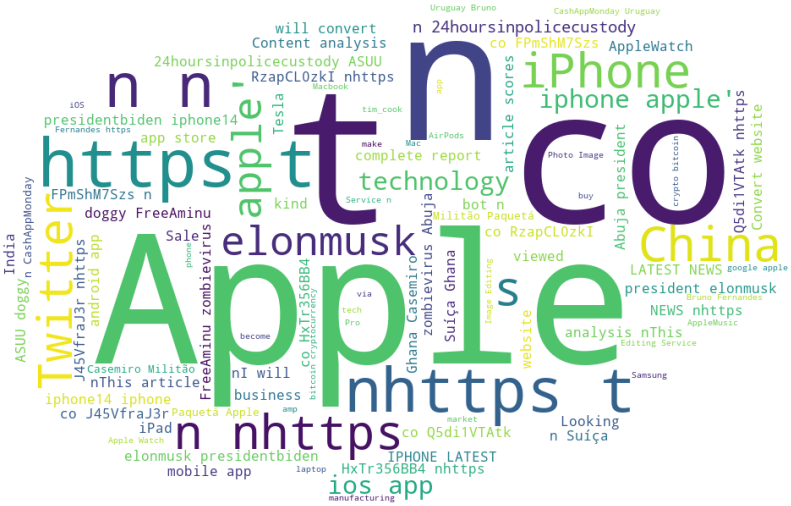
```
# Creating wordcloud for all tweets

create_wordcloud(tweet_list_df_negative["cleaned"].values)
```

```
Word Cloud Saved Successfully
```

In [34]:

```
create_wordcloud(tweet_list_df_neutral["text"].values)
```

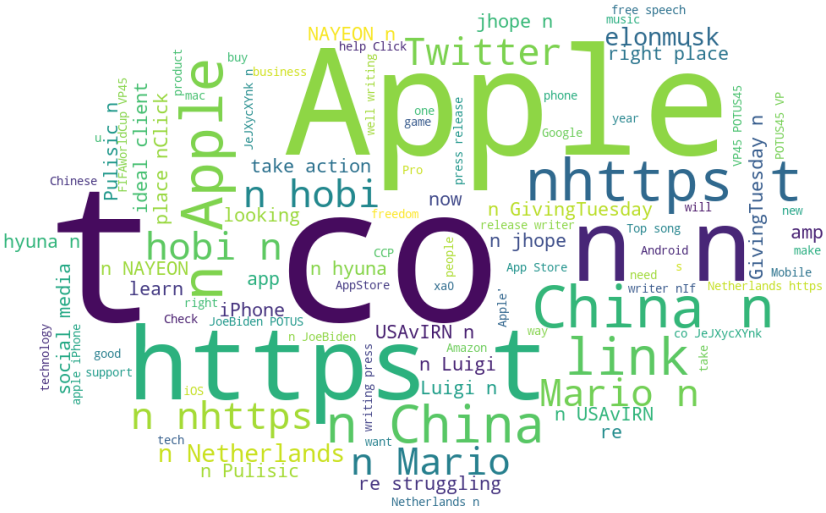
```
Word Cloud Saved Successfully
```



In [33]:

```
create_wordcloud(tweet_list_df_positive["text"].values)
```

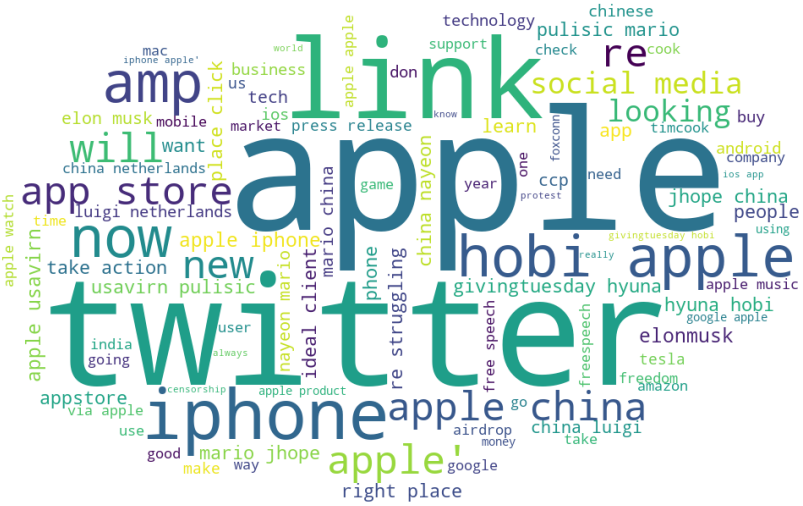
```
Word Cloud Saved Successfully
```



In [32]:

```
create_wordcloud(tweet_list_df["cleaned"].values)
```

```
Word Cloud Saved Successfully
```



Model

In [21]:

```
X=tweet_list_df.cleaned
y=tweet_list_df.sentiment
```

In [22]:

```
# Separating the 95% data for training data and 5% for testing data
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size = 0.05, random_state
```

In [24]:

```
from sklearn.feature_extraction.text import TfidfVectorizer
vectoriser = TfidfVectorizer(ngram_range=(1,2), max_features=500000)
vectoriser.fit(X_train)
print('No. of feature_words: ', len(vectoriser.get_feature_names()))
```

```
No. of feature_words:  15896

C:\Users\muska\anaconda3\lib\site-packages\sklearn\utils\deprecation.py:8
7: FutureWarning: Function get_feature_names is deprecated; get_feature_n
ames is deprecated in 1.0 and will be removed in 1.2. Please use get_feat
ure_names_out instead.
  warnings.warn(msg, category=FutureWarning)
```

In [25]:

```
X_train = vectoriser.transform(X_train)
X_test  = vectoriser.transform(X_test)
```

Model evaluation

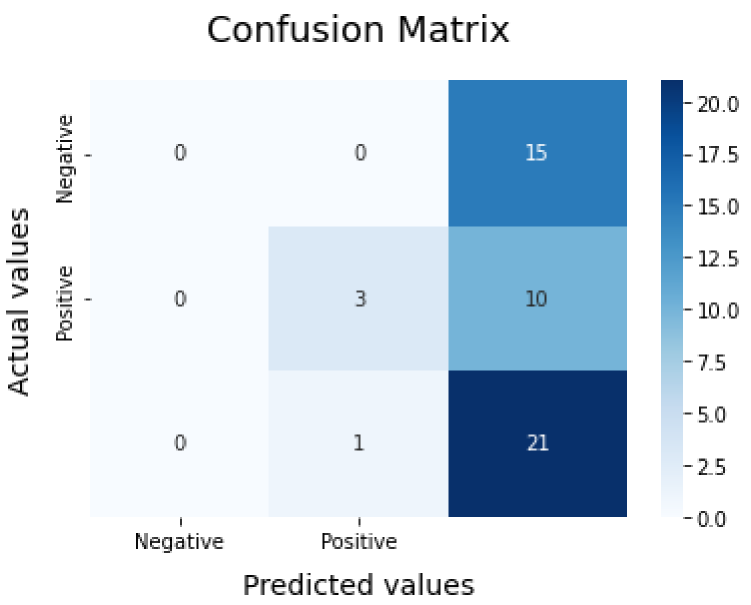
In [42]:

```
def model_Evaluate(model):
    # Predict values for Test dataset
    y_pred = model.predict(X_test)
    # Print the evaluation metrics for the dataset.
    print(classification_report(y_test, y_pred))
    # Compute and plot the Confusion matrix
    cf_matrix = confusion_matrix(y_test, y_pred)
    categories = ['Negative','Positive']
    group_names = ['True Neg','False Pos', 'False Neg','True Pos']
    group_percentages = ['{0:.2%}'.format(value) for value in cf_matrix.flatten() / np.
    labels = [f'{v1}n{v2}' for v1, v2 in zip(group_names,group_percentages)]
    labels = np.asarray(labels).reshape(2,2)
    sns.heatmap(cf_matrix, annot = True, cmap = 'Blues',fmt = '',
    xticklabels = categories, yticklabels = categories)
    plt.xlabel("Predicted values", fontdict = {'size':14}, labelpad = 10)
    plt.ylabel("Actual values" , fontdict = {'size':14}, labelpad = 10)
    plt.title ("Confusion Matrix", fontdict = {'size':18}, pad = 20)
```

In [43]:

```
from sklearn.naive_bayes import BernoulliNB
BNBmodel = BernoulliNB()
BNBmodel.fit(X_train, y_train)
model_Evaluate(BNBmodel)
y_pred1 = BNBmodel.predict(X_test)
```

```
C:\Users\muska\anaconda3\lib\site-packages\sklearn\metrics\_classificatio
n.py:1318: UndefinedMetricWarning: Precision and F-score are ill-defined
and being set to 0.0 in labels with no predicted samples. Use `zero_divis
ion` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\muska\anaconda3\lib\site-packages\sklearn\metrics\_classificatio
n.py:1318: UndefinedMetricWarning: Precision and F-score are ill-defined
and being set to 0.0 in labels with no predicted samples. Use `zero_divis
ion` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
C:\Users\muska\anaconda3\lib\site-packages\sklearn\metrics\_classificatio
n.py:1318: UndefinedMetricWarning: Precision and F-score are ill-defined
and being set to 0.0 in labels with no predicted samples. Use `zero_divis
ion` parameter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))

              precision    recall  f1-score   support

    negative       0.00      0.00      0.00        15
     neutral       0.75      0.23      0.35        13
    positive       0.46      0.95      0.62        22

    accuracy                           0.48        50
   macro avg       0.40      0.40      0.32        50
weighted avg       0.40      0.48      0.36        50
```



Text Insights

In [21]:

```
#Calculating tweet's lenght and word count
tweet_list_df['text_len'] = tweet_list_df['cleaned'].astype(str).apply(len)
tweet_list_df['text_word_count'] = tweet_list_df['cleaned'].apply(lambda x: len(str(x).
```

In [22]:

```
round(pd.DataFrame(tweet_list_df.groupby("sentiment").text_len.mean()),2)
```

Out[22]:

sentiment	text_len
negative	148.63
neutral	120.45
positive	176.64

In [23]:

```
round(pd.DataFrame(tweet_list_df.groupby("sentiment").text_word_count.mean()),2)
```

Out[23]:

sentiment	text_word_count
negative	24.51
neutral	18.11
positive	28.56

Saving Output Tweets File

In [24]:

```
tweet_list_df.to_csv("c2_sentimentanalysis_output.csv", sep=',', encoding='UTF-8')
tweet_list_df.head(5)
```

Out[24]:

	text	cleaned	polarity	subjectivity	sentiment	neg	neu	pos	compou
0	@SpiceJungle1 @ProtestBot @Etsy Your store is ...	your store is attractive can help you boost y...	0.650000	0.750000	positive	0.000	0.743	0.257	0.80
1	Yup. I don’t care so much about Twitter, but w...	yup don care so much about twitter but what ap...	-0.266667	0.422222	negative	0.223	0.679	0.098	-0.87
2	Please see our #iOS, #android, and #windows #a...	please see our ios android and windows apps pl...	0.250000	0.333333	positive	0.000	0.839	0.161	0.55
3	@bsc_daily @Imovofficial @itamcube @Covalent_H...	daily hq husl what do you test it is top 1 be...	0.150000	0.350000	positive	0.000	0.661	0.339	0.89
4	Why is Apple removing \nTwitter from the Apple...	why is apple removing twitter from the apple a...	0.000000	0.000000	neutral	0.000	1.000	0.000	0.00