Import necessary dependencies

In [1]:
```
import pandas
from matplotlib import pyplot as plt
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction.text import CountVectorizer
import numpy
from sklearn.feature_selection import chi2
from PIL import Image
from wordcloud import WordCloud, STOPWORDS, ImageColorGenerator
from collections import Counter
import re
import sqlite3
from nltk.tokenize import word_tokenize
from nltk.corpus import stopwords
import string
```

Read in the data

In [9]:
```
train_data = pandas.read_csv("./data/train.csv", header=None)
train_data.head()
```

Out[9]:

	0	1	2
0	3	Wall St. Bears Claw Back Into the Black (Reuters)	Reuters - Short-sellers, Wall Street's dwindli...
1	3	Carlyle Looks Toward Commercial Aerospace (Reu...	Reuters - Private investment firm Carlyle Grou...
2	3	Oil and Economy Cloud Stocks' Outlook (Reuters)	Reuters - Soaring crude prices plus worries\ab...
3	3	Iraq Halts Oil Exports from Main Southern Pipe...	Reuters - Authorities have halted oil export\f...
4	3	Oil prices soar to all-time record, posing new...	AFP - Tearaway world oil prices, toppling reco...

In [10]:
```
test_data = pandas.read_csv("./data/test.csv", header=None)
test_data.head()
```

Out[10]:

	0	1	2
0	3	Fears for T N pension after talks	Unions representing workers at Turner Newall...
1	4	The Race is On: Second Private Team Sets Launc...	SPACE.com - TORONTO, Canada -- A second\team o...
2	4	Ky. Company Wins Grant to Study Peptides (AP)	AP - A company founded by a chemistry research...
3	4	Prediction Unit Helps Forecast Wildfires (AP)	AP - It's barely dawn when Mike Fitzpatrick st...
4	4	Calif. Aims to Limit Farm-Related Smog (AP)	AP - Southern California's smog-fighting agenc...

Save necessary data in database, first open connection.

In [12]:
```
db = sqlite3.connect('newsclassifier.db')
cat_list = pandas.read_csv('./data/classes.txt', header=None)
cat_list.head()
cat_list.to_sql("category_list", db, if_exists='replace')
```

Data Cleaning

In [11]:
```
train_data.columns = ['category', 'headline', 'content']
train_data.head()
```

Out[11]:

	category	headline	content
0	3	Wall St. Bears Claw Back Into the Black (Reuters)	Reuters - Short-sellers, Wall Street's dwindli...
1	3	Carlyle Looks Toward Commercial Aerospace (Reu...	Reuters - Private investment firm Carlyle Grou...
2	3	Oil and Economy Cloud Stocks' Outlook (Reuters)	Reuters - Soaring crude prices plus worries\ab...
3	3	Iraq Halts Oil Exports from Main Southern Pipe...	Reuters - Authorities have halted oil export\f...
4	3	Oil prices soar to all-time record, posing new...	AFP - Tearaway world oil prices, toppling reco...

In [12]:
```python
test_data.columns = ['category', 'headline', 'content']
test_data.head()
```

Out[12]:

	category	headline	content
0	3	Fears for T N pension after talks	Unions representing workers at Turner Newall...
1	4	The Race is On: Second Private Team Sets Launc...	SPACE.com - TORONTO, Canada -- A second\team o...
2	4	Ky. Company Wins Grant to Study Peptides (AP)	AP - A company founded by a chemistry research...
3	4	Prediction Unit Helps Forecast Wildfires (AP)	AP - It's barely dawn when Mike Fitzpatrick st...
4	4	Calif. Aims to Limit Farm-Related Smog (AP)	AP - Southern California's smog-fighting agenc...

Sample 1000 rows

In [17]:
```python
train_data_sample = train_data.sample(n = 5000, replace = False, random_state = 123)
train_data_sample.head()
```

Out[17]:

	category	headline	content
30870	2	NHL on Ice, Maybe for Whole 2004-05 Season (AP)	AP - No shots, no saves, no goals. The Nationa...
7738	2	Rowers to be punished for criticism of teammate	ROWER Sally Robbins #39;s teammates are expect...
25351	2	Changing Directions	Over at USA Today -- Slogan: "All the News Tha...
74309	4	Cassini snapshots murky moon Titan	The Cassini probe got the first close-up photo...
88347	1	Farewell Yasser Arafat	GAZA CITY, - The world will bid farewell to Ab...

In [19]:
```python
test_data_sample = test_data.sample(n = 5000, replace = False, random_state = 123)
test_data_sample.head()
```

Out[19]:

	category	headline	content
646	1	Panama pardons Castro 'plotters'	Four men accused of planning to kill Cuba's Fi...
2616	4	Elephant DNA Could Help Stem Ivory Trade (AP)	AP - Analyzing the DNA of elephants may help t...
2300	1	Job-Loss Panic Rises in Western Europe (AP)	AP - Stephane Zervos first suspected his job w...
4764	1	Remark on Homosexuality Delays Seating of Euro...	The European Union #39;s normally yawn-inducin...
3617	3	Linux: Paris weighs a shift to open-source camp	PARIS The open-source computer system known as...

Clean HTML code & news sources from headline

In [20]:
```python
import string
import re

def clean(x):
    # strip HTML and sources of the format eg. "&lt and (Reuters)"
    x = re.sub(r'(&[A-Za-z]+)|\(.*\)', '', x)
    # split into words
    tokens = word_tokenize(x)
    # convert to lower case
    tokens = [w.lower() for w in tokens]
    # # remove punctuation from each word
    # table = str.maketrans(string.punctuation, ' ')
    # stripped = [w.translate(table) for w in tokens]
    # remove remaining tokens that are not alphabetic
    words = [word for word in tokens if word.isalpha()]
    # filter out stop words
    stop_words = set(stopwords.words('english'))
    words = [w for w in words if not w in stop_words]
    # re-create document from words
    doc = ' '.join(words)
    return str(doc)

for i, row in train_data_sample.iterrows():
    train_data_sample.at[i, "headline_cleaned"] = clean(row.headline)

for i, row in test_data_sample.iterrows():
    test_data_sample.at[i, "headline_cleaned"] = clean(row.headline)
```

Clean news sources from content

In [21]:

```
# Function to clean out the dates
def clean_dates(x):
    x = re.sub(r'[0-9 ]*(January|February|March|April|May|June|July|August|September|October|November|December|JANUARY|FEBRUARY|MARCH
    return x

# Clean out the dates for training data
for i, row in train_data.iterrows():
    train_data.at[i, "content_cleaned"] = clean_dates(row.content)

# Clean out the dates for testing data
for i, row in test_data.iterrows():
    test_data.at[i, "content_cleaned"] = clean_dates(row.content)
```

In [70]:

```
# Generate the sources list
def extract_sources(x):
    sources = []
    for sentence in x.content:
        trimmed = sentence[:35]
        temp = re.search(r'^[A-Za-z0-9\/,. ]*\(*[A-Za-z.]+\)* -', trimmed)
        if temp is not None:
            sources.append(temp.group())
    sources = numpy.array(sources)
    sources = numpy.unique(sources)
    return sources

# Call function to generate the sources list and save it
sources = extract_sources(train_data.content_cleaned)
sources = numpy.append(sources, extract_sources(test_data.content_cleaned))
sources = numpy.unique(sources)

# Save the sources to a file
numpy.savetxt("./data/news_sources_from_both.csv", sources, \
             header='list', delimiter=',', fmt='%s')
```

In [51]:

```
sources_data = pandas.read_csv("./data/news_sources_clean_v1.csv")

def remove_sources(x, sources):
    x = str(x)
    for i, source in sources.iterrows():
        if source.list in x:
            x = x.replace(source.list, ' ')
    return x

for i, row in train_data.iterrows():
    train_data.at[i, "content_nosources"] = remove_sources(row.content_cleaned, sources_df)

for i, row in test_data.iterrows():
    test_data.at[i, "content_nosources"] = remove_sources(row.content_cleaned, sources_df)

for i, row in train_data.iterrows():
    train_data.at[i, "content_cleaned"] = clean(row.content_nosources)
train_data.head()

for i, row in test_data.iterrows():
    test_data.at[i, "content_cleaned"] = clean(row.content_nosources)
test_data.head()
```

```
National Hockey League
USA Today
Foreign Ministry said
Wall Street Journal
IBM
Interior Minister Dominique

---------------------------------------------------------------------------
KeyboardInterrupt                         Traceback (most recent call last)
<ipython-input-51-1557a9100804> in <module>
     10
     11 for i, row in train_data_sample.iterrows():
---> 12     train_data_sample.at[i, "content_cleaned"] = remove_sources(row.content)

<ipython-input-51-1557a9100804> in remove_sources(x)
      4     x = str(x)
      5     for i, source in sources_data.iterrows():
----> 6         if source.list in x:
      7             print(source.list)
      8             x = x.replace(source.list, ' ')

~\.conda\envs\env1\lib\site-packages\pandas\core\generic.py in __getattr__(self, name)
   5271         else:
   5272             if self._info_axis._can_hold_identifiers_and_holds_name(name):
-> 5273                 return self[name]
   5274             return object.__getattribute__(self, name)
   5275

~\.conda\envs\env1\lib\site-packages\pandas\core\series.py in __getitem__(self, key)
    869         key = com.apply_if_callable(key, self)
    870         try:
--> 871             result = self.index.get_value(self, key)
    872
    873             if not is_scalar(result):

~\.conda\envs\env1\lib\site-packages\pandas\core\indexes\base.py in get_value(self, series, key)
   4400         k = com.values_from_object(key)
   4401
-> 4402         k = self._convert_scalar_indexer(k, kind="getitem")
   4403         try:
   4404             return self._engine.get_value(s, k, tz=getattr(series.dtype, "tz", None))

~\.conda\envs\env1\lib\site-packages\pandas\core\indexes\base.py in _convert_scalar_indexer(self, key, kind)
   2857             return self._validate_indexer("positional", key, kind)
   2858
-> 2859         if len(self) and not isinstance(self, ABCMultiIndex):
   2860
   2861             # we can raise here if we are definitive that this

KeyboardInterrupt:
```

Save to Database

```
In [ ]: db = sqlite3.connect('./data/newsclassifier.db')
        cat_list = pandas.read_csv('./data/classes.txt', header=None)
        cat_list.head()
        cat_list.to_sql("category_list", db, if_exists='replace')
        train_data.to_sql('train_data', db, if_exists='replace')
        test_data.to_sql('test_data', db, if_exists='replace')
        train_data_sample.to_sql('train_data_sample', db, if_exists='replace')
        test_data_sample.to_sql('test_data_sample', db, if_exists='replace')
        db.commit()
        db.close()
```

Make a CountVector (Bag of words)

```
In [7]: # create a CountVectorizer from raw data, with options to clean it
        cv = CountVectorizer(min_df = 2, lowercase = True, token_pattern=r'(?u)\b[A-Za-z]{2,}\b',
                                strip_accents = 'ascii', ngram_range = (1, 1),
                                stop_words = 'english')
        cv_matrix = cv.fit_transform(train_data_sample.headline).toarray()

        # get all unique words in the corpus
        vocab = cv.get_feature_names()

        # produce a dataframe including the feature names
        cv_matrix_df = pandas.DataFrame(cv_matrix, columns=vocab)
```

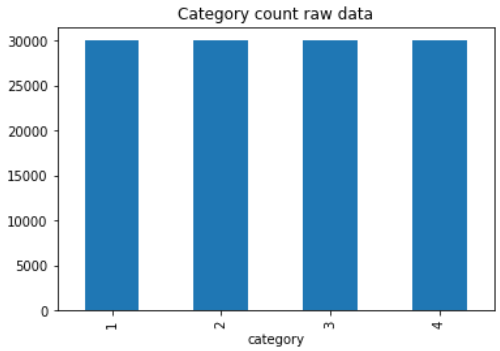
```
Out[7]: '====================================================================='
```

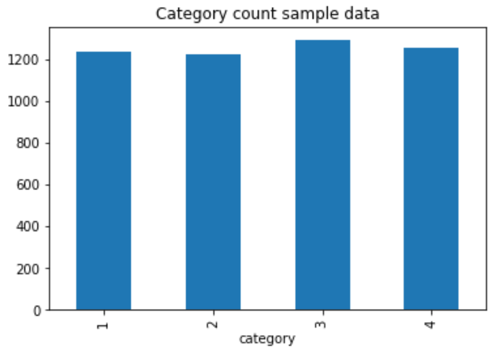
Save the bag of words

```
In [ ]: cv_matrix_df.to_sql('headline_bagofwords', db, if_exists='replace')
        db.commit()
        db.close()
```

Data Exploration

```
In [18]: # bar plot of the count of unique things in each category
         train_data.groupby('category').headline.count().plot.bar(ylim = 0)
         plt.title("Category count raw data")
         plt.show()
         train_data_sample.groupby('category').headline.count().plot.bar(ylim = 0)
         plt.title("Category count sample data")
         plt.show()
```





The number of unique documents in each category

```
In [9]: print(pandas.DataFrame(train_data_sample.groupby(['category']).count()))
```

```
headline  content  content_cleaned
category
1              236      236              236
2              251      251              251
3              258      258              258
4              255      255              255
```

The count of observations and features

```
In [10]: print("There are {} observations and {} features in this dataset. \n".\
             format(cv_matrix_df.shape[0],cv_matrix_df.shape[1]))
```

```
There are 1000 observations and 893 features in this dataset.
```

A description of the categories

```
In [11]: categories = train_data_sample.groupby("category")
         categories.describe().head()
```

Out[11]:

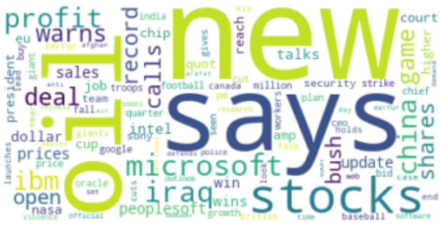
	headline				content				content_cleaned			
	count	unique	top	freq	count	unique	top	freq	count	unique	top	freq
category												
1	236	236	Bush's Convention Tops Kerry's in Primetime Po...	1	236	235	TAIPEI (Reuters) - The pro-independence party...	2	236	235	TAIPEI (Reuters) - The pro-independence party...	2
2	251	251	Edwards banned from Games	1	251	251	ISTANBUL, Turkey -- Striker Andriy Shevchenko ...	1	251	251	NEW YORK (Reuters) - Lamar Odom supplemented ...	1
3	258	258	Consumer Sentiment Improves in November	1	258	258	The Congress-led UPA government decided on Wed...	1	258	258	The Congress-led UPA government decided on Wed...	1
4	255	255	Arguments conclude in evolution sticker trial	1	255	255	com September 14, 2004, 4:00 AM PT. With the e...	1	255	255	AP - The on Thursday filed the first case in ...	1

WordCloud/TagCloud of the top words in the headlines

```
In [12]: # prepare the dictionary to be used in wordcloud
         word_count_dict = {}
         for word in vocab:
             word_count_dict[word] = int(sum(cv_matrix_df.loc[:, word]))
```

```
In [13]: # generate a word cloud image with top 100 words and 80% horizontal:
         wordcloud = WordCloud(max_words=100, prefer_horizontal=0.8, background_color='white').\
                     generate_from_frequencies(word_count_dict)

         # display the generated image:
         plt.imshow(wordcloud, interpolation='bilinear')
         plt.axis("off")
         plt.show()
```



Plots of the data

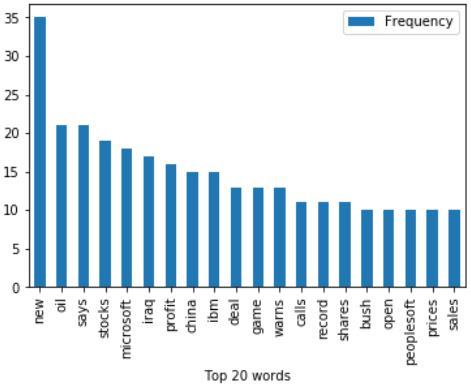
Bar plot of the top word counts

In [18]:

```
from collections import Counter

counter = Counter(word_count_dict)

freq_df = pandas.DataFrame.from_records(counter.most_common(20),
                                        columns=['Top 20 words', 'Frequency'])
freq_df.plot(kind='bar', x='Top 20 words');
```


Frequency
new
oil
says
stocks
microsoft
iraq
profit
china
ibm
deal
game
warns
calls
record
shares
bush
open
peoplesoft
prices
sales
Top 20 words