In [1]:
```
import nltk
# python -m nltk.downloader all  ##type this on command line to download required
```

In [163]:
```
import warnings
warnings.filterwarnings('ignore')
```

In [2]:
```
import pandas as pd
import os
os.chdir("D:/PlayGround/NLP/")
```

In [3]:
```
df_init = pd.read_excel('keyword_grouping.xlsx')
```

In [4]:
```
df_init.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 6554 entries, 0 to 6553
Data columns (total 2 columns):
Keyword            6553 non-null object
Refined Keyword    3391 non-null object
dtypes: object(2)
memory usage: 102.5+ KB
```

In [5]:
```
df_init[:5]
```

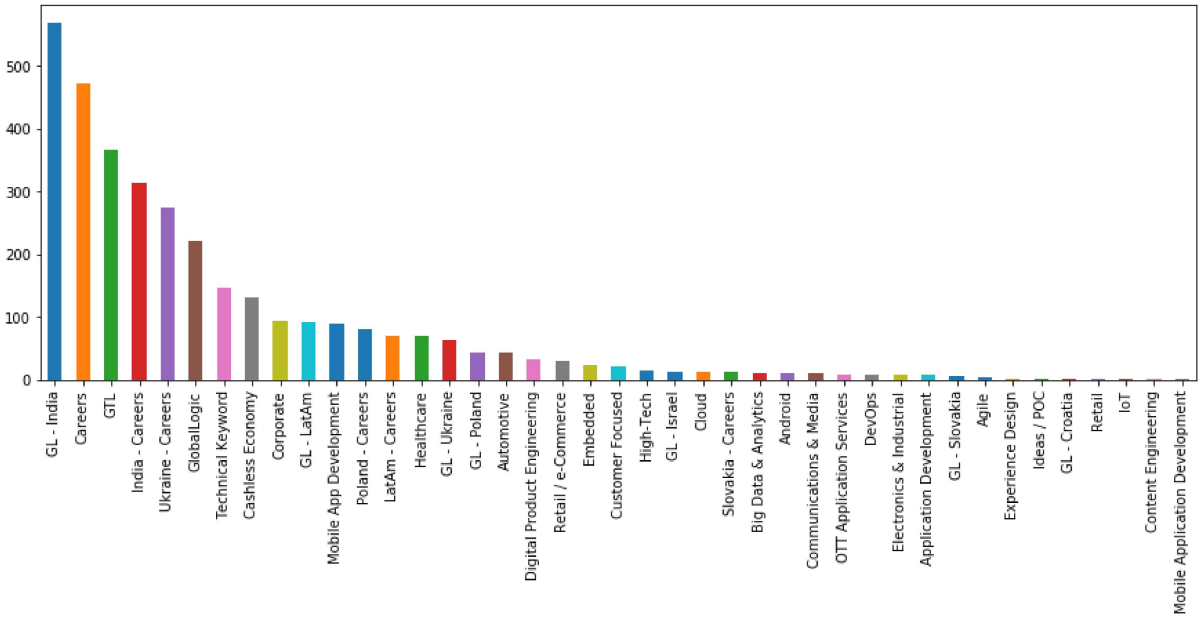
Out[5]:

	Keyword	Refined Keyword
0	0_4da850ed6c-18e2076de5-99212033	NaN
1	0_5f41bbf30e-9fad566447-	NaN
2	0_161dc7017d-fb01084e85-186735817	NaN
3	0_161dc7017d-fb01084e85-186735837	NaN
4	0_161dc7017d-fb01084e85-186735845	NaN

In [6]:
```
keywords = df_init['Refined Keyword'].value_counts()
```

In [9]:
```
keywords.plot(kind = 'bar', figsize = (15,5))
```

Out[9]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1bdf9b42978>
```



In [11]:
```
df_init['Keyword'].nunique()
```

Out[11]:
```
6553
```

In [12]:
```
df = df_init.copy()
```

In [13]:
```
# Remove NaN/Empty
df = df.dropna()
```

In [14]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 3391 entries, 77 to 6553
Data columns (total 2 columns):
Keyword            3391 non-null object
Refined Keyword    3391 non-null object
dtypes: object(2)
memory usage: 79.5+ KB
```

In [15]:
```
# checking if keyword has non-english characters. 0 means no non-english chars.
df['non_eng'] = 0
```

In [35]:
```
# function to detect language
def detect_language(line):
    maxchar = max(line)
    # print(maxchar,ord(maxchar))
    if ord(maxchar)>127:
        return 1
    else:
        return 0
```

In [36]:
```
for index,row in df.iterrows():
    df['non_eng'][index] = detect_language(row['Keyword'])
```

In [37]:
```
df['non_eng'].value_counts()
```

Out[37]:
```
0    3310
1      81
Name: non_eng, dtype: int64
```

In [38]:
```
df[:5]
```

Out[38]:

	Keyword	Refined Keyword	non_eng
77	1mobile market	Mobile App Development	0
78	2 2 channel ukraine	GL - Ukraine	0
79	5 ETAPAS DE BPMN	Technical Keyword	0
80	5 ETAPAS DEL BPMN	Technical Keyword	0
81	5 g live mobile	Mobile App Development	0

In [63]:
```
# function to split urls
def split_url(line):
    import re
    words = re.split('\:|\/|, |\.|\n|\>|\<|\-|\@',line)
    non_empty = []
    for word in words:
        if len(word)>0:
            non_empty.append(word)
    return ' '.join(non_empty)
```

In [61]:
```
# converting urls to string of space separated words
for index, row in df.iterrows():
    df['Keyword'][index] = split_url(str(row['Keyword']))
# split_url('<http://www.globallogic.com/>')
```

In [39]:
```
# - *- coding: utf- 8 - *-
```

In [40]:
```
# detecting language in the text.
# Adding new language column and setting values to english.
df['lang'] = 'en'
```

In [62]:
```
# detecting language of the keywords

from langdetect import detect
for index, row in df.iterrows():
    try:
        df['lang'][index] = detect(row['Keyword'])
    except:
        print(row)
```

```
Keyword            career@globallogic
Refined Keyword                Careers
non_eng                              0
lang                                en
Name: 444, dtype: object
```

In [65]:
```
df['Keyword'][444]='career globallogic'
```

In [66]:
```
df['lang'][444] = detect('career globallogic')
```

In [74]:
```
df[:5]
```

Out[74]:

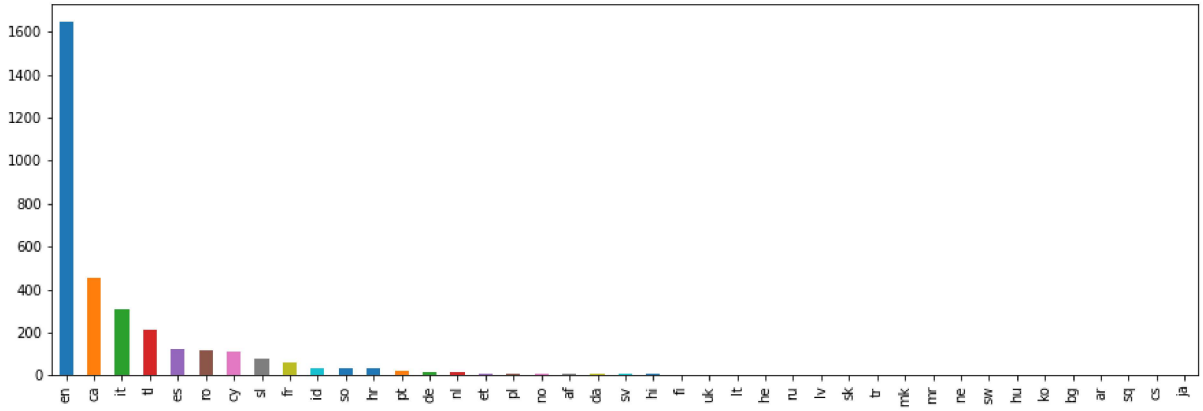
	Keyword	Refined Keyword	non_eng	lang
77	1mobile market	Mobile App Development	0	tr
78	2 2 channel ukraine	GL - Ukraine	0	de
79	5 ETAPAS DE BPMN	Technical Keyword	0	de
80	5 ETAPAS DEL BPMN	Technical Keyword	0	de
81	5 g live mobile	Mobile App Development	0	sl

In [75]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 3391 entries, 77 to 6553
Data columns (total 4 columns):
Keyword            3391 non-null object
Refined Keyword    3391 non-null object
non_eng            3391 non-null object
lang               3391 non-null object
dtypes: object(4)
memory usage: 292.5+ KB
```

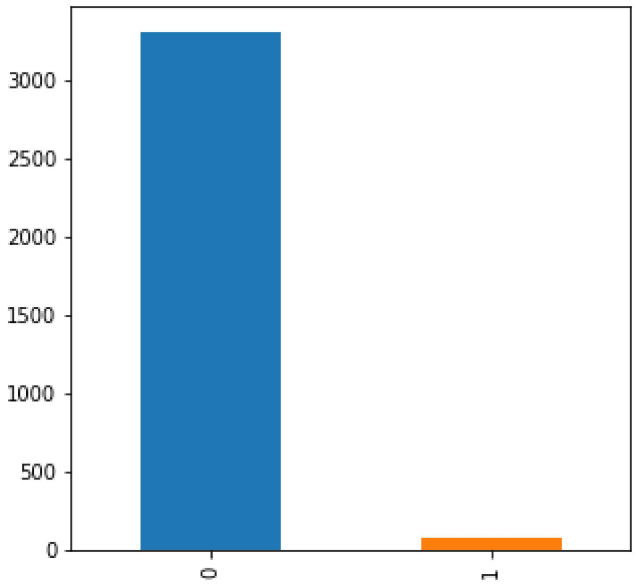
In [70]:
```
df['lang'].value_counts().plot(kind = 'bar', figsize=(15, 5))
```

Out[70]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1bdfc8454a8>
```



In [73]:
```
df['non_eng'].value_counts().plot(kind = 'bar', figsize=(5, 5))
```

Out[73]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1bdfb693278>
```



In [81]:
```
# separating df with only english characters
df_eng = df[df['non_eng']==0]
```

In [88]:
```
df_eng['lang'].value_counts()[:5]
```

Out[88]:
```
en    1643
ca     446
it     306
tl     215
ro     118
Name: lang, dtype: int64
```

In [82]:
```
from sklearn.feature_extraction.text import TfidfVectorizer, CountVectorizer
# create a count vectorizer object
count_vect = CountVectorizer(analyzer='word')
count_vect.fit(df_eng['Keyword'])
```

Out[82]:
```
CountVectorizer(analyzer='word', binary=False, decode_error='strict',
        dtype=<class 'numpy.int64'>, encoding='utf-8', input='content',
        lowercase=True, max_df=1.0, max_features=None, min_df=1,
        ngram_range=(1, 1), preprocessor=None, stop_words=None,
        strip_accents=None, token_pattern='(?u)\\b\\w\\w+\\b',
        tokenizer=None, vocabulary=None)
```

In [83]:
```
# transform the data using count vectorizer object
keyword_feature_matrix =  count_vect.transform(df_eng['Keyword'])
```

In [84]:
```
keyword_feature_matrix.shape
```

Out[84]:
```
(3310, 2365)
```

In [89]:
```
features = count_vect.get_feature_names()
```

In [90]:
```
tokenize_df = pd.DataFrame(keyword_feature_matrix.toarray(), columns = features)
```

In [91]:
```
tokenize_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3310 entries, 0 to 3309
Columns: 2365 entries, 003 to zppakode
dtypes: int64(2365)
memory usage: 59.7 MB
```

In [92]:
```
tokenize_df[:5]
```

Out[92]:

	003	005	0221210211	08	09	0b19a637cc	0h9ms5fxgtkj	10	1042	10698	...	you	your	you
0	0	0	0	0	0	0	0	0	0	0	...	0	0	
1	0	0	0	0	0	0	0	0	0	0	...	0	0	
2	0	0	0	0	0	0	0	0	0	0	...	0	0	
3	0	0	0	0	0	0	0	0	0	0	...	0	0	
4	0	0	0	0	0	0	0	0	0	0	...	0	0	

5 rows × 2365 columns

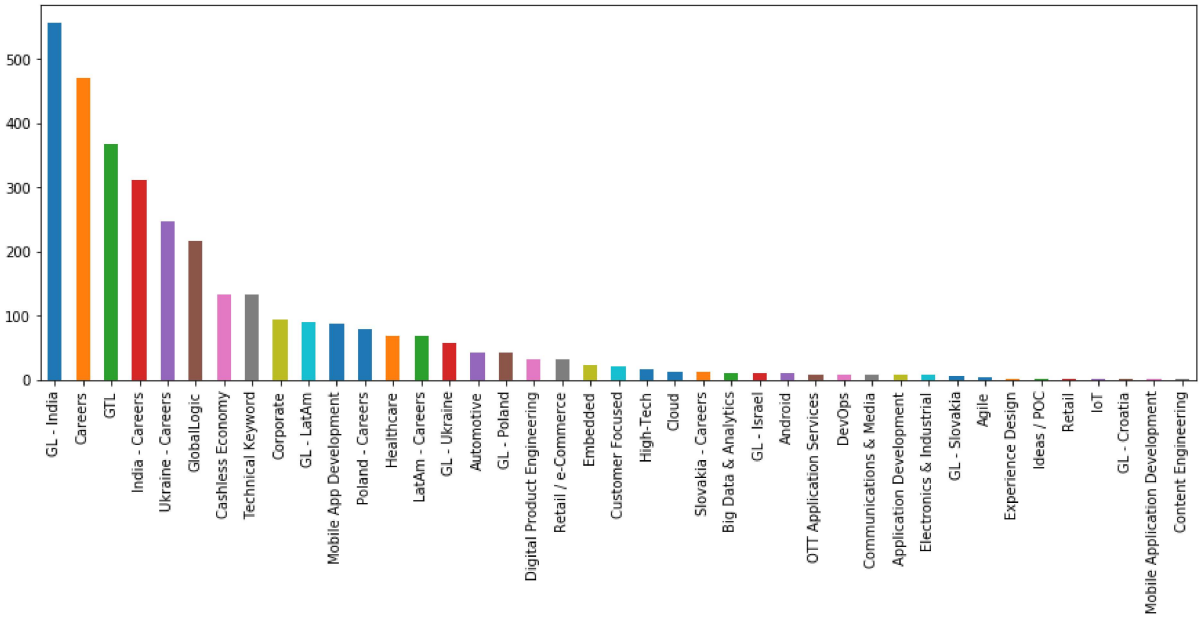
In [93]:
```
tokenize_df['label'] = df_eng['Refined Keyword'].tolist()
```

In [94]:
```
tokenize_df['label'].nunique()
```

Out[94]:
```
41
```

In [121]:
```
tokenize_df['label'].value_counts().plot(kind = 'bar', figsize = (15,5))
```

Out[121]: <matplotlib.axes._subplots.AxesSubplot at 0x1bdff372630>



In [97]:
```
tokenize_df['label'].isna().sum()
```

Out[97]: 0

In [98]:
```
tokenize_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3310 entries, 0 to 3309
Columns: 2366 entries, 003 to label
dtypes: int64(2365), object(1)
memory usage: 59.7+ MB
```

In [99]:
```
tokenize_df[:5]
```

Out[99]:

	003	005	0221210211	08	09	0b19a637cc	0h9ms5fxgtkj	10	1042	10698	...	your	youtube
0	0	0	0	0	0	0	0	0	0	0	...	0	0
1	0	0	0	0	0	0	0	0	0	0	...	0	0
2	0	0	0	0	0	0	0	0	0	0	...	0	0
3	0	0	0	0	0	0	0	0	0	0	...	0	0
4	0	0	0	0	0	0	0	0	0	0	...	0	0

5 rows × 2366 columns

In [112]:
```
tokenize_df['003'].value_counts()
```

Out[112]:
```
0    3309
1       1
Name: 003, dtype: int64
```

In [113]:
```
# no of rows where each feature exists
feat_total = []
for feat in features:
    feat_sum = tokenize_df[feat].sum()
    feat_total.append([feat, feat_sum])
```

In [116]:
```
feat_total_df = pd.DataFrame(feat_total, columns=['Feature', 'Occurance'])
```

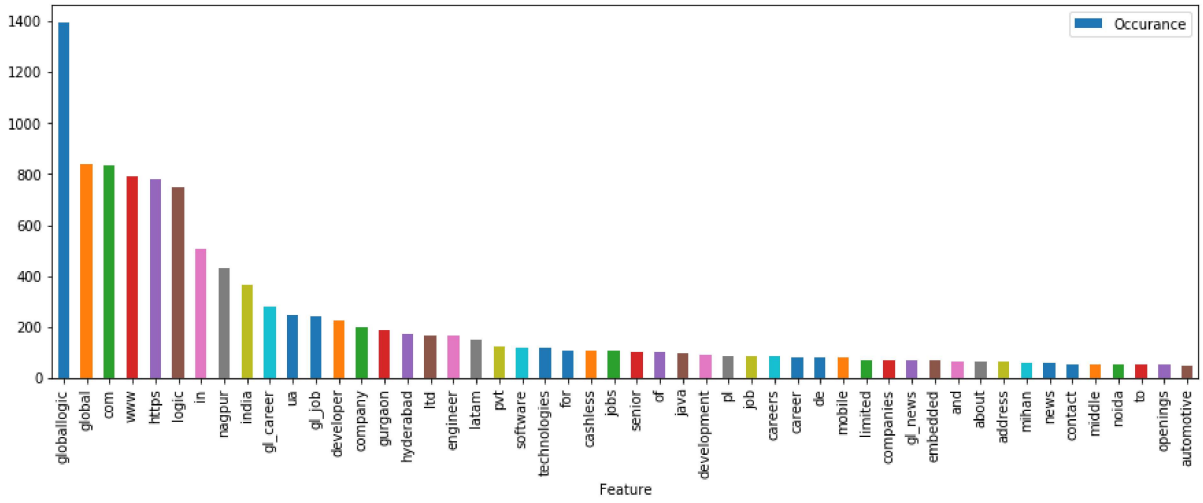
In [122]:
```
feat_total_df.sort_values('Occurance', ascending=False)[:10]
```

Out[122]:

	Feature	Occurance
939	globallogic	1392
930	global	838
468	com	833
2344	www	790
1067	https	778
1440	logic	747
1107	in	506
1584	nagpur	429
1115	india	369
893	gl_career	280

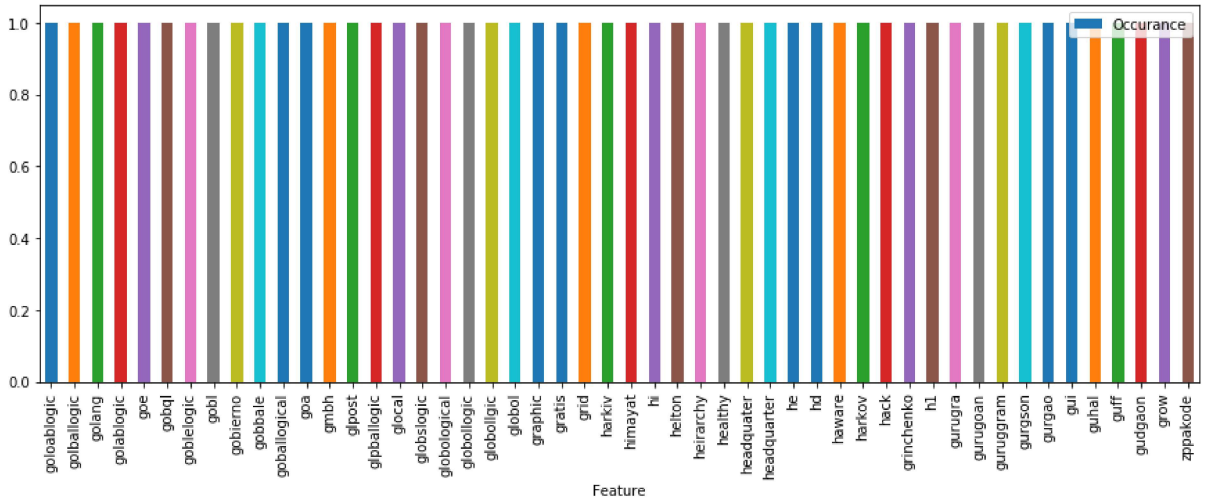
In [132]:
```
feat_total_df.sort_values('Occurance', ascending=False)[:50].plot.bar(y='Occurance
```

Out[132]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1bd8569a908>
```



In [134]:
```
feat_total_df.sort_values('Occurance', ascending=False)[-50:].plot.bar(y='Occuran
```

Out[134]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1bd85d0ce10>
```



In [137]:
```
# Total features
feat_total_df.shape[0]
```

Out[137]:
```
2365
```

In [136]:
```
# no of words occuring only 1 time
feat_total_df[feat_total_df['Occurance']==1].shape[0]
```

Out[136]:
```
1472
```

In [138]:
```
# no of words occuring less than or equal to 5 times
feat_total_df[feat_total_df['Occurance']<=5].shape[0]
```

Out[138]:
```
2062
```

In [141]:
```
# no of words occuring less than 10 times
feat_total_df[feat_total_df['Occurance']<10].shape[0]
```

Out[141]:
```
2155
```

In [142]:
```
# no of words occuring more than or equal to 10 times
feat_total_df[feat_total_df['Occurance']>=10].shape[0]
```

Out[142]:
```
210
```

Modeling Feature Vectors using various classification algorithms

In [185]:
```
# creating train and test dataset randomly
import numpy as np
msk = np.random.rand(len(tokenize_df)) <= 0.8
train_df = tokenize_df[msk]
test_df = tokenize_df[~msk]
len(train_df), len(test_df)
```

Out[185]:
```
(2643, 667)
```

In [154]:
```
x_col = features     # x_col : Features

y_col = ['label'] # y_col : Target Variable

train_x = train_df[x_col]
train_y = train_df[y_col]
test_x = test_df[x_col]
test_y = test_df[y_col]
```

In [158]:
```
train_y['label'].nunique(),test_y['label'].nunique()
```

Out[158]:
```
(40, 35)
```

In [161]:
```
# Creating a accuracy function:
def train_model(classifier, feature_vector_train, label, feature_vector_valid, is_
    # fit the training dataset on the classifier
    from sklearn.metrics import accuracy_score
    classifier.fit(feature_vector_train, label)

    # predict the labels on validation dataset
    predictions = classifier.predict(feature_vector_valid)

    if is_neural_net:
        predictions = predictions.argmax(axis=-1)

    return accuracy_score(predictions, test_y)
```

Naive Bayes

In [168]:
```
# using sklearn's multinomial naive bayes classifier
from sklearn.naive_bayes import MultinomialNB
accuracy_nb = train_model(MultinomialNB(), train_x, train_y, test_x)
print('NB accuracy : ' , accuracy_nb)
```

```
NB accuracy :  0.6341829085457271
```

Linear Classifier

In [179]:
```
# Linear Classifier on Count Vectors
from sklearn import *
accuracy_lc = train_model(linear_model.LogisticRegression(), train_x, train_y, te
print('LC accuracy : ' , accuracy_lc)
```

```
LC accuracy :  0.8185907046476761
```

SVM

In [171]:
```
# SVM
accuracy_svm = train_model(svm.SVC(), train_x, train_y, test_x)
print('SVM accuracy : ' , accuracy_svm)
```

```
SVM accuracy :  0.14392803598200898
```

Random Forest

In [172]:
```
# Random Forest
accuracy_rf = train_model(ensemble.RandomForestClassifier(), train_x, train_y, te
print('RF accuracy : ' , accuracy_rf)
```

```
SVM accuracy :  0.7886056971514243
```

XGBoost

In [193]:
```
# Extereme Gradient Boosting on Count Vectors
import xgboost
accuracy_xgb = train_model(xgboost.XGBClassifier(), train_x, train_y, test_x)
print('XGB accuracy : ' , accuracy_xgb)
```

```
XGB accuracy :  0.7901049475262368
```

LightGBM

In [182]:
```
# using lightgbm

# encoding categorial column label for lightgbm
lgbm_df = tokenize_df.copy()
from sklearn import preprocessing
cat_cols = ['label']
for col in cat_cols:
    lbl = preprocessing.LabelEncoder()
    lbl.fit(list(lgbm_df[col].values.astype('str')))
    lgbm_df[col] = lbl.transform(list(lgbm_df[col].values.astype('str')))
```

In [187]:
```
# creating test and train data for lgbm
lgbm_train_df = lgbm_df[msk]
lgbm_test_df = lgbm_df[~msk]
```

In [188]:
```
lgbm_train_x = lgbm_train_df[x_col]
lgbm_train_y = lgbm_train_df[y_col]
lgbm_test_x = lgbm_test_df[x_col]
lgbm_test_y = lgbm_test_df[y_col]
```

In [190]:
```
# Creating a accuracy function for lgbm:
def train_model_lgbm(classifier, feature_vector_train, label, feature_vector_vali
    # fit the training dataset on the classifier
    from sklearn.metrics import accuracy_score
    classifier.fit(feature_vector_train, label)

    # predict the labels on validation dataset
    predictions = classifier.predict(feature_vector_valid)

    if is_neural_net:
        predictions = predictions.argmax(axis=-1)

    return accuracy_score(predictions, lgbm_test_y)
```

In [192]:
```
import lightgbm as lgb
accuracy_lgbm = train_model_lgbm(lgb.LGBMClassifier(), lgbm_train_x, lgbm_train_y
print('LGBM accuracy : ' , accuracy_lgbm)
```

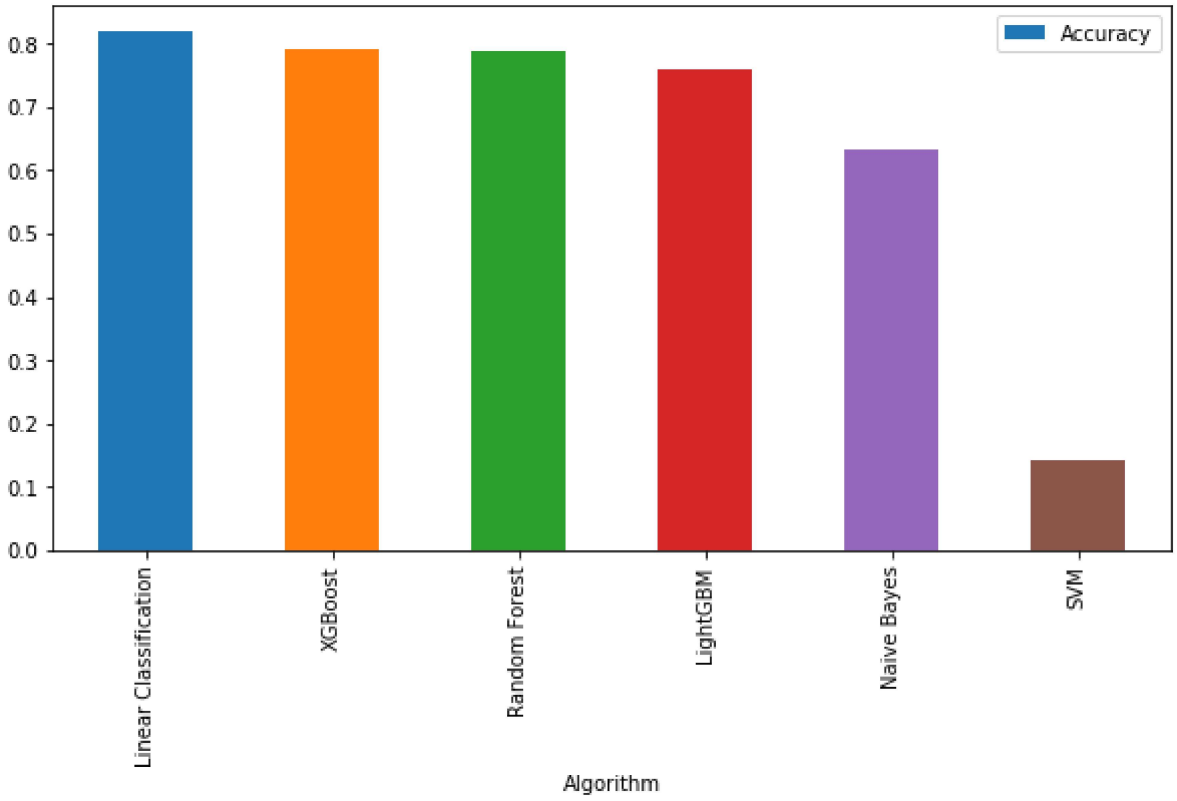
```
LGBM accuracy :  0.760119940029985
```

In [195]:
```
accuracy_matrices = [['Naive Bayes', accuracy_nb],
                     ['Linear Classification', accuracy_lc],
                     ['SVM', accuracy_svm],
                     ['Random Forest', accuracy_rf],
                     ['XGBoost', accuracy_xgb],
                     ['LightGBM', accuracy_lgbm],
                    ]
```

In [196]:
```
accuracy_df = pd.DataFrame(accuracy_matrices, columns=['Algorithm', 'Accuracy'])
```

In [204]:
```
accuracy_df.sort_values('Accuracy', ascending=False).plot.bar(y='Accuracy', x='Al
```

Out[204]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1bd94280358>
```



Demo

In [2]:
```
import numpy as np
train_i = np.random.rand(len(tokenize_df)) <= 0.95
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-2-ff6882a3512a> in <module>()
      1 import numpy as np
----> 2 train_i = np.random.rand(len(tokenize_df)) <= 0.95

NameError: name 'tokenize_df' is not defined
```