In [1]:

```
%matplotlib inline
import warnings
warnings.filterwarnings("ignore")

import sqlite3
import pandas as pd
import numpy as np
import nltk
import string
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.feature_extraction.text import TfidfVectorizer

from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics import confusion_matrix
from sklearn import metrics
from sklearn.metrics import roc_curve, auc
from nltk.stem.porter import PorterStemmer

import re
import string
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
from nltk.stem.wordnet import WordNetLemmatizer

from gensim.models import Word2Vec
from gensim.models import KeyedVectors
import pickle

from tqdm import tqdm
import os

#from plotly import plotly
import plotly.offline as offline
import plotly.graph_objs as go
offline.init_notebook_mode()
from collections import Counter
```

In [2]:

```
training_data = pd.read_csv('train_data.csv')
resource_data = pd.read_csv('resources.csv')
```

In [3]:

```python
print("\n\nNumber of data points in training data", training_data.shape)
print("\n\nThe attributes of data :", training_data.columns.values)
print('\n')
training_data.head(2)
```

```
Number of data points in training data (109248, 17)


The attributes of data : ['Unnamed: 0' 'id' 'teacher_id' 'teac
her_prefix' 'school_state'
 'project_submitted_datetime' 'project_grade_category'
 'project_subject_categories' 'project_subject_subcategories'
 'project_title' 'project_essay_1' 'project_essay_2' 'project_
essay_3'
 'project_essay_4' 'project_resource_summary'
 'teacher_number_of_previously_posted_projects' 'project_is_ap
proved']
```

Out[3]:

	Unnamed: 0	id	teacher_id	teacher_prefix	scl
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	

Preprocessing teacher_prefix

In [4]:

```
training_data['teacher_prefix'] = training_data['teacher_prefix'].replace(np.
training_data['teacher_prefix'] = training_data['teacher_prefix'].replace('Dr
training_data['teacher_prefix'] = training_data['teacher_prefix'].replace('Te
training_data['teacher_prefix'] = training_data['teacher_prefix'].replace('Mr
training_data['teacher_prefix'] = training_data['teacher_prefix'].replace('Ms
training_data['teacher_prefix'] = training_data['teacher_prefix'].replace('Mr
print(training_data['teacher_prefix'].head(5))
training_data.head(2)
```

```
0     MRS
1      MR
2      MS
3     MRS
4     MRS
Name: teacher_prefix, dtype: object
```

Out[4]:

	Unnamed: 0	id	teacher_id	teacher_prefix	scl
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	MRS	
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	MR	

Summary

- Removing np.nan values from teacher_prefix column and converting to MRS
- Removing Full stops from teacher_prefix column and converting to Upper case

Preprocessing project_grade_category

In [5]:

```
training_data['project_grade_category'] = training_data['project_grade_catego
training_data['project_grade_category'] = training_data['project_grade_catego
training_data['project_grade_category'] = training_data['project_grade_catego
training_data['project_grade_category'] = training_data['project_grade_catego
print(training_data['project_grade_category'].head(5))
training_data.head(2)
```

```
0     Grades_PreK_2
1        Grades_6_8
2        Grades_6_8
3     Grades_PreK_2
4     Grades_PreK_2
Name: project_grade_category, dtype: object
```

Out[5]:

	Unnamed: 0	id	teacher_id	teacher_prefix	scl
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	MRS	
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	MR	

Summary

- Replacing ' ' and '-' with '_' for all the values of project_grade_category column

In [6]:

```
print("\n\nNumber of data points in resource data", resource_data.shape)
print("\n\nThe attributes of data :",resource_data.columns.values)
resource_data.head(2)
```

```


Number of data points in resource data (1541272, 4)


The attributes of data : ['id' 'description' 'quantity' 'pric
e']
```

Out[6]:

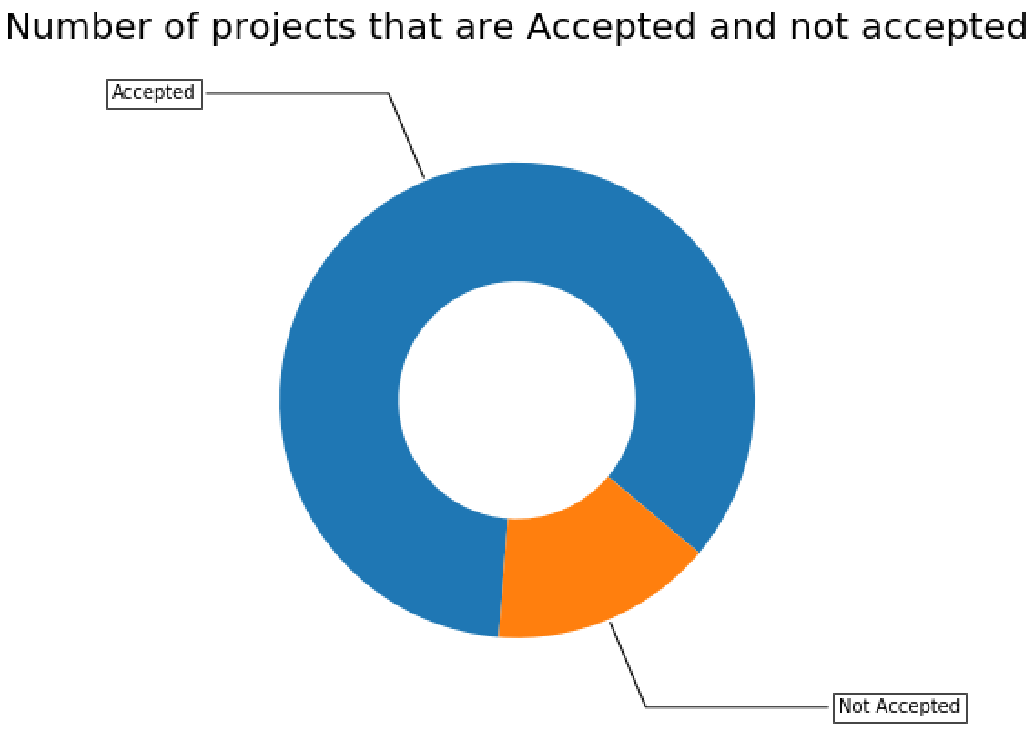
	id	description	quantity	price
0	p233245	LC652 - Lakeshore Double-Space Mobile Drying Rack	1	149.00
1	p069063	Bouncy Bands for Desks (Blue support pipes)	3	14.95

Data Analysis

In [7]:

```
# https://matplotlib.org/gallery/pie_and_polar_charts/pie_and_donut_labels.ht


y_value_counts = training_data['project_is_approved'].value_counts()
print("Number of projects that are approved for funding ", y_value_counts[1],
print("Number of projects that are not approved for funding ", y_value_counts

fig, ax = plt.subplots(figsize=(6, 6), subplot_kw=dict(aspect="equal"))
recipe = ["Accepted", "Not Accepted"]

data = [y_value_counts[1], y_value_counts[0]]

wedges, texts = ax.pie(data, wedgeprops=dict(width=0.5), startangle=-40)

bbox_props = dict(boxstyle="square,pad=0.3", fc="w", ec="k", lw=0.72)
kw = dict(xycoords='data', textcoords='data', arrowprops=dict(arrowstyle="-")
          bbox=bbox_props, zorder=0, va="center")

for i, p in enumerate(wedges):
    ang = (p.theta2 - p.theta1)/2. + p.theta1
    y = np.sin(np.deg2rad(ang))
    x = np.cos(np.deg2rad(ang))
    horizontalalignment = {-1: "right", 1: "left"}[int(np.sign(x))]
    connectionstyle = "angle,angleA=0,angleB={}".format(ang)
    kw["arrowprops"].update({"connectionstyle": connectionstyle})
    ax.annotate(recipe[i], xy=(x, y), xytext=(1.35*np.sign(x), 1.4*y),
                horizontalalignment=horizontalalignment, **kw)

ax.set_title("Number of projects that are Accepted and not accepted", fontsiz

plt.show()
```

```
Number of projects that are approved for funding  92706 , ( 8
4.85830404217927 %)
Number of projects that are not approved for funding  16542 ,
( 15.141695957820739 %)
```

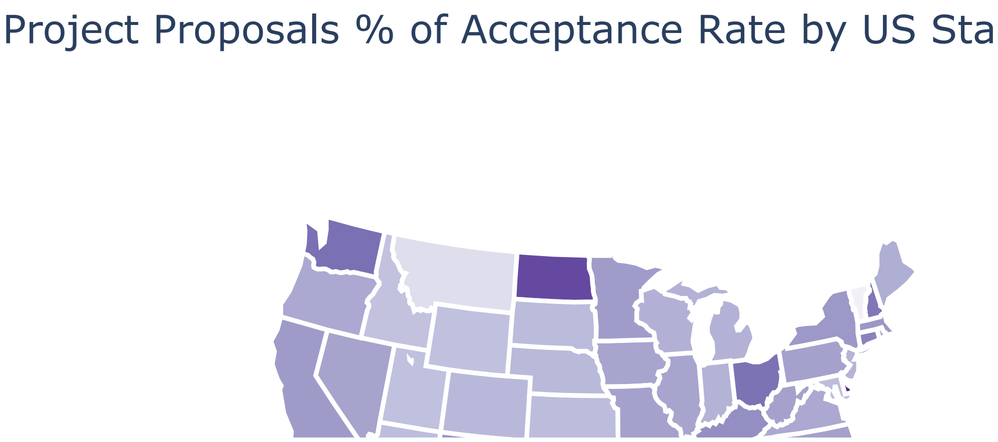

Number of projects that are Accepted and not accepted

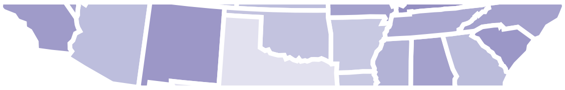
Summary

- 92706 projects were approved for funding out of 109248 applications i.e. 84.85 %
- 16542 projects were not approved for funding out of 109248 applications i.e. 15.14%
- Looks like an imbalanced dataset

In [8]:

```
# Pandas dataframe groupby count, mean: https://stackoverflow.com/a/19385591/

temp = pd.DataFrame(training_data.groupby("school_state")["project_is_approve
# if you have data which contain only 0 and 1, then the mean = percentage (th
temp.columns = ['state_code', 'num_proposals']

# How to plot US state heatmap: https://datascience.stackexchange.com/a/9620

scl = [[0.0, 'rgb(242,240,247)'],[0.2, 'rgb(218,218,235)'],[0.4, 'rgb(188,189
            [0.6, 'rgb(158,154,200)'],[0.8, 'rgb(117,107,177)'],[1.0, 'rgb(84

data = [ dict(
        type='choropleth',
        colorscale = scl,
        autocolorscale = False,
        locations = temp['state_code'],
        z = temp['num_proposals'].astype(float),
        locationmode = 'USA-states',
        text = temp['state_code'],
        marker = dict(line = dict (color = 'rgb(255,255,255)',width = 2)),
        colorbar = dict(title = "% of pro")
    ) ]

layout = dict(
        title = 'Project Proposals % of Acceptance Rate by US States',
        geo = dict(
            scope='usa',
            projection=dict( type='albers usa' ),
            showlakes = True,
            lakecolor = 'rgb(255, 255, 255)',
        ),
    )

fig = go.Figure(data=data, layout=layout)
offline.iplot(fig, filename='us-map-heat-map')
```





Summary

- The plot shows all the 51 states of United States of America with rate of acceptance
- The shades of purple represents the percentage of acceptance
- The darker the shade the higher the acceptance percentage
- Delaware (DE) is the state with Most Acceptance percentage i.e. 89.79 %
- North Dakota (ND) is the state with Second most Acceptance percentage i.e. 88.81 %
- Washington (WA) is the state with Third most Acceptance percentage i.e. 87.61 %

In [9]:

```python
# https://www.csi.cuny.edu/sites/default/files/pdf/administration/ops/2letter
temp.sort_values(by=['num_proposals'], inplace=True)
print("States with lowest % approvals\n")
print(temp.head(5))
print("\n\nStates with highest % approvals\n")
print(temp.tail(5))
```

```
States with lowest % approvals

   state_code  num_proposals
46         VT       0.800000
7          DC       0.802326
43         TX       0.813142
26         MT       0.816327
18         LA       0.831245


States with highest % approvals

   state_code  num_proposals
30         NH       0.873563
35         OH       0.875152
47         WA       0.876178
28         ND       0.888112
8          DE       0.897959
```

Summary

- Vermont state has the lowest percentage of acceptance i.e. 80.00 %
- Washington, D.C. has the second lowest percentage of acceptance i.e. 80.23 %
- Texas state has the third lowest percentage of acceptance i.e. 81.31 %
- Every state has greater than 80 % acceptance rate

In [10]:

```
#stacked bar plots matplotlib: https://matplotlib.org/gallery/lines_bars_and_
def stack_plot(data, xtick, col2='project_is_approved', col3='total'):
    ind = np.arange(data.shape[0])

    plt.figure(figsize=(20,5))
    p1 = plt.bar(ind, data[col3].values)
    p2 = plt.bar(ind, data[col2].values)

    plt.ylabel('Projects')
    plt.title('Number of projects aproved vs rejected')
    plt.xticks(ind, list(data[xtick].values))
    plt.legend((p1[0], p2[0]), ('total', 'accepted'))
    plt.show()
```

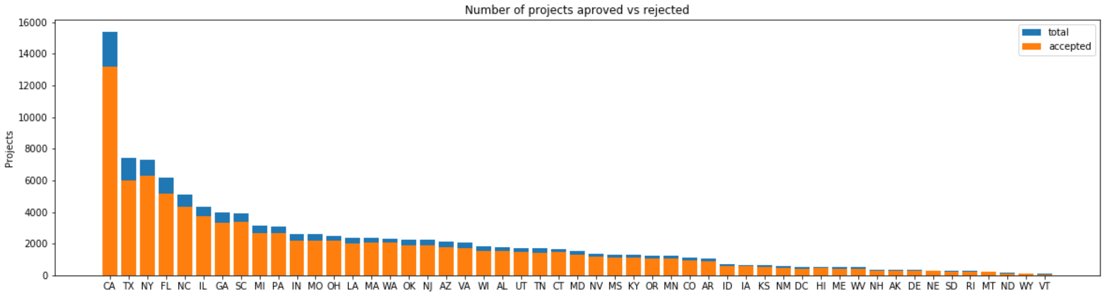
In [11]:

```
def univariate_barplots(data, col1, col2='project_is_approved', top=False):
    # Count number of zeros in dataframe python: https://stackoverflow.com/a/
    temp = pd.DataFrame(training_data.groupby(col1)[col2].agg(lambda x: x.eq(

    # Pandas dataframe grouby count: https://stackoverflow.com/a/19385591/408
    temp['total'] = pd.DataFrame(training_data.groupby(col1)[col2].agg({'tota
    temp['Avg'] = pd.DataFrame(training_data.groupby(col1)[col2].agg({'Avg':

    temp.sort_values(by=['total'],inplace=True, ascending=False)

    if top:
        temp = temp[0:top]

    stack_plot(temp, xtick=col1, col2=col2, col3='total')
    print(temp.head(5))
    print('\n\n')
    print(temp.tail(5))
    print('\n')
```

Univariate Analysis: school_state

In [12]:

```
univariate_barplots(training_data, 'school_state', 'project_is_approved', Fal
```



```
   school_state  project_is_approved  total       Avg
4            CA                13205  15388  0.858136
43           TX                 6014   7396  0.813142
34           NY                 6291   7318  0.859661
9            FL                 5144   6185  0.831690
27           NC                 4353   5091  0.855038
```

```
   school_state  project_is_approved  total       Avg
39           RI                  243    285  0.852632
26           MT                  200    245  0.816327
28           ND                  127    143  0.888112
50           WY                   82     98  0.836735
46           VT                   64     80  0.800000
```

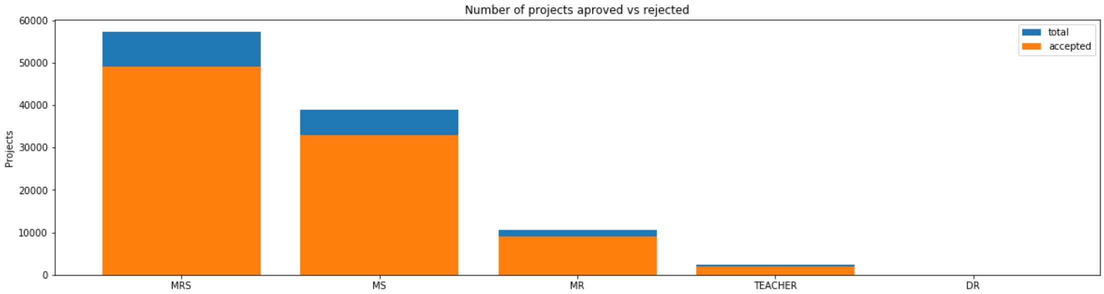
Summary

- California state has the most number of project submissions i.e. 15388
- Texas state has the second most number of project submissions i.e. 7396
- Wyoming state has the second least number of project submissions i.e. 98
- Vermont state has the least number of project submissions i.e. 80

Univariate Analysis: teacher_prefix

In [13]:

```
univariate_barplots(training_data, 'teacher_prefix', 'project_is_approved' ,
```



```
  teacher_prefix  project_is_approved  total       Avg
2            MRS                49000  57272  0.855566
3             MS                32860  38955  0.843537
1             MR                 8960  10648  0.841473
4        TEACHER                 1877   2360  0.795339
0             DR                    9     13  0.692308
```

```
  teacher_prefix  project_is_approved  total       Avg
2            MRS                49000  57272  0.855566
3             MS                32860  38955  0.843537
1             MR                 8960  10648  0.841473
4        TEACHER                 1877   2360  0.795339
0             DR                    9     13  0.692308
```

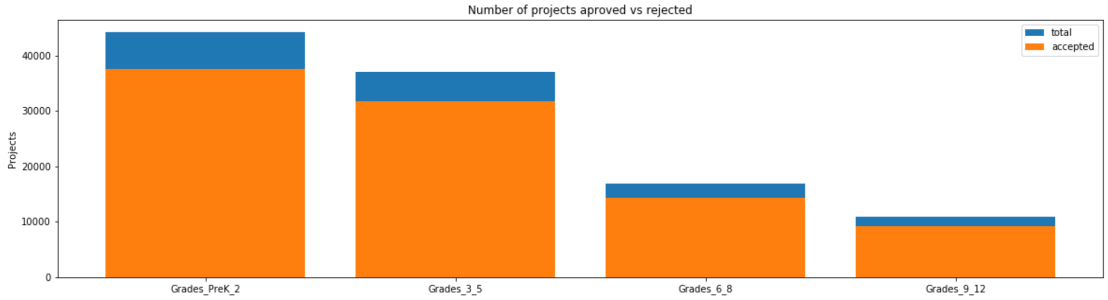
Summary

- MRS teacher_prefix has the most number of project submissions i.e. 57272 with 85.55 % acceptance rate
- MS teacher_prefix has the second most number of project submissions i.e. 38955 with 84.35 % acceptance rate
- Teacher teacher_prefix has the second least number of project submissions i.e. 2360 with 79.53 % acceptance rate
- DR teacher_prefix has the least number of project submissions i.e. 13 with 69.23 % acceptance rate

Univariate Analysis: project_grade_category

In [14]:

```
univariate_barplots(training_data, 'project_grade_category', 'project_is_appr
```



```
  project_grade_category  project_is_approved  total       Avg
3          Grades_PreK_2                37536  44225  0.848751
0             Grades_3_5                31729  37137  0.854377
1             Grades_6_8                14258  16923  0.842522
2            Grades_9_12                 9183  10963  0.837636
```

```
  project_grade_category  project_is_approved  total       Avg
3          Grades_PreK_2                37536  44225  0.848751
0             Grades_3_5                31729  37137  0.854377
1             Grades_6_8                14258  16923  0.842522
2            Grades_9_12                 9183  10963  0.837636
```

Summary

- Most number of projects are for Grades pre K - 2 i.e. 44225 with 84.87 % acceptance rate
- Second Most number of projects are for Grades 3-5 i.e. 37137 with 85.43 % acceptance rate
- Third Most number of projects are for Grades 6 - 8 i.e. 16923 with 84.25 % acceptance rate
- Least number of projects are for Grades 9 - 12 i.e. 10963 with 83.76 % acceptance rate

Univariate Analysis: project_subject_categories

In [15]:

```
catogories = list(training_data['project_subject_categories'].values)
# remove special characters from list of strings python: https://stackoverflo

# https://www.geeksforgeeks.org/removing-stop-words-nltk-python/
# https://stackoverflow.com/questions/23669024/how-to-strip-a-specific-word-f
# https://stackoverflow.com/questions/8270092/remove-all-whitespace-in-a-stri
cat_list = []
for i in catogories:
    temp = ""
    # consider we have text like this "Math & Science, Warmth, Care & Hunger"
    for j in i.split(','): # it will split it in three parts ["Math & Science
        if 'The' in j.split(): # this will split each of the catogory based o
            j=j.replace('The','') # if we have the words "The" we are going t
        j = j.replace(' ','') # we are placeing all the ' '(space) with ''(em
        temp+=j.strip()+" " #" abc ".strip() will return "abc", remove the tr
        temp = temp.replace('&','_') # we are replacing the & value into
    cat_list.append(temp.strip())
```

In [16]:

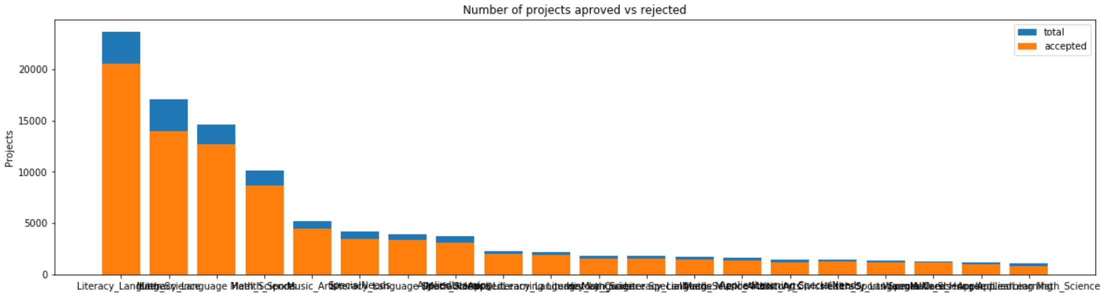
```
training_data['clean_categories'] = cat_list
training_data.drop(['project_subject_categories'], axis=1, inplace=True)
training_data.head(2)
```

Out[16]:

	Unnamed: 0	id	teacher_id	teacher_prefix	scl
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	MRS	
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	MR	

In [17]:

```
univariate_barplots(training_data, 'clean_categories', 'project_is_approved'
```



```
                      clean_categories  project_is_approved  total
Avg
24                   Literacy_Language                20520  23655
0.867470
32                        Math_Science                13991  17072
0.819529
28    Literacy_Language Math_Science                  12725  14636
0.869432
8                        Health_Sports                 8640  10177
0.848973
40                          Music_Arts                 4429   5180
0.855019



                        clean_categories  project_is_approved  tot
al        Avg
19  History_Civics Literacy_Language                  1271   14
21  0.894441
14        Health_Sports SpecialNeeds                  1215   13
91  0.873472
50                Warmth Care_Hunger                  1212   13
09  0.925898
33      Math_Science AppliedLearning                  1019   12
20  0.835246
4       AppliedLearning Math_Science                   855   10
52  0.812738
```

Summary

- Most number of projects are for Category Literacy & Language i.e. 23655 with 86.74 % acceptance rate
- Second Most number of projects are for Category Math & Science i.e. 17072 with 81.95 % acceptance rate

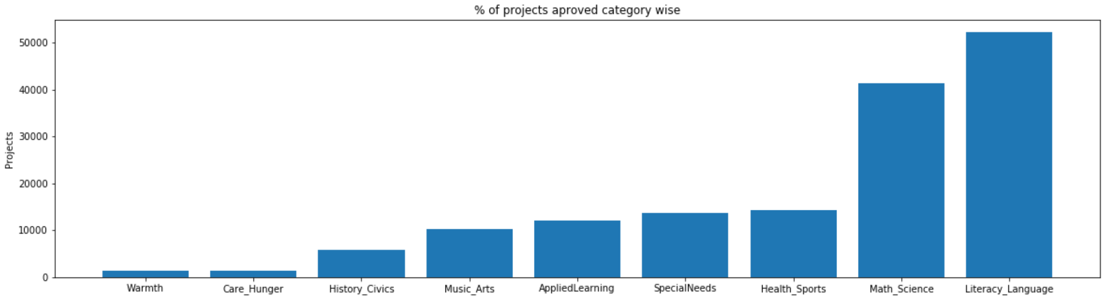
- Third Most number of projects are for Category Literacy, Language, Math & Science i.e. 14636 with 0.86.94 % acceptance rate
- Least number of projects are for Category AppliedLearning, Math & Science i.e. 1052 with 81.27 % acceptance rate

In [18]:

```
# count of all the words in corpus python: https://stackoverflow.com/a/228985
from collections import Counter
my_counter = Counter()
for word in training_data['clean_categories'].values:
    my_counter.update(word.split())
```

In [19]:

```
# dict sort by value python: https://stackoverflow.com/a/613218/4084039
cat_dict = dict(my_counter)
sorted_cat_dict = dict(sorted(cat_dict.items(), key=lambda kv: kv[1]))


ind = np.arange(len(sorted_cat_dict))
plt.figure(figsize=(20,5))
p1 = plt.bar(ind, list(sorted_cat_dict.values()))

plt.ylabel('Projects')
plt.title('% of projects aproved category wise')
plt.xticks(ind, list(sorted_cat_dict.keys()))
plt.show()
```



In [20]:

```
for i, j in sorted_cat_dict.items():
    print("{:20} :{:10}".format(i,j))
```

```
Warmth               :       1388
Care_Hunger          :       1388
History_Civics       :       5914
Music_Arts           :      10293
AppliedLearning      :      12135
SpecialNeeds         :      13642
Health_Sports        :      14223
Math_Science         :      41421
Literacy_Language    :      52239
```

1.2.5 Univariate Analysis: project_subject_subcategories

In [21]:

```
sub_catogories = list(training_data['project_subject_subcategories'].values)
# remove special characters from list of strings python: https://stackoverflo

# https://www.geeksforgeeks.org/removing-stop-words-nltk-python/
# https://stackoverflow.com/questions/23669024/how-to-strip-a-specific-word-f
# https://stackoverflow.com/questions/8270092/remove-all-whitespace-in-a-stri

sub_cat_list = []
for i in sub_catogories:
    temp = ""
    # consider we have text like this "Math & Science, Warmth, Care & Hunger"
    for j in i.split(','): # it will split it in three parts ["Math & Science
        if 'The' in j.split(): # this will split each of the catogory based o
            j=j.replace('The','') # if we have the words "The" we are going t
        j = j.replace(' ','') # we are placeing all the ' '(space) with ''(em
        temp +=j.strip()+" "#" abc ".strip() will return "abc", remove the tr
        temp = temp.replace('&','_')
    sub_cat_list.append(temp.strip())
```

In [22]:

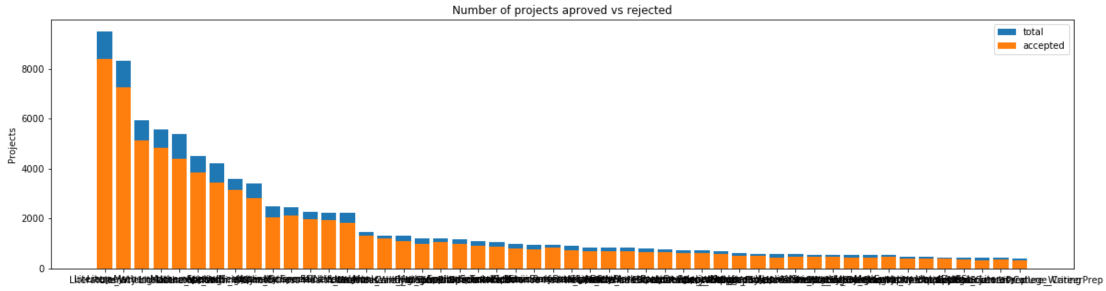
```
training_data['clean_subcategories'] = sub_cat_list
training_data.drop(['project_subject_subcategories'], axis=1, inplace=True)
training_data.head(2)
```

Out[22]:

	Unnamed: 0	id	teacher_id	teacher_prefix	scl
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	MRS	
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	MR	

In [23]:

```
univariate_barplots(training_data, 'clean_subcategories', 'project_is_approve
```



```
                clean_subcategories  project_is_approved  tota
l       Avg
317                        Literacy                 8371   948
6  0.882458
319            Literacy Mathematics                 7260   832
5  0.872072
331  Literature_Writing Mathematics                 5140   592
3  0.867803
318     Literacy Literature_Writing                 4823   557
1  0.865733
342                     Mathematics                 4385   537
9  0.815207



                    clean_subcategories  project_is_approved
total       Avg
196       EnvironmentalScience Literacy                  389
444  0.876126
127                                 ESL                  349
421  0.828979
79                   College_CareerPrep                  343
421  0.814727
17   AppliedSciences Literature_Writing                  361
420  0.859524
3    AppliedSciences College_CareerPrep                  330
405  0.814815
```

Summary

- Most number of projects are for Sub-Category Literacy i.e. 9486 with 88.2458 % acceptance rate
- Secomd Most number of projects are for Sub-Category Literacy & Mathematics i.e. 8325 with 87.2072 % acceptance rate

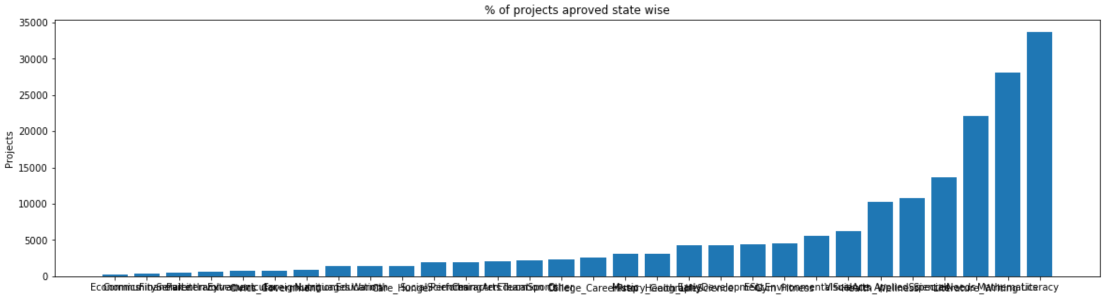
- Least number of projects are for Sub-Category AppliedSciences & College_CareerPrep i.e. 405 with 81.4815 % acceptance rate

In [24]:

```
# count of all the words in corpus python: https://stackoverflow.com/a/228985
from collections import Counter
my_counter = Counter()
for word in training_data['clean_subcategories'].values:
    my_counter.update(word.split())
```

In [25]:

```
# dict sort by value python: https://stackoverflow.com/a/613218/4084039
sub_cat_dict = dict(my_counter)
sorted_sub_cat_dict = dict(sorted(sub_cat_dict.items(), key=lambda kv: kv[1])


ind = np.arange(len(sorted_sub_cat_dict))
plt.figure(figsize=(20,5))
p1 = plt.bar(ind, list(sorted_sub_cat_dict.values()))

plt.ylabel('Projects')
plt.title('% of projects aproved state wise')
plt.xticks(ind, list(sorted_sub_cat_dict.keys()))
plt.show()
```



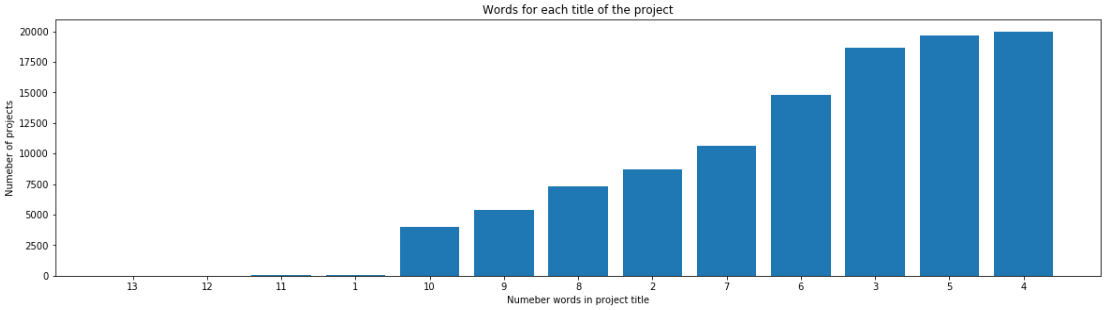
In [26]:

```
for i, j in sorted_sub_cat_dict.items():
    print("{:20} :{:10}".format(i,j))
```

```
Economics            :       269
CommunityService     :       441
FinancialLiteracy    :       568
ParentInvolvement    :       677
Extracurricular      :       810
Civics_Government    :       815
ForeignLanguages     :       890
NutritionEducation   :      1355
Warmth               :      1388
Care_Hunger          :      1388
SocialSciences       :      1920
PerformingArts       :      1961
CharacterEducation   :      2065
TeamSports           :      2192
Other                :      2372
College_CareerPrep   :      2568
Music                :      3145
History_Geography    :      3171
Health_LifeScience   :      4235
EarlyDevelopment     :      4254
ESL                  :      4367
Gym_Fitness          :      4509
EnvironmentalScience :      5591
VisualArts           :      6278
Health_Wellness      :     10234
AppliedSciences      :     10816
SpecialNeeds         :     13642
Literature_Writing   :     22179
Mathematics          :     28074
Literacy             :     33700
```

In [27]:

```
#How to calculate number of words in a string in DataFrame: https://stackover
word_count = training_data['project_title'].str.split().apply(len).value_cour
word_dict = dict(word_count)
word_dict = dict(sorted(word_dict.items(), key=lambda kv: kv[1]))


ind = np.arange(len(word_dict))
plt.figure(figsize=(20,5))
p1 = plt.bar(ind, list(word_dict.values()))

plt.ylabel('Numeber of projects')
plt.xlabel('Numeber words in project title')
plt.title('Words for each title of the project')
plt.xticks(ind, list(word_dict.keys()))
plt.show()
```

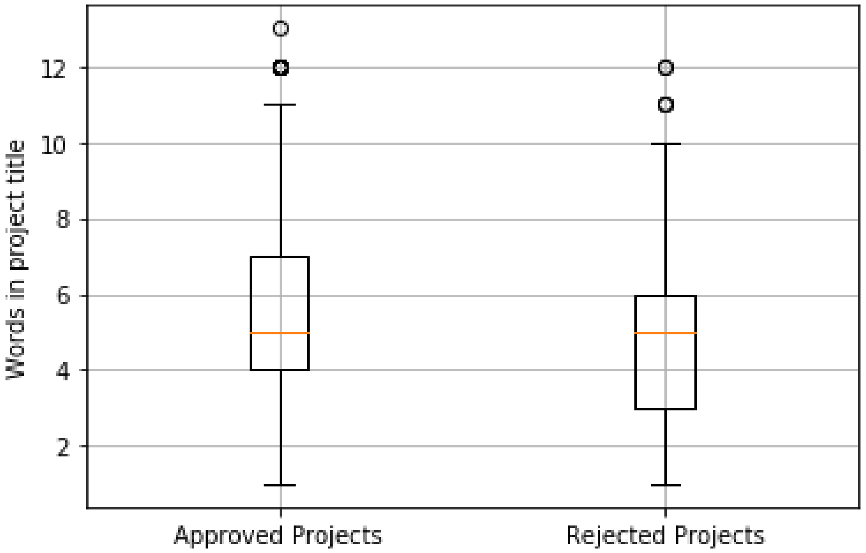


In [28]:

```
approved_title_word_count = training_data[training_data['project_is_approved'
approved_title_word_count = approved_title_word_count.values

rejected_title_word_count = training_data[training_data['project_is_approved'
rejected_title_word_count = rejected_title_word_count.values
```

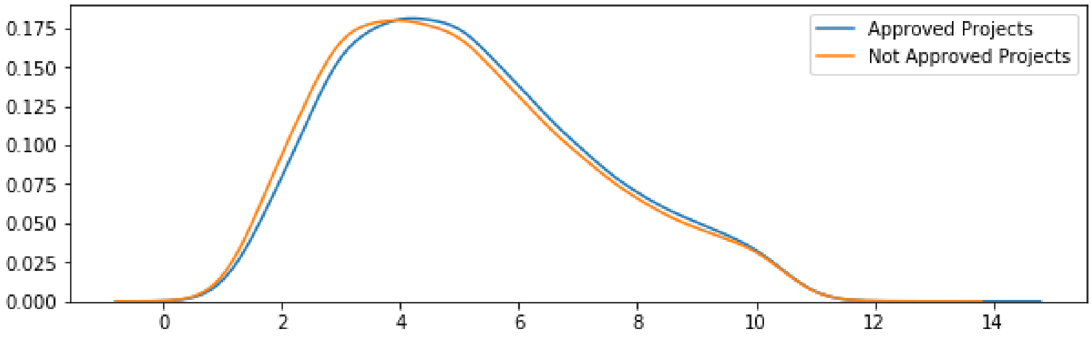
In [29]:

```
# https://glowingpython.blogspot.com/2012/09/boxplot-with-matplotlib.html
plt.boxplot([approved_title_word_count, rejected_title_word_count])
plt.xticks([1,2],('Approved Projects','Rejected Projects'))
plt.ylabel('Words in project title')
plt.grid()
plt.show()
```



In [30]:

```
plt.figure(figsize=(10,3))
sns.kdeplot(approved_title_word_count,label="Approved Projects", bw=0.6)
sns.kdeplot(rejected_title_word_count,label="Not Approved Projects", bw=0.6)
plt.legend()
plt.show()
```



Summary

- Most number of projects are accepted with 4 words in the title
- Second Most number of projects are accepted with 5 words in the title
- Third Most number of projects are accepted with 3 words in the title
- Least number of projects are accepted with 13 words in the title

1.2.7 Univariate Analysis: Text features (Project Essay's)

In [31]:

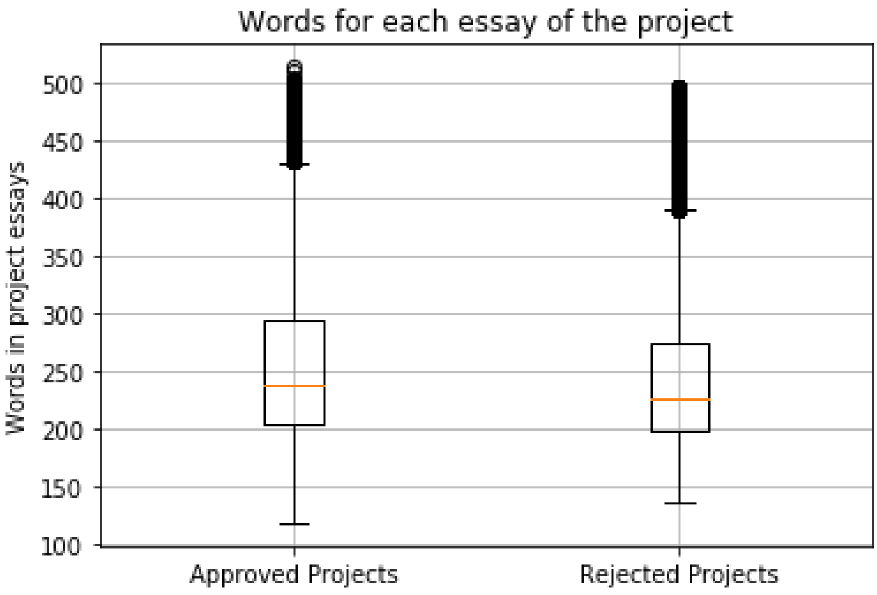
```
# merge two column text dataframe:
training_data["essay"] = training_data["project_essay_1"].map(str) +\
                        training_data["project_essay_2"].map(str) + \
                        training_data["project_essay_3"].map(str) + \
                        training_data["project_essay_4"].map(str)
```

In [32]:

```
approved_word_count = training_data[training_data['project_is_approved']==1]
approved_word_count = approved_word_count.values

rejected_word_count = training_data[training_data['project_is_approved']==0]
rejected_word_count = rejected_word_count.values
```

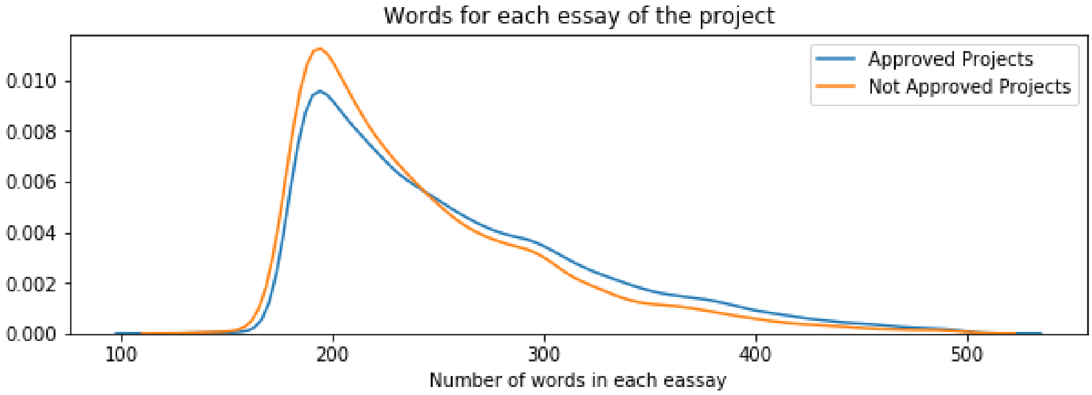
In [33]:

```
# https://glowingpython.blogspot.com/2012/09/boxplot-with-matplotlib.html
plt.boxplot([approved_word_count, rejected_word_count])
plt.title('Words for each essay of the project')
plt.xticks([1,2],('Approved Projects','Rejected Projects'))
plt.ylabel('Words in project essays')
plt.grid()
plt.show()
```



In [34]:

```
plt.figure(figsize=(10,3))
sns.distplot(approved_word_count, hist=False, label="Approved Projects")
sns.distplot(rejected_word_count, hist=False, label="Not Approved Projects")
plt.title('Words for each essay of the project')
plt.xlabel('Number of words in each eassay')
plt.legend()
plt.show()
```



Summary

- More than 50 % of accepted projects have less than 250 words in their essays
- More than 50 % of rejected projects have less than 250 words in their essays
- More than 75 % of accepted projects have less than 300 words in their essays
- More than 75 % of rejected projects have less than 300 words in their essays

1.2.8 Univariate Analysis: Cost per project

In [35]:

```
# we get the cost of the project using resource.csv file
resource_data.head(2)
```

Out[35]:

	id	description	quantity	price
0	p233245	LC652 - Lakeshore Double-Space Mobile Drying Rack	1	149.00
1	p069063	Bouncy Bands for Desks (Blue support pipes)	3	14.95

In [36]:

```
# https://stackoverflow.com/questions/22407798/how-to-reset-a-dataframes-inde
price_data = resource_data.groupby('id').agg({'price':'sum', 'quantity':'sum'
price_data.head(2)
```

Out[36]:

	id	price	quantity
0	p000001	459.56	7
1	p000002	515.89	21

In [37]:

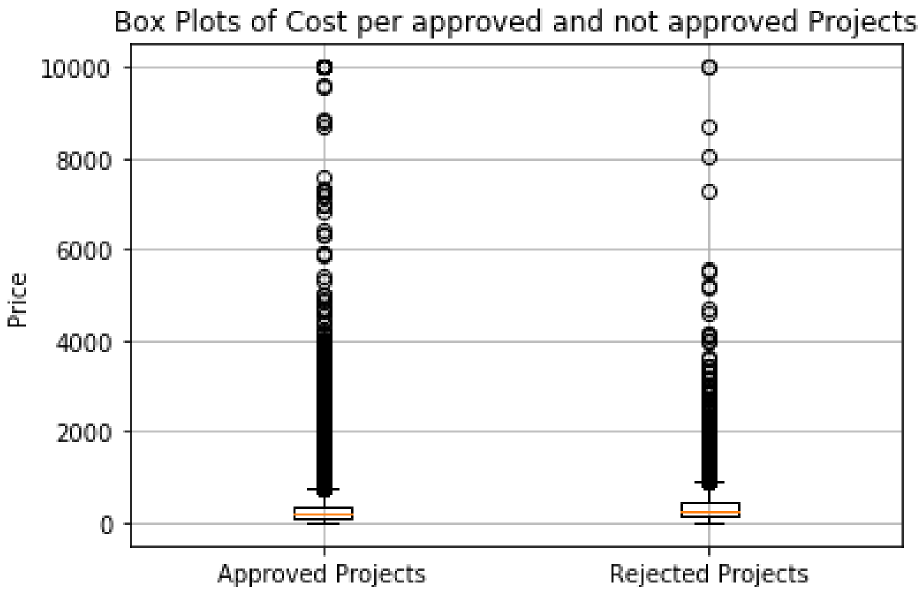
```
# join two dataframes in python:
training_data = pd.merge(training_data, price_data, on='id', how='left')
```

In [38]:

```
approved_price = training_data[training_data['project_is_approved']==1]['pric

rejected_price = training_data[training_data['project_is_approved']==0]['pric
```

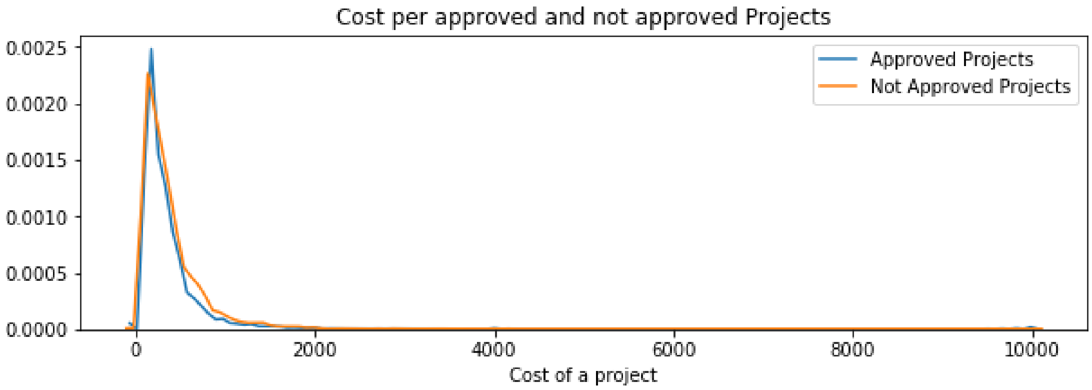
In [39]:

```
# https://glowingpython.blogspot.com/2012/09/boxplot-with-matplotlib.html
plt.boxplot([approved_price, rejected_price])
plt.title('Box Plots of Cost per approved and not approved Projects')
plt.xticks([1,2],('Approved Projects','Rejected Projects'))
plt.ylabel('Price')
plt.grid()
plt.show()
```



In [40]:

```
plt.figure(figsize=(10,3))
sns.distplot(approved_price, hist=False, label="Approved Projects")
sns.distplot(rejected_price, hist=False, label="Not Approved Projects")
plt.title('Cost per approved and not approved Projects')
plt.xlabel('Cost of a project')
plt.legend()
plt.show()
```



In [41]:

```
# http://zetcode.com/python/prettytable/
from prettytable import PrettyTable

#If you get a ModuleNotFoundError error , install prettytable using: pip3 ins

x = PrettyTable()
x.field_names = ["Percentile", "Approved Projects", "Not Approved Projects"]

for i in range(0,101,5):
    x.add_row([i,np.round(np.percentile(approved_price,i), 3), np.round(np.pe
print(x)
```

```
+------------+-------------------+-----------------------+
| Percentile | Approved Projects | Not Approved Projects |
+------------+-------------------+-----------------------+
|     0      |        0.66       |          1.97         |
|     5      |       13.59       |          41.9         |
|     10     |       33.88       |         73.67         |
|     15     |        58.0       |         99.109        |
|     20     |       77.38       |         118.56        |
|     25     |       99.95       |        140.892        |
|     30     |       116.68      |         162.23        |
|     35     |      137.232      |        184.014        |
|     40     |       157.0       |        208.632        |
|     45     |      178.265      |        235.106        |
|     50     |       198.99      |        263.145        |
|     55     |       223.99      |         292.61        |
|     60     |       255.63      |        325.144        |
|     65     |      285.412      |         362.39        |
|     70     |      321.225      |         399.99        |
|     75     |      366.075      |        449.945        |
|     80     |       411.67      |        519.282        |
|     85     |       479.0       |        618.276        |
|     90     |       593.11      |        739.356        |
|     95     |      801.598      |        992.486        |
|    100     |       9999.0      |         9999.0        |
+------------+-------------------+-----------------------+
```

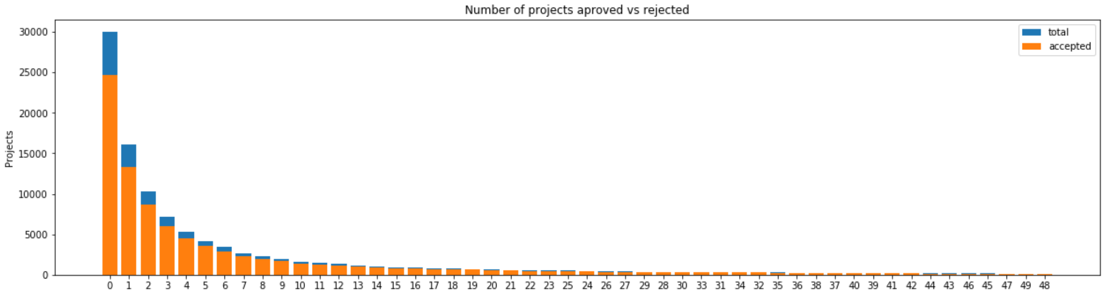
Summary

- All the projects prices are between 0.66 to 9999.0
- 50 % of accepted project prices are under 198.99
- 50 % of rejected project prices are under 263.145
- Accepted project prices are less when compared to rejected projects prices

Univariate Analysis: teacher_number_of_previously_posted_projects

In [42]:

```
univariate_barplots(training_data, 'teacher_number_of_previously_posted_proje
```

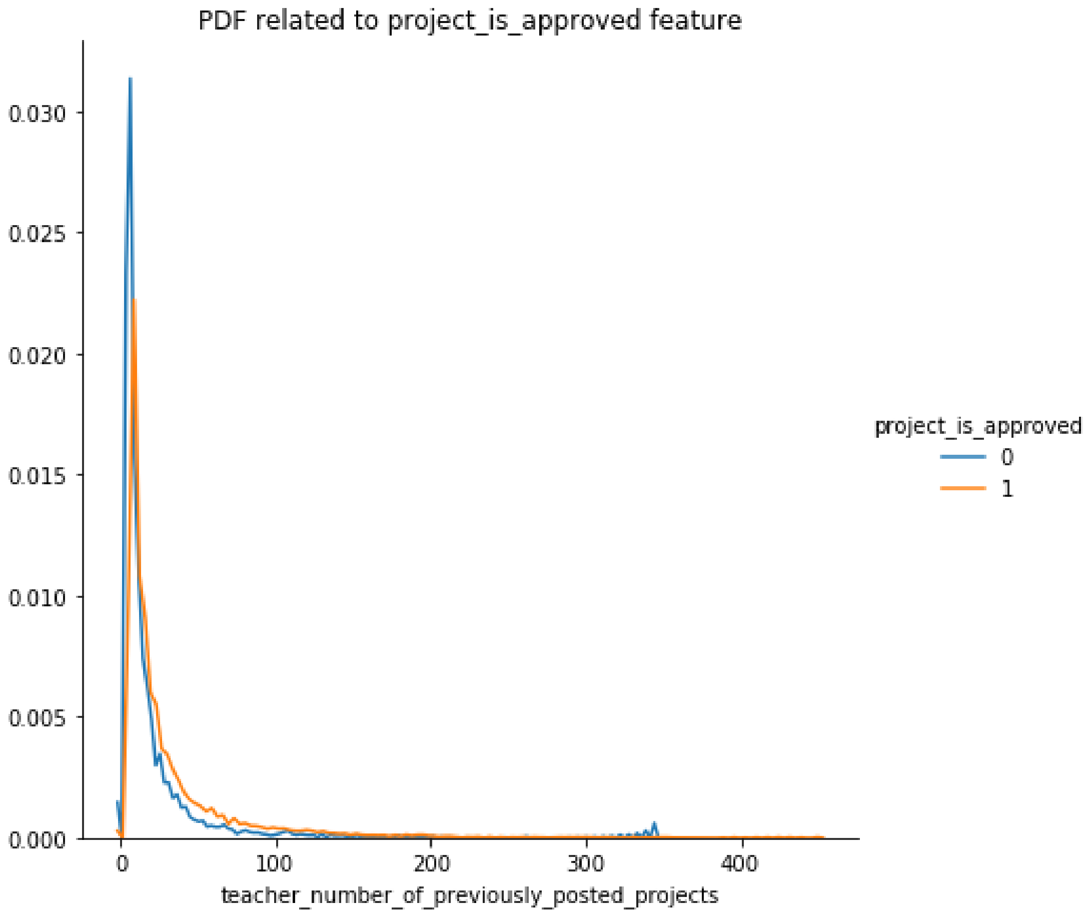


```
   teacher_number_of_previously_posted_projects  project_is
_approved  total  \
0                                             0
24652  30014
1                                             1
13329  16058
2                                             2
8705  10350
3                                             3
5997   7110
4                                             4
4452   5266

        Avg
0  0.821350
1  0.830054
2  0.841063
3  0.843460
4  0.845423



    teacher_number_of_previously_posted_projects  project_i
s_approved  total  \
46                                            46
149    164
45                                            45
141    153
47                                            47
129    144
49                                            49
128    143
48                                            48
135    140

         Avg
46  0.908537
45  0.921569
47  0.895833
49  0.895105
```

```
48  0.964286
```

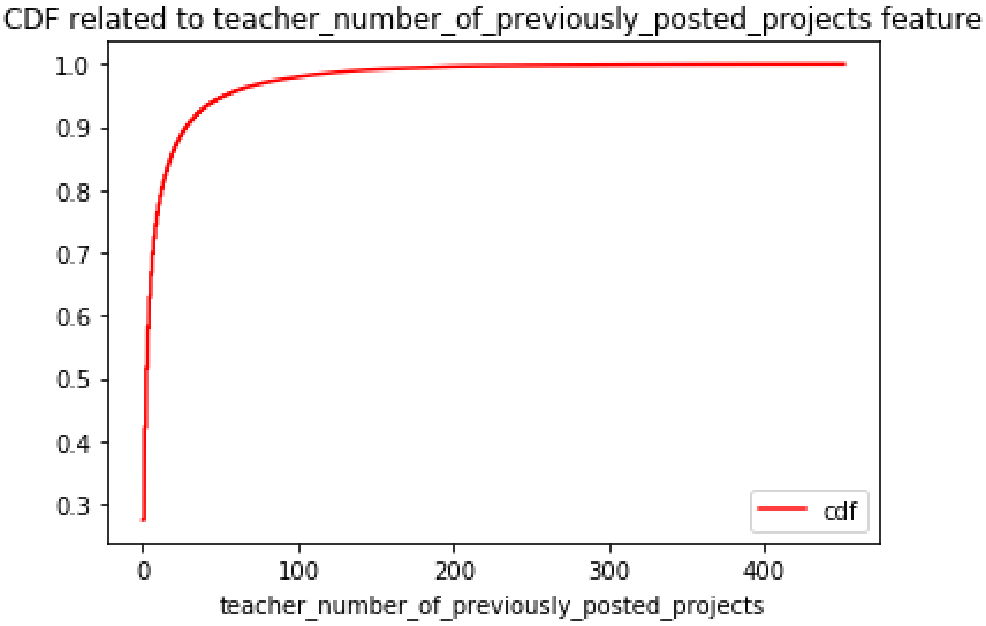
In [43]:

```
sns.FacetGrid(training_data, hue = 'project_is_approved', height = 6).map(sns
                                              'teacher_number_of_previously_pos
plt.title('PDF related to project_is_approved feature')
plt.show()
```



In [44]:

```
number_of_Points, bin_edges = np.histogram(training_data['teacher_number_of_p
                                bins = 109248, density='True')

pdf = number_of_Points/sum(number_of_Points)
cdf = np.cumsum(pdf)
plt.xlabel('teacher_number_of_previously_posted_projects')
plt.plot(bin_edges[1:], cdf, 'r-', label = 'cdf')

plt.title('CDF related to teacher_number_of_previously_posted_projects featur
plt.legend()
plt.show()
training_data['teacher_number_of_previously_posted_projects'].max()
```



Out[44]:

```
451
```

Summary

- 27.46 % of teachers have posted the projects for the first time
- The first timers have posted 30014 projects with 82.13 % acceptance rate
- The maximum number of projects posted by any teacher is 451

project_resource_summary

In [45]:

```
training_data.project_resource_summary.head(20).get
```

Out[45]:

```
<bound method NDFrame.get of 0     My students need opportunit
ies to practice beg...
1     My students need a projector to help with view...
2     My students need shine guards, athletic socks,...
3     My students need to engage in Reading and Math...
4     My students need hands on practice in mathemat...
5     My students need movement to be successful. Be...
6     My students need some dependable laptops for d...
7     My students need ipads to help them access a w...
8     My students need three devices and three manag...
9     My students need great books to use during Ind...
10    My students need books by their favorite autho...
11    My students need paper, three chromebooks, and...
12    My students need 3D and 4D life science activi...
13    My students need access to technology that wil...
14    My students need 5 tablets for our classroom t...
15    My students need activities to play during rec...
16    My students need 2 LeapPad that will engage th...
17    My students need Chromebooks to publish writte...
18    My students need privacy partitions to use whi...
19    My students need 7 Hokki stools to encourage a...
Name: project_resource_summary, dtype: object>
```

In [46]:

```
summary_list = list(training_data['project_resource_summary'].values)

project_resource_summary_list = []
for i in summary_list:
    if re.search('\d',  i):
        project_resource_summary_list.append(1)
    else:
        project_resource_summary_list.append(0)
```

In [47]:

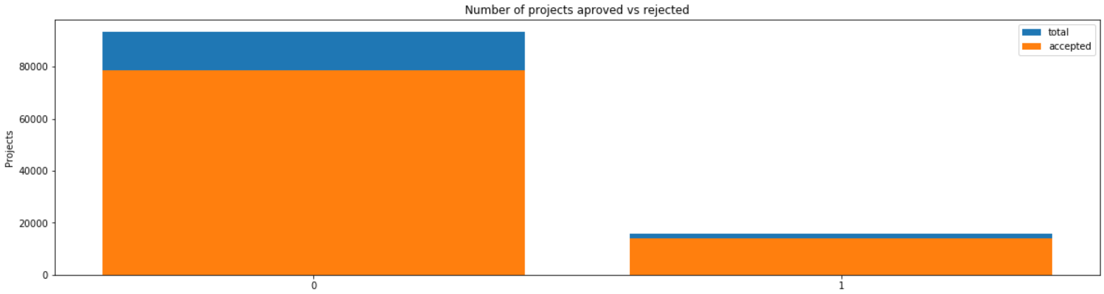
```
training_data['project_resource_summary_with_digits'] = project_resource_summ
training_data.head(20)
```

Out[47]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	MRS	IN
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	MR	FL

In [48]:

```
univariate_barplots(training_data, 'project_resource_summary_with_digits', 'p
```

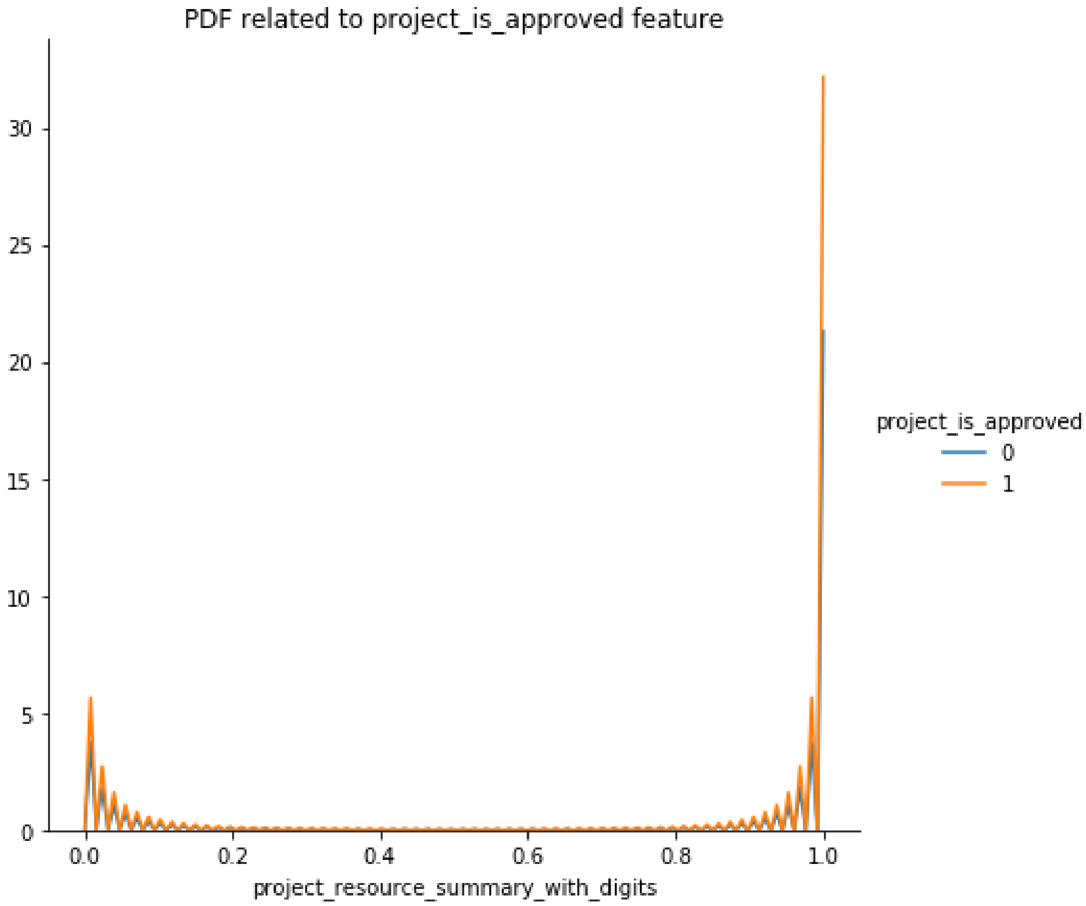


```
   project_resource_summary_with_digits  project_is_approved
total        Avg
0                                     0                78616
93492  0.840885
1                                     1                14090
15756  0.894263
```

```
   project_resource_summary_with_digits  project_is_approved
total        Avg
0                                     0                78616
93492  0.840885
1                                     1                14090
15756  0.894263
```

In [49]:

```
sns.FacetGrid(training_data, hue = 'project_is_approved', height = 6).map(sns
                                                   'project_resource_summary_with_di
plt.title('PDF related to project_is_approved feature')
plt.show()
```



In [50]:

```
training_data.head(2)
```

Out[50]:

	Unnamed: 0	id	teacher_id	teacher_prefix	scl
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	MRS	
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	MR	

2 rows × 21 columns

Summary

- 93492 projects were submitted without any digits in their essays with 84.0885 % acceptance ratio
- 15756 projects were submitted without any digits in their essays with 89.4263 % acceptance ratio
- Projects with digits in their essays have 5.33 % more acceptance ratio than projects without digits

In [51]:

```python
# printing some random essays.
print(training_data['essay'].values[0])
print("\n\n")
print(training_data['essay'].values[150])
print("\n\n")
print(training_data['essay'].values[1000])
print("\n\n")
print(training_data['essay'].values[20000])
print("\n\n")
print(training_data['essay'].values[99999])
print("\n\n")
```

```
My students are English learners that are working on English a
s their second or third languages. We are a melting pot of ref
ugees, immigrants, and native-born Americans bringing the gift
of language to our school. \r\n\r\n We have over 24 languages
represented in our English Learner program with students at ev
ery level of mastery.  We also have over 40 countries represen
ted with the families within our school.  Each student brings
a wealth of knowledge and experiences to us that open our eyes
to new cultures, beliefs, and respect.\"The limits of your lan
guage are the limits of your world.\"-Ludwig Wittgenstein  Our
English learner's have a strong support system at home that be
gs for more resources.  Many times our parents are learning to
read and speak English along side of their children.  Sometime
s this creates barriers for parents to be able to help their c
hild learn phonetics, letter recognition, and other reading sk
ills.\r\n\r\nBy providing these dvd's and players, students ar
e able to continue their mastery of the English language even
if no one at home is able to assist.  All families with studen
ts within the Level 1 proficiency status, will be a offered to
be a part of this program.  These educational videos will be s
pecially chosen by the English Learner Teacher and will be sen
t home regularly to watch.  The videos are to help the child d
evelop early reading skills.\r\n\r\nParents that do not have a
ccess to a dvd player will have the opportunity to check out a
dvd player to use for the year.  The plan is to use these vide
os and educational dvd's for the years to come for other EL st
udents.\r\nnannan



The 51 fifth grade students that will cycle through my classro
om this year all love learning, at least most of the time. At
our school, 97.3% of the students receive free or reduced pric
e lunch. Of the 560 students, 97.3% are minority students. \r
\nThe school has a vibrant community that loves to get togethe
r and celebrate. Around Halloween there is a whole school para
de to show off the beautiful costumes that students wear. On C
```

inco de Mayo we put on a big festival with crafts made by the students, dances, and games. At the end of the year the school hosts a carnival to celebrate the hard work put in during the school year, with a dunk tank being the most popular activity. My students will use these five brightly colored Hokki stools in place of regular, stationary, 4-legged chairs. As I will only have a total of ten in the classroom and not enough for each student to have an individual one, they will be used in a variety of ways. During independent reading time they will be used as special chairs students will each use on occasion. I will utilize them in place of chairs at my small group tables during math and reading times. The rest of the day they will be used by the students who need the highest amount of movement in their life in order to stay focused on school.\r\n\r\nWhenever asked what the classroom is missing, my students always say more Hokki Stools. They can't get their fill of the 5 stools we already have. When the students are sitting in group with me on the Hokki Stools, they are always moving, but at the same time doing their work. Anytime the students get to pick where they can sit, the Hokki Stools are the first to be taken. There are always students who head over to the kidney table to get one of the stools who are disappointed as there are not enough of them. \r\n\r\nWe ask a lot of students to sit for 7 hours a day. The Hokki stools will be a compromise that allow my students to do desk work and move at the same time. These stools will help students to meet their 60 minutes a day of movement by allowing them to activate their core muscles for balance while they sit. For many of my students, these chairs will take away the barrier that exists in schools for a child who can't sit still.nannan

How do you remember your days of school? Was it in a sterile environment with plain walls, rows of desks, and a teacher in front of the room? A typical day in our room is nothing like that. I work hard to create a warm inviting themed room for my students look forward to coming to each day.\r\n\r\nMy class is made up of 28 wonderfully unique boys and girls of mixed races in Arkansas.\r\nThey attend a Title I school, which means there is a high enough percentage of free and reduced-price lunch to qualify. Our school is an \"open classroom\" concept, which is very unique as there are no walls separating the classrooms. These 9 and 10 year-old students are very eager learners; they are like sponges, absorbing all the information and experiences and keep on wanting more.With these resources such as the comfy red throw pillows and the whimsical nautical hanging decor and the blue fish nets, I will be able to help create the mood in our classroom setting to be one of a themed nautical environment. Creating a classroom environment is very important in the success in each and every child's education. The nautical photo props will be used with each child as they step foot into our classroom for the first time on Meet the Teacher even ing. I'll take pictures of each child with them, have them developed, and then hung in our classroom ready for their first day of 4th grade. This kind gesture will set the tone before even the first day of school! The nautical thank you cards will be used throughout the year by the students as they create thank you cards to their team groups.\r\n\r\nYour generous donations will help me to help make our classroom a fun, inviting, learning environment from day one.\r\n\r\nIt costs lost of money out of my own pocket on resources to get our classroom ready. Please consider helping with this project to make our new school year a very successful one. Thank you!nannan

My kindergarten students have varied disabilities ranging from speech and language delays, cognitive delays, gross/fine motor delays, to autism. They are eager beavers and always strive to work their hardest working past their limitations. \r\n\r\nThe materials we have are the ones I seek out for my students. I teach in a Title I school where most of the students receive free or reduced price lunch. Despite their disabilities and limitations, my students love coming to school and come eager to learn and explore.Have you ever felt like you had ants in your pants and you needed to groove and move as you were in a meeting? This is how my kids feel all the time. The want to be able to move as they learn or so they say.Wobble chairs are the answer and I love then because they develop their core, which enhances gross motor and in Turn fine motor skills. \r\nThey also want to learn through games, my kids don't want to sit and do worksheets. They want to learn to count by jumping and playing. Physical engagement is the key to our success. The number toss and color and shape mats can make that happen. My students will forget they are doing work and just have the fun a 6 year old deserves.nannan

The mediocre teacher tells. The good teacher explains. The superior teacher demonstrates. The great teacher inspires. -William A. Ward\r\n\r\nMy school has 803 students which is makeup is 97.6% African-American, making up the largest segment of the student body. A typical school in Dallas is made up of 23.2% African-American students. Most of the students are on free or reduced lunch. We aren't receiving doctors, lawyers, or engineers children from rich backgrounds or neighborhoods. As an educator I am inspiring minds of young children and we focus not only on academics but one smart, effective, efficient, and disciplined students with good character.In our classroom we can utilize the Bluetooth for swift transitions during class. I use a speaker which doesn't amplify the sound enough to receive the message. Due to the volume of my speaker my students can't hear videos or books clearly and it isn't making the lessons as meaningful. But with the bluetooth speaker my students will

```
be able to hear and I can stop, pause and replay it at any tim
e.\r\nThe cart will allow me to have more room for storage of
things that are needed for the day and has an extra part to it
I can use.  The table top chart has all of the letter, words a
nd pictures for students to learn about different letters and
it is more accessible.nannan
```

In [52]:

```
# https://stackoverflow.com/a/47091490/4084039
import re

def decontracted(phrase):
    # specific
    phrase = re.sub(r"won't", "will not", phrase)
    phrase = re.sub(r"can\'t", "can not", phrase)

    # general
    phrase = re.sub(r"n\'t", " not", phrase)
    phrase = re.sub(r"\'re", " are", phrase)
    phrase = re.sub(r"\'s", " is", phrase)
    phrase = re.sub(r"\'d", " would", phrase)
    phrase = re.sub(r"\'ll", " will", phrase)
    phrase = re.sub(r"\'t", " not", phrase)
    phrase = re.sub(r"\'ve", " have", phrase)
    phrase = re.sub(r"\'m", " am", phrase)
    return phrase
```

In [53]:

```
formatted_essay = decontracted(training_data['essay'].values[20000])
print(formatted_essay)
```

```
My kindergarten students have varied disabilities ranging from
speech and language delays, cognitive delays, gross/fine motor
delays, to autism. They are eager beavers and always strive to
work their hardest working past their limitations. \r\n\r\nThe
materials we have are the ones I seek out for my students. I t
each in a Title I school where most of the students receive fr
ee or reduced price lunch.  Despite their disabilities and lim
itations, my students love coming to school and come eager to
learn and explore.Have you ever felt like you had ants in your
pants and you needed to groove and move as you were in a meeti
ng? This is how my kids feel all the time. The want to be able
to move as they learn or so they say.Wobble chairs are the ans
wer and I love then because they develop their core, which enh
ances gross motor and in Turn fine motor skills. \r\nThey also
want to learn through games, my kids do not want to sit and do
worksheets. They want to learn to count by jumping and playin
g. Physical engagement is the key to our success. The number t
oss and color and shape mats can make that happen. My students
will forget they are doing work and just have the fun a 6 year
old deserves.nannan
```

In [54]:

```
# \r \n \t remove from string python: http://texthandler.com/info/remove-line
formatted_essay = formatted_essay.replace('\\r', ' ')
formatted_essay = formatted_essay.replace('\\"', ' ')
formatted_essay = formatted_essay.replace('\\n', ' ')
print(formatted_essay)
```

```
My kindergarten students have varied disabilities ranging from
speech and language delays, cognitive delays, gross/fine motor
delays, to autism. They are eager beavers and always strive to
work their hardest working past their limitations.     The mat
erials we have are the ones I seek out for my students. I teac
h in a Title I school where most of the students receive free
or reduced price lunch.  Despite their disabilities and limita
tions, my students love coming to school and come eager to lea
rn and explore.Have you ever felt like you had ants in your pa
nts and you needed to groove and move as you were in a meetin
g? This is how my kids feel all the time. The want to be able
to move as they learn or so they say.Wobble chairs are the ans
wer and I love then because they develop their core, which enh
ances gross motor and in Turn fine motor skills.   They also w
ant to learn through games, my kids do not want to sit and do
worksheets. They want to learn to count by jumping and playin
g. Physical engagement is the key to our success. The number t
oss and color and shape mats can make that happen. My students
will forget they are doing work and just have the fun a 6 year
old deserves.nannan
```

In [55]:

```
#remove spacial character: https://stackoverflow.com/a/5843547/4084039
formatted_essay = re.sub('[^A-Za-z0-9]+', ' ', formatted_essay)
print(formatted_essay)
```

```
My kindergarten students have varied disabilities ranging from
speech and language delays cognitive delays gross fine motor d
elays to autism They are eager beavers and always strive to wo
rk their hardest working past their limitations The materials
we have are the ones I seek out for my students I teach in a T
itle I school where most of the students receive free or reduc
ed price lunch Despite their disabilities and limitations my s
tudents love coming to school and come eager to learn and expl
ore Have you ever felt like you had ants in your pants and you
needed to groove and move as you were in a meeting This is how
my kids feel all the time The want to be able to move as they
learn or so they say Wobble chairs are the answer and I love t
hen because they develop their core which enhances gross motor
and in Turn fine motor skills They also want to learn through
games my kids do not want to sit and do worksheets They want t
o learn to count by jumping and playing Physical engagement is
the key to our success The number toss and color and shape mat
s can make that happen My students will forget they are doing
work and just have the fun a 6 year old deserves nannan
```

In [56]:

```
# we are removing the words from the stop words list: 'no', 'nor', 'not'
stopwords= ['i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ourselves', 'you
            "you'll", "you'd", 'your', 'yours', 'yourself', 'yourselves', 'he
            'she', "she's", 'her', 'hers', 'herself', 'it', "it's", 'its', 'i
            'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this', '
            'am', 'is', 'are', 'was', 'were', 'be', 'been', 'being', 'have',
            'did', 'doing', 'a', 'an', 'the', 'and', 'but', 'if', 'or', 'beca
            'at', 'by', 'for', 'with', 'about', 'against', 'between', 'into',
            'above', 'below', 'to', 'from', 'up', 'down', 'in', 'out', 'on',
            'then', 'once', 'here', 'there', 'when', 'where', 'why', 'how', '
            'most', 'other', 'some', 'such', 'only', 'own', 'same', 'so', 'th
            's', 't', 'can', 'will', 'just', 'don', "don't", 'should', "shoul
            've', 'y', 'ain', 'aren', "aren't", 'couldn', "couldn't", 'didn',
            "hadn't", 'hasn', "hasn't", 'haven', "haven't", 'isn', "isn't", '
            "mustn't", 'needn', "needn't", 'shan', "shan't", 'shouldn', "shou
            'won', "won't", 'wouldn', "wouldn't"]
```

In [57]:

```
# Combining all the above statemennts
from tqdm import tqdm
preprocessed_essays = []
# tqdm is for printing the status bar
for sentance in tqdm(training_data['essay'].values):
    sent = decontracted(sentance)
    sent = sent.replace('\\r', ' ')
    sent = sent.replace('\\"', ' ')
    sent = sent.replace('\\n', ' ')
    sent = re.sub('[^A-Za-z0-9]+', ' ', sent)
    sent = ' '.join(e for e in sent.split() if e not in stopwords)
    preprocessed_essays.append(sent.lower().strip())
```

```
100%|███████████████████████████████████████████
███████████| 109248/109248 [00:53<00:00, 2055.54it/s]
```

In [58]:

```
# after preprocesing
print(len(preprocessed_essays))
```

```
109248
```

In [59]:

```
training_data.head(30)
```

Out[59]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	MRS	IN
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	MR	FL

In [60]:

```
# Combining all the above statemennts
from tqdm import tqdm
preprocessed_titles = []
# tqdm is for printing the status bar
for sentance in tqdm(training_data['project_title'].values):
    sent = decontracted(sentance)
    sent = sent.replace('\\r', ' ')
    sent = sent.replace('\\"', ' ')
    sent = sent.replace('\\n', ' ')
    sent = re.sub('[^A-Za-z0-9]+', ' ', sent)
    sent = ' '.join(e for e in sent.split() if e not in stopwords)
    preprocessed_titles.append(sent.lower().strip())
```

```
100%|████████████████████████████████████████████████████████
██████████████| 109248/109248 [00:02<00:00, 44584.12it/s]
```

In [61]:

```
print(preprocessed_titles[20000],'\n\n')

print(preprocessed_essays[20000])

training_data.values[20000]
```

```
we need to move it while we input it


my kindergarten students varied disabilities ranging speech la
nguage delays cognitive delays gross fine motor delays autism
they eager beavers always strive work hardest working past lim
itations the materials ones i seek students i teach title i sc
hool students receive free reduced price lunch despite disabil
ities limitations students love coming school come eager learn
explore have ever felt like ants pants needed groove move meet
ing this kids feel time the want able move learn say wobble ch
airs answer i love develop core enhances gross motor turn fine
motor skills they also want learn games kids not want sit work
sheets they want learn count jumping playing physical engageme
nt key success the number toss color shape mats make happen my
students forget work fun 6 year old deserves nannan
```

Out[61]:

```
array([65303, 'p115814', 'ffa0035d53b0c5379720954131051f60',
'MRS', 'NJ',
       '2016-08-11 09:06:14', 'Grades_PreK_2',
       'We Need To Move It While We Input It!',
       'My kindergarten students have varied disabilities rang
ing from speech and language delays, cognitive delays, gross/f
ine motor delays, to autism. They are eager beavers and always
strive to work their hardest working past their limitations.
\\r\\n\\r\\nThe materials we have are the ones I seek out for
my students. I teach in a Title I school where most of the stu
dents receive free or reduced price lunch.  Despite their disa
bilities and limitations, my students love coming to school an
d come eager to learn and explore.',
       "Have you ever felt like you had ants in your pants and
you needed to groove and move as you were in a meeting? This i
s how my kids feel all the time. The want to be able to move a
s they learn or so they say.Wobble chairs are the answer and I
love then because they develop their core, which enhances gros
s motor and in Turn fine motor skills. \\r\\nThey also want to
learn through games, my kids don't want to sit and do workshee
ts. They want to learn to count by jumping and playing. Physic
al engagement is the key to our success. The number toss and c
olor and shape mats can make that happen. My students will for
get they are doing work and just have the fun a 6 year old des
erves.",
       nan, nan,
       'My students need wobble chairs, number toss games and
colors and shapes mats to make our learning fun, hands on and
physically engaging!',
       21, 1, 'Health_Sports SpecialNeeds',
       'Health_Wellness SpecialNeeds',
       "My kindergarten students have varied disabilities rang
ing from speech and language delays, cognitive delays, gross/f
ine motor delays, to autism. They are eager beavers and always
strive to work their hardest working past their limitations.
\\r\\n\\r\\nThe materials we have are the ones I seek out for
my students. I teach in a Title I school where most of the stu
dents receive free or reduced price lunch.  Despite their disa
bilities and limitations, my students love coming to school an
d come eager to learn and explore.Have you ever felt like you
had ants in your pants and you needed to groove and move as yo
u were in a meeting? This is how my kids feel all the time. Th
e want to be able to move as they learn or so they say.Wobble
chairs are the answer and I love then because they develop the
ir core, which enhances gross motor and in Turn fine motor ski
lls. \\r\\nThey also want to learn through games, my kids do
n't want to sit and do worksheets. They want to learn to count
by jumping and playing. Physical engagement is the key to our
success. The number toss and color and shape mats can make tha
t happen. My students will forget they are doing work and just
have the fun a 6 year old deserves.nannan",
       171.94, 12, 0], dtype=object)
```

Preparing data for models

In [62]:

```
training_data.columns
```

Out[62]:

```
Index(['Unnamed: 0', 'id', 'teacher_id', 'teacher_prefix', 'sc
hool_state',
       'project_submitted_datetime', 'project_grade_category',
'project_title',
       'project_essay_1', 'project_essay_2', 'project_essay_
3',
       'project_essay_4', 'project_resource_summary',
       'teacher_number_of_previously_posted_projects', 'projec
t_is_approved',
       'clean_categories', 'clean_subcategories', 'essay', 'pr
ice', 'quantity',
       'project_resource_summary_with_digits'],
      dtype='object')
```

we are going to consider

```
    - school_state : categorical data
    - clean_categories : categorical data
    - clean_subcategories : categorical data
    - project_grade_category : categorical data
    - teacher_prefix : categorical data

    - project_title : text data
    - text : text data
    - project_resource_summary: text data

    - quantity : numerical
    - teacher_number_of_previously_posted_projects : numerical
    - price : numerical
```

Vectorizing Categorical data

In [63]:

```
# we use count vectorizer to convert the values into one hot encoded feature
from sklearn.feature_extraction.text import CountVectorizer
vectorizer = CountVectorizer(vocabulary=list(sorted_cat_dict.keys()), lowerca
vectorizer.fit(training_data['clean_categories'].values)
print(vectorizer.get_feature_names())


categories_one_hot = vectorizer.transform(training_data['clean_categories'].
print("Shape of matrix after one hot encodig ",categories_one_hot.shape)
```

```
['Warmth', 'Care_Hunger', 'History_Civics', 'Music_Arts', 'App
liedLearning', 'SpecialNeeds', 'Health_Sports', 'Math_Scienc
e', 'Literacy_Language']
Shape of matrix after one hot encodig  (109248, 9)
```

In [64]:

```
# we use count vectorizer to convert the values into one hot encoded features
vectorizer = CountVectorizer(vocabulary=list(sorted_sub_cat_dict.keys()), low
vectorizer.fit(training_data['clean_subcategories'].values)
print(vectorizer.get_feature_names())


sub_categories_one_hot = vectorizer.transform(training_data['clean_subcategor
print("Shape of matrix after one hot encodig ",sub_categories_one_hot.shape)
```

```
['Economics', 'CommunityService', 'FinancialLiteracy', 'Parent
Involvement', 'Extracurricular', 'Civics_Government', 'Foreign
Languages', 'NutritionEducation', 'Warmth', 'Care_Hunger', 'So
cialSciences', 'PerformingArts', 'CharacterEducation', 'TeamSp
orts', 'Other', 'College_CareerPrep', 'Music', 'History_Geogra
phy', 'Health_LifeScience', 'EarlyDevelopment', 'ESL', 'Gym_Fi
tness', 'EnvironmentalScience', 'VisualArts', 'Health_Wellnes
s', 'AppliedSciences', 'SpecialNeeds', 'Literature_Writing',
'Mathematics', 'Literacy']
Shape of matrix after one hot encodig  (109248, 30)
```

In [65]:

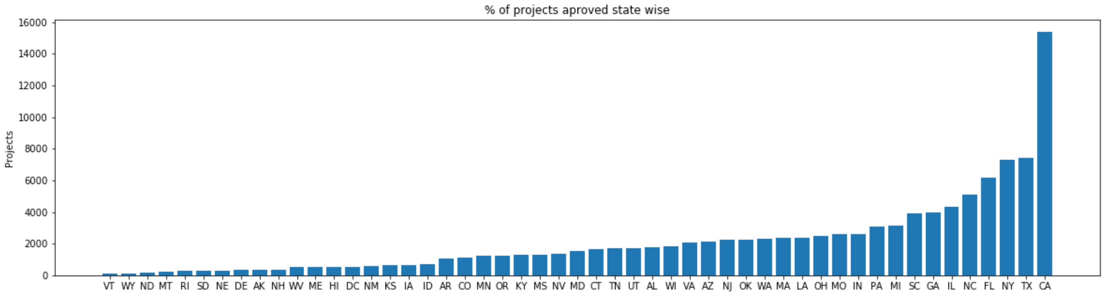
```
# count of all the words in corpus python: https://stackoverflow.com/a/228985
from collections import Counter
state_counter = Counter()
for word in training_data['school_state'].values:
    state_counter.update(word.split())
```

In [66]:

```
# dict sort by value python: https://stackoverflow.com/a/613218/4084039
school_state_dict = dict(state_counter)
sorted_school_state_dict = dict(sorted(school_state_dict.items(), key=lambda
```

In [67]:

```
ind = np.arange(len(sorted_school_state_dict))
plt.figure(figsize=(20,5))
p1 = plt.bar(ind, list(sorted_school_state_dict.values()))

plt.ylabel('Projects')
plt.title('% of projects aproved state wise')
plt.xticks(ind, list(sorted_school_state_dict.keys()))
plt.show()
```



In [68]:

```
for i, j in sorted_school_state_dict.items():
    print("{:20} :{:10}".format(i,j))
```

```
VT                   :        80
WY                   :        98
ND                   :       143
MT                   :       245
RI                   :       285
SD                   :       300
NE                   :       309
DE                   :       343
AK                   :       345
NH                   :       348
WV                   :       503
ME                   :       505
HI                   :       507
DC                   :       516
NM                   :       557
KS                   :       634
IA                   :       666
ID                   :       693
AR                   :      1049
CO                   :      1111
MN                   :      1208
OR                   :      1242
KY                   :      1304
MS                   :      1323
NV                   :      1367
MD                   :      1514
CT                   :      1663
TN                   :      1688
UT                   :      1731
AL                   :      1762
WI                   :      1827
VA                   :      2045
AZ                   :      2147
NJ                   :      2237
OK                   :      2276
WA                   :      2334
MA                   :      2389
LA                   :      2394
OH                   :      2467
MO                   :      2576
IN                   :      2620
PA                   :      3109
MI                   :      3161
SC                   :      3936
GA                   :      3963
IL                   :      4350
NC                   :      5091
```

```
FL                    :      6185
NY                    :      7318
TX                    :      7396
CA                    :     15388
```

In [69]:

```
vectorizer = CountVectorizer(vocabulary=list(sorted_school_state_dict.keys())
vectorizer.fit(training_data['school_state'].values)
print(vectorizer.get_feature_names())


school_state_one_hot = vectorizer.transform(training_data['school_state'].val
print("Shape of matrix after one hot encodig ",school_state_one_hot.shape)
```

```
['VT', 'WY', 'ND', 'MT', 'RI', 'SD', 'NE', 'DE', 'AK', 'NH',
'WV', 'ME', 'HI', 'DC', 'NM', 'KS', 'IA', 'ID', 'AR', 'CO', 'M
N', 'OR', 'KY', 'MS', 'NV', 'MD', 'CT', 'TN', 'UT', 'AL', 'W
I', 'VA', 'AZ', 'NJ', 'OK', 'WA', 'MA', 'LA', 'OH', 'MO', 'I
N', 'PA', 'MI', 'SC', 'GA', 'IL', 'NC', 'FL', 'NY', 'TX', 'C
A']
Shape of matrix after one hot encodig  (109248, 51)
```

Vectorizing teacher_prefix

In [70]:

```
# count of all the words in corpus python: https://stackoverflow.com/a/228985
from collections import Counter
teacher_prefix_counter = Counter()
for word in training_data['teacher_prefix'].values:
    teacher_prefix_counter.update(word.split())
```

In [71]:

```
# dict sort by value python: https://stackoverflow.com/a/613218/4084039
teacher_prefix_dict = dict(teacher_prefix_counter)
sorted_teacher_prefix_dict = dict(sorted(teacher_prefix_dict.items(), key=lam
```

In [72]:

```
for i, j in sorted_teacher_prefix_dict.items():
    print("{:20} :{:10}".format(i,j))
```

```
DR                   :        13
TEACHER              :      2360
MR                   :     10648
MS                   :     38955
MRS                  :     57272
```

In [73]:

```
vectorizer = CountVectorizer(vocabulary=list(sorted_teacher_prefix_dict.keys(
vectorizer.fit(training_data['teacher_prefix'].values)
print(vectorizer.get_feature_names())


teacher_prefix_one_hot = vectorizer.transform(training_data['teacher_prefix']
print("Shape of matrix after one hot encodig ",teacher_prefix_one_hot.shape)
```

```
['DR', 'TEACHER', 'MR', 'MS', 'MRS']
Shape of matrix after one hot encodig  (109248, 5)
```

Vectorizing project_grade_category

In [74]:

```
project_grade_counter = Counter()
for word in training_data['project_grade_category'].values:
    project_grade_counter.update(word.split())
```

In [75]:

```
project_grade_dict = dict(project_grade_counter)
sorted_project_grade_dict = dict(sorted(project_grade_dict.items(), key=lambd
```

In [76]:

```
for i, j in sorted_project_grade_dict.items():
    print("{:20} :{:10}".format(i,j))
```

```
Grades_9_12          :     10963
Grades_6_8           :     16923
Grades_3_5           :     37137
Grades_PreK_2        :     44225
```

In [77]:

```
vectorizer = CountVectorizer(vocabulary=list(sorted_project_grade_dict.keys()
vectorizer.fit(training_data['project_grade_category'].values)
print(vectorizer.get_feature_names())


project_grade_category_one_hot = vectorizer.transform(training_data['project_
print("Shape of matrix after one hot encodig ",project_grade_category_one_hot
```

```
['Grades_9_12', 'Grades_6_8', 'Grades_3_5', 'Grades_PreK_2']
Shape of matrix after one hot encodig  (109248, 4)
```

Vectorizing Text data

1.4.2.1

In [78]:

```
# We are considering only the words which appeared in at least 10 documents(r
vectorizer = CountVectorizer(min_df=10)
essays_bow = vectorizer.fit_transform(preprocessed_essays)
print("Shape of matrix after one hot encodig ",essays_bow.shape)
```

```
Shape of matrix after one hot encodig  (109248, 16623)
```

In [79]:

```
# We are considering only the words which appeared in at least 10 documents(r
vectorizer = CountVectorizer(min_df=10)
titles_bow = vectorizer.fit_transform(preprocessed_titles)
print("Shape of matrix after one hot encodig ",titles_bow.shape)
```

```
Shape of matrix after one hot encodig  (109248, 3329)
```

In [80]:

```
from sklearn.feature_extraction.text import TfidfVectorizer
vectorizer = TfidfVectorizer(min_df=10)
essays_tfidf = vectorizer.fit_transform(preprocessed_essays)
print("Shape of matrix after one hot encodig ",essays_tfidf.shape)
```

```
Shape of matrix after one hot encodig  (109248, 16623)
```

In [81]:

```
from sklearn.feature_extraction.text import TfidfVectorizer
vectorizer = TfidfVectorizer(min_df=10)
titles_tfidf = vectorizer.fit_transform(preprocessed_titles)
print("Shape of matrix after one hot encodig ",titles_tfidf.shape)
```

```
Shape of matrix after one hot encodig  (109248, 3329)
```

In [82]:

```
'''# Reading glove vectors in python: https://stackoverflow.com/a/38230349/40
def loadGloveModel(gloveFile):
    print ("Loading Glove Model")
    f = open(gloveFile,'r', encoding="utf8")
    model = {}
    for line in tqdm(f):
        splitLine = line.split()
        word = splitLine[0]
        embedding = np.array([float(val) for val in splitLine[1:]])
        model[word] = embedding
    print ("Done.",len(model)," words loaded!")
    return model
model = loadGloveModel('glove.42B.300d.txt')

'''
```

Out[82]:

```
'# Reading glove vectors in python: https://stackoverflow.com/
a/38230349/4084039\ndef (https://stackoverflow.com/a/38230349/
4084039\ndef) loadGloveModel(gloveFile):\n    print ("Loading
 Glove Model")\n    f = open(gloveFile,\'r\', encoding="utf8")
\n    model = {}\n    for line in tqdm(f):\n        splitLine
 = line.split()\n        word = splitLine[0]\n        embeddin
g = np.array([float(val) for val in splitLine[1:]])\n        m
odel[word] = embedding\n    print ("Done.",len(model)," words
 loaded!")\n    return model\nmodel = loadGloveModel(\'glove.4
2B.300d.txt\')\n\n'
```

In [83]:

```
'''words = []
for i in preprocessed_essays:
    words.extend(i.split(' '))

for i in preprocessed_titles:
    words.extend(i.split(' '))
print("all the words in the coupus", len(words))
words = set(words)
print("the unique words in the coupus", len(words))

inter_words = set(model.keys()).intersection(words)
print("The number of words that are present in both glove vectors and our cou
      len(inter_words),"(",np.round(len(inter_words)/len(words)*100,3),"%)")

words_courpus = {}
words_glove = set(model.keys())
for i in words:
    if i in words_glove:
        words_courpus[i] = model[i]
print("word 2 vec length", len(words_courpus))'''
```

Out[83]:

```
'words = []\nfor i in preprocessed_essays:\n    words.extend
(i.split(\' \'))\n\nfor i in preprocessed_titles:\n    words.e
xtend(i.split(\' \'))\nprint("all the words in the coupus", le
n(words))\nwords = set(words)\nprint("the unique words in the
coupus", len(words))\n\ninter_words = set(model.keys()).inters
ection(words)\nprint("The number of words that are present in
both glove vectors and our coupus",       len(inter_words),"
(",np.round(len(inter_words)/len(words)*100,3),"%)")\n\nwords_
courpus = {}\nwords_glove = set(model.keys())\nfor i in word
s:\n    if i in words_glove:\n        words_courpus[i] = model
[i]\nprint("word 2 vec length", len(words_courpus))'
```

In [84]:

```
'''# stronging variables into pickle files python: http://www.jessicayung.com

import pickle
with open('glove_vectors', 'wb') as f:
    pickle.dump(words_courpus, f)
'''
```

Out[84]:

```
"# stronging variables into pickle files python: http://www.je
ssicayung.com/how-to-use-pickle-to-save-and-load-variables-in-
python/\n\nimport (http://www.jessicayung.com/how-to-use-pickl
e-to-save-and-load-variables-in-python/\n\nimport) pickle\nwit
h open('glove_vectors', 'wb') as f:\n    pickle.dump(words_cou
rpus, f)\n"
```

In [85]:

```
# stronging variables into pickle files python: http://www.jessicayung.com/ho
# make sure you have the glove_vectors file
with open('glove_vectors', 'rb') as f:
    model = pickle.load(f)
    glove_words =  set(model.keys())
```

In [86]:

```
# average Word2Vec
# compute average word2vec for each review.
avg_w2v_vectors = []; # the avg-w2v for each sentence/review is stored in thi
for sentence in tqdm(preprocessed_essays): # for each review/sentence
    vector = np.zeros(300) # as word vectors are of zero length
    cnt_words =0; # num of words with a valid vector in the sentence/review
    for word in sentence.split(): # for each word in a review/sentence
        if word in glove_words:
            vector += model[word]
            cnt_words += 1
    if cnt_words != 0:
        vector /= cnt_words
    avg_w2v_vectors.append(vector)

print(len(avg_w2v_vectors))
print(len(avg_w2v_vectors[0]))
```

```
100%|█████████████████████████████████████████████████████████
███████████████| 109248/109248 [00:26<00:00, 4056.67it/s]

109248
300
```

In [87]:

```
# average Word2Vec
# compute average word2vec for each review.
avg_w2v_vectors_titles = []; # the avg-w2v for each sentence/review is stored
for sentence in tqdm(preprocessed_titles): # for each review/sentence
    vector = np.zeros(300) # as word vectors are of zero length
    cnt_words =0; # num of words with a valid vector in the sentence/review
    for word in sentence.split(): # for each word in a review/sentence
        if word in glove_words:
            vector += model[word]
            cnt_words += 1
    if cnt_words != 0:
        vector /= cnt_words
    avg_w2v_vectors_titles.append(vector)

print(len(avg_w2v_vectors_titles))
print(len(avg_w2v_vectors_titles[0]))
```

```
100%|█████████████████████████████████████████████████████████
██████████████| 109248/109248 [00:01<00:00, 81507.06it/s]

109248
300
```

Using Pretrained Models: TFIDF weighted W2V

In [88]:

```
tfidf_model = TfidfVectorizer()
tfidf_model.fit(preprocessed_essays)
# we are converting a dictionary with word as a key, and the idf as a value
dictionary = dict(zip(tfidf_model.get_feature_names(), list(tfidf_model.idf_
tfidf_words = set(tfidf_model.get_feature_names())
```

In [89]:

```
# average Word2Vec
# compute average word2vec for each review.
tfidf_w2v_vectors = []; # the avg-w2v for each sentence/review is stored in t
for sentence in tqdm(preprocessed_essays): # for each review/sentence
    vector = np.zeros(300) # as word vectors are of zero length
    tf_idf_weight =0; # num of words with a valid vector in the sentence/revi
    for word in sentence.split(): # for each word in a review/sentence
        if (word in glove_words) and (word in tfidf_words):
            vec = model[word] # getting the vector for each word
            # here we are multiplying idf value(dictionary[word]) and the tf
            tf_idf = dictionary[word]*(sentence.count(word)/len(sentence.spli
            vector += (vec * tf_idf) # calculating tfidf weighted w2v
            tf_idf_weight += tf_idf
    if tf_idf_weight != 0:
        vector /= tf_idf_weight
    tfidf_w2v_vectors.append(vector)

print(len(tfidf_w2v_vectors))
print(len(tfidf_w2v_vectors[0]))
```

```
100%|███████████████████████████████████████████████████████████
████████████████| 109248/109248 [03:26<00:00, 527.78it/s]

109248
300
```

In [90]:

```
tfidf_model_titles = TfidfVectorizer()
tfidf_model_titles.fit(preprocessed_titles)
# we are converting a dictionary with word as a key, and the idf as a value
dictionary = dict(zip(tfidf_model_titles.get_feature_names(), list(tfidf_mode
tfidf_words_titles = set(tfidf_model_titles.get_feature_names())
```

In [91]:

```
# average Word2Vec
# compute average word2vec for each review.
tfidf_w2v_vectors_titles = []; # the avg-w2v for each sentence/review is stor
for sentence in tqdm(preprocessed_titles): # for each review/sentence
    vector = np.zeros(300) # as word vectors are of zero length
    tf_idf_weight =0; # num of words with a valid vector in the sentence/revi
    for word in sentence.split(): # for each word in a review/sentence
        if (word in glove_words) and (word in tfidf_words):
            vec = model[word] # getting the vector for each word
            # here we are multiplying idf value(dictionary[word]) and the tf
            tf_idf = dictionary[word]*(sentence.count(word)/len(sentence.spli
            vector += (vec * tf_idf) # calculating tfidf weighted w2v
            tf_idf_weight += tf_idf
    if tf_idf_weight != 0:
        vector /= tf_idf_weight
    tfidf_w2v_vectors_titles.append(vector)

print(len(tfidf_w2v_vectors_titles))
print(len(tfidf_w2v_vectors_titles[0]))
```

```
100%|████████████████████████████
███████| 109248/109248 [00:03<00:00, 35703.71it/s]

109248
300
```

In [92]:

```
# standardization sklearn: https://scikit-learn.org/stable/modules/generated/
from sklearn.preprocessing import StandardScaler

# price_standardized = standardScalar.fit(project_data['price'].values)
# this will rise the error
# ValueError: Expected 2D array, got 1D array instead: array=[725.05 213.03 3
# Reshape your data either using array.reshape(-1, 1)

price_scalar = StandardScaler()
price_scalar.fit(training_data['price'].values.reshape(-1,1)) # finding the m
print(f"Mean : {price_scalar.mean_[0]}, Standard deviation : {np.sqrt(price_s

# Now standardize the data with above maen and variance.
price_standardized = price_scalar.transform(training_data['price'].values.res
```

```
Mean : 298.1193425966608, Standard deviation : 367.49634838483
496
```

In [93]:

```
# standardization sklearn: https://scikit-learn.org/stable/modules/generated/
from sklearn.preprocessing import StandardScaler

# price_standardized = standardScalar.fit(project_data['price'].values)
# this will rise the error
# ValueError: Expected 2D array, got 1D array instead: array=[725.05 213.03 3
# Reshape your data either using array.reshape(-1, 1)

teacher_noppp_scalar = StandardScaler()
teacher_noppp_scalar.fit(training_data['teacher_number_of_previously_posted_p
print(f"Mean : {teacher_noppp_scalar.mean_[0]}, Standard deviation : {np.sqrt

# Now standardize the data with above maen and variance.
teacher_noppp_standardized = teacher_noppp_scalar.transform(training_data['te
```

```
Mean : 11.153165275336848, Standard deviation : 367.4963483848
3496
```

Merging all the above features

In [94]:

```
print('School State ',school_state_one_hot.shape)
print('Teacher Prefix ',teacher_prefix_one_hot.shape)
print('Project Grade ',project_grade_category_one_hot.shape)
print('Title ',titles_bow.shape)
print('Essay ',essays_bow.shape)
print('Categories ',categories_one_hot.shape)
print('Sub Categories',sub_categories_one_hot.shape)
print('Price',price_standardized.shape)
print('Teacher number of previously posted projects',teacher_noppp_standardiz
```

```
School State  (109248, 51)
Teacher Prefix  (109248, 5)
Project Grade  (109248, 4)
Title  (109248, 3329)
Essay  (109248, 16623)
Categories  (109248, 9)
Sub Categories (109248, 30)
Price (109248, 1)
Teacher number of previously posted projects (109248, 1)
```

In [95]:

```
print('Title BOW',titles_bow.shape)
print('Essay BOW',essays_bow.shape)
print('Title TFIDF',titles_tfidf.shape)
print('Essay TFIDF',essays_tfidf.shape)
print('Title AVG W2V (',len(avg_w2v_vectors_titles),',',len(avg_w2v_vectors_t
print('Essay AVG W2V (',len(avg_w2v_vectors),',',len(avg_w2v_vectors[0]),')')
print('Title TFIDF AVG W2V (',len(tfidf_w2v_vectors_titles),',',len(tfidf_w2v
print('Essay TFIDF AVG W2V (',len(tfidf_w2v_vectors),',',len(tfidf_w2v_vector
```

```
Title BOW (109248, 3329)
Essay BOW (109248, 16623)
Title TFIDF (109248, 3329)
Essay TFIDF (109248, 16623)
Title AVG W2V ( 109248 , 300 )
Essay AVG W2V ( 109248 , 300 )
Title TFIDF AVG W2V ( 109248 , 300 )
Essay TFIDF AVG W2V ( 109248 , 300 )
```

In [96]:

```
# merge two sparse matrices: https://stackoverflow.com/a/19710648/4084039
from scipy.sparse import hstack
# with the same hstack function we are concatinating a sparse matrix and a de
X_BOW = hstack((school_state_one_hot, teacher_prefix_one_hot, project_grade_c
            categories_one_hot, sub_categories_one_hot, price_standardized,
            teacher_noppp_standardized, titles_bow)).tocsr()
X_BOW.shape
```

Out[96]:

```
(109248, 3430)
```

In [97]:

```
X_BOW_5000 = X_BOW[0:5000,:]
X_BOW_5000.shape
```

Out[97]:

```
(5000, 3430)
```

In [98]:

```
X_BOW_1000 = X_BOW[0:1000,:]
X_BOW_1000.shape
```

Out[98]:

```
(1000, 3430)
```

In [99]:

```
X_BOW_10000 = X_BOW[0:10000,:]
X_BOW_10000.shape
```

Out[99]:

```
(10000, 3430)
```

In [100]:

```
labels = training_data['project_is_approved']
labels.shape
```

Out[100]:

```
(109248,)
```

In [101]:

```
labels_1000 = labels[0: 1000]
labels_1000.shape
```

Out[101]:

```
(1000,)
```

In [102]:

```
labels_5000 = labels[0: 5000]
labels_5000.shape
```

Out[102]:

```
(5000,)
```

In [103]:

```
labels_10000 = labels[0: 10000]
labels_10000.shape
```

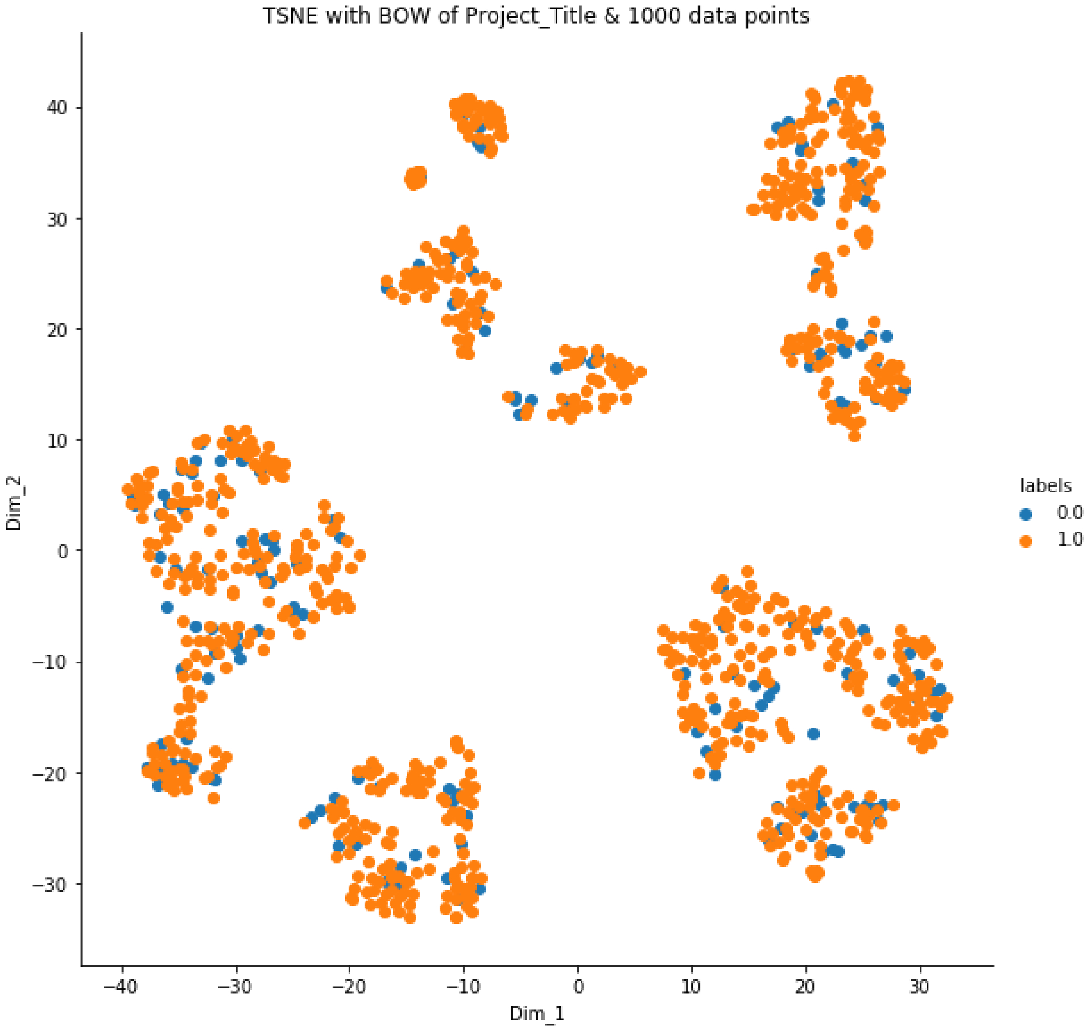
Out[103]:

```
(10000,)
```

2.1 TSNE with 'BOW' encoding of 'project_title' feature

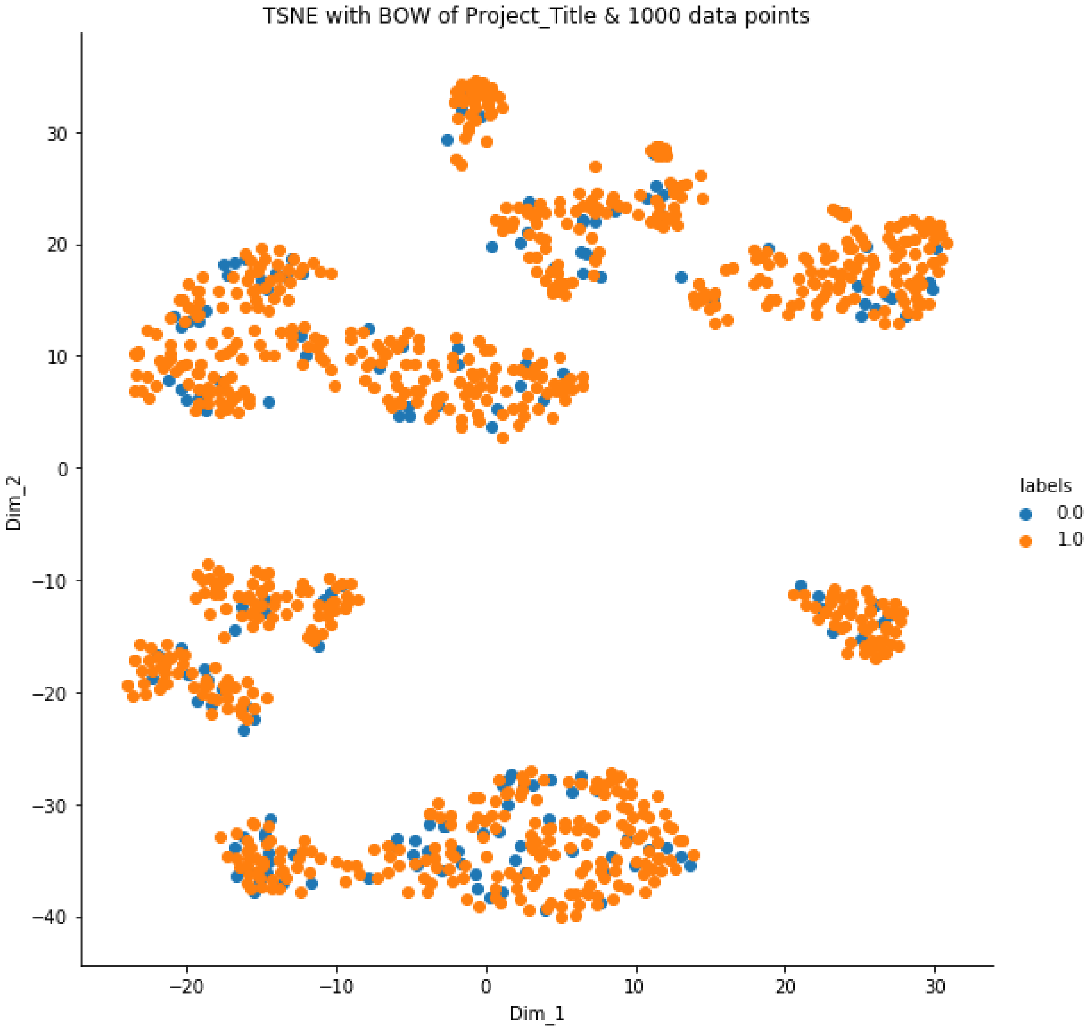
In [104]:

```
from sklearn.manifold import TSNE

x = X_BOW_1000
y = labels_1000

model = TSNE(n_components=2, perplexity=30, learning_rate=300, random_state=0

X_embedding = model.fit_transform(x.toarray())
tsne_data = model.fit_transform(X_embedding)


# creating a new data frame which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T, y)).T
tsne_df = pd.DataFrame(tsne_data, columns=("Dim_1", "Dim_2", "labels"))


# Ploting the result of tsne
sns.FacetGrid(tsne_df, hue="labels", height=8).map(plt.scatter, 'Dim_1', 'Di
plt.title('TSNE with BOW of Project_Title & 1000 data points')
plt.show()
```



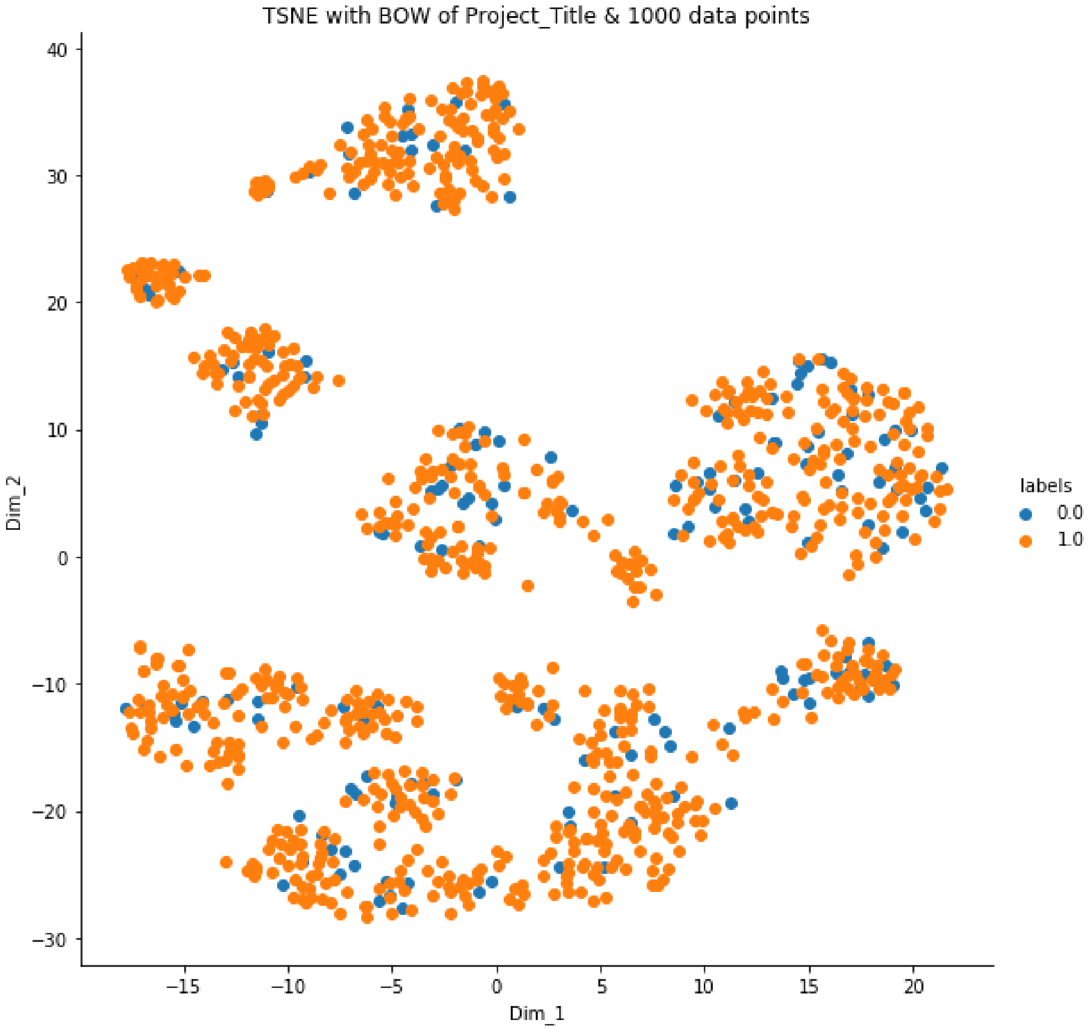
In [105]:

```
from sklearn.manifold import TSNE

x = X_BOW_1000
y = labels_1000

model = TSNE(n_components=2, perplexity=40, learning_rate=300, random_state=

X_embedding = model.fit_transform(x.toarray())
tsne_data = model.fit_transform(X_embedding)


# creating a new data frame which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T, y)).T
tsne_df = pd.DataFrame(tsne_data, columns=("Dim_1", "Dim_2", "labels"))


# Ploting the result of tsne
sns.FacetGrid(tsne_df, hue="labels", height=8).map(plt.scatter, 'Dim_1', 'Di
plt.title('TSNE with BOW of Project_Title & 1000 data points')
plt.show()
```



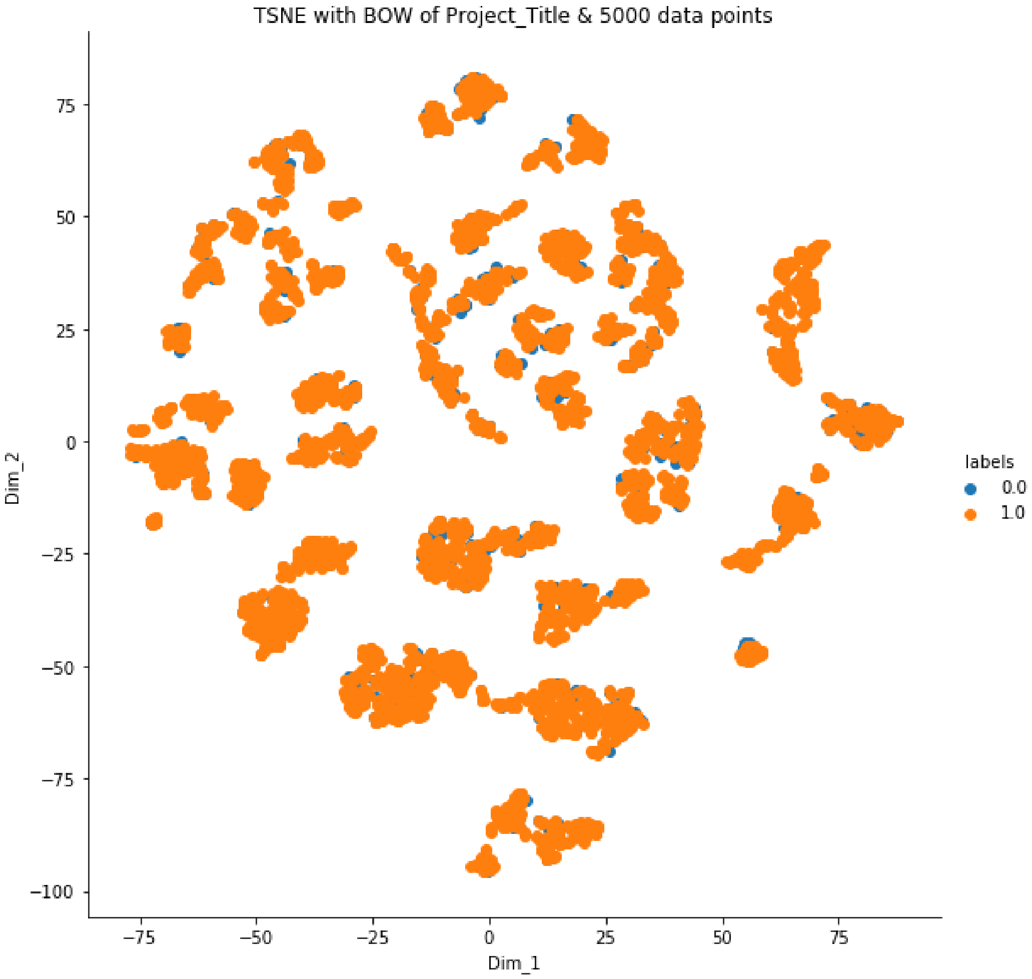
In [106]:

```

from sklearn.manifold import TSNE

x = X_BOW_1000
y = labels_1000

model = TSNE(n_components=2, perplexity=50, learning_rate=300, random_state=(

X_embedding = model.fit_transform(x.toarray())
tsne_data = model.fit_transform(X_embedding)


# creating a new data frame which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T, y)).T
tsne_df = pd.DataFrame(tsne_data, columns=("Dim_1", "Dim_2", "labels"))


# Ploting the result of tsne
sns.FacetGrid(tsne_df, hue="labels", height=8).map(plt.scatter, 'Dim_1', 'Dir
plt.title('TSNE with BOW of Project_Title & 1000 data points')
plt.show()
```



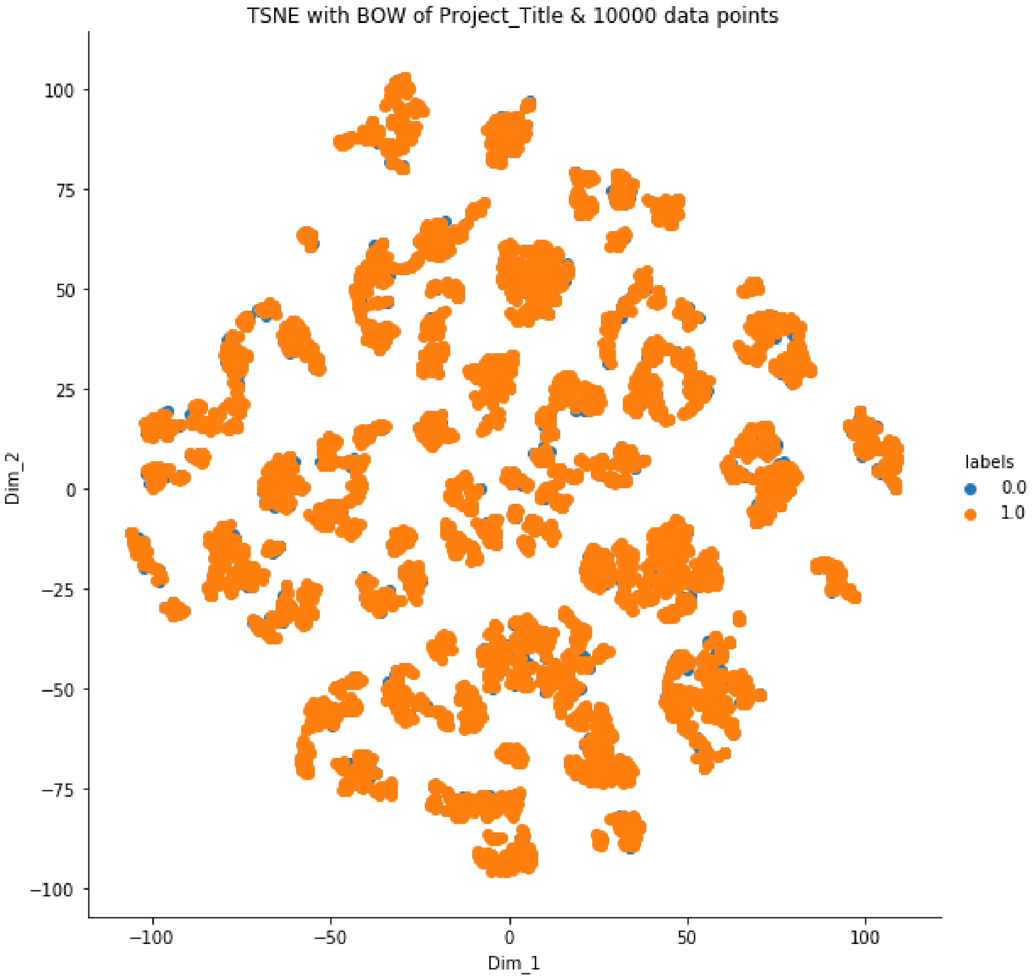
In [107]:

```
# TSNE with 5000 data points

X_BOW_1000 = X_BOW[0:1000,:]
X_BOW_1000.shape

from sklearn.manifold import TSNE

# Picking the top 1000 points as TSNE takes a lot of time for 15K points
x = X_BOW_5000
y = labels_5000

model = TSNE(n_components=2, perplexity=30, learning_rate=300, random_state=0

X_embedding = model.fit_transform(x.toarray())
# configuring the parameteres
# the number of components = 2
# default perplexity = 30
# default learning rate = 200
# default Maximum number of iterations for the optimization = 1000

tsne_data = model.fit_transform(X_embedding)


# creating a new data frame which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T, y)).T
tsne_df = pd.DataFrame(tsne_data, columns=("Dim_1", "Dim_2", "labels"))


# Ploting the result of tsne
sns.FacetGrid(tsne_df, hue="labels", height=8).map(plt.scatter, 'Dim_1', 'Dim
plt.title('TSNE with BOW of Project_Title & 5000 data points')
plt.show()
```


TSNE with BOW of Project_Title & 5000 data points
Dim_2
75
50
25
0
−25
−50
−75
−100
−75
−50
−25
0
25
50
75
Dim_1
labels
● 0.0
● 1.0

In [108]:

```
# TSNE with 10000 data points

from sklearn.manifold import TSNE

# Picking the top 1000 points as TSNE takes a lot of time for 15K points
x = X_BOW_10000
y = labels_10000

model = TSNE(n_components=2, perplexity=30, learning_rate=300, random_state=

X_embedding = model.fit_transform(x.toarray())
# configuring the parameteres
# the number of components = 2
# default perplexity = 30
# default learning rate = 200
# default Maximum number of iterations for the optimization = 1000

tsne_data = model.fit_transform(X_embedding)


# creating a new data frame which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T, y)).T
tsne_df = pd.DataFrame(tsne_data, columns=("Dim_1", "Dim_2", "labels"))


# Ploting the result of tsne
sns.FacetGrid(tsne_df, hue="labels", height=8).map(plt.scatter, 'Dim_1', 'Di
plt.title('TSNE with BOW of Project_Title & 10000 data points')
plt.show()
```



Summary

- Vectorized categorical and numerical features and stacked it with title BOW vector
- Plotted TSNE with different Perplexity and Random_State values for 1000 data points
- After experimenting with different combinations, choosed the final values of perplexity and random_state as 30 and 300 respectively.
- Plotted TSNE with all categorical, numerical features and Title BOW vector for 1K, 5K and 10K data points
- Observed that the accepted projects are more than the rejected projects.
- Accepted and Rejected classes are heavily overlaping and not seperated at this point

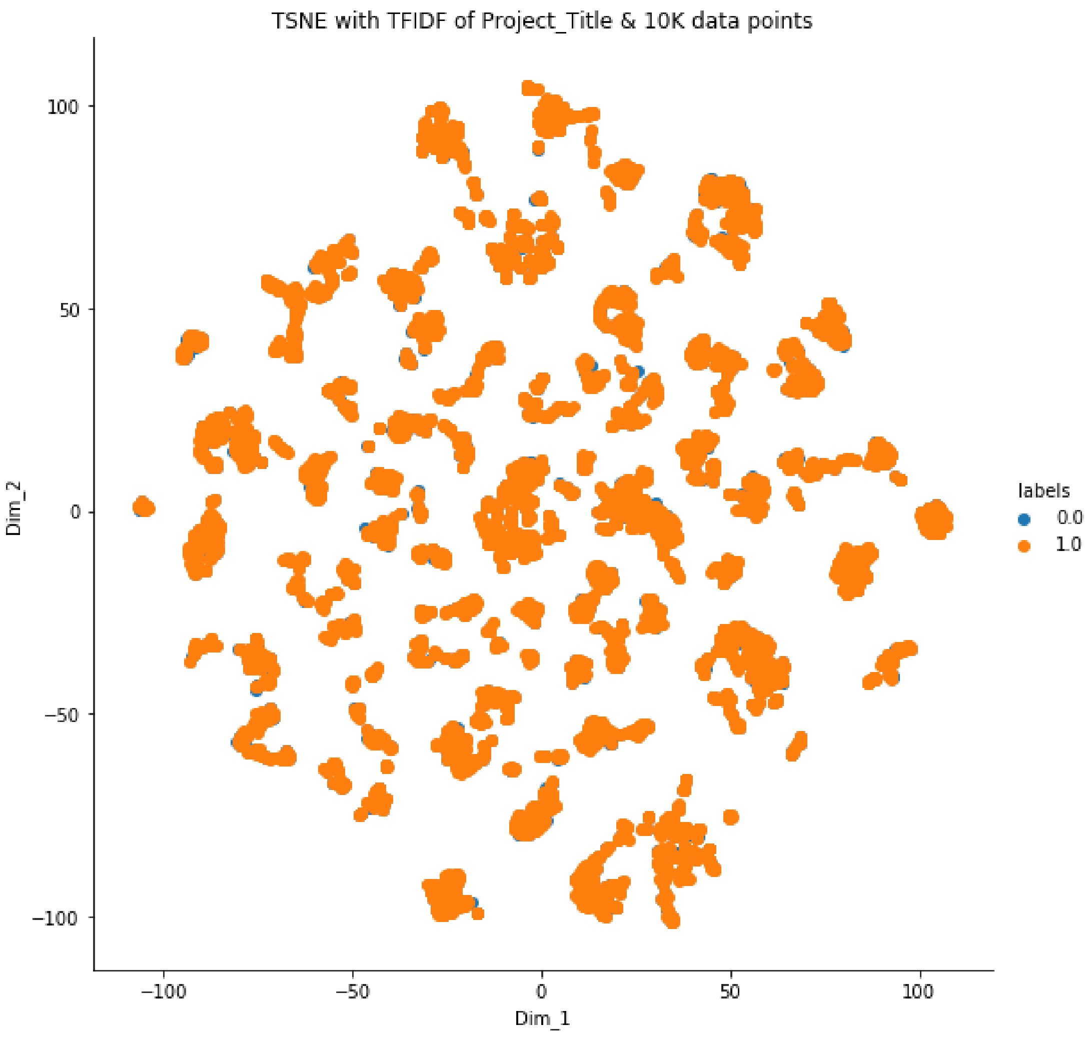
2.2 TSNE with 'TFIDF' encoding of 'project_title' feature

In [109]:

```
X_TFIDF = hstack((school_state_one_hot, teacher_prefix_one_hot, project_grade
            categories_one_hot, sub_categories_one_hot, price_standardized,
            teacher_noppp_standardized, titles_tfidf)).tocsr()

X_TFIDF_5000 = X_TFIDF[0:5000,:]
X_TFIDF_10000 = X_TFIDF[0:10000,:]
```

In [110]:

```
from sklearn.manifold import TSNE

x = X_TFIDF_10000
y = labels_10000

model = TSNE(n_components=2, perplexity=30, learning_rate=300, random_state=0

X_embedding = model.fit_transform(x.toarray())

tsne_data = model.fit_transform(X_embedding)


# creating a new data frame which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T, y)).T
tsne_df = pd.DataFrame(tsne_data, columns=("Dim_1", "Dim_2", "labels"))


# Ploting the result of tsne
sns.FacetGrid(tsne_df, hue="labels", height=8).map(plt.scatter, 'Dim_1', 'Dir
plt.title('TSNE with TFIDF of Project_Title & 10K data points')
plt.show()
```



Summary

- Plotted TSNE with all categorical, numerical features and Title TFIDF vector for 10K data points
- Observed that the accepted projects are more than the rejected projects.
- Accepted and Rejected classes are heavily overlaping and not seperated at this point
- Didn't find any major difference when compared to TSNE BOW title vector

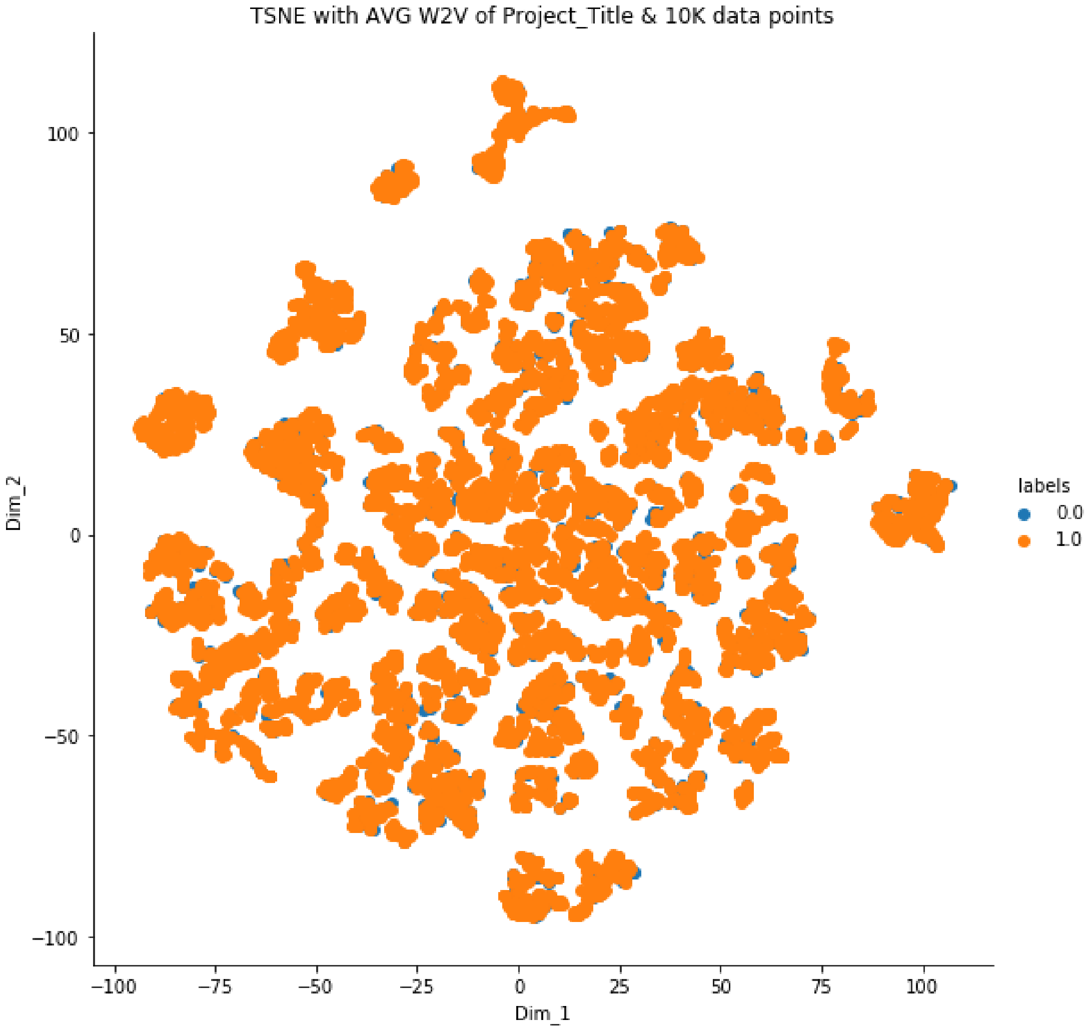
2.3 TSNE with 'AVG W2V' encoding of 'project_title' feature

In [111]:

```
X_AVG_W2V = hstack((school_state_one_hot, teacher_prefix_one_hot, project_gra
            categories_one_hot, sub_categories_one_hot, price_standardized,
            teacher_noppp_standardized, avg_w2v_vectors_titles)).tocsr()

X_AVG_W2V_10000 = X_AVG_W2V[0:10000,:]
```

In [112]:

```
from sklearn.manifold import TSNE

x = X_AVG_W2V_10000
y = labels_10000

model = TSNE(n_components=2, perplexity=30, learning_rate=300, random_state=(

X_embedding = model.fit_transform(x.toarray())

tsne_data = model.fit_transform(X_embedding)


# creating a new data frame which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T, y)).T
tsne_df = pd.DataFrame(tsne_data, columns=("Dim_1", "Dim_2", "labels"))


# Ploting the result of tsne
sns.FacetGrid(tsne_df, hue="labels", height=8).map(plt.scatter, 'Dim_1', 'Dir
plt.title('TSNE with AVG W2V of Project_Title & 10K data points')
plt.show()
```



Summary

- Plotted TSNE with all categorical and numerical features and Title AVG W2V vector for 10K data points
- Observed that the accepted projects are more than the rejected projects.
- Accepted and Rejected classes are heavily overlaping and not seperated at this point
- Found that the plot has dense data points when compared to TSNE of BOW and TFIDF title vectors

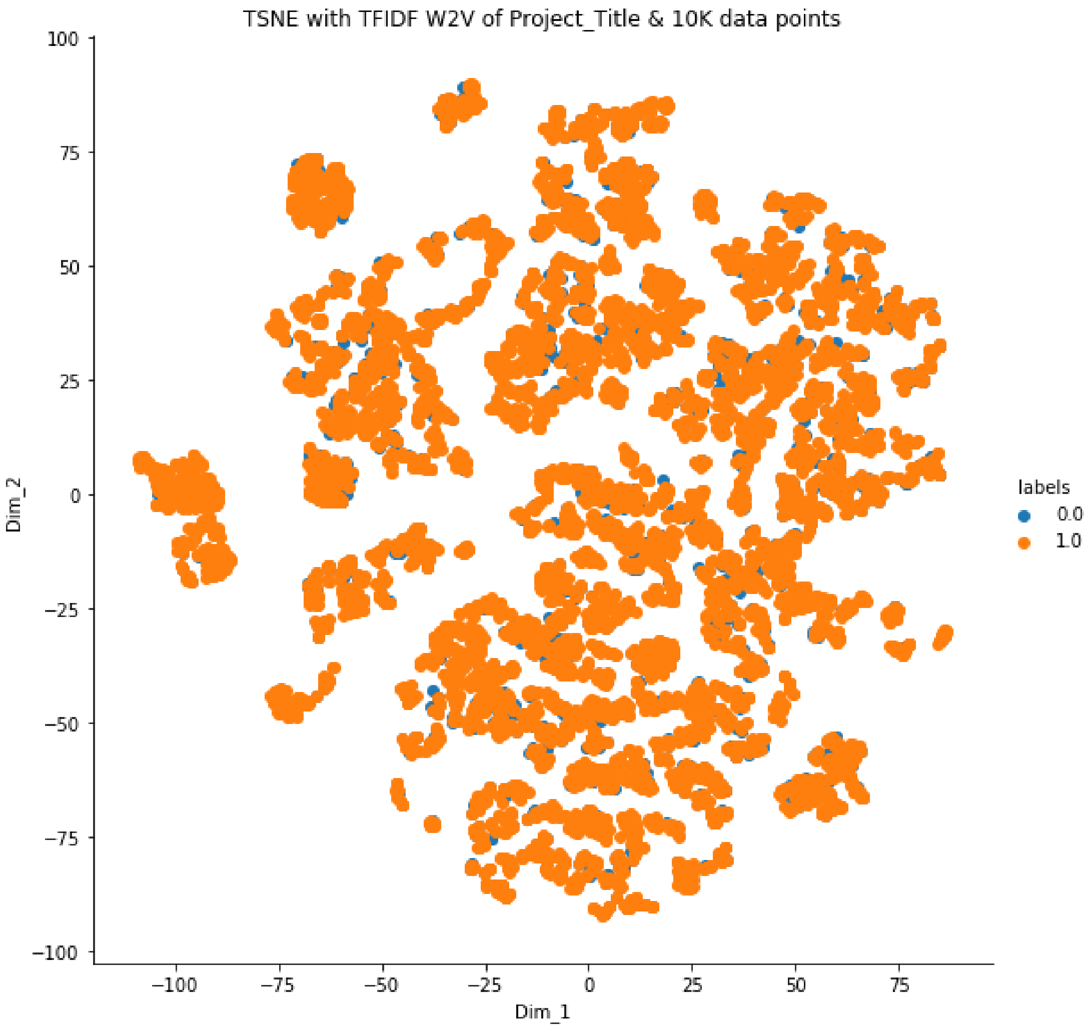
2.4 TSNE with 'TFIDF Weighted W2V' encoding of 'project_title' feature

In [113]:

```
X_TFIDF_W2V = hstack((school_state_one_hot, teacher_prefix_one_hot, project_
            categories_one_hot, sub_categories_one_hot, price_standardized,
            teacher_noppp_standardized, tfidf_w2v_vectors_titles)).tocsr()

X_TFIDF_W2V_10000 = X_TFIDF_W2V[0:10000,:]
```

In [114]:

```
from sklearn.manifold import TSNE

x = X_TFIDF_W2V_10000
y = labels_10000

model = TSNE(n_components=2, perplexity=30, learning_rate=300, random_state=0

X_embedding = model.fit_transform(x.toarray())

tsne_data = model.fit_transform(X_embedding)


# creating a new data frame which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T, y)).T
tsne_df = pd.DataFrame(tsne_data, columns=("Dim_1", "Dim_2", "labels"))


# Ploting the result of tsne
sns.FacetGrid(tsne_df, hue="labels", height=8).map(plt.scatter, 'Dim_1', 'Dim
plt.title('TSNE with TFIDF W2V of Project_Title & 10K data points')
plt.show()
```



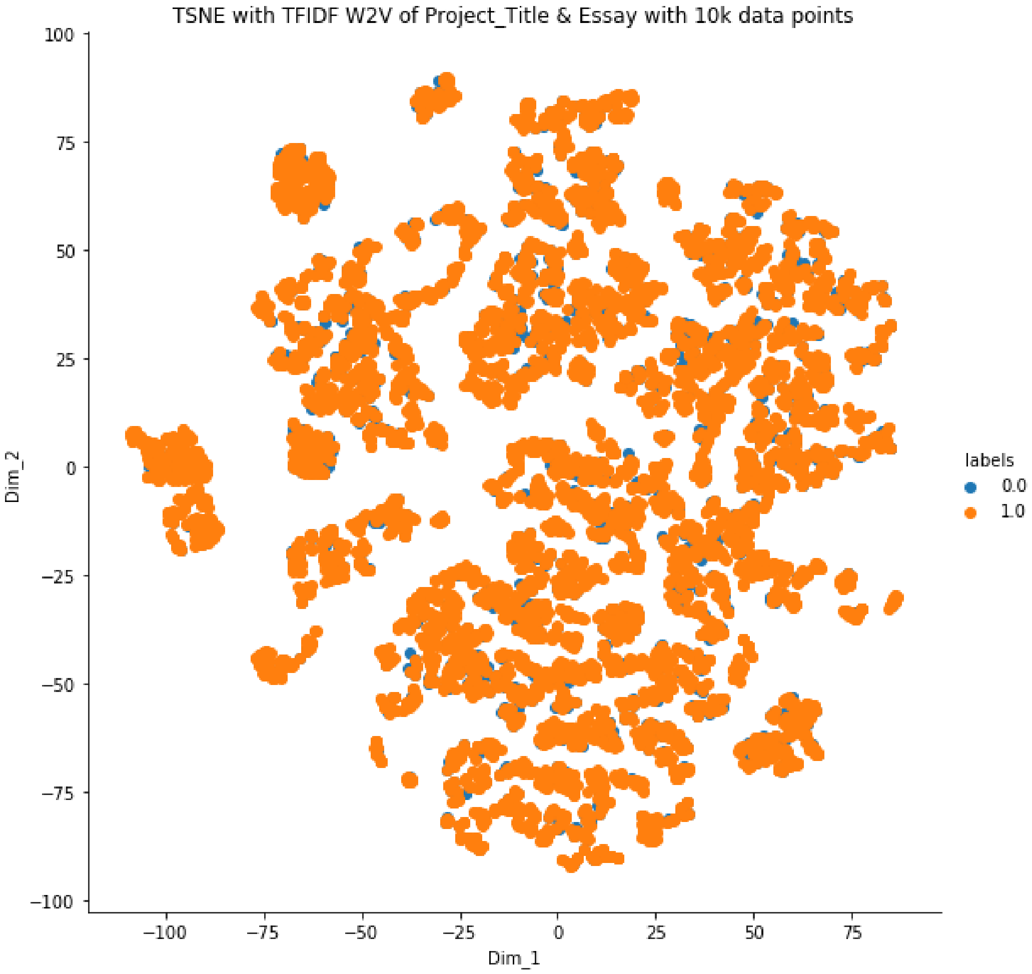
Summary

- Plotted TSNE with all categorical and numerical features and Title TFIDF W2V vector for 10K data points
- Observed that the accepted projects are more than the rejected projects.
- Accepted and Rejected classes are heavily overlaping and not seperated at this point
- Found that the plot has dense data points when compared to TSNE of BOW and TFIDF title vectors, but no major difference when compared to TSNE of AVG W2V Title vector

2.4.1 TSNE with 'TFIDF Weighted W2V' encoding of 'project_title' and 'project_essay' features (Extra)

In [115]:

```
X_TFIDF_W2V_E = hstack((school_state_one_hot, teacher_prefix_one_hot, project
            categories_one_hot, sub_categories_one_hot, price_standardized,
            teacher_noppp_standardized, tfidf_w2v_vectors, tfidf_w2v_vectors_

X_TFIDF_W2V_E_10000 = X_TFIDF_W2V_E[0:10000,:]


from sklearn.manifold import TSNE

x = X_TFIDF_W2V_10000
y = labels_10000

model = TSNE(n_components=2, perplexity=30, learning_rate=300, random_state=

X_embedding = model.fit_transform(x.toarray())

tsne_data = model.fit_transform(X_embedding)


# creating a new data frame which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T, y)).T
tsne_df = pd.DataFrame(tsne_data, columns=("Dim_1", "Dim_2", "labels"))


# Ploting the result of tsne
sns.FacetGrid(tsne_df, hue="labels", height=8).map(plt.scatter, 'Dim_1', 'Dim
plt.title('TSNE with TFIDF W2V of Project_Title & Essay with 10k data points
plt.show()
```



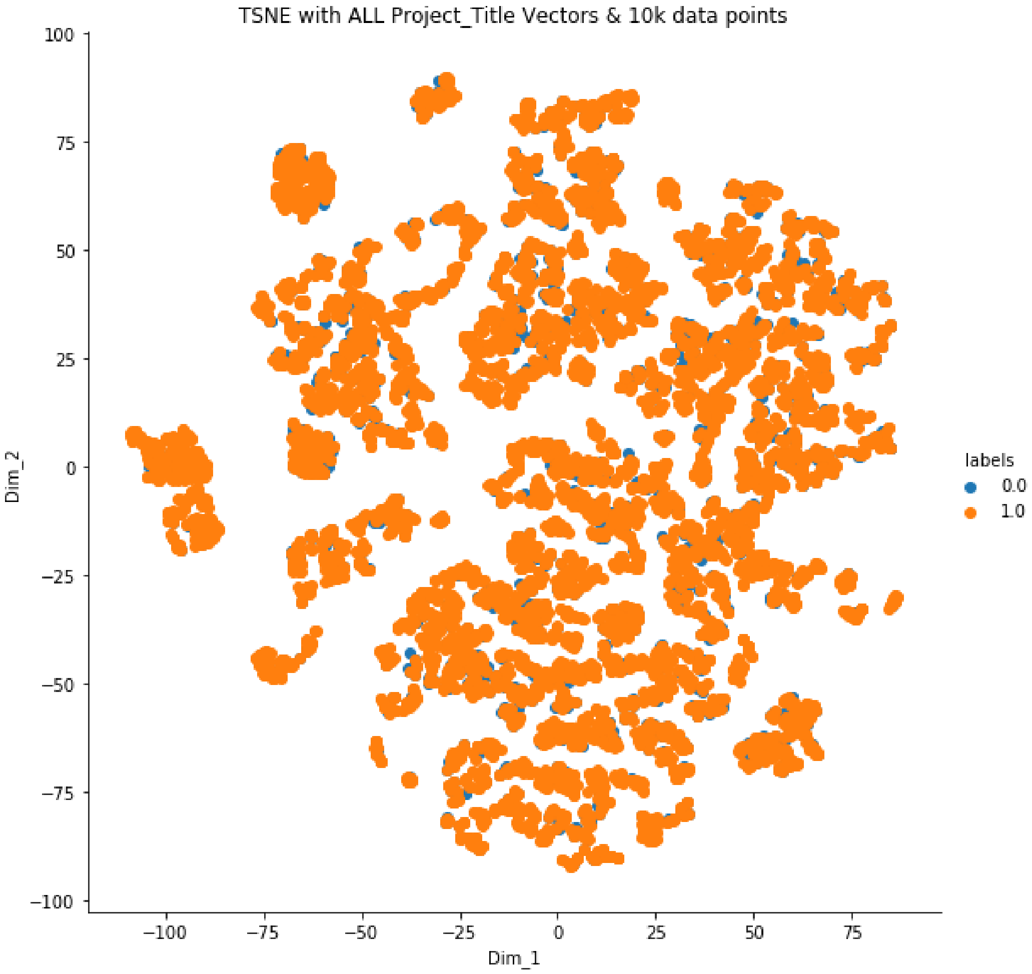
Summary

- Plotted TSNE with all categorical and numerical features, Title TFIDF W2V vector and Essay TFIDF W2V vector for 10K data points
- Observed that the accepted projects are more than the rejected projects.
- Accepted and Rejected classes are heavily overlaping and not seperated at this point
- Found that the plot has dense data points when compared to TSNE of BOW and TFIDF title vectors, but no major difference when compared to TSNE of AVG W2V Title vector and TSNE of Title TFIDF W2V vector

2.4 TSNE with all encoding of 'project_title' feature

In [116]:

```
X_ALL_TITLES = hstack((school_state_one_hot, teacher_prefix_one_hot, project_
            categories_one_hot, sub_categories_one_hot, price_standardized,
            teacher_noppp_standardized, titles_bow, titles_tfidf,avg_w2v_vect
            tfidf_w2v_vectors_titles)).tocsr()

X_ALL_TITLES_10000 = X_ALL_TITLES[0:10000,:]


from sklearn.manifold import TSNE

x = X_TFIDF_W2V_10000
y = labels_10000

model = TSNE(n_components=2, perplexity=30, learning_rate=300, random_state=

X_embedding = model.fit_transform(x.toarray())

tsne_data = model.fit_transform(X_embedding)


# creating a new data frame which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T, y)).T
tsne_df = pd.DataFrame(tsne_data, columns=("Dim_1", "Dim_2", "labels"))


# Ploting the result of tsne
sns.FacetGrid(tsne_df, hue="labels", height=8).map(plt.scatter, 'Dim_1', 'Di
plt.title('TSNE with ALL Project_Title Vectors & 10k data points')
plt.show()
```



Summary

- Plotted TSNE with all categorical and numerical features and all variations of Title vector for 10K data points
- Observed that the accepted projects are more than the rejected projects.
- Accepted and Rejected classes are heavily overlaping and not seperated at this point
- Found that the plot has dense data points when compared to TSNE of BOW and TFIDF title vectors, but no major difference when compared to TSNE of AVG W2V Title vector and TSNE of Title TFIDF W2V vector

Summary

- The objective is to automate project approval task using the text and meta data of the project
- 92706 projects were approved for funding out of 109248 applications i.e. 84.85 %
- 16542 projects were not approved for funding out of 109248 applications i.e. 15.14%
- Looks like an imbalanced dataset
- Removed np.nan values from teacher_prefix column and converted to MRS
- Removed Full stops from teacher_prefix column and converted to Upper case
- Ploted all the 51 states of United States of America with rate of acceptance using plotly.graph_objs

- Delaware (DE) is the state with Most Acceptance percentage i.e. 89.79 %
- North Dakota (ND) is the state with Second most Acceptance percentage i.e. 88.81 %
- Washington (WA) is the state with Third most Acceptance percentage i.e. 87.61 %
- Vermont state has the lowest percentage of acceptance i.e. 80.00 %
- Washington, D.C. has the second lowest percentage of acceptance i.e. 80.23 %
- Texas state has the third lowest percentage of acceptance i.e. 81.31 %
- Every state has greater than 80 % acceptance rate
- California state has the most number of project submissions i.e. 15388
- Texas state has the second most number of project submissions i.e. 7396
- Wyoming state has the second least number of project submissions i.e. 98
- Vermont state has the least number of project submissions i.e. 80
- MRS teacher_prefix has the most number of project submissions i.e. 57272 with 85.55 % acceptance rate
- MS teacher_prefix has the second most number of project submissions i.e. 38955 with 84.35 % acceptance rate
- Teacher teacher_prefix has the second least number of project submissions i.e. 2360 with 79.53 % acceptance rate
- DR teacher_prefix has the least number of project submissions i.e. 13 with 69.23 % acceptance rate
- Most number of projects are for Grades pre K - 2 i.e. 44225 with 84.87 % acceptance rate
- Second Most number of projects are for Grades 3-5 i.e. 37137 with 85.43 % acceptance rate
- Third Most number of projects are for Grades 6 - 8 i.e. 16923 with 84.25 % acceptance rate
- Least number of projects are for Grades 9 - 12 i.e. 10963 with 83.76 % acceptance rate
- Most number of projects are for Category Literacy & Language i.e. 23655 with 86.74 % acceptance rate
- Second Most number of projects are for Category Math & Science i.e. 17072 with 81.95 % acceptance rate
- Third Most number of projects are for Category Literacy, Language, Math & Science i.e. 14636 with 0.86.94 % acceptance rate
- Least number of projects are for Category AppliedLearning, Math & Science i.e. 1052 with 81.27 % acceptance rate
- More than 50 % of accepted projects have less than 250 words in their essays
- More than 50 % of rejected projects have less than 250 words in their essays
- More than 75 % of accepted projects have less than 300 words in their essays
- More than 75 % of rejected projects have less than 300 words in their essays
- All the projects prices are between 0.66 to 9999.0
- 50 % of accepted project prices are under 198.99
- 50 % of rejected project prices are under 263.145
- Accepted project prices are less when compared to rejected projects prices
- 27.46 % of teachers have posted the projects for the first time
- The first timers have posted 30014 projects with 82.13 % acceptance rate
- The maximum number of projects posted by any teacher is 451

- 93492 projects were submitted without any digits in their essays with 84.0885 % acceptance ratio
- 15756 projects were submitted without any digits in their essays with 89.4263 % acceptance ratio
- Projects with digits in their essays have 5.33 % more acceptance ratio than projects without digits
- Vectorized categorical and numerical features and stacked it with title BOW vector
- Plotted TSNE with different Perplexity and Random_State values for 1000 data points
- After experimenting with different combinations, choosed the final values of perplexity and random_state as 30 and 300 respectively.
- Plotted TSNE with all categorical, numerical features and Title BOW vector for 1K, 5K and 10K data points
- Plotted TSNE with all categorical, numerical features and Title TFIDF vector for 10K data points
- Didn't find any major difference when compared to TSNE of BOW title vector
- Plotted TSNE with all categorical and numerical features and Title AVG W2V vector for 10K data points
- Found that the plot has dense data points when compared to TSNE of BOW and TFIDF title vectors
- Plotted TSNE with all categorical and numerical features and Title TFIDF W2V vector for 10K data points
- Found that the plot has dense data points when compared to TSNE of BOW and TFIDF title vectors, but no major difference when compared to TSNE of AVG W2V Title vector
- Plotted TSNE with all categorical and numerical features, Title TFIDF W2V vector and Essay TFIDF W2V vector for 10K data points
- Found that the plot has dense data points when compared to TSNE of BOW and TFIDF title vectors, but no major difference when compared to TSNE of AVG W2V Title vector and TSNE of Title TFIDF W2V vector
- Plotted TSNE with all categorical and numerical features and all variations of Title vector for 10K data points
- Found that the plot has dense data points when compared to TSNE of BOW and TFIDF title vectors, but no major difference when compared to TSNE of AVG W2V Title vector and TSNE of Title TFIDF W2V vector
- The accepted and rejected points are heavily overlaping and not seperated at this point.