DonorsChoose

DonorsChoose.org receives hundreds of thousands of project proposals each year for classroom projects in need of funding. Right now, a large number of volunteers is needed to manually screen each submission before it's approved to be posted on the DonorsChoose.org website.

Next year, DonorsChoose.org expects to receive close to 500,000 project proposals. As a result, there are three main problems they need to solve:

- How to scale current manual processes and resources to screen 500,000 projects so that they can be posted as quickly and as efficiently as possible
- How to increase the consistency of project vetting across different volunteers to improve the experience for teachers
- How to focus volunteer time on the applications that need the most assistance

The goal of the competition is to predict whether or not a DonorsChoose.org project proposal submitted by a teacher will be approved, using the text of project descriptions as well as additional metadata about the project, teacher, and school. DonorsChoose.org can then use this information to identify projects most likely to need further review before approval.

About the DonorsChoose Data Set

The `train.csv` data set provided by DonorsChoose contains the following features:

Feature	Description
`project_id`	A unique identifier for the proposed project. **Example:** `p036502`
`project_title`	Title of the project. **Examples:** • `Art Will Make You Happy!` • `First Grade Fun`
`project_grade_category`	Grade level of students for which the project is targeted. One of the following enumerated values: • `Grades PreK-2` • `Grades 3-5` • `Grades 6-8` • `Grades 9-12`
`project_subject_categories`	One or more (comma-separated) subject categories for the project from the following enumerated list of values: • `Applied Learning` • `Care & Hunger` • `Health & Sports` • `History & Civics` • `Literacy & Language` • `Math & Science` • `Music & The Arts` • `Special Needs` • `Warmth` **Examples:** • `Music & The Arts` • `Literacy & Language, Math & Science`
`school_state`	State where school is located (Two-letter U.S. postal code). **Example:** `WY`
`project_subject_subcategories`	One or more (comma-separated) subject subcategories for the project. **Examples:** • `Literacy`

- `Literature & Writing, Social Sciences`

Feature	Description
`project_resource_summary`	An explanation of the resources needed for the project. **Example:** • `My students need hands on literacy materials to manage sensory needs!`
`project_essay_1`	First application essay*
`project_essay_2`	Second application essay*
`project_essay_3`	Third application essay*
`project_essay_4`	Fourth application essay*
`project_submitted_datetime`	Datetime when project application was submitted. **Example:** `2016-04-28 12:43:56.245`
`teacher_id`	A unique identifier for the teacher of the proposed project. **Example:** `bdf8baa8fedef6bfeec7ae4ff1c15c56`
`teacher_prefix`	Teacher's title. One of the following enumerated values: • `nan` • `Dr.` • `Mr.` • `Mrs.` • `Ms.` • `Teacher.`
`teacher_number_of_previously_posted_projects`	Number of project applications previously submitted by the same teacher. **Example:** `2`

* See the section **Notes on the Essay Data** for more details about these features.

Additionally, the `resources.csv` data set provides more data about the resources required for each project. Each line in this file represents a resource required by a project:

Feature	Description
`id`	A `project_id` value from the `train.csv` file. **Example:** `p036502`
`description`	Desciption of the resource. **Example:** `Tenor Saxophone Reeds, Box of 25`
`quantity`	Quantity of the resource required. **Example:** `3`
`price`	Price of the resource required. **Example:** `9.95`

Note: Many projects require multiple resources. The `id` value corresponds to a `project_id` in train.csv, so you use it as a key to retrieve all resources needed for a project:

The data set contains the following label (the value you will attempt to predict):

Label	Description
`project_is_approved`	A binary flag indicating whether DonorsChoose approved the project. A value of `0` indicates the project was not approved, and a value of `1` indicates the project was approved.

Notes on the Essay Data

Prior to May 17, 2016, the prompts for the essays were as follows:

- __project_essay_1:__ "Introduce us to your classroom"
- __project_essay_2:__ "Tell us more about your students"
- __project_essay_3:__ "Describe how your students will use the materials you're requesting"
- __project_essay_4:__ "Close by sharing why your project will make a difference"

Starting on May 17, 2016, the number of essays was reduced from 4 to 2, and the prompts for the first 2 essays were changed to the following:

- __project_essay_1:__ "Describe your students: What makes your students special? Specific details about their background, your neighborhood, and your school are all helpful."

your neighborhood, and your school are all helpful.

- __project_essay_2:__ "About your project: How will these materials make a difference in your students' learning and improve their school lives?"

  For all projects with project_submitted_datetime of 2016-05-17 and later, the values of project_essay_3 and project_essay_4 will be NaN.

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
# Tutorial about Python regular expressions: https://pymotw.com/2/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
```

1.1 Reading Data

In [2]:

```
project_data= pd.read_csv('train_new_data.csv')
resource_data= pd.read_csv('resources.csv')
```

In [3]:

```
print(project_data.shape)
print(resource_data.shape)
```

```
(109248, 17)
(1541272, 4)
```

In [4]:

```
print("Number of data points in train data", project_data.shape)
print('-'*50)
print("The attributes of data :", project_data.columns.values)
```

```
Number of data points in train data (109248, 17)
--------------------------------------------------
The attributes of data : ['Unnamed: 0' 'id' 'teacher_id' 'teacher_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_approved']
```

In [5]:

```
print("Number of data points in train data", resource_data.shape)
print(resource_data.columns.values)
resource_data.head(2)
```

```
Number of data points in train data (1541272, 4)
['id' 'description' 'quantity' 'price']
```

Out[5]:

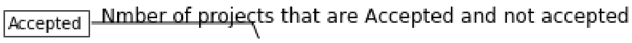
	id	description	quantity	price
0	p233245	LC652 - Lakeshore Double-Space Mobile Drying Rack	1	149.00
1	p069063	Bouncy Bands for Desks (Blue support pipes)	3	14.95

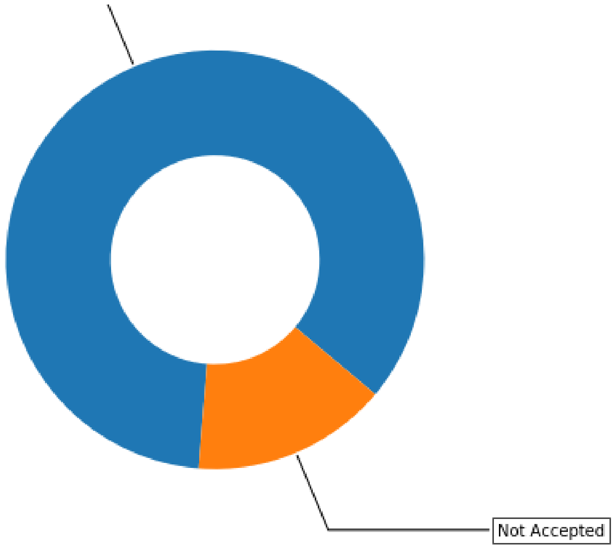
1.2 Data Analysis

In [6]:

```
# PROVIDE CITATIONS TO YOUR CODE IF YOU TAKE IT FROM ANOTHER WEBSITE.
# https://matplotlib.org/gallery/pie_and_polar_charts/pie_and_donut_labels.html#sphx-glr-gallery-p
ie-and-polar-charts-pie-and-donut-labels-py


y_value_counts = project_data['project_is_approved'].value_counts()
print("Number of projects thar are approved for funding ", y_value_counts[1], ", (",
(y_value_counts[1]/(y_value_counts[1]+y_value_counts[0]))*100,"%)")
print("Number of projects thar are not approved for funding ", y_value_counts[0], ", (",
(y_value_counts[0]/(y_value_counts[1]+y_value_counts[0]))*100,"%)")

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("Nmber of projects that are Accepted and not accepted")

plt.show()
```

```
Number of projects thar are approved for funding  92706 , ( 84.85830404217927 %)
Number of projects thar are not approved for funding  16542 , ( 15.141695957820739 %)
```





Observation: 1.Around 85% of projects are accepted 2.15% projects are not accepted

1.2.1 Univariate Analysis: School State

In [7]:

```
# Pandas dataframe groupby count, mean: https://stackoverflow.com/a/19385591/4084039

temp = pd.DataFrame(project_data.groupby("school_state")
["project_is_approved"].apply(np.mean)).reset_index()
# if you have data which contain only 0 and 1, then the mean = percentage (think about it)
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(188,189,220)'],\
            [0.6, 'rgb(158,154,200)'],[0.8, 'rgb(117,107,177)'],[1.0, 'rgb(84,39,143)']]

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')
'''
```

Out[7]:

```
'# How to plot US state heatmap: https://datascience.stackexchange.com/a/9620\n\nscl = [[0.0, \'rg
b(242,240,247)\'],[0.2, \'rgb(218,218,235)\'],[0.4, \'rgb(188,189,220)\'],            [0.6, \'rgb(1
58,154,200)\'],[0.8, \'rgb(117,107,177)\'],[1.0, \'rgb(84,39,143)\']]\n\ndata = [ dict(\n        ty
pe=\'choropleth\',\n        colorscale = scl,\n        autocolorscale = False,\n        locations =
temp[\'state_code\'],\n        z = temp[\'num_proposals\'].astype(float),\n        locationmode = \
'USA-states\',\n        text = temp[\'state_code\'],\n        marker = dict(line = dict (color = \'
rgb(255,255,255)\',width = 2)),\n        colorbar = dict(title = "% of pro")\n    ) ]\n\nlayout = d
```

```
ict(\n        title = \'Project Proposals % of Acceptance Rate by US States\',\n        geo = dict(
\n        scope=\'usa\',\n            projection=dict( type=\'albers usa\' ),\n            show
akes = True,\n            lakecolor = \'rgb(255, 255, 255)\',\n        ),\n    )\n\nfig =
go.Figure(data=data, layout=layout)\noffline.iplot(fig, filename=\'us-map-heat-map\')\n'
```

In [8]:

```
# https://www.csi.cuny.edu/sites/default/files/pdf/administration/ops/2letterstabbrev.pdf
temp.sort_values(by=['num_proposals'], inplace=True)
print("States with lowest % approvals")
print(temp.head(5))
print('='*50)
print("States with highest % approvals")
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
```

In [9]:

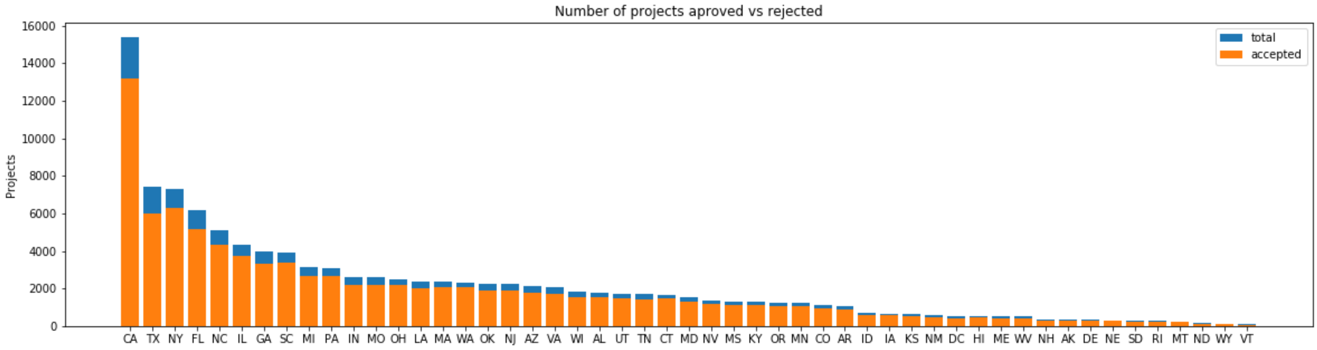
```
#stacked bar plots matplotlib:
https://matplotlib.org/gallery/lines_bars_and_markers/bar_stacked.html
def stack_plot(data, xtick, col2='project_is_approved', col3='total'):
    ind = np.arange(data.shape[0])

    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 [10]:

```
def univariate_barplots(data, col1, col2='project_is_approved', top=False):
    # Count number of zeros in dataframe python: https://stackoverflow.com/a/51540521/4084039
    temp = pd.DataFrame(project_data.groupby(col1)[col2].agg(lambda x: x.eq(1).sum())).reset_index(
)

    # Pandas dataframe grouby count: https://stackoverflow.com/a/19385591/4084039
    temp['total'] = pd.DataFrame(project_data.groupby(col1)
[col2].agg({'total':'count'})).reset_index()['total']
    temp['Avg'] = pd.DataFrame(project_data.groupby(col1)[col2].agg({'Avg':'mean'})).reset_index()[
'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("="*50)
    print(temp.tail(5))
```

In [11]:

```
univariate_barplots(project_data, 'school_state', 'project_is_approved', False)
```



```
   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
```

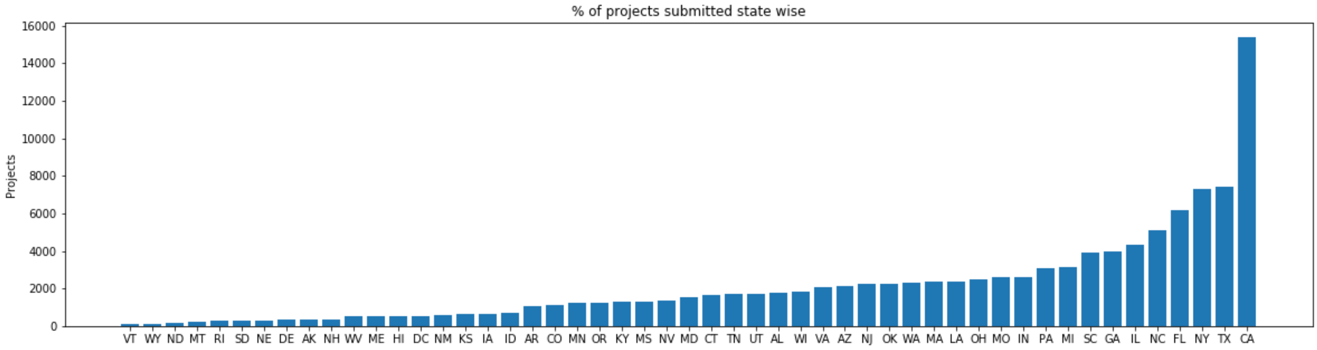
SUMMARY: 1.Every state has greater than 80% success rate in approval 2.California Teachers have submitted most number of projects. 3.Vermont Teachers have least submission and approval rate.

In [12]:

```
# count of all the words in corpus python: https://stackoverflow.com/a/22898595/4084039
from collections import Counter
my_counter = Counter()
for word in project_data['school_state'].values:
    my_counter.update(word.split())
```

In [13]:

```
state_dict = dict(my_counter)
sorted_state_dict = dict(sorted(state_dict.items(), key=lambda kv: kv[1]))


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

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

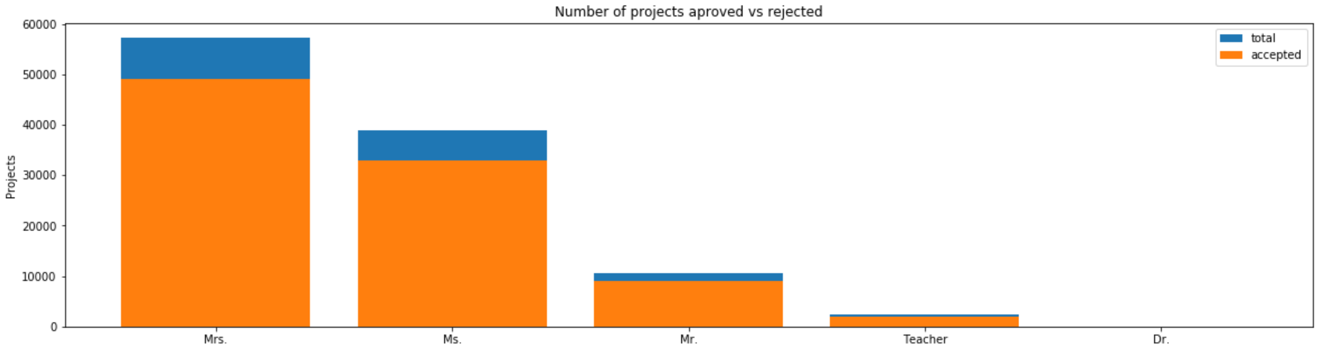


Observation: 1.California has highest project submission rate. 2.least number of projects are submitted by vermont.

1.2.2 Univariate Analysis: teacher_prefix

In [14]:

```
univariate_barplots(project_data, 'teacher_prefix', 'project_is_approved' , top=False)
```



```
  teacher_prefix  project_is_approved  total       Avg
2           Mrs.                48997  57269  0.855559
3            Ms.                32860  38955  0.843537
1            Mr.                 8960  10648  0.841473
4        Teacher                 1880   2363  0.795599
0            Dr.                    9     13  0.692308
==================================================
  teacher_prefix  project_is_approved  total       Avg
2           Mrs.                48997  57269  0.855559
3            Ms.                32860  38955  0.843537
1            Mr.                 8960  10648  0.841473
4        Teacher                 1880   2363  0.795599
0            Dr.                    9     13  0.692308
```

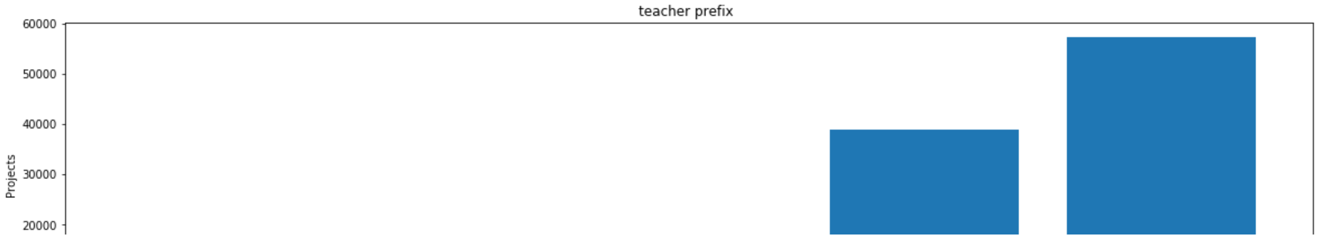
Observation: 1.Most number of project submissions are done by female as compared to men teachers. 2.More number of project approvals are for married female teacher i.e who have a Teacher_prefix of Mrs. 3.Least number of projects are submitted by teachers who have a doctrate. 4.Majority of teachers dont have a doctrate degree.

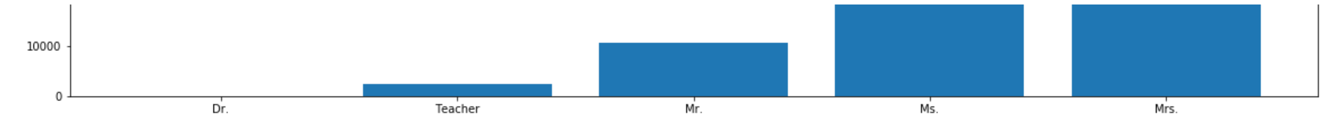
In [15]:

```
from collections import Counter
my_counter = Counter()
for word in project_data['teacher_prefix'].values:
    my_counter.update(word.split())
```

In [16]:

```
prefix_dict = dict(my_counter)
sorted_prefix_dict = dict(sorted(prefix_dict.items(), key=lambda kv: kv[1]))


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

plt.ylabel('Projects')
plt.title('teacher prefix ')
plt.xticks(ind, list(sorted_prefix_dict.keys()))
plt.show()
```



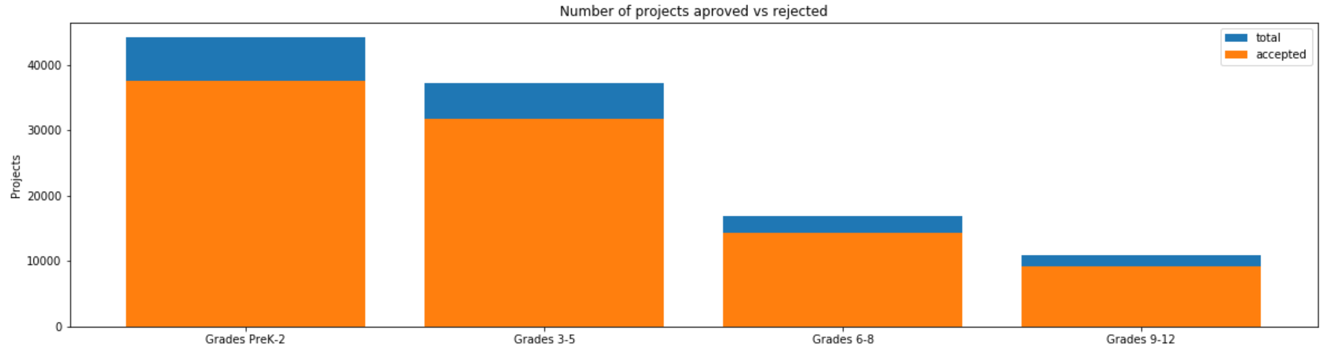


Observation: 1.Teachers with doctrates have submittedvery less projects 2.Married female teacher projects have high approval rates.

1.2.3 Univariate Analysis: project_grade_category

In [17]:

```
univariate_barplots(project_data, 'project_grade_category', 'project_is_approved', top=False)
```



```
  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
```

Observation: 1.Maximum number of projects are submitted for Grades PreK-2. 2.More number of project approvals are for Grades 3-5. 3.Least number of projects are submitted for class 9-12.

In [18]:

```
catogories = list(project_data['project_grade_category'].values)
# remove special characters from list of strings python:
https://stackoverflow.com/a/47301924/4084039

# https://www.geeksforgeeks.org/removing-stop-words-nltk-python/
# https://stackoverflow.com/questions/23669024/how-to-strip-a-specific-word-from-a-string
# https://stackoverflow.com/questions/8270092/remove-all-whitespace-in-a-string-in-python
pgc_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", "Warmth", "Care & H
unger"]
        if 'The' in j.split(): # this will split each of the catogory based on space "Math & Scienc
e"=> "Math","&", "Science"
            j=j.replace('The','') # if we have the words "The" we are going to replace it with ''(i
.e removing 'The')
        j = j.replace(' ','') # we are placeing all the ' '(space) with ''(empty) ex:"Math &
Science"=>"Math&Science"
        temp+=j.strip()+" " #" abc ".strip() will return "abc", remove the trailing spaces
        temp = temp.replace('&','_') # we are replacing the & value into
    pgc_list.append(temp.strip())
```

In [19]:

```
project_data['clean_project_grade_category'] = pgc_list
```

```
project_data['clean_project_grade_category'] = pgc_list
project_data.drop(['project_grade_category'], axis=1, inplace=True)
project_data.head(2)
```

Out[19]:

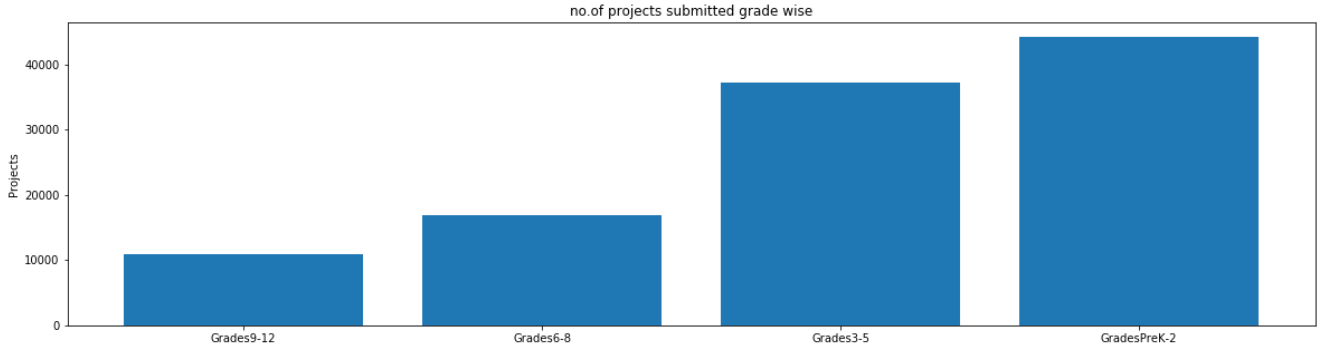
	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	proj
0	0	p036502	484aaf11257089a66cfedc9461c6bd0a	Ms.	NV	18-11-2016 14:45	Liter
1	3	p185307	525fdbb6ec7f538a48beebaa0a51b24f	Mr.	NC	12-08-2016 15:42	Heal

In [20]:

```
from collections import Counter
my_counter = Counter()
for word in project_data['clean_project_grade_category'].values:
    my_counter.update(word.split())
```

In [21]:

```
project_grade_dict = dict(my_counter)
sorted_project_grade_dict = dict(sorted(project_grade_dict.items(), key=lambda kv: kv[1]))


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

plt.ylabel('Projects')
plt.title('no.of projects submitted grade wise')
plt.xticks(ind, list(sorted_project_grade_dict.keys()))
plt.show()
```



Observation: 1.Most of the projects are proposed for grade PreK-2. 2.least projects were proposed for Grade 9-12.

1.2.4 Univariate Analysis: project_subject_categories

In [22]:

```
catogories = list(project_data['project_subject_categories'].values)
# remove special characters from list of strings python:
https://stackoverflow.com/a/47301924/4084039

# https://www.geeksforgeeks.org/removing-stop-words-nltk-python/
# https://stackoverflow.com/questions/23669024/how-to-strip-a-specific-word-from-a-string
# https://stackoverflow.com/questions/8270092/remove-all-whitespace-in-a-string-in-python
cat_list = []
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", "Warmth", "Care & H
unger"]
        if 'The' in j.split(): # this will split each of the catogory based on space "Math & Scienc
e"=> "Math","&", "Science"
            j=j.replace('The','') # if we have the words "The" we are going to replace it with ''(i
.e removing 'The')
        j = j.replace(' ','') # we are placeing all the ' '(space) with ''(empty) ex:"Math &
Science"=>"Math&Science"
        temp+=j.strip()+" " #" abc ".strip() will return "abc", remove the trailing spaces
        temp = temp.replace('&','_') # we are replacing the & value into
    cat_list.append(temp.strip())
```

In [23]:

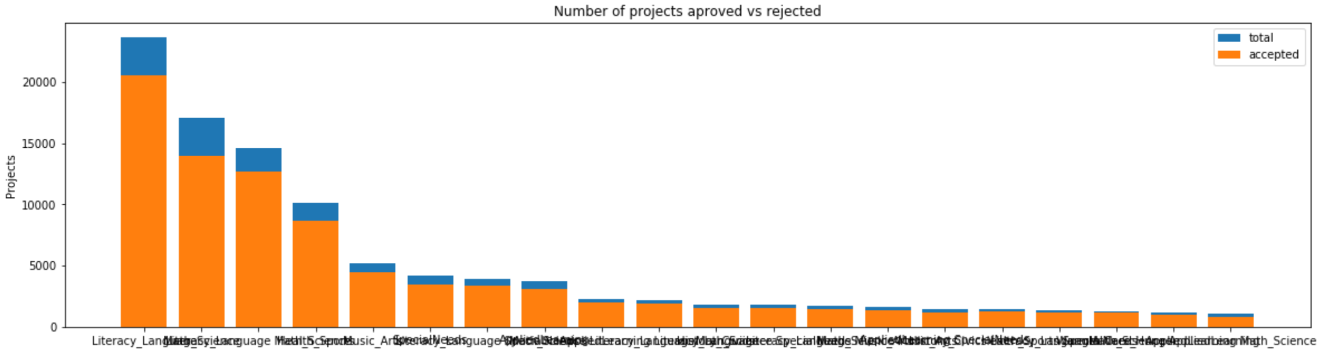
```
project_data['clean_categories'] = cat_list
project_data.drop(['project_subject_categories'], axis=1, inplace=True)
project_data.head(2)
```

Out[23]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	proj
0	0	p036502	484aaf11257089a66cfedc9461c6bd0a	Ms.	NV	18-11-2016 14:45	Liter
1	3	p185307	525fdbb6ec7f538a48beebaa0a51b24f	Mr.	NC	12-08-2016 15:42	Heal

In [24]:

```
univariate_barplots(project_data, 'clean_categories', 'project_is_approved', top=20)
```



```
                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  total       Avg
19  History_Civics Literacy_Language                 1271   1421  0.894441
14        Health_Sports SpecialNeeds                 1215   1391  0.873472
50                Warmth Care_Hunger                 1212   1309  0.925898
33      Math_Science AppliedLearning                 1019   1220  0.835246
4       AppliedLearning Math_Science                  855   1052  0.812738
```

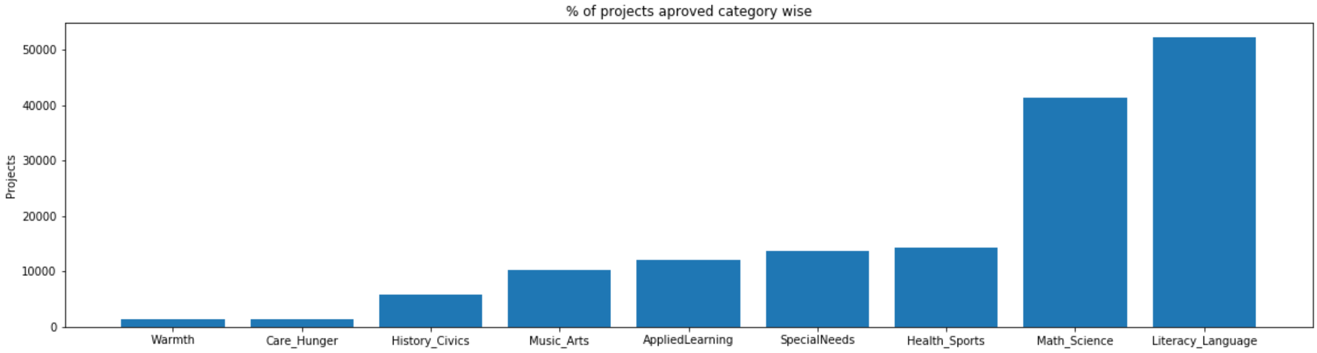
Observation: 1.Most number of projects are submitted in domain Literacy_language. 2.Most number of projects are approved in domain of warmth care_hunger. 3.Least number of projects are approved in domain of AppliedLearning Math_Science.

In [25]:

```
# count of all the words in corpus python: https://stackoverflow.com/a/22898595/4084039
from collections import Counter
my_counter = Counter()
for word in project_data['clean_categories'].values:
    my_counter.update(word.split())
```

In [26]:

```
# 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()
```



Observation: 1.Most number of projects are submitted in literacy language. 2.Least number of projects are submitted in area of Warmth.

In [27]:

```
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 [28]:

```
sub_catogories = list(project_data['project_subject_subcategories'].values)
# remove special characters from list of strings python:
https://stackoverflow.com/a/47301924/4084039

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

```
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", "Warmth", "Care & H
unger"]
        if 'The' in j.split(): # this will split each of the catogory based on space "Math & Scienc
e"=> "Math","&", "Science"
            j=j.replace('The','') # if we have the words "The" we are going to replace it with ''(i
.e removing 'The')
        j = j.replace(' ','') # we are placeing all the ' '(space) with ''(empty) ex:"Math &
Science"=>"Math&Science"
        temp +=j.strip()+" " #" abc ".strip() will return "abc", remove the trailing spaces
        temp = temp.replace('&','_')
    sub_cat_list.append(temp.strip())
```

In [29]:

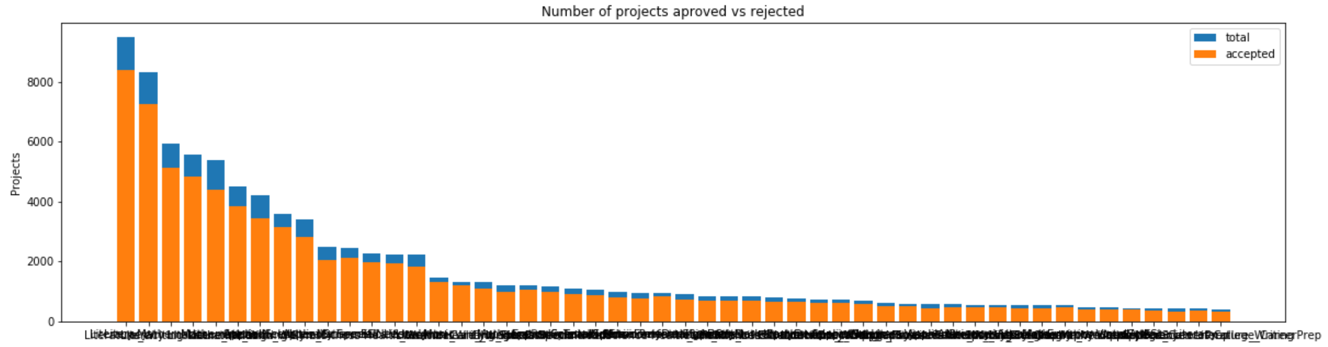
```
project_data['clean_subcategories'] = sub_cat_list
project_data.drop(['project_subject_subcategories'], axis=1, inplace=True)
project_data.head(2)
```

Out[29]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	proj
0	0	p036502	484aaf11257089a66cfedc9461c6bd0a	Ms.	NV	18-11-2016 14:45	Supe Wor Cent
1	3	p185307	525fdbb6ec7f538a48beebaa0a51b24f	Mr.	NC	12-08-2016 15:42	\"Kid Insp Equi to In Activ

In [30]:

```
univariate_barplots(project_data, 'clean_subcategories', 'project_is_approved', top=50)
```



```
                  clean_subcategories  project_is_approved  total       Avg
317                          Literacy                 8371   9486  0.882458
319              Literacy Mathematics                 7260   8325  0.872072
331  Literature_Writing Mathematics                   5140   5923  0.867803
318     Literacy Literature_Writing                   4823   5571  0.865733
342                       Mathematics                 4385   5379  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
```

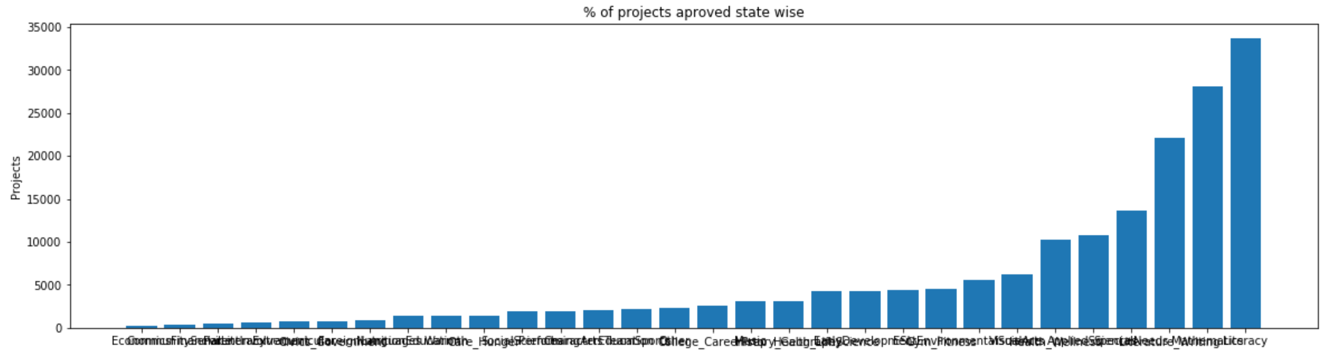
Observation: 1.The Literacy language has 5 subcategories in which the Literacy has the maximum number of projects and Mathematics has least number of projects submitted. 2.Least number of projects are submitted in area of AppliedSciences College_CareerPrep.

In [31]:

```
# count of all the words in corpus python: https://stackoverflow.com/a/22898595/4084039
from collections import Counter
my_counter = Counter()
for word in project_data['clean_subcategories'].values:
    my_counter.update(word.split())
```

In [32]:

```
# 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 [33]:

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

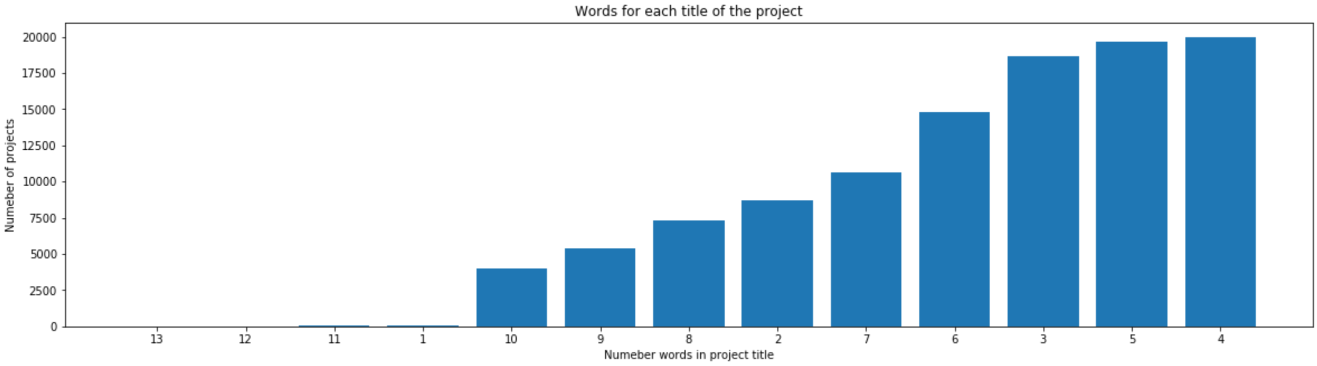
```
Economics            :       269
CommunityService     :       441
FinancialLiteracy    :       568
ParentInvolvement    :       677
Extracurricular      :       810
Civics_Government    :       815
ForeignLanguages     :       890
NutritionEducation   :      1355
Warmth               :      1388
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
AppliedSciences      :      10816
SpecialNeeds         :      13642
Literature_Writing   :      22179
Mathematics          :      28074
Literacy             :      33700
```

Observation: 1.Minimum projects are in the area of economics. 2.Maximum projects are in the area of literacy.

1.2.6 Univariate Analysis: Text features (Title)

In [34]:

```
#How to calculate number of words in a string in DataFrame:
https://stackoverflow.com/a/37483537/4084039
word_count = project_data['project_title'].str.split().apply(len).value_counts()
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()
```



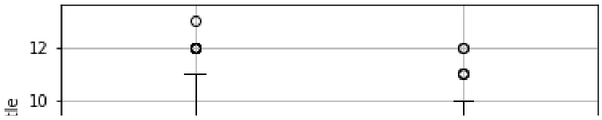
Observation: 1.Most number of projects have 4-5 words in their project title. 2.least number of projects have 1 or 11-13 words in their project title.

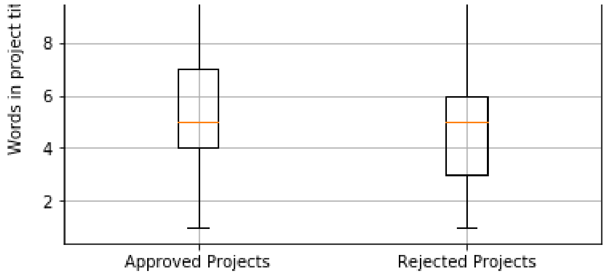
In [35]:

```
approved_title_word_count = project_data[project_data['project_is_approved']==1]['project_title'].
str.split().apply(len)
approved_title_word_count = approved_title_word_count.values

rejected_title_word_count = project_data[project_data['project_is_approved']==0]['project_title'].
str.split().apply(len)
rejected_title_word_count = rejected_title_word_count.values
```

In [36]:

```
# 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()
```

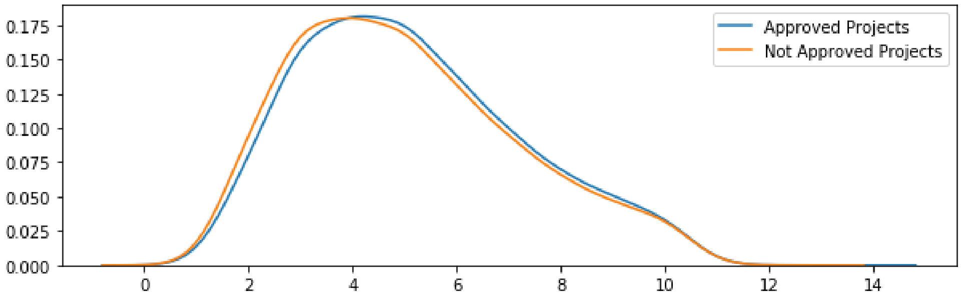




Observation: 1.Most of the Aprroved and Rejected projects have 4-5 words in their project titles. 2.No. of approved projects are more as compared to rejected projects 3.Approved projects have a maximum of 11 words and minimum of 1 word 4.Rejected projects have a maximum of 10 words and minimum of 1 word

In [37]:

```
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()
```



Observation: Approved projects have slightly more number of words in their project title.

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

In [38]:

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

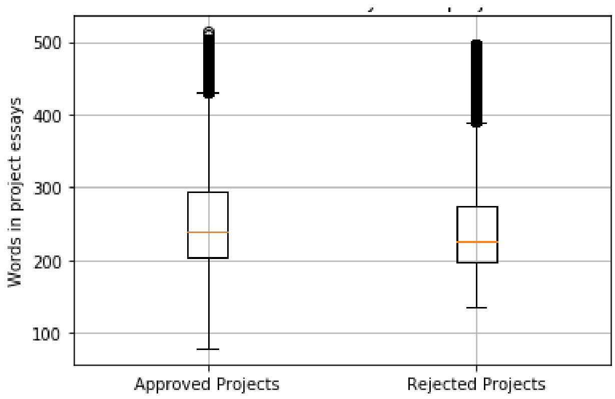
In [39]:

```
approved_word_count = project_data[project_data['project_is_approved']==1]['essay'].str.split().app
ly(len)
approved_word_count = approved_word_count.values

rejected_word_count = project_data[project_data['project_is_approved']==0]['essay'].str.split().app
ly(len)
rejected_word_count = rejected_word_count.values
```

In [40]:

```
# 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()
```

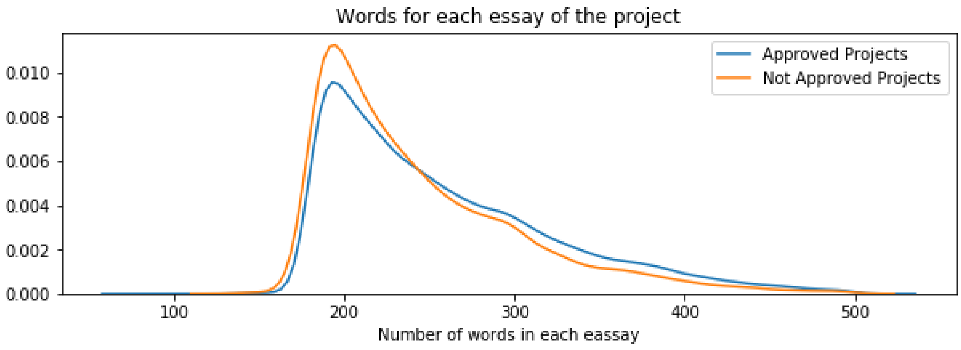
Words for each essay of the project



Observtion: 1.Approved Projects have maximum and least number of words in their project essays. 2.Rejected Projects have an average of 225 words in thir project essays.

In [41]:

```
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()
```



Observation: 1.Non Approved Projects have greater than 100 words in their project essays. 2.There are approved projects which have less than 100 words in their project essays.

1.2.8 Univariate Analysis: Cost per project

In [42]:

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

Out[42]:

	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 [43]:

```
# https://stackoverflow.com/questions/22407798/how-to-reset-a-dataframes-indexes-for-all-groups-in
-one-step
price_data = resource_data.groupby('id').agg({'price':'sum', 'quantity':'sum'}).reset_index()
price_data.head(2)
```

Out[43]:

	id	price	quantity
0	p000001	459.56	7
1	p000002	515.89	21

In [44]:

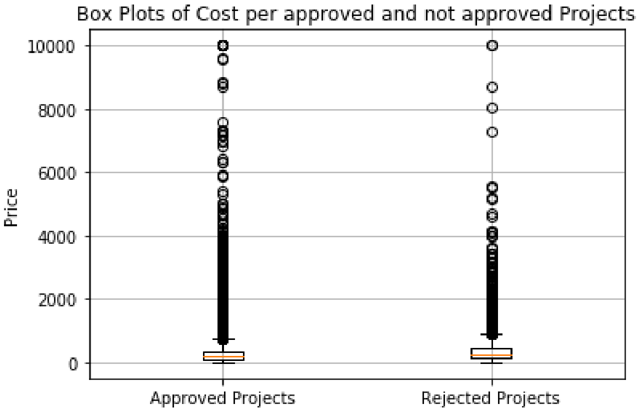
```
# join two dataframes in python:
project_data = pd.merge(project_data, price_data, on='id', how='left')
```

In [45]:

```
approved_price = project_data[project_data['project_is_approved']==1]['price'].values

rejected_price = project_data[project_data['project_is_approved']==0]['price'].values
```

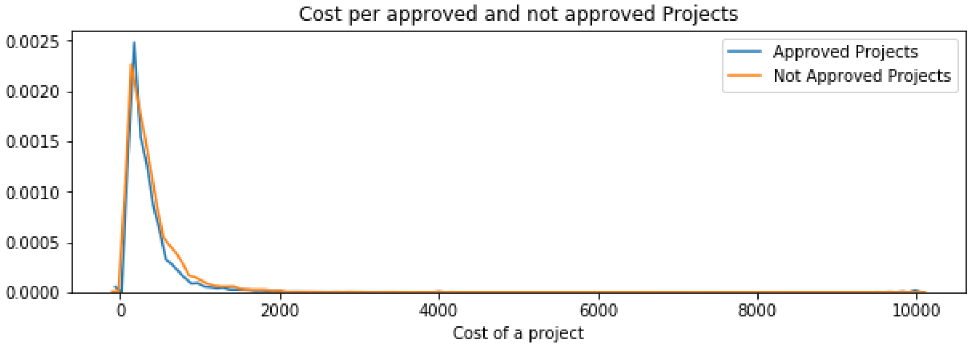
In [46]:

```
# 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()
```


Box Plots of Cost per approved and not approved Projects

In [47]:

```
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()
```


Cost per approved and not approved Projects

Observation: Cost of approved projects are less as compared to non approved projects and maximum cost of a project is around

10,000 dollars.

In [48]:

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

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

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.percentile(rejected_price,i), 3)])
print(x)
```

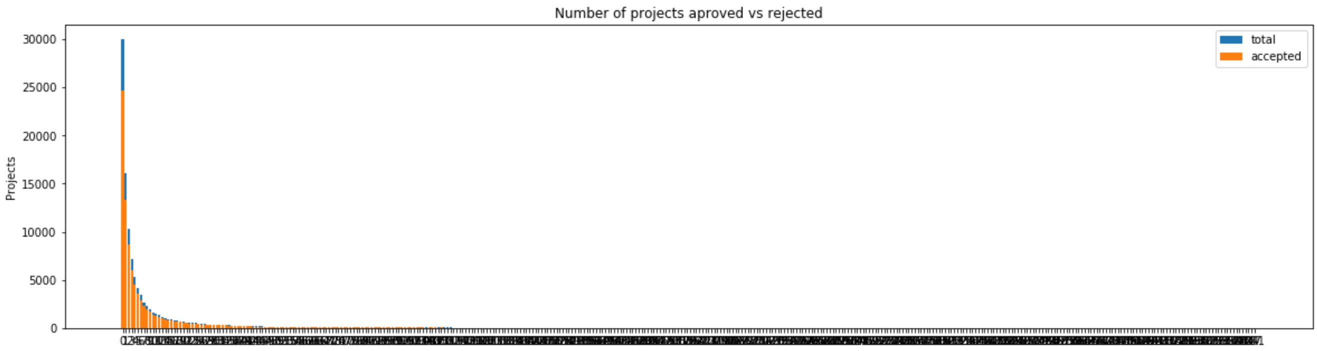
```
+------------+-------------------+-----------------------+
| Percentile | Approved Projects | Not Approved Projects |
+------------+-------------------+-----------------------+
|     0      |        0.66       |          1.97         |
|     5      |       13.59       |          41.9         |
|     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        |
+------------+-------------------+-----------------------+
```

1.2.9 Univariate Analysis: teacher_number_of_previously_posted_projects

Please do this on your own based on the data analysis that was done in the above cells

In [49]:

```
univariate_barplots(project_data, 'teacher_number_of_previously_posted_projects', 'project_is_approved', top=500)
```



```
   teacher_number_of_previously_posted_projects  project_is_approved  total  \
0                                             0                24652  30014   
1                                             1                13329  16058   
2                                             2                 8704  10349   
3                                             3                 5997   7110   
4                                             4                 4452   5266   
```

```
        Avg
0  0.821350
1  0.830054
2  0.841047
3  0.843460
4  0.845423
==================================================
     teacher_number_of_previously_posted_projects  project_is_approved  total  \
242                                           242                    1      1
268                                           270                    1      1
234                                           234                    1      1
335                                           347                    1      1
373                                           451                    1      1

     Avg
242  1.0
268  1.0
234  1.0
335  1.0
373  1.0
```

Observation: 1.More number of participants are the teachers who didnot submit any project previously. 2.If the number of previously posted projets are high then the project acceptance rate is aslo high. 3.There is only one teacher with maximum project submission previously of 451.

1.2.10 Univariate Analysis: project_resource_summary

Please do this on your own based on the data analysis that was done in the above cells

Check if the `presence of the numerical digits` in the `project_resource_summary` effects the acceptance of the project or not. If you observe that `presence of the numerical digits` is helpful in the classification, please include it for further process or you can ignore it.

In [50]:

```
def digit_in_text(x):
    k=any(i.isdigit() for i in x)
    if k==True:
        return 1
    else:
        return 0
```

In [51]:

```
text = project_data['project_resource_summary']
v = text.map(digit_in_text)
project_data['digits_in_summary'] = v
print("Number of data points in our data", project_data.shape)
project_data.head(50)
```

```
Number of data points in our data (109248, 21)
```

Out[51]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	
0	0	p036502	484aaf11257089a66cfedc9461c6bd0a	Ms.	NV	18-11-2016 14:45	S W
1	3	p185307	525fdbb6ec7f538a48beebaa0a51b24f	Mr.	NC	12-08-2016 15:42	\"I E

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	In A
2	4	p013780	a63b5547a7239eae4c1872670848e61a	Mr.	CA	06-08-2016 09:09	W w cu cl
3	5	p063374	403c6783e9286e51ab318fba40f8d729	Mrs.	DE	05-11-2016 10:01	N O M
4	6	p103285	4e156c5fb3eea2531601c8736f3751a7	Mrs.	MO	31-08-2016 00:30	A K
5	7	p181781	c71f2ef13b4bc91afac61ca8fd4c0f9f	Mrs.	SC	03-08-2016 13:26	F Fi W L
6	8	p114989	b580c11b1497a0a67317763b7f03eb27	Ms.	IN	13-09-2016 22:35	W H K
7	9	p191410	2071fb0af994f8f16e7c6ed0f35062a1	Mrs.	IL	24-09-2016 18:38	S W B
8	10	p030093	b9e731e16ad8669f37a43e5316518106	Teacher	VA	09-03-2017 17:16	W W
9	11	p226941	103cc1667cf9361bf1c58c8425e76e95	Mrs.	CA	05-09-2016 19:28	T B
10	14	p055350	882c8ddea1d5c4c31976e34f20b461f9	Ms.	FL	02-02-2017 13:46	Fl
11	15	p060293	74c7a7de62df6005b718dfea1447c745	Mrs.	NJ	18-11-2016 18:03	A
12	16	p199435	d69e412550b14dd8286e347f726908c2	Mr.	TX	04-09-2016 22:48	iF B E
13	17	p074849	5d710e545d6952a3c12bfb45a7f9f08c	Mrs.	IN	25-01-2017 22:08	T O C

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	
14	20	p230221	3bfe21c62feb8fd744a696a36487b452	Mrs.	PA	19-08-2016 21:46	A P S S
15	21	p116615	b3593a375f2cf7fd4469b928ffac1c95	Mrs.	NY	30-09-2016 08:12	O D th of
16	23	p070918	a22774168d7910adce6969c8d8faee7c	Mr.	TX	16-06-2016 14:27	M W O
17	24	p144291	fdf9938d5f9e381630384c2452b159e0	Mrs.	PA	22-10-2016 22:25	L fo L
18	26	p070029	b74b266d6e52c0348a8dcef8b0ea4a2b	Mrs.	NJ	13-01-2017 17:40	N P
19	27	p107356	f4594111d55f22ee3ed5e8e4a1c2852b	Ms.	UT	11-10-2016 19:16	C m
20	28	p031939	32a2fb6f6a1aca27a686cea452973f03	Mr.	ID	31-10-2016 19:17	Fi T Li
21	29	p044085	65f5f57c7b035d58ec095602a8f7dcf6	Mrs.	OH	25-10-2016 12:37	L
22	30	p081434	17563b7d138a9ca1e7308f0f480e7d09	Ms.	NY	06-12-2016 21:19	S B C
23	32	p156550	a902ce7ebdce6f236873d6b443c3ca08	Ms.	NY	30-03-2017 20:05	K S F F T
24	34	p139731	d89c560612543869db2ca395d5831759	Mr.	CA	10-01-2017 01:24	H K
25	35	p048657	6aeff850182daa6ff1e041c341d46d42	Mr.	WA	26-01-2017 20:21	F F Y D
26	36	p234430	300a3c291f8134b6e03d531fa8ead900	Mrs.	SC	24-08-2016 11:40	W W L

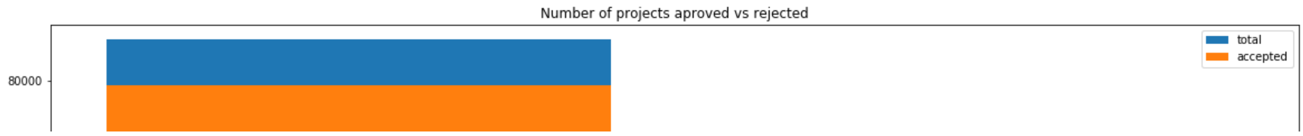
	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	
27	37	p000139	f68fedcb0852d8a6ce88f7b4139b9227	Mr.	TX	07-08-2016 20:33	D R
28	38	p240738	6f6e951e435aa9dc966091945414bcc4	Ms.	NC	16-02-2017 08:13	iF L T S C
29	41	p211511	9784fcc981bda0139eeaf17beb03d8bb	Mrs.	NC	28-12-2016 16:58	K L te
30	42	p220000	87d06a109a06e632ddc1a94467cae00f	Ms.	IL	01-03-2017 20:52	L S S
31	43	p183686	a4e76cd2a86c2ad66459c35a2bd93f1e	Ms.	NC	24-09-2016 15:13	E R T
32	44	p045806	75675b5ba428bc65df5f7233dcf9ef80	Ms.	MA	03-08-2016 11:55	In M S C
33	45	p246581	f3cb9bffbba169bef1a77b243e620b60	Mrs.	KY	06-10-2016 21:16	T K
34	46	p228935	6386aca8d27d9c98c02384920a211e15	Mrs.	IN	26-12-2016 22:24	M M R
35	47	p176012	62f7c40fbd176a2d9c3d93bb4b9c64ad	Mrs.	NC	23-05-2016 15:12	C S L
36	48	p229479	428cb70a246dc4a2adb1e12bef5452b2	Ms.	AZ	28-02-2017 18:52	T T
37	54	p009578	d626d8b2ff909ce856e47395c7cb3837	Mrs.	NC	02-03-2017 14:10	N N
38	55	p245173	7c2fd243feb5389974ed988c99b5f355	Mrs.	AR	12-12-2016 18:18	S R
							L

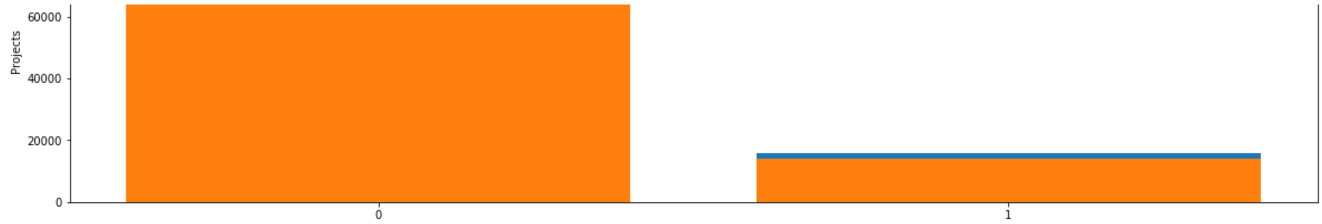
	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	th
39	57	p207223	b7d11821f26c65bc7e4350fbd57f7602	Mr.	CA	10-01-2017 13:18	C
40	58	p069404	29cbf9bcad5e379cbc92f44434189657	Ms.	IL	29-01-2017 21:11	O E N G
41	59	p186381	da67f09a612a32fa30c9c80bed7e6365	Mrs.	NY	24-09-2016 11:36	Li L G
42	60	p056807	a3ba6667f3b15e1f0f976711f29052f1	Ms.	MO	13-11-2016 23:02	A B
43	61	p131333	3e6202eb6cfdac00e49851d888059cb8	Ms.	WV	18-02-2017 23:11	W T G
44	63	p250930	e31c99a7540d578fd578d3c705918014	Mrs.	NY	24-02-2017 21:14	C
45	64	p051288	e7d7d12bd22f51c829a27f08293f27bf	Mrs.	MO	07-08-2016 23:05	L W M
46	65	p183614	5cd4210392b5c528512e69337e161a92	Mrs.	VA	01-02-2017 08:52	D H w S
47	67	p240150	c96cd1860dc941f781a206059e38ceac	Mrs.	GA	28-10-2016 23:32	E D P S
48	69	p055462	c9a1a6c9ff38502c9aa0492fdccc940e	Mrs.	SC	20-04-2017 14:14	T C
49	71	p216335	06ac5121c71ac3a4aae34a8ee59e75ab	Ms.	WI	21-12-2016 14:03	C C

50 rows × 21 columns

In [52]:

```
univariate_barplots(project_data, 'digits_in_summary', 'project_is_approved', top=2)
```





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

Observation: 1.If digits are present in project resource summary then it has an higher acceptance rate of 89.4% 2.Most of the project resource summaries dont have digits present in it.

1.3 Text preprocessing

1.3.1 Essay Text

In [53]:

```
project_data.head(2)
```

Out[53]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime	proj
0	0	p036502	484aaf11257089a66cfedc9461c6bd0a	Ms.	NV	18-11-2016 14:45	Supe Wor Cent
1	3	p185307	525fdbb6ec7f538a48beebaa0a51b24f	Mr.	NC	12-08-2016 15:42	\"Kid Insp Equi to In Activ

2 rows × 21 columns

In [54]:

```
# printing some random essays.
print(project_data['essay'].values[0])
print("="*50)
print(project_data['essay'].values[150])
print("="*50)
print(project_data['essay'].values[1000])
print("="*50)
print(project_data['essay'].values[20000])
print("="*50)
print(project_data['essay'].values[99999])
print("="*50)
```

```
Most of my kindergarten students come from low-income households and are considered \"at-risk\". T
hese kids walk to school alongside their parents and most have never been further than walking dis
tance from their house. For 80% of my students, English is not their first language or the
language spoken at home. \r\n\r\nWhile my kindergarten kids have many obstacles in front of them,
they come to school each day excited and ready to learn. Most students started the year out never
being in a school setting. At the start of the year many had never been exposed to letters. Each d
```

ay they soak up more knowledge and try their hardest to succeed. They are highly motivated to learn new things every day. We are halfway through the year and they are starting to take off. They know know all letters, some sight words, numbers to 20, and a majority of their letter sounds because of their hard work and determination. I am excited to see the places we will go from here!I currently have a differentiated sight word center that we do daily during our literacy stations. The students have activities that relate to whatever sight word list they are on. This is one of their favorite station activities. I want to continue to provide the students with engaging ways to practice their sight words. \r\n\r\nI dream of having the students use QR readers to scan the sight words that they are struggling with and the Ipods reading the sight words with them. This would help so many of my students by giving them multiple exposures to the words. My students need someone who can go over these sight words daily and I can't always get around to everyone to practice their flashcards with them. With the Ipods they would still have a way to practice their sight words on a daily basis.nannan

==

Our school is located the second smallest city in Los Angeles County. Our elementary school is 552 students strong. We have 1 percent African American, and 98 percent Latinos. We have a 90percent socioeconomically disadvantaged population and 4 percent foster youth. 100% of our students get free lunch.\r\n   \r\n   Despite the many challenges they face, my students arrive every morning full of life, ready to learn, and excited to get started on our day. I do my best to provide my students with creative and meaningful learning experiences.Every morning we begin our learning by coming to the rug and setting our goals for the day. We come together to begin our activities and we come together to end our activities. We also come to the carpet to just have independent reading time. The carpet area is crucial part of our learning space.\r\n\r\n   \r\n   My students are currently, sitting in a torn, stained carpet that continues to deteriorate every day. Some of the strings have begun to run and the students can no longer just sit and focus. They have began to pull and tug at the disintegrating carpet.\r\n\r\n\r\n   This carpet will allow my students to have a nice, clean and soft place where we can meet and learn. They need a place where they can sit, focus and not worry about their seating coming apart.nannan

==

Our Pre-K students come from very diverse backgrounds. Many come through our doors with developmental and communication delays and learn how to engage with the world around them through play and collaborate social-emotional skills. Our students also come to us from home environments that are identified as being \"at-risk\" due to family income, languages spoken at home, and other developmental and medical situations. Though they are diverse, they all come to us with the same excitement and desire to learn.The sandbox will provide our students will excellent opportunities for the development and practice of fine motor skills, social skills, and communication. By having a place where students can sit and play closely with their peers, we can effectively teach and work on the social skills that we actively teach in the classroom. \r\nThough we have a great outdoor space, we don't have many opportunities for our students to be close and interact cooperatively outside. With this sandbox and the play materials, our kids will be able to get valuable sensory input and tactile stimulation, all while learning through play!nannan

==

Chicago schools, like many urban school districts across America, have been fighting against the challenges of the current state of education; severe budget cuts, lack of resources, increased classroom sizes, lead in the drinking water, and many others. When basic needs in school are not being met, the power of education to transform our young people is hindered. \r\n\r\nIn a few short weeks, I am proud to be joining the team of education warriors as I will be stepping into my own classroom as a first year teacher. My new school, being both 98% African American and 75% low income, faces many challenges similar to the other schools in Chicago. \r\n\r\nI am thrilled to be working with a group of about 90 eager 4th grade readers and writers. Like every child, regardless of race or socioeconomic background, they deserve the best teachers, education, and resources. It is the job of myself, my fellow teachers and staff of my school to make sure that happens. Despite these challenges, I am dedicated to teaching the strongest culturally relevant, identity confirming, social justice curriculum that I can!\"People don't realize how a man's whole life can be changed by one book.\" -Malcolm X\r\n\r\nDo you remember reading that one book in elementary school that changed your life? There's a good chance you were able to relate to the character in the book. But what happens in schools that are predominantly African American and Latino when students only have access to reading books about white characters and animals? These books are windows into other people's lives. Many classroom libraries are missing mirrors into their student's lives. Young people, like 11 year old Marley Dias, are bringing awareness to this issue. Dias launched a list of books, calling it 1,000 Black Girl Books. \r\n\r\nBeing in a school that is 98% African American, my goal is similar. I want my students to walk into their classroom library and find more than a bin of books labeled \"Multicultural Books.\" I want my students to see reflections of themselves in every genre. I want them to see people of color in positions of power and doing amazing things in the world. I want my students to hear some of the real stories about history and important people. I truly believe that having access to these books during read alouds, mini lessons, silent reading, and to check out will foster a love for reading. This love for reading will change lives.nannan

==

Many of our students walk into their classrooms excited and always ready to tackle their work day! The students at this K-5 school are given opportunities to grow and are always encouraged to be themselves! Our students are comprised of many different backgrounds and cultures. Our teachers and staff always make our students their number one priority. \r\n\r\nThe students at our school are unique and amazing in their own way. Every day they take on their school challenges and try their best to succeed. No matter what our teachers embrace and support the students for their efforts. Our students know they can count on us as teachers and staff and we know that we can count on them to learn and succeed.\r\n\r\n\r\nThese students participate in our Positive Behavior Support (PBS)

```
program to increase academic performance, increase safety, decrease problem behavior and establish
positive school outcomes. PBS is a researched based positive intervention system that is used to c
reate and support positive school culture by increasing positive behavior, social competence and a
cademic performance. This support system is expected to help reinforce positive conduct and reduce
challenging behaviors. For example, when students demonstrate positive behaviors they will earn “T
iger Bucks”. Once they earn their bucks they will be able to use them to shop at our PBS store and
they may have enough to participate in our monthly socials, which students have a privilege of att
ending themed parties. \r\n\r\nPBS will help our students stay focused and help them show improvem
ent! Essentially, by purchasing items for our PBS project, such as Lego, markers, boards, kitchen
set, toy cars, and many other items listed in our cart will help students decrease problem behavio
rs and improve academic performance in school. Our program will help reinforce a desired positive
school culture in turn rewarding students to make good decisions. These supplies will help us
encourage our students to be the best students they can be and teach them all that good that comes
with being on their best behavior!\r\nnannan
==================================================
```

In [55]:

```python
# 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 [56]:

```python
sent = decontracted(project_data['essay'].values[20000])
print(sent)
print("="*50)
```

```
Chicago schools, like many urban school districts across America, have been fighting against the c
hallenges of the current state of education; severe budget cuts, lack of resources, increased
classroom sizes, lead in the drinking water, and many others. When basic needs in school are not b
eing met, the power of education to transform our young people is hindered.  \r\n\r\nIn a few shor
t weeks, I am proud to be joining the team of education warriors as I will be stepping into my own
classroom as a first year teacher. My new school, being both 98% African American and 75% low inco
me, faces many challenges similar to the other schools in Chicago. \r\n\r\nI am thrilled to be
working with a group of about 90 eager 4th grade readers and writers. Like every child, regardless
of race or socioeconomic background, they deserve the best teachers, education, and resources. It
is the job of myself, my fellow teachers and staff of my school to make sure that happens. Despite
these challenges, I am dedicated to teaching the strongest culturally relevant, identity
confirming, social justice curriculum that I can!\"People do not realize how a man is whole life c
an be changed by one book.\" -Malcolm X\r\n\r\nDo you remember reading that one book in elementary
school that changed your life? There is a good chance you were able to relate to the character in
the book. But what happens in schools that are predominantly African American and Latino when stud
ents only have access to reading books about white characters and animals? These books are windows
into other people is lives. Many classroom libraries are missing mirrors into their student is liv
es.  Young people, like 11 year old Marley Dias, are bringing awareness to this issue. Dias
launched a list of books, calling it 1,000 Black Girl Books. \r\n\r\nBeing in a school that is 98%
African American, my goal is similar. I want my students to walk into their classroom library and
find more than a bin of books labeled \"Multicultural Books.\" I want my students to see
reflections of themselves in every genre. I want them to see people of color in positions of power
and doing amazing things in the world. I want my students to hear some of the real stories about h
istory and important people. I truly believe that having access to these books during read alouds,
mini lessons, silent reading, and to check out will foster a love for reading. This love for readi
ng will change lives.nannan
==================================================
```

In [57]:

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

```
Chicago schools, like many urban school districts across America, have been fighting against the c
hallenges of the current state of education; severe budget cuts, lack of resources, increased
classroom sizes, lead in the drinking water, and many others. When basic needs in school are not b
eing met, the power of education to transform our young people is hindered.      In a few short
weeks, I am proud to be joining the team of education warriors as I will be stepping into my own c
lassroom as a first year teacher. My new school, being both 98% African American and 75% low incom
e, faces many challenges similar to the other schools in Chicago.     I am thrilled to be working
with a group of about 90 eager 4th grade readers and writers. Like every child, regardless of race
or socioeconomic background, they deserve the best teachers, education, and resources. It is the j
ob of myself, my fellow teachers and staff of my school to make sure that happens. Despite these c
hallenges, I am dedicated to teaching the strongest culturally relevant, identity confirming, soci
al justice curriculum that I can! People do not realize how a man is whole life can be changed by
one book.  -Malcolm X    Do you remember reading that one book in elementary school that changed y
our life? There is a good chance you were able to relate to the character in the book. But what ha
ppens in schools that are predominantly African American and Latino when students only have access
to reading books about white characters and animals? These books are windows into other people is
lives. Many classroom libraries are missing mirrors into their student is lives.  Young people,
like 11 year old Marley Dias, are bringing awareness to this issue. Dias launched a list of books,
calling it 1,000 Black Girl Books.     Being in a school that is 98% African American, my goal is
similar. I want my students to walk into their classroom library and find more than a bin of books
labeled  Multicultural Books.  I want my students to see reflections of themselves in every genre.
I want them to see people of color in positions of power and doing amazing things in the world. I
want my students to hear some of the real stories about history and important people. I truly beli
eve that having access to these books during read alouds, mini lessons, silent reading, and to che
ck out will foster a love for reading. This love for reading will change lives.nannan
```

In [58]:

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

```
Chicago schools like many urban school districts across America have been fighting against the cha
llenges of the current state of education severe budget cuts lack of resources increased classroom
sizes lead in the drinking water and many others When basic needs in school are not being met the
power of education to transform our young people is hindered In a few short weeks I am proud to be
joining the team of education warriors as I will be stepping into my own classroom as a first year
teacher My new school being both 98 African American and 75 low income faces many challenges simil
ar to the other schools in Chicago I am thrilled to be working with a group of about 90 eager 4th
grade readers and writers Like every child regardless of race or socioeconomic background they
deserve the best teachers education and resources It is the job of myself my fellow teachers and s
taff of my school to make sure that happens Despite these challenges I am dedicated to teaching th
e strongest culturally relevant identity confirming social justice curriculum that I can People do
not realize how a man is whole life can be changed by one book Malcolm X Do you remember reading t
hat one book in elementary school that changed your life There is a good chance you were able to r
elate to the character in the book But what happens in schools that are predominantly African Amer
ican and Latino when students only have access to reading books about white characters and animals
These books are windows into other people is lives Many classroom libraries are missing mirrors in
to their student is lives Young people like 11 year old Marley Dias are bringing awareness to this
issue Dias launched a list of books calling it 1 000 Black Girl Books Being in a school that is 98
African American my goal is similar I want my students to walk into their classroom library and fi
nd more than a bin of books labeled Multicultural Books I want my students to see reflections of t
hemselves in every genre I want them to see people of color in positions of power and doing
amazing things in the world I want my students to hear some of the real stories about history and
important people I truly believe that having access to these books during read alouds mini lessons
silent reading and to check out will foster a love for reading This love for reading will change l
ives nannan
```

In [59]:

```
# https://gist.github.com/sebleier/554280
# we are removing the words from the stop words list: 'no', 'nor', 'not'
stopwords= ['i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ourselves', 'you', "you're", "you've",
\
            "you'll", "you'd", 'your', 'yours', 'yourself', 'yourselves', 'he', 'him', 'his',
'himself', \
            'she', "she's", 'her', 'hers', 'herself', 'it', "it's", 'its', 'itself', 'they', 'them',
'their',\
            'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this', 'that', "that'll",
            'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this', 'that', "that'll",
'these', 'those', \
            'am', 'is', 'are', 'was', 'were', 'be', 'been', 'being', 'have', 'has', 'had', 'having',
'do', 'does', \
            'did', 'doing', 'a', 'an', 'the', 'and', 'but', 'if', 'or', 'because', 'as', 'until', '
while', 'of', \
            'at', 'by', 'for', 'with', 'about', 'against', 'between', 'into', 'through', 'during',
'before', 'after',\
            'above', 'below', 'to', 'from', 'up', 'down', 'in', 'out', 'on', 'off', 'over', 'under'
, 'again', 'further',\
            'then', 'once', 'here', 'there', 'when', 'where', 'why', 'how', 'all', 'any', 'both', 'e
ach', 'few', 'more',\
            'most', 'other', 'some', 'such', 'only', 'own', 'same', 'so', 'than', 'too', 'very', \
            's', 't', 'can', 'will', 'just', 'don', "don't", 'should', "should've", 'now', 'd', 'll'
, 'm', 'o', 're', \
            've', 'y', 'ain', 'aren', "aren't", 'couldn', "couldn't", 'didn', "didn't", 'doesn', "do
esn't", 'hadn',\
            "hadn't", 'hasn', "hasn't", 'haven', "haven't", 'isn', "isn't", 'ma', 'mightn',
"mightn't", 'mustn',\
            "mustn't", 'needn', "needn't", 'shan', "shan't", 'shouldn', "shouldn't", 'wasn',
"wasn't", 'weren', "weren't", \
            'won', "won't", 'wouldn', "wouldn't"]
```

In [60]:

```
# Combining all the above statemennts
from tqdm import tqdm
preprocessed_essays = []
# tqdm is for printing the status bar
for sentance in tqdm(project_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)
    # https://gist.github.com/sebleier/554280
    sent = ' '.join(e for e in sent.split() if e not in stopwords)
    preprocessed_essays.append(sent.lower().strip())
```

```
100%|██████████| 109248/109248 [01:38<00:00, 1108.68it/s]
```

In [61]:

```
# after preprocesing
preprocessed_essays[20000]
```

Out[61]:

```
'chicago schools like many urban school districts across america fighting challenges current state
education severe budget cuts lack resources increased classroom sizes lead drinking water many oth
ers when basic needs school not met power education transform young people hindered in short weeks
i proud joining team education warriors i stepping classroom first year teacher my new school 98 a
frican american 75 low income faces many challenges similar schools chicago i thrilled working gro
up 90 eager 4th grade readers writers like every child regardless race socioeconomic background
deserve best teachers education resources it job fellow teachers staff school make sure happens de
spite challenges i dedicated teaching strongest culturally relevant identity confirming social jus
tice curriculum i people not realize man whole life changed one book malcolm x do remember reading
one book elementary school changed life there good chance able relate character book but happens s
chools predominantly african american latino students access reading books white characters
animals these books windows people lives many classroom libraries missing mirrors student lives
young people like 11 year old marley dias bringing awareness issue dias launched list books callin
g 1 000 black girl books being school 98 african american goal similar i want students walk
classroom library find bin books labeled multicultural books i want students see reflections every
genre i want see people color positions power amazing things world i want students hear real stori
es history important people i truly believe access books read alouds mini lessons silent reading c
heck foster love reading this love reading change lives nannan'
```

1.3.2 Project title Text

In [62]:

```
# similarly you can preprocess the titles also
from tqdm import tqdm
from tqdm import tqdm
preprocessed_project_titles = []
# tqdm is for printing the status bar
for sentence in tqdm(project_data['project_title'].values):
    sent = decontracted(sentence)
    sent = sent.replace('\\r', ' ')
    sent = sent.replace('\\"', ' ')
    sent = sent.replace('\\n', ' ')
    sent = re.sub('[^A-Za-z0-9]+', ' ', sent)
    # https://gist.github.com/sebleier/554280
    sent = ' '.join(e for e in sent.split() if e not in stopwords)
    preprocessed_project_titles.append(sent.lower().strip())
```

```
100%|██████████| 109248/109248 [00:04<00:00, 24388.96it/s]
```

1. 4 Preparing data for models

In [63]:

```
project_data.columns
```

Out[63]:

```
Index(['Unnamed: 0', 'id', 'teacher_id', 'teacher_prefix', 'school_state',
       'project_submitted_datetime', '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_approved',
       'clean_project_grade_category', 'clean_categories',
       'clean_subcategories', 'essay', 'price', 'quantity',
       'digits_in_summary'],
      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
```

1.4.1 Vectorizing Categorical data

- https://www.appliedaicourse.com/course/applied-ai-course-online/lessons/handling-categorical-and-numerical-features/

In [64]:

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


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

```
['Warmth', 'Care Hunger', 'History Civics', 'Music Arts', 'AppliedLearning', 'SpecialNeeds',
'Health_Sports', 'Math_Science', 'Literacy_Language']
Shape of matrix after one hot encodig  (109248, 9)
```

In [65]:

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


sub_categories_one_hot = vectorizer.transform(project_data['clean_subcategories'].values)
print("Shape of matrix after one hot encodig ",sub_categories_one_hot.shape)
```

```
['Economics', 'CommunityService', 'FinancialLiteracy', 'ParentInvolvement', 'Extracurricular',
'Civics_Government', 'ForeignLanguages', 'NutritionEducation', 'Warmth', 'Care_Hunger',
'SocialSciences', 'PerformingArts', 'CharacterEducation', 'TeamSports', 'Other',
'College_CareerPrep', 'Music', 'History_Geography', 'Health_LifeScience', 'EarlyDevelopment', 'ESL
', 'Gym_Fitness', 'EnvironmentalScience', 'VisualArts', 'Health_Wellness', 'AppliedSciences',
'SpecialNeeds', 'Literature_Writing', 'Mathematics', 'Literacy']
Shape of matrix after one hot encodig  (109248, 30)
```

In [66]:

```
# Please do the similar feature encoding with state, teacher_prefix and project_grade_category als
o

from sklearn.feature_extraction.text import CountVectorizer
vectorizer = CountVectorizer(vocabulary=list(sorted_state_dict.keys()), lowercase=False, binary=Tr
ue)
vectorizer.fit(project_data['school_state'].values)
print(vectorizer.get_feature_names())


state_one_hot = vectorizer.transform(project_data['school_state'].values)
print("Shape of matrix after one hot encodig ",state_one_hot.shape)
```

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

In [67]:

```
vectorizer = CountVectorizer(vocabulary=list(sorted_project_grade_dict.keys()), lowercase=False, b
inary=True)
vectorizer.fit(project_data['clean_project_grade_category'].values)
print(vectorizer.get_feature_names())
project_grade_category_one_hot = vectorizer.transform(project_data['clean_project_grade_category']
.values)
print("Shape of matrix after one hot encoding ",project_grade_category_one_hot.shape)
```

```
['Grades9-12', 'Grades6-8', 'Grades3-5', 'GradesPreK-2']
Shape of matrix after one hot encoding  (109248, 4)
```

In [68]:

```
vectorizer = CountVectorizer(vocabulary=list(sorted_prefix_dict.keys()), lowercase=False, binary=T
rue)
vectorizer.fit(project_data['teacher_prefix'].values)
print(vectorizer.get_feature_names())
teacher_prefix_one_hot = vectorizer.transform(project_data['teacher_prefix'].values)
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)
```

1.4.2 Vectorizing Text data

1.4.2.1 Bag of words

In [69]:

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

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

1.4.2.2 Bag of Words on `project_title`

In [70]:

```
# you can vectorize the title also
# before you vectorize the title make sure you preprocess it
vectorizer = CountVectorizer(min_df=10)
text_bow_p_t= vectorizer.fit_transform(preprocessed_project_titles)
print("Shape of matrix after one hot encodig ",text_bow_p_t.shape)
```

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

1.4.2.3 TFIDF vectorizer

In [71]:

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

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

1.4.2.4 TFIDF Vectorizer on `project_title`

In [72]:

```
# Similarly you can vectorize for title also
vectorizer = TfidfVectorizer(min_df=10)
text_tfidf_p_t = vectorizer.fit_transform(preprocessed_project_titles)
print("Shape of matrix after one hot encodig ",text_tfidf_p_t.shape)
```

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

1.4.2.5 Using Pretrained Models: Avg W2V

In [73]:

```
# Reading glove vectors in python: https://stackoverflow.com/a/38230349/4084039
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')
```

```
# =============================
'''Output:

Loading Glove Model
1917495it [06:32, 4879.69it/s]
Done. 1917495  words loaded!'''

# =============================

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

for i in preprocessed_project_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 coupus", \
      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))


# stronging variables into pickle files python: http://www.jessicayung.com/how-to-use-pickle-to-sa
ve-and-load-variables-in-python/

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

```
Loading Glove Model
```

```
279727it [01:37, 2855.88it/s]
```

```
Done. 279727  words loaded!
all the words in the coupus 17014183
the unique words in the coupus 58969
The number of words that are present in both glove vectors and our coupus 44769 ( 75.92 %)
word 2 vec length 44769
```

In [74]:

```
# stronging variables into pickle files python: http://www.jessicayung.com/how-to-use-pickle-to-sa
ve-and-load-variables-in-python/
# 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 [75]:

```
# average Word2Vec
# compute average word2vec for each review.
avg_w2v_vectors = []; # the avg-w2v for each sentence/review is stored in this list
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 [00:48<00:00, 2075.44it/s]
```

```
109248
300
```

1.4.2.6 Using Pretrained Models: AVG W2V on `project_title`

In [76]:

```
# Similarly you can vectorize for title also
avg_w2v_vectors_p_t = []; # the avg-w2v for each sentence/review is stored in this list
for sentence in tqdm(preprocessed_project_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_p_t.append(vector)

print(len(avg_w2v_vectors_p_t))
print(len(avg_w2v_vectors_p_t[0]))
```

```
100%|██████████| 109248/109248 [00:02<00:00, 40028.56it/s]
```

```
109248
300
```

1.4.2.7 Using Pretrained Models: TFIDF weighted W2V

In [77]:

```
# S = ["abc def pqr", "def def def abc", "pqr pqr def"]
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 [78]:

```
# average Word2Vec
# compute average word2vec for each review.
tfidf_w2v_vectors = []; # the avg-w2v for each sentence/review is stored in this list
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/review
    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
value((sentence.count(word)/len(sentence.split())))
            tf_idf = dictionary[word]*(sentence.count(word)/len(sentence.split())) # getting the tf
idf value for each word
            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 [06:18<00:00, 288.41it/s]
```

```
100%|██████████| 109248/109248 [00:18<00:00, 288.41it/s]
```

```
109248
300
```

1.4.2.9 Using Pretrained Models: TFIDF weighted W2V on `project_title`

In [79]:

```python
# Similarly you can vectorize for title also
tfidf_model_pt = TfidfVectorizer()
tfidf_model_pt.fit(preprocessed_project_titles)
# we are converting a dictionary with word as a key, and the idf as a value
dictionary = dict(zip(tfidf_model_pt.get_feature_names(), list(tfidf_model_pt.idf_)))
tfidf_words_pt = set(tfidf_model_pt.get_feature_names())
```

In [80]:

```python
tfidf_w2v_vectors_pt = []; # the avg-w2v for each sentence/review is stored in this list
for sentence in tqdm(preprocessed_project_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/review
    for word in sentence.split(): # for each word in a review/sentence
        if (word in glove_words) and (word in tfidf_words_pt):
            vec = model[word] # getting the vector for each word
            # here we are multiplying idf value(dictionary[word]) and the tf
value((sentence.count(word)/len(sentence.split())))
            tf_idf = dictionary[word]*(sentence.count(word)/len(sentence.split())) # getting the tf
idf value for each word
            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_pt.append(vector)

print(len(tfidf_w2v_vectors_pt))
print(len(tfidf_w2v_vectors_pt[0]))
```

```
100%|██████████| 109248/109248 [00:05<00:00, 18833.18it/s]
```

```
109248
300
```

1.4.3 Vectorizing Numerical features

In [81]:

```python
# check this one: https://www.youtube.com/watch?v=0HOqOcln3Z4&t=530s
# standardization sklearn: https://scikit-
learn.org/stable/modules/generated/sklearn.preprocessing.StandardScaler.html
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=[725.05 213.03 329.   ... 399.   287.
73   5.5 ].
# Reshape your data either using array.reshape(-1, 1)

price_scalar = StandardScaler()
price_scalar.fit(project_data['price'].values.reshape(-1,1)) # finding the mean and standard
deviation of this data
print(f"Mean : {price_scalar.mean_[0]}, Standard deviation : {np.sqrt(price_scalar.var_[0])}")

# Now standardize the data with above maen and variance.
price_standardized = price_scalar.transform(project_data['price'].values.reshape(-1, 1))
```

```
Mean : 298.11934259666083, Standard deviation : 367.49634838483496
```

In [82]:

In [82]:

```
price_standardized
```

Out[82]:

```
array([[ 0.00506306],
       [ 1.05130475],
       [ 0.15613939],
       ...,
       [ 0.6823487 ],
       [-0.12157765],
       [ 0.10851987]])
```

In [83]:

```
# check this one: https://www.youtube.com/watch?v=0HOqOcln3Z4&t=530s
# standardization sklearn: https://scikit-
learn.org/stable/modules/generated/sklearn.preprocessing.StandardScaler.html
# price_standardized = standardScalar.fit(project_data['price'].values)
# this will rise the error
# ValueError: Expected 2D array, got 1D array instead: array=[725.05 213.03 329.   ... 399.   287.
73   5.5 ].
# Reshape your data either using array.reshape(-1, 1)price_scalar = StandardScaler()
price_scalar.fit(project_data['teacher_number_of_previously_posted_projects'].values.reshape(-1,1))
# finding the mean and standard deviation of this data
print(f"Mean : {price_scalar.mean_[0]}, Standard deviation : {np.sqrt(price_scalar.var_[0])}")

# Now standardize the data with above maen and variance.
teacher_number_of_previously_posted_projects_standardized = price_scalar.transform(project_data['t
eacher_number_of_previously_posted_projects'].values.reshape(-1, 1))
```

```
Mean : 11.153211042765085, Standard deviation : 27.777015452500134
```

In [84]:

```
teacher_number_of_previously_posted_projects_standardized
```

Out[84]:

```
array([[ 0.53449907],
       [ 0.17448919],
       [ 1.11051488],
       ...,
       [-0.36552563],
       [-0.36552563],
       [-0.36552563]])
```

1.4.4 Merging all the above features

- we need to merge all the numerical vectors i.e catogorical, text, numerical vectors

In [85]:

```
print(categories_one_hot.shape)
print(sub_categories_one_hot.shape)
print(text_bow.shape)
print(price_standardized.shape)
```

```
(109248, 9)
(109248, 30)
(109248, 16623)
(109248, 1)
```

In [86]:

```
# 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 dense matirx :)
X = hstack((categories_one_hot, sub_categories_one_hot, text_bow, price_standardized))
X.shape
```

```
x.shape
```

Out[86]:

```
(109248, 16663)
```

TSNE PLOT COMBINING ALL FEATURES AND ALL ENCODINGS OF PROJECT TITLE:

NO. OF DATAPOINTS USED-5K.

In [87]:

```
S =hstack((categories_one_hot,sub_categories_one_hot,state_one_hot,project_grade_category_one_hot,
teacher_prefix_one_hot,
text_bow_p_t,text_tfidf_p_t,avg_w2v_vectors_p_t,tfidf_w2v_vectors_pt,price_standardized,teacher_num
ber_of_previously_posted_projects_standardized))
S.shape
```

Out[87]:

```
(109248, 7359)
```

In [88]:

```
from sklearn.manifold import TSNE
S = S.tocsr()
S_new = S[0:5000,:]
```

In [89]:

```
S_new = S_new.toarray()
model = TSNE(n_components = 2, perplexity = 50, random_state = 0)
tsne_data = model.fit_transform(S_new)
```

In [90]:

```
target = project_data["project_is_approved"]
target_new = target[0: 5000]
print(target_new.shape)
```

```
(5000,)
```

In [91]:

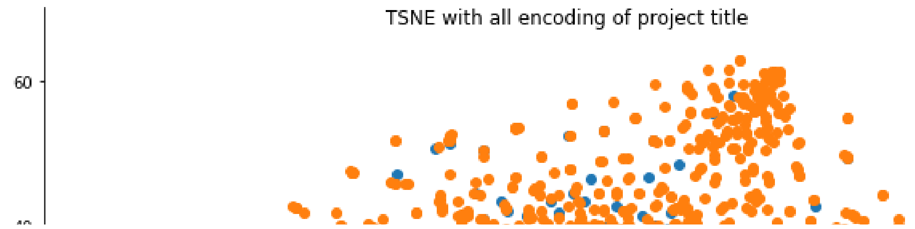
```
tsne_data = np.vstack((tsne_data.T, target_new)).T
tsne_data_frame = pd.DataFrame(tsne_data, columns = ("1st_Dim","2nd_Dim","Targets"))
tsne_data_frame.shape
```

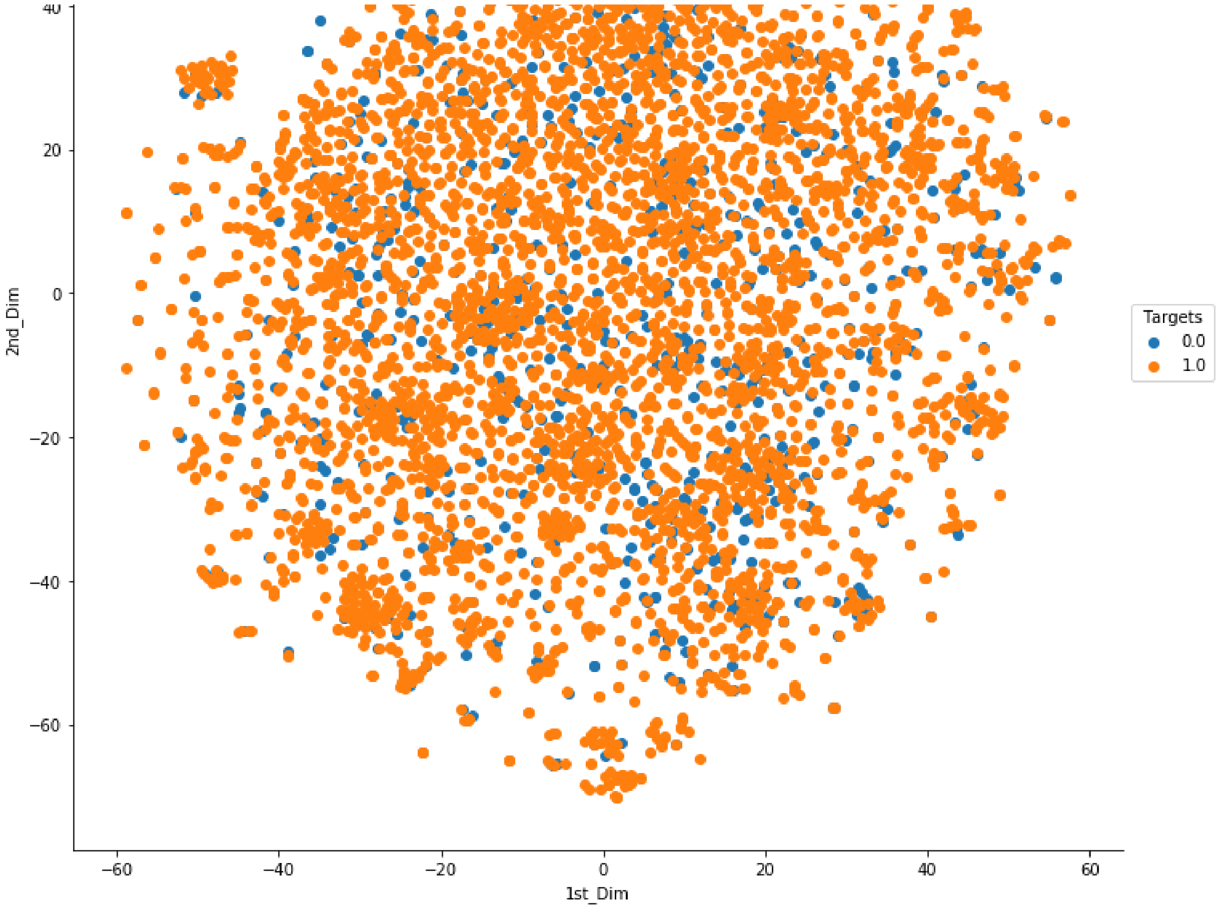
Out[91]:

```
(5000, 3)
```

In [92]:

```
sns.FacetGrid(tsne_data_frame, hue = "Targets", size = 10).map(plt.scatter, "1st_Dim", "2nd_Dim").a
dd_legend().fig.suptitle("TSNE with all encoding of project title ")
plt.show()
```





Assignment 2: Apply TSNE

If you are using any code snippet from the internet, you have to provide the reference/citations, as we did in the above cells. Otherwise, it will be treated as plagiarism without citations.

1. In the above cells we have plotted and analyzed many features. Please observe the plots and write the observations in markdown cells below every plot.
2. EDA: Please complete the analysis of the feature: teacher_number_of_previously_posted_projects
3. Build the data matrix using these features
    - school_state : categorical data (one hot encoding)
    - clean_categories : categorical data (one hot encoding)
    - clean_subcategories : categorical data (one hot encoding)
    - teacher_prefix : categorical data (one hot encoding)
    - project_grade_category : categorical data (one hot encoding)
    - project_title : text data (BOW, TFIDF, AVG W2V, TFIDF W2V)
    - price : numerical
    - teacher_number_of_previously_posted_projects : numerical
4. Now, plot FOUR t-SNE plots with each of these feature sets.
    A. categorical, numerical features + project_title(BOW)
    B. categorical, numerical features + project_title(TFIDF)
    C. categorical, numerical features + project_title(AVG W2V)
    D. categorical, numerical features + project_title(TFIDF W2V)
5. Concatenate all the features and Apply TNSE on the final data matrix
6. Note 1: The TSNE accepts only dense matrices
7. Note 2: Consider only 5k to 6k data points to avoid memory issues. If you run into memory error issues, reduce the number of data points but clearly state the number of datat-poins you are using

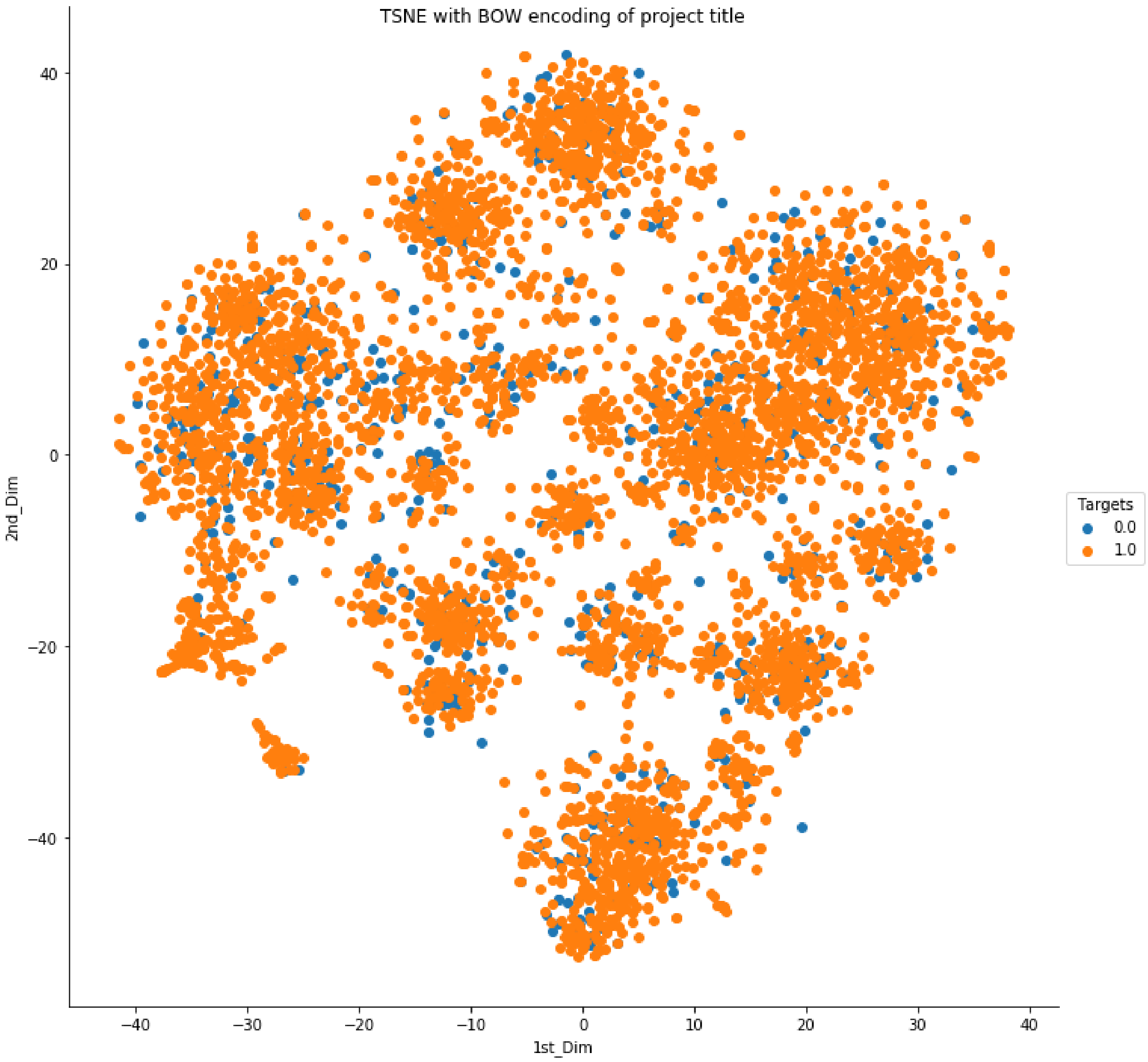
2.1 TSNE with `BOW` encoding of `project_title` feature

NO. OF DATAPOINTS USED-5K.

In [93]:

```
# please write all of the code with proper documentation and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
    # c. X-axis label
    # d. Y-axis label
S =hstack((categories_one_hot,sub_categories_one_hot,state_one_hot,project_grade_category_one_hot,
teacher_prefix_one_hot,
text_bow_p_t,price_standardized,teacher_number_of_previously_posted_projects_standardized))
S.shape
S = S.tocsr()
S_new = S[0:5000,:]
S_new = S_new.toarray()
model = TSNE(n_components = 2, perplexity = 50, random_state = 0)
tsne_data = model.fit_transform(S_new)
target = project_data["project_is_approved"]
target_new = target[0: 5000]
print(target_new.shape)
tsne_data = np.vstack((tsne_data.T, target_new)).T
tsne_data_frame = pd.DataFrame(tsne_data, columns = ("1st_Dim","2nd_Dim","Targets"))
tsne_data_frame.shape
sns.FacetGrid(tsne_data_frame, hue = "Targets", size = 10).map(plt.scatter, "1st_Dim", "2nd_Dim").a
dd_legend().fig.suptitle("TSNE with BOW encoding of project title ")
plt.show()
```

```
(5000,)
```



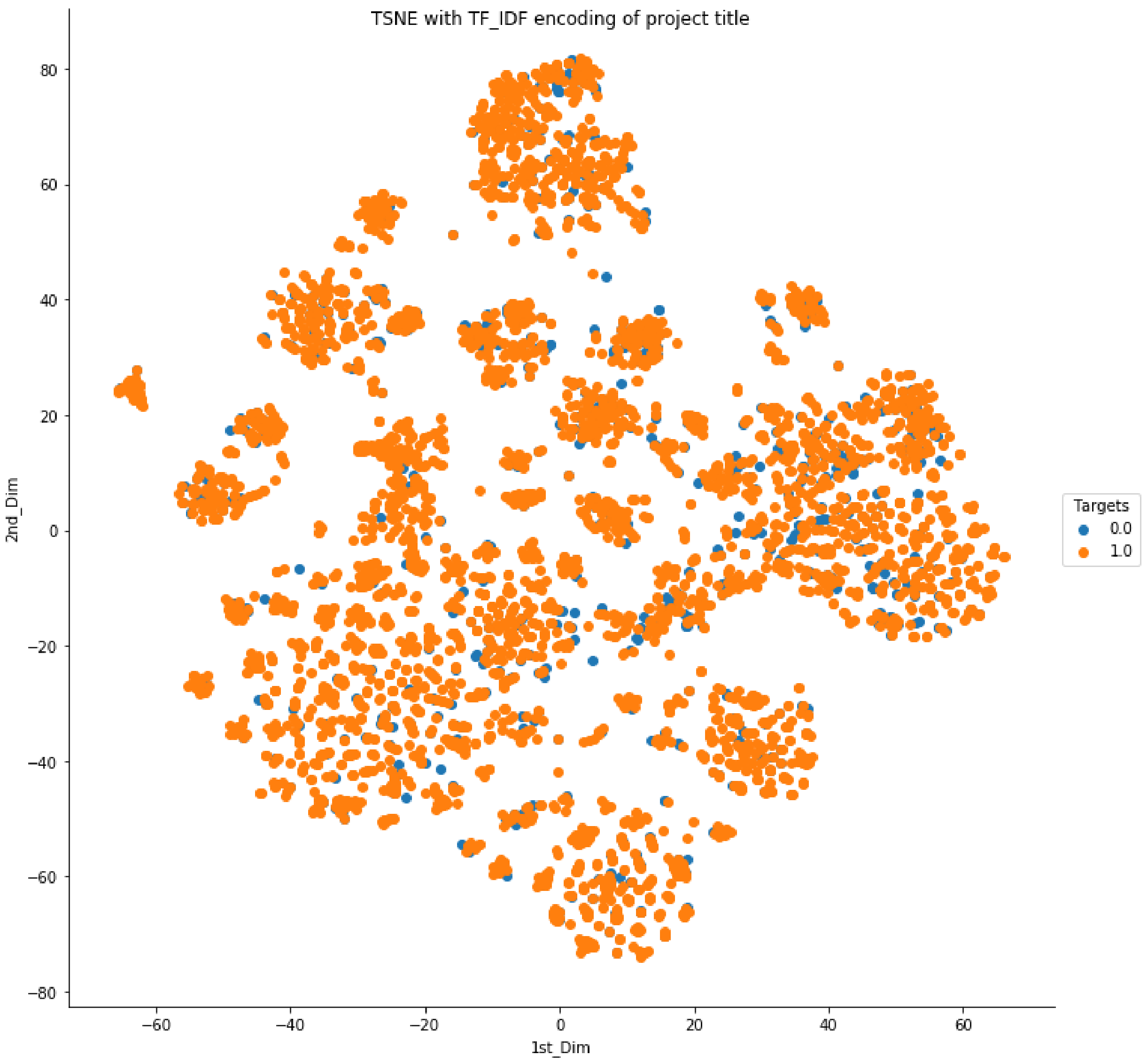
2.2 TSNE with `TFIDF` encoding of `project_title` feature

NO. OF DATAPOINTS USED-5K.

In [94]:

```
# please write all the code with proper documentation, and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
    # c. X-axis label
    # d. Y-axis label
S =hstack((categories_one_hot,sub_categories_one_hot,state_one_hot,project_grade_category_one_hot,
teacher_prefix_one_hot,
text_tfidf_p_t,price_standardized,teacher_number_of_previously_posted_projects_standardized))
S.shape
S = S.tocsr()
S_new = S[0:5000,:]
S_new = S_new.toarray()
model = TSNE(n_components = 2, perplexity = 50, random_state = 0)
tsne_data = model.fit_transform(S_new)
target = project_data["project_is_approved"]
target_new = target[0: 5000]
print(target_new.shape)
tsne_data = np.vstack((tsne_data.T, target_new)).T
tsne_data_frame = pd.DataFrame(tsne_data, columns = ("1st_Dim","2nd_Dim","Targets"))
tsne_data_frame.shape
sns.FacetGrid(tsne_data_frame, hue = "Targets", size = 10).map(plt.scatter, "1st_Dim", "2nd_Dim").a
dd_legend().fig.suptitle("TSNE with TF_IDF encoding of project title ")
plt.show()
```

```
(5000,)
```



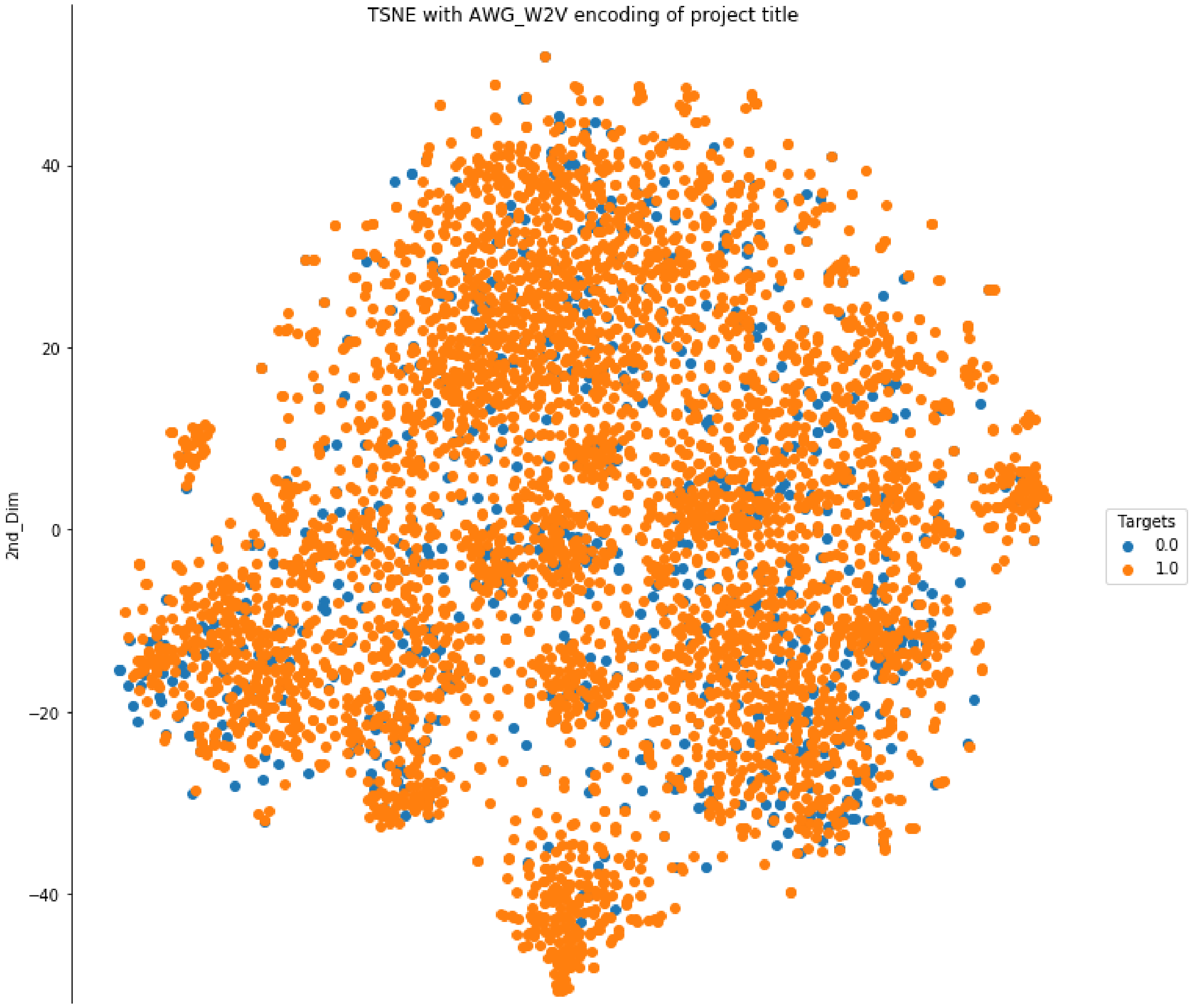
2.3 TSNE with `AVG W2V` encoding of `project_title` feature

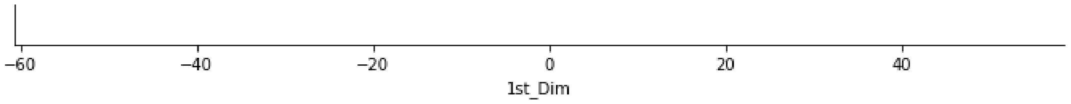
NO. OF DATAPOINTS USED-5K.

In [95]:

```
# please write all the code with proper documentation, and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
    # c. X-axis label
    # d. Y-axis label
S =hstack((categories_one_hot,sub_categories_one_hot,state_one_hot,project_grade_category_one_hot,
teacher_prefix_one_hot,avg_w2v_vectors_p_t,price_standardized,teacher_number_of_previously_posted_p
ojects_standardized))
S.shape
S = S.tocsr()
S_new = S[0:5000,:]
S_new = S_new.toarray()
model = TSNE(n_components = 2, perplexity = 50, random_state = 0)
tsne_data = model.fit_transform(S_new)
target = project_data["project_is_approved"]
target_new = target[0: 5000]
print(target_new.shape)
tsne_data = np.vstack((tsne_data.T, target_new)).T
tsne_data_frame = pd.DataFrame(tsne_data, columns = ("1st_Dim","2nd_Dim","Targets"))
tsne_data_frame.shape
sns.FacetGrid(tsne_data_frame, hue = "Targets", size = 10).map(plt.scatter, "1st_Dim", "2nd_Dim").a
dd_legend().fig.suptitle("TSNE with AWG_W2V encoding of project title ")
plt.show()
```

```
(5000,)
```





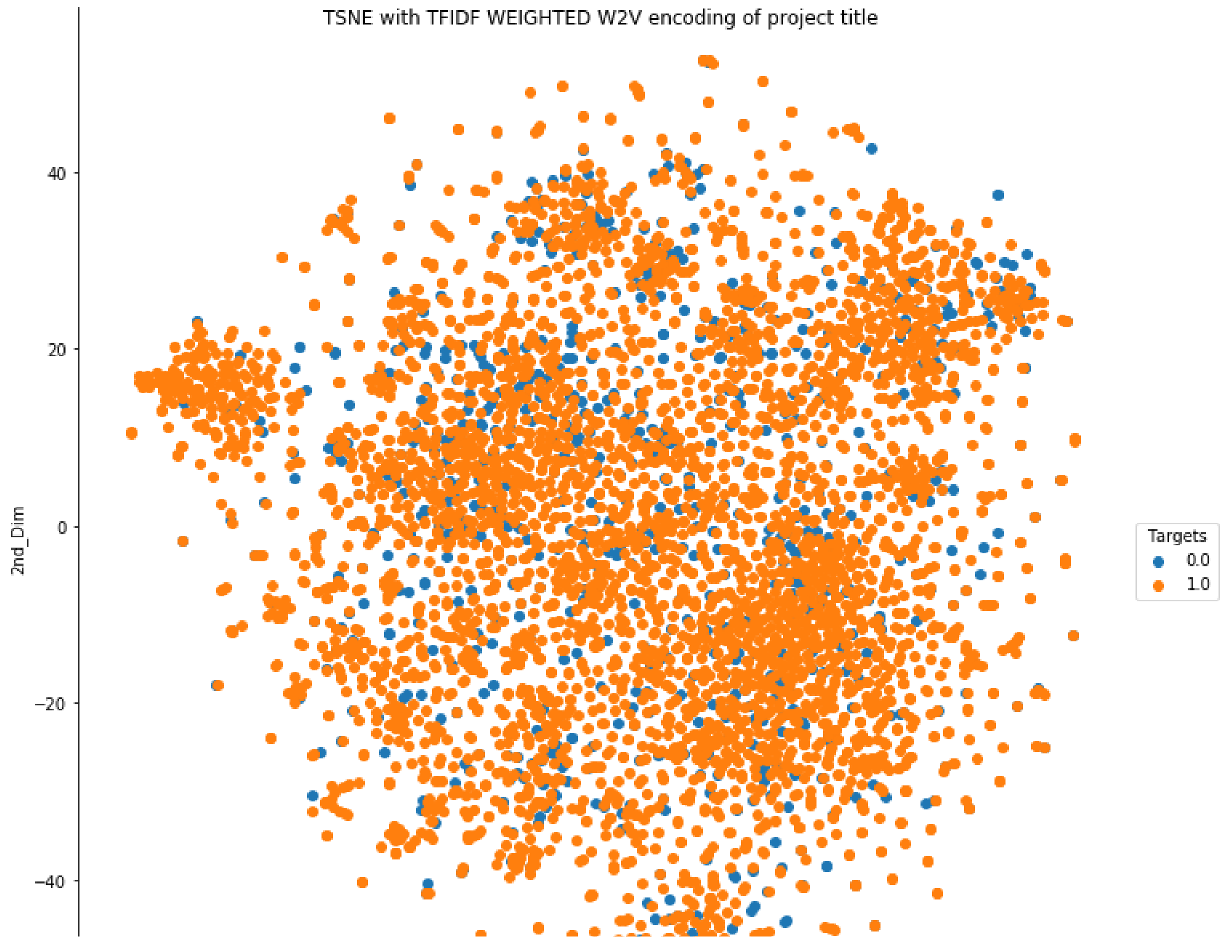
2.4 TSNE with `TFIDF Weighted W2V` encoding of `project_title` feature

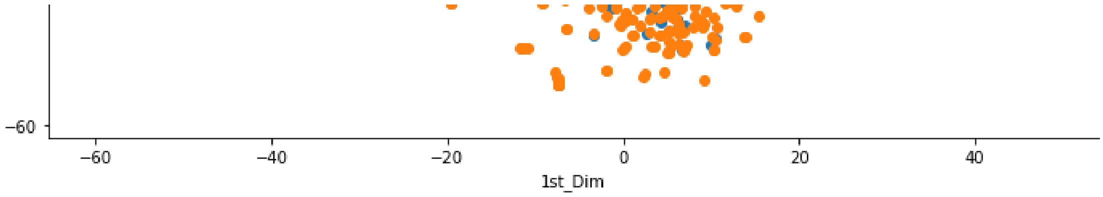
NO. OF DATAPOINTS USED-5K.

In [96]:

```
# please write all the code with proper documentation, and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
    # c. X-axis label
    # d. Y-axis label
S =hstack((categories_one_hot,sub_categories_one_hot,state_one_hot,project_grade_category_one_hot,
teacher_prefix_one_hot,tfidf_w2v_vectors_pt,price_standardized,teacher_number_of_previously_posted_
rojects_standardized))
S.shape
S = S.tocsr()
S_new = S[0:5000,:]
S_new = S_new.toarray()
model = TSNE(n_components = 2, perplexity = 50, random_state = 0)
tsne_data = model.fit_transform(S_new)
target = project_data["project_is_approved"]
target_new = target[0: 5000]
print(target_new.shape)
tsne_data = np.vstack((tsne_data.T, target_new)).T
tsne_data_frame = pd.DataFrame(tsne_data, columns = ("1st_Dim","2nd_Dim","Targets"))
tsne_data_frame.shape
sns.FacetGrid(tsne_data_frame, hue = "Targets", size = 10).map(plt.scatter, "1st_Dim", "2nd_Dim").a
dd_legend().fig.suptitle("TSNE with TFIDF WEIGHTED W2V encoding of project title ")
plt.show()
```

```
(5000,)
```





2.5 Summary

Write few sentences about the results that you obtained and the observations you made.

All the TSNE plots have lots of overlapping of datapoints.So we are not able to make much sense out of plots as all points are well scattered.So to make sense out of data we to either increase number of datapoints or use any other method for vectorizing the text.