Assignment on Donor Choose

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

Attirbutes in the train.csv- 1) project_id 2) project_title 3) project_grade_category 4) project_subject_categories 5) school_state 6) project_subject_subcategories 7) project_resource_summary 8) project_essay_1 9) project_essay_2 10) project_essay_3 11) project_essay_4 12) projecct_submitted_datetime 13) teacher_id 14) teacher_prefix 15)teacher_number_of_previously_posted_project Attributes in resource.csv - 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: 1) id - A project_id value from the train.csv file. 2) description - Desciption of the resource. 3) quantity - Quantity of the resource required. 4) price - Price of the resource required. The data set contains the following label: 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.

In [1]:
```
Here we importing bunch of libraries to perform Univariate analysis
%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


#https://plot.ly/python/getting-started-with-chart-studio/

import chart_studio.plotly as py
```

```
from collections import Counter
```

1.1 Reading the Data

In [2]:
```
#we are loading two datas in pandas dataframe
project_data = pd.read_csv(r'C:\Users\SAI\Downloads\Assignment_donorcho
ose 2018\train_data.csv')
resource_data = pd.read_csv('resources.csv')
```

In [3]:
```
print("Number of data points in train data", project_data.shape)
print('-'*50)
print("The attributes of data :", project_data.columns.values)
project_data.head(3)
```

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

Out[3]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_s
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_s
2	21895	p182444	3465aaf82da834c0582ebd0ef8040ca0	Ms.	AZ	2

here we have 109248 projects and 17 different attributes i.e.'teacher_id' 'teacher_prefix' 'school_state''project_submitted_datetime' 'project_grade_category' and others

In [4]:
```
project_data.dtypes
```

Out[4]:
```
Unnamed: 0                                       int64
id                                              object
teacher_id                                      object
teacher_prefix                                  object
school_state                                    object
project_submitted_datetime                      object
project_grade_category                          object
project_subject_categories                      object
project_subject_subcategories                   object
project_title                                   object
project_essay_1                                 object
project_essay_2                                 object
project_essay_3                                 object
project_essay_4                                 object
project_resource_summary                        object
teacher_number_of_previously_posted_projects     int64
project_is_approved                              int64
dtype: object
```

In [5]:
```
project_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 109248 entries, 0 to 109247
Data columns (total 17 columns):
Unnamed: 0                                      109248 non-null int64
id                                              109248 non-null object
teacher_id                                      109248 non-null object
teacher_prefix                                  109245 non-null object
school_state                                    109248 non-null object
project_submitted_datetime                      109248 non-null object
project_grade_category                          109248 non-null object
project_subject_categories                      109248 non-null object
project_subject_subcategories                   109248 non-null object
project_title                                   109248 non-null object
project_essay_1                                 109248 non-null object
project_essay_2                                 109248 non-null object
project_essay_3                                 3758 non-null object
project_essay_4                                 3758 non-null object
project_resource_summary                        109248 non-null object
teacher_number_of_previously_posted_projects    109248 non-null int64
project_is_approved                             109248 non-null int64
dtypes: int64(3), object(14)
memory usage: 14.2+ MB
```

In [6]:
```
print(list(project_data['project_is_approved'].unique()))
```

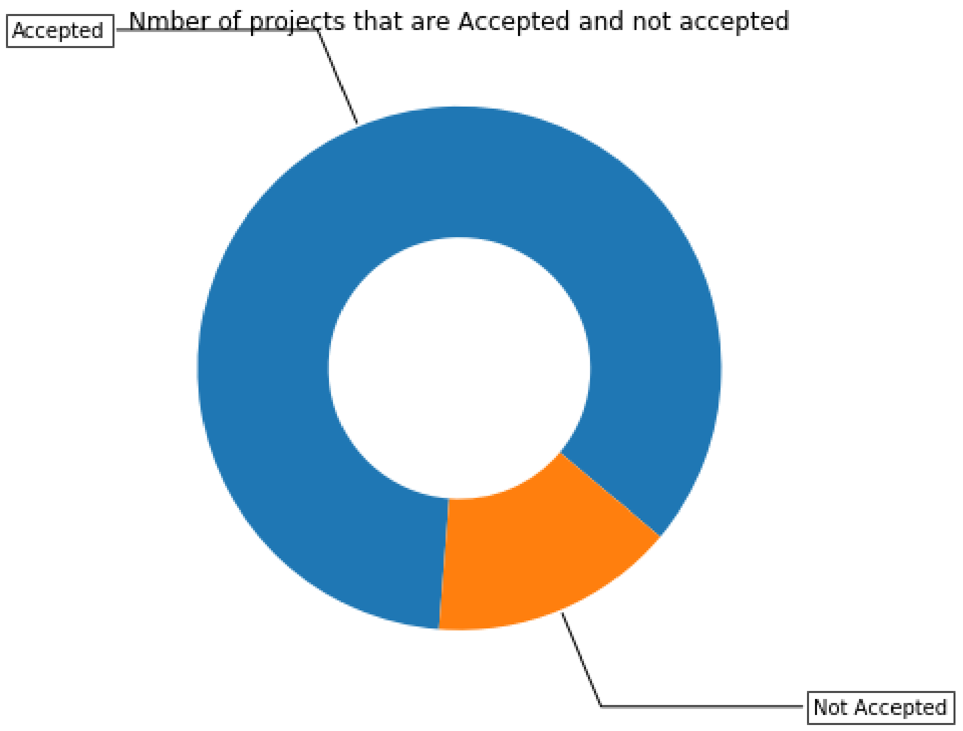
```
[0, 1]
```

1.2 Data Analysis

In [7]:
```
y_value_counts = project_data['project_is_approved'].value_counts()
print("Number of projects thar are approved for funding ", y_value_coun
ts[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(arrowstyl
e="-"),
          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 , ( 84.85830404
217927 %)
Number of projects thar are not approved for funding  16542 , ( 15.1416
95957820739 %)
```



from above results we can see that by visually and numerically that there are 85% of projects got funding and 15% of projects are nonfunding projects

```
In [9]: #for each projects we need a multiple resources
        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[9]:

	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

here we can see the there are 1541272 resources whicih more than no of projects also there are 4 columns of resorces 'id' 'description' 'quantity' 'price'

In [10]:
```
resource_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1541272 entries, 0 to 1541271
Data columns (total 4 columns):
id             1541272 non-null object
description    1540980 non-null object
quantity       1541272 non-null int64
price          1541272 non-null float64
dtypes: float64(1), int64(1), object(2)
memory usage: 47.0+ MB
```

In [11]:
```
resource_data.describe()
```

Out[11]:

	quantity	price
count	1.541272e+06	1.541272e+06
mean	2.860509e+00	5.028398e+01
std	7.570345e+00	1.447326e+02
min	1.000000e+00	0.000000e+00
25%	1.000000e+00	7.900000e+00
50%	1.000000e+00	1.499000e+01
75%	2.000000e+00	3.980000e+01

	quantity	price
max	8.000000e+02	9.999000e+03

1.2.1 Univariate Analysis: School State

In [12]:
```
#for univariate analysis we are trying to get codes.
#by searching different code and moifying it we putting here by giving
 citation to all search query

# Pandas dataframe groupby count, mean: https://stackoverflow.com/a/193
85591/4084039

temp = pd.DataFrame(project_data.groupby("school_state")["project_is_ap
proved"].apply(np.mean)).reset_index()
# if you have data which contain only 0 and 1, then the mean = percenta
ge (think about it)
temp.columns = ['state_code', 'num_proposals']

'''# How to plot US state heatmap: https://datascience.stackexchange.co
m/a/9620

scl = [[0.0, 'rgb(242,240,247)'],[0.2, 'rgb(218,218,235)'],[0.4, 'rgb(1
88,189,220)'],\
            [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[12]:

```
'# How to plot US state heatmap: https://datascience.stackexchange.com/
a/9620\n\nscl = [[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)\']]\n\ndata = [
dict(\n        type=\'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        co
lorbar = dict(title = "% of pro")\n    ) ]\n\nlayout = dict(\n        t
itle = \'Project Proposals % of Acceptance Rate by US States\',\n
  geo = dict(\n            scope=\'usa\',\n            projection=dict(
type=\'albers usa\' ),\n            showlakes = True,\n            lake
color = \'rgb(255, 255, 255)\',\n        ),\n    )\n\nfig = go.Figure(d
ata=data, layout=layout)\noffline.iplot(fig, filename=\'us-map-heat-map
\')\n'
```

In [13]:

```
# https://www.csi.cuny.edu/sites/default/files/pdf/administration/ops/2
letterstabbrev.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
```

Summary

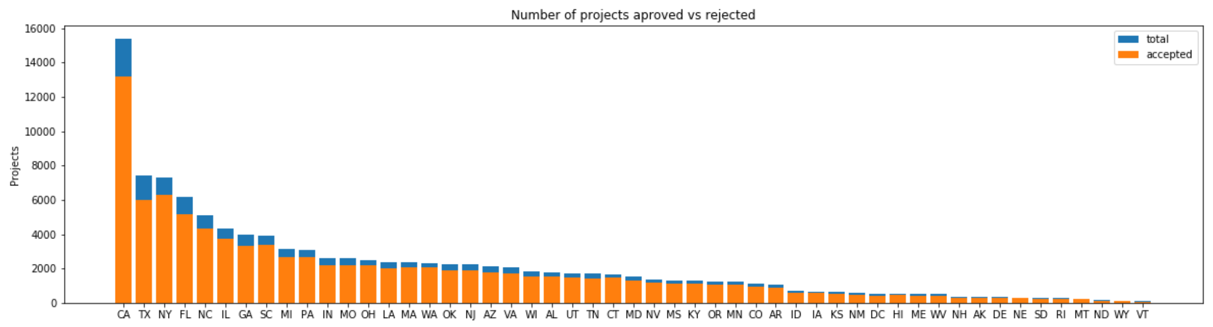
1-from above information we observe that Delaware(DE)has the highest percentage of project acceptance having approximately 90% acceptance rate sucseeded by North Dakota(ND)and Washington(WA) neaarly y 89% & 88% respectively

2-Also we could obsererved that Vermount is the lowest approval rated state by exactly 80% followed by District of coloumbia (DC) and Texas(TX) with nearly 80% and 81% respectively 3-Avg approval rate is 855 but here we getting respective state percentages upeer Five showing states with lower approval rate and bottom five showing states with higher approval rate

In [14]:
```
# now we are going to run some fuctions to get stacked bar plots
#stacked bar plots matplotlib: https://matplotlib.org/gallery/lines_bar
s_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 [15]:
```
def univariate_barplots(data, col1, col2='project_is_approved', top=Fal
se):
    # 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/193855
91/4084039
    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({'A
vg':'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 [16]:
```
univariate_barplots(project_data, 'school_state', 'project_is_approved'
, False)
```



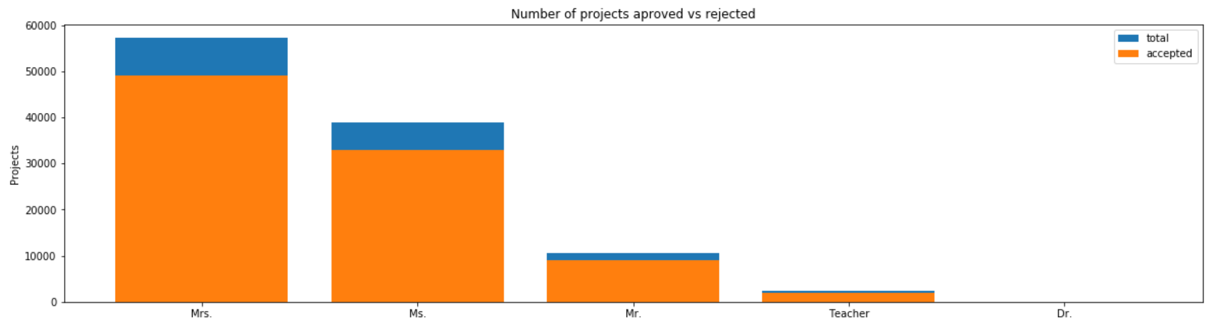
```
   school_state  project_is_approved  total       Avg
4            CA                13205  15388  0.858136
43           TX                 6014   7396  0.813142
34           NY                 6291   7318  0.859661
9            FL                 5144   6185  0.831690
27           NC                 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. There is a lot of variability in the number of projects that have been submitted across the States.
3. California(CA) has the highest number of project proposals when compared to the other states, Surprisingly, 85% of the projects gets approved on an average which is nearly 13205 out of 15388 project proposals.
4. Vermont(VT) has the lowest number of project proposals initiated (80) and almost 80% of the project proposal gets acceptance (64 out of 80). Well, in terms of rejection only 16 were rejected.

1.2.2 Univariate Analysis: teacher_prefix

```
In [17]: univariate_barplots(project_data, 'teacher_prefix', 'project_is_approve
d' , 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                 1877   2360  0.795339
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                 1877   2360  0.795339
0            Dr.                    9     13  0.692308
```

SUMMARY :

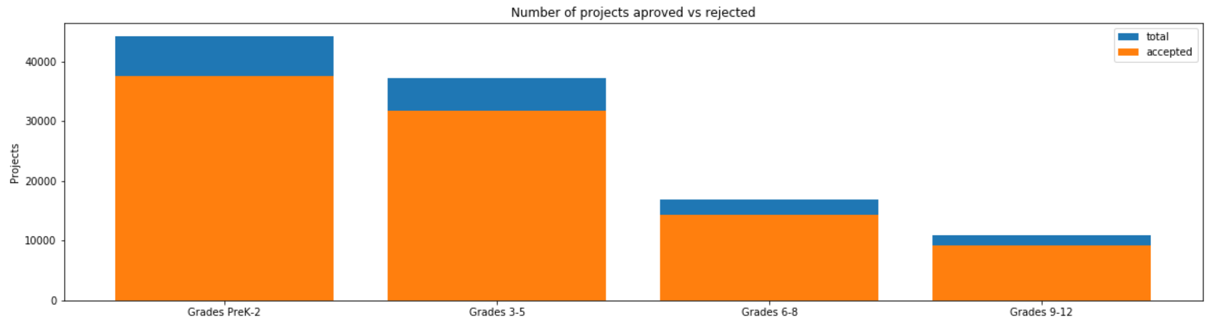
1. Female Teachers have the maximum number of projects proposed and accepted compared to the male teachers.
2. Teachers with prefixes Mrs. , which means Married Women as teachers have a higher number of projects Proposed as well as Accepted when compared to the younger

Unmarried Women Teachers.

3. Teachers with Dr. title have proposed hardly 13 projects and out of which 9 of them have been approved.

1.2.3 Univariate Analysis: project_grade_category

In [18]:
```
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
```

SUMMARY :

1. There are alot of projects proposed for the students between Pre Kindergarden and 2nd Grade while for the rest it keeps decreasing.
2. The average Acceptance rate of the project is 84% irrespective of the Grade.
3. We also notice that Students between the 9th Grade and 12th Grade have the lowest number of projects proposed as well as accepted.

1.2.4 Univariate Analysis: project_subject_categories

In [19]:
```
#by following the below code we are doing simple  Text Preprocessing
catogories = list(project_data['project_subject_categories'].values)
# remove special characters from list of strings python: https://stacko
verflow.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 = []
for i in catogories:
    temp = ""
    # consider we have text like this "Math & Science, Warmth, Care & H
unger"
    for j in i.split(','): # it will split it in three parts ["Math & S
cience", "Warmth", "Care & Hunger"]
        if 'The' in j.split(): # this will split each of the catogory b
ased on space "Math & Science"=> "Math","&", "Science"
            j=j.replace('The','') # if we have the words "The" we are g
oing 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 int
```

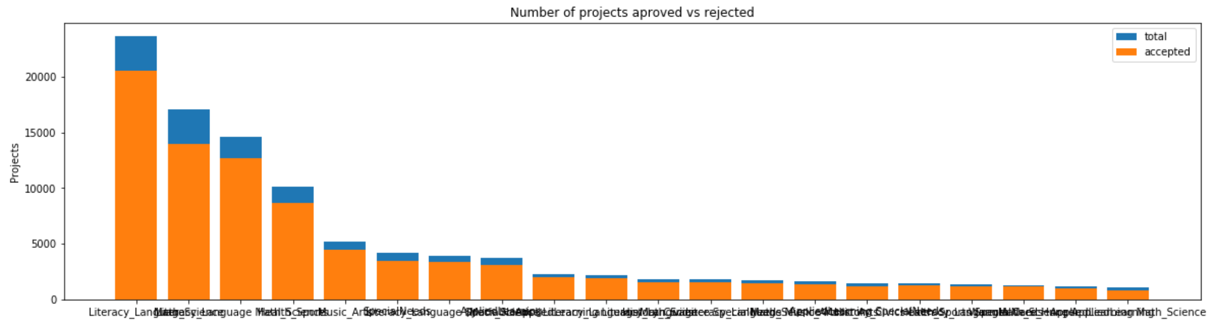
```
o
    cat_list.append(temp.strip())
```

In [20]:
```
project_data['clean_categories'] = cat_list
project_data.drop(['project_subject_categories'], axis=1, inplace=True)
project_data.head(2)
```

Out[20]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_s
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2

In [21]:
```
univariate_barplots(project_data, 'clean_categories', 'project_is_appro
ved', top=20)
```



```
                 clean_categories  project_is_approved  total       Av
g
24              Literacy_Language                20520  23655  0.86747
0
32                   Math_Science                13991  17072  0.81952
9
```

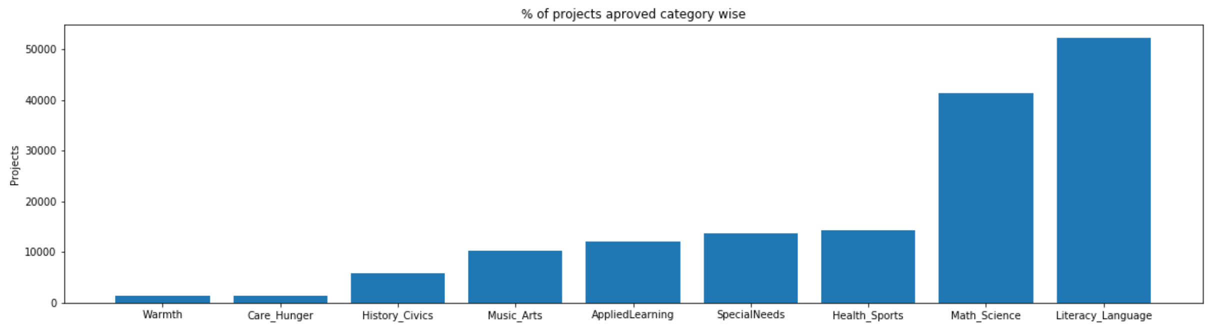
```
28  Literacy_Language Math_Science                12725  14636  0.86943
2
8                   Health_Sports                  8640  10177  0.84897
3
40                     Music_Arts                  4429   5180  0.85501
9
==================================================
                    clean_categories  project_is_approved  total
Avg
19  History_Civics Literacy_Language                1271   1421  0.894
441
14        Health_Sports SpecialNeeds                1215   1391  0.873
472
50                Warmth Care_Hunger                1212   1309  0.925
898
33      Math_Science AppliedLearning                1019   1220  0.835
246
4       AppliedLearning Math_Science                 855   1052  0.812
738
```

SUMMARY :

1. Projects belonging to the Literacy and Language categories have the highest number of projects proposed under. The maximum number of accepted projects also belong to this category, having an acceptance rate of nearly 87%.
2. Projects belonging to both Maths and Science have acceptance rate of nearly 82% while introducing the concept of Literacy and Language to this can increase its accpetance rate to nearly 87%
3. There is a lot of variablity in the total number of projects proposed per Category of the project.
4. Projects belonging to both Maths and Science when combined with Applied Learning has the least number of projects proposed as well approved.
5. There is also Variability in Acceptance rate, projects under the category Warmth, Care and Hunger have an acceptance rate of 93.5%

In [22]:
```
# 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 [23]:
```
# dict sort by value python: https://stackoverflow.com/a/613218/4084039
cat_dict = dict(my_counter)
sorted_cat_dict = dict(sorted(cat_dict.items(), key=lambda kv: kv[1]))


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

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



In [24]:
```
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
```

SUMMARY

1. The highest number of projects are registered under Literacy and Language with 52,239 projects, followed by Maths and Science having 41,421 projects.

1. There are only 1388 projects under the category of Warmth , Care or Hunger.

1.2.5 Univariate Analysis: project_subject_subcategories

In [25]:
```
sub_catogories = list(project_data['project_subject_subcategories'].val
ues)
# remove special characters from list of strings python: https://stacko
verflow.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 & H
unger"
    for j in i.split(','): # it will split it in three parts ["Math & S
cience", "Warmth", "Care & Hunger"]
        if 'The' in j.split(): # this will split each of the catogory b
ased on space "Math & Science"=> "Math","&", "Science"
            j=j.replace('The','') # if we have the words "The" we are g
oing 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 [26]:

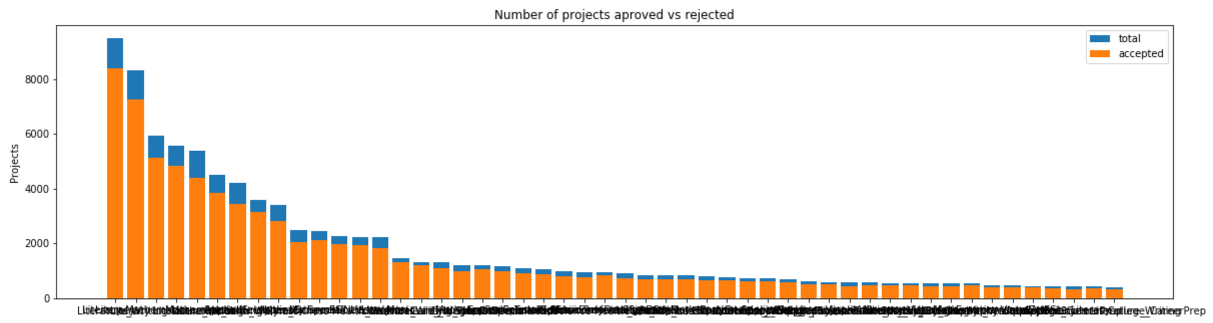
```
project_data['clean_subcategories'] = sub_cat_list
project_data.drop(['project_subject_subcategories'], axis=1, inplace=Tr
ue)
project_data.head(2)
```

Out[26]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_s
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2

In [27]:

```
univariate_barplots(project_data, 'clean_subcategories', 'project_is_ap
proved', top=50)
```



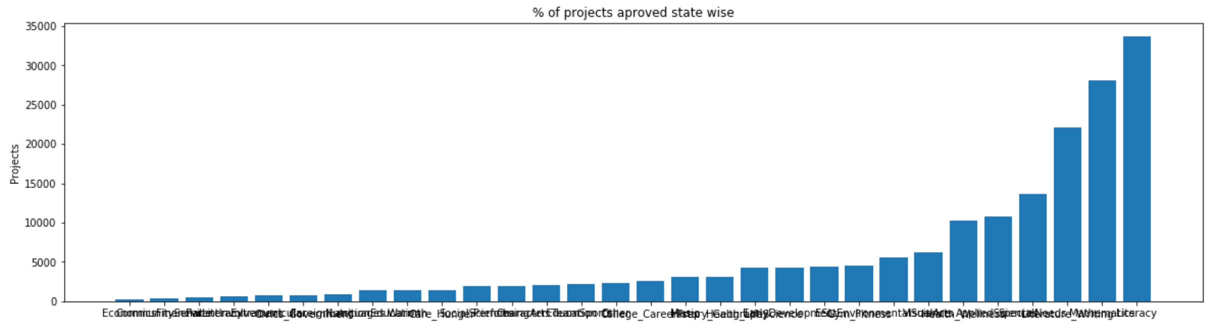
```
                clean_subcategories  project_is_approved  total        A
vg
317                        Literacy                 8371   9486  0.8824
58
319             Literacy Mathematics                 7260   8325  0.8720
72
331  Literature_Writing Mathematics                 5140   5923  0.8678
03
318     Literacy Literature_Writing                 4823   5571  0.8657
33
342                     Mathematics                 4385   5379  0.8152
07
==================================================
                    clean_subcategories  project_is_approved  total
   Avg
196       EnvironmentalScience Literacy                  389    444  0.
876126
127                                 ESL                  349    421  0.
828979
79                    College_CareerPrep                  343    421  0.
814727
17   AppliedSciences Literature_Writing                  361    420  0.
859524
3    AppliedSciences College_CareerPrep                  330    405  0.
814815
```

SUMMARY :

1. The sub-Category Literacy has the highest number of projects approved with 8371 projects. Also the acceptance rate is 88%.
2. The sub-Category Health and Wellness have the lowest number of projects proposed with 3,583 projects only.

In [28]:
```
# 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 [29]:
```
# 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 [30]: for i, j in sorted_sub_cat_dict.items():
             print("{:20} :{:10}".format(i,j))
```

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

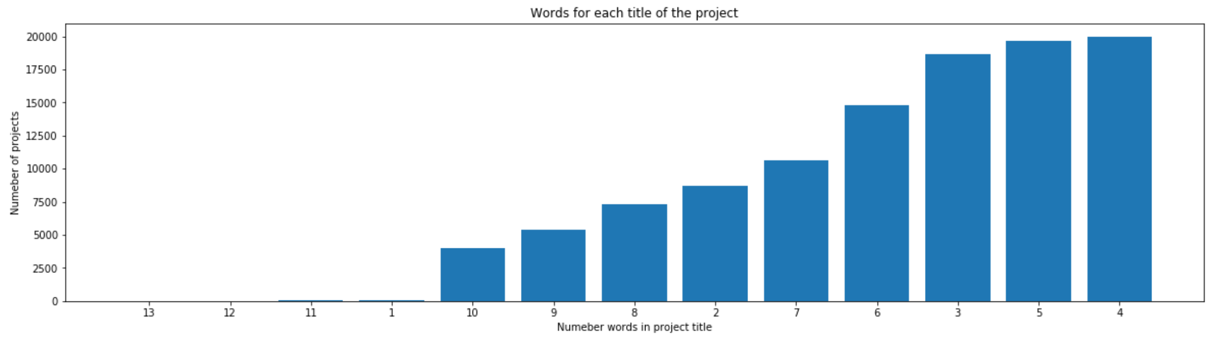
Summary:

1.The largest amount of projects are recorded with 33700 & 28074 projects in Literacy and Mathematics followed by 22179 projects in Literature_Writing.

2.In the Economics(269)and CommunityService (441) recorded very low projects among all subjects.

1.2.6 Univariate Analysis: Text features (Title)

In [31]:
```
#How to calculate number of words in a string in DataFrame: https://sta
ckoverflow.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()
```

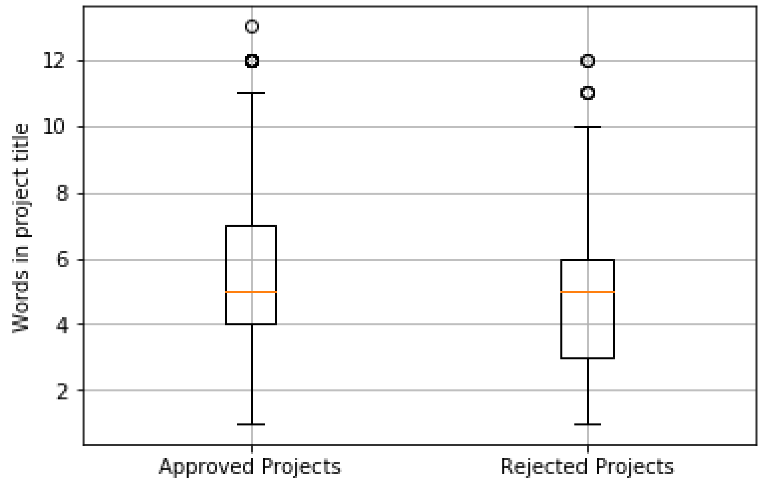


SUMMARY :

1. Most of the projects have 4 words in the title.
2. Roughly most of the projects have 3, 4 or 5 words in the title.
3. There are hardly any project titles containing more than 10 words and single word

In [32]:
```
approved_title_word_count = project_data[project_data['project_is_appro
ved']==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_appro
ved']==0]['project_title'].str.split().apply(len)
rejected_title_word_count = rejected_title_word_count.values
```

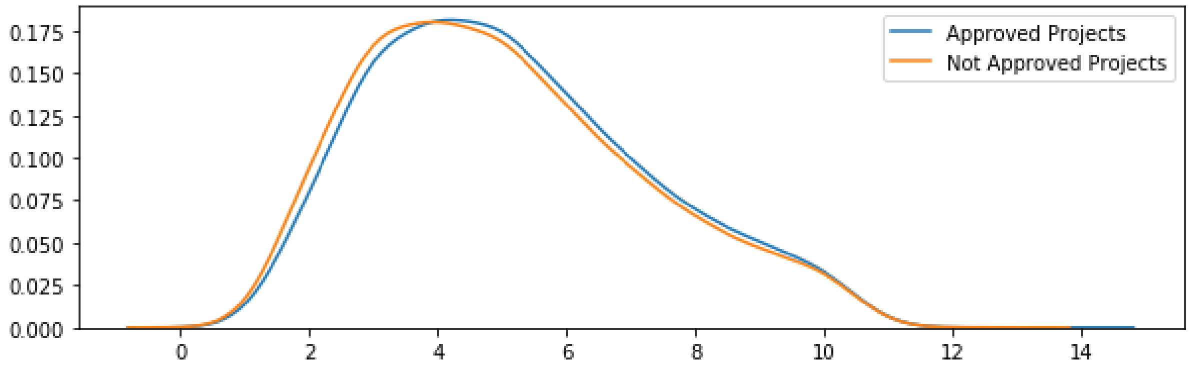
In [33]:
```
# https://glowingpython.blogspot.com/2012/09/boxplot-with-matplotlib.ht
ml
plt.boxplot([approved_title_word_count, rejected_title_word_count])
plt.xticks([1,2],('Approved Projects','Rejected Projects'))
plt.ylabel('Words in project title')
plt.grid()
plt.show()
```



Summary:

```
1-From above box plot we can see that boxplot for approved proje
cts is slightly higher           than rejected projects althogh
 median of both plots coincides slighltly.

2- The no of words in approved projects are slighltly more than
 rejected projects
```

In [34]:
```python
plt.figure(figsize=(10,3))
sns.kdeplot(approved_title_word_count,label="Approved Projects", bw=0.6
)
sns.kdeplot(rejected_title_word_count,label="Not Approved Projects", bw
=0.6)
plt.legend()
plt.show()
```



Summary:

```
1-This is the PDF of no of words in Title.Blue line indicates Pr
oject aprroved curve
  and orange line shows projects not approved curve.

2-From PDf graph we can observe that blue line is slighltly ahea
d orange line which
```

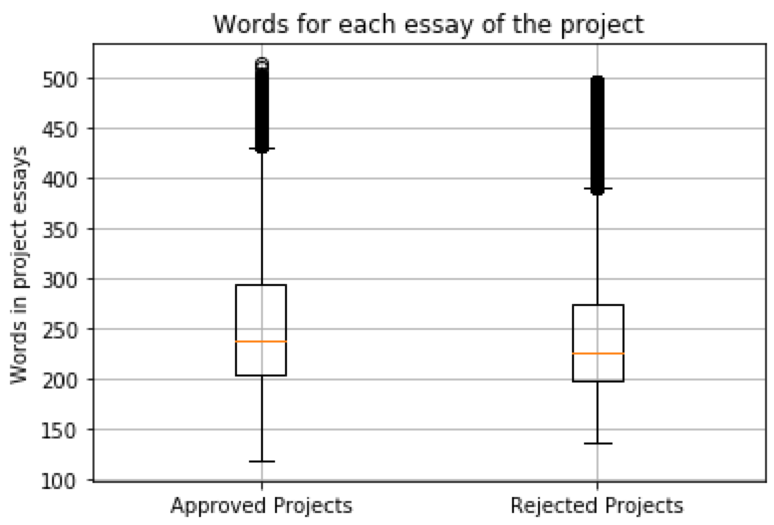
```
  means no of words are more in approved projects than not appro
ved
```

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

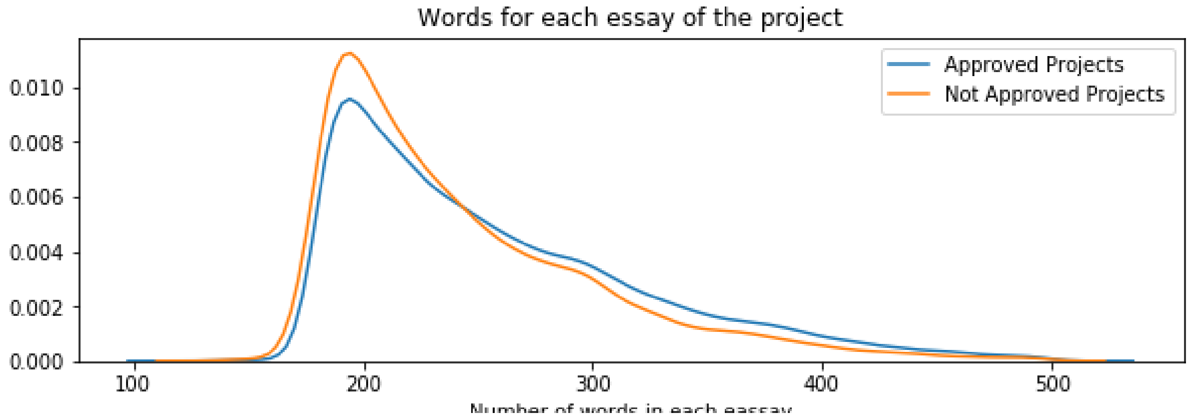
In [35]:
```
# merge two column text dataframe:
project_data["essay"] = project_data["project_essay_1"].map(str) +\
                        project_data["project_essay_2"].map(str) + \
                        project_data["project_essay_3"].map(str) + \
                        project_data["project_essay_4"].map(str)
```

In [36]:
```
approved_word_count = project_data[project_data['project_is_approved']=
=1]['essay'].str.split().apply(len)
approved_word_count = approved_word_count.values

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

In [38]:
```
#we choose the following code to find the no of words in essays
# https://glowingpython.blogspot.com/2012/09/boxplot-with-matplotlib.ht
ml
plt.boxplot([approved_word_count, rejected_word_count])
plt.title('Words for each essay of the project')
plt.xticks([1,2],('Approved Projects','Rejected Projects'))
plt.ylabel('Words in project essays')
plt.grid()
plt.show()
```



In [39]:
```
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 Proje
cts")
plt.title('Words for each essay of the project')
plt.xlabel('Number of words in each eassay')
plt.legend()
plt.show()
```



SUMMARY :

From both the plot it is clear that the number of Projects approved have a slightly more number of words in the Title when compared to the Rejected Projects. The Boxplots use the Percentiles while the above graph used Probability densities.

1.2.8 Univariate Analysis: Cost per project

In [40]:
```
# we get the cost of the project using resource.csv file
resource_data.head(3)
```

Out[40]:

	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
2	p069063	Cory Stories: A Kid's Book About Living With Adhd	1	8.45

In [41]:
```
# https://stackoverflow.com/questions/22407798/how-to-reset-a-dataframe
s-indexes-for-all-groups-in-one-step
price_data = resource_data.groupby('id').agg({'price':'sum', 'quantity'
:'sum'}).reset_index()
price_data.head(2)
```

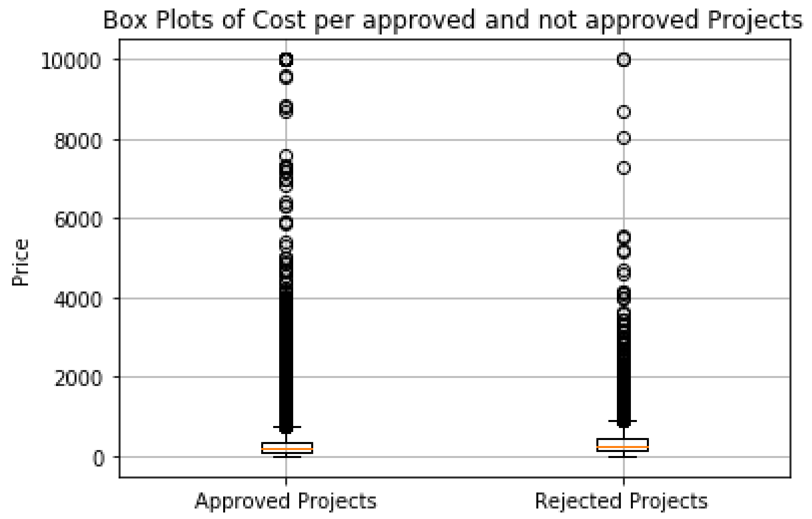
Out[41]:

	id	price	quantity
0	p000001	459.56	7
1	p000002	515.89	21

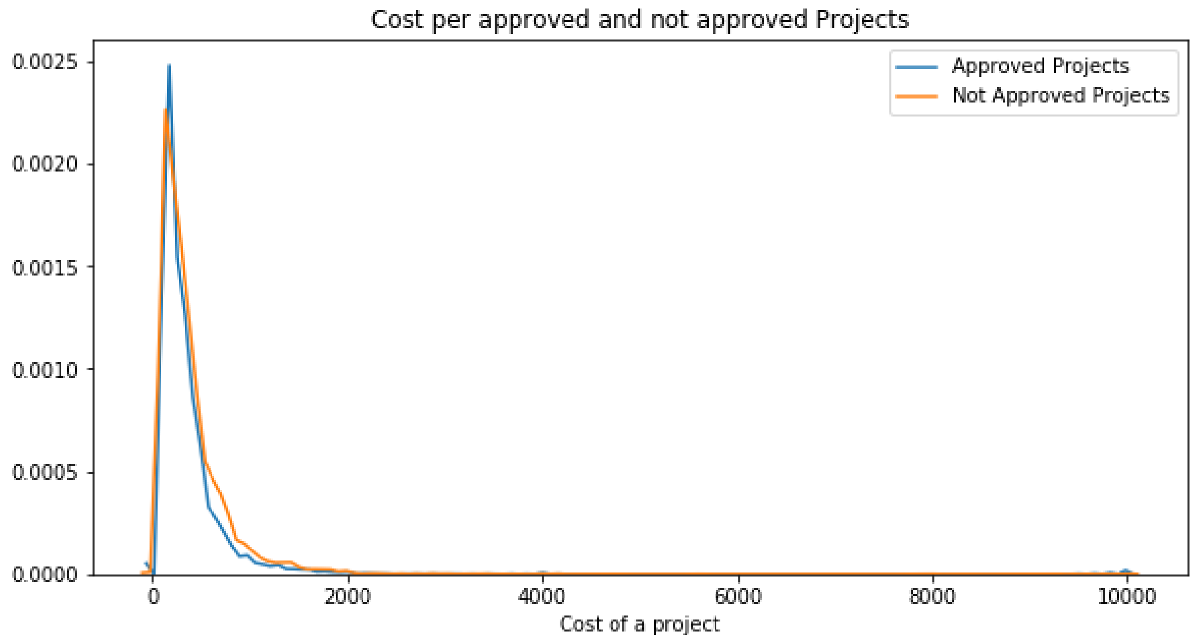
In [42]:
```
# join two dataframes in python:
project_data = pd.merge(project_data, price_data, on='id', how='left')
```

In [43]:
```
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 [44]:
```
# https://glowingpython.blogspot.com/2012/09/boxplot-with-matplotlib.ht
ml
plt.boxplot([approved_price, rejected_price])
plt.title('Box Plots of Cost per approved and not approved Projects')
plt.xticks([1,2],('Approved Projects','Rejected Projects'))
plt.ylabel('Price')
plt.grid()
plt.show()
```



In [45]:
```
plt.figure(figsize=(10,5))
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()
```



Summary:

```
Not much can be understood from the box plot depicting the Cost
 involved per project. We can generalise from the PDF curves tha
t mostly Projects that are very costly are usually not approved.
```

In [48]:
```
# http://zetcode.com/python/prettytable/
from prettytable import PrettyTable

#If you get a ModuleNotFoundError error , install prettytable using: pi
p3 install prettytable

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

```
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        |
+------------+-------------------+-----------------------+
```

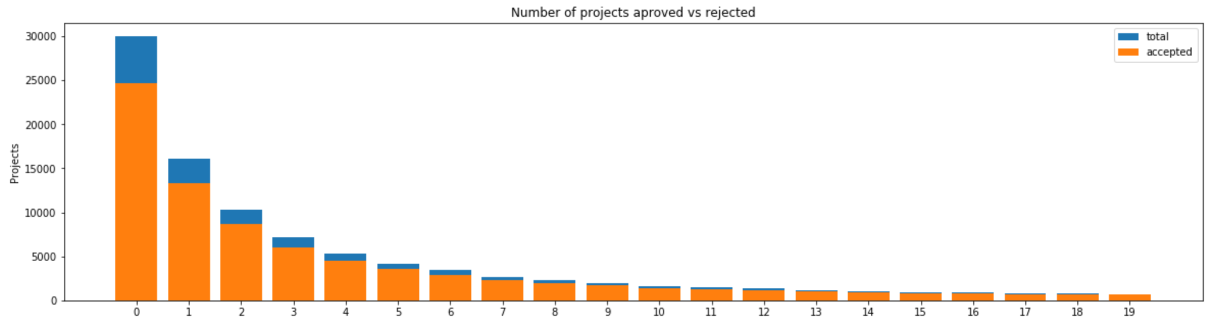
SUMMARY :

1. The approved projects tend to have lower cost when compared to the projects that have not been approved. This can be noticed by looking at the percentile values. The 50th percentile Cost value for an approved project is 199 dollars while for the cost for the not approved projects is 263 dollars.
2. The Maximum price for any project should be less than 10,000 dollars.

3. Typically, any approved Project costs less than the that of the Projects not approved across the spectrum of Percentiles.

1.2.9 Univariate Analysis: teacher_number_of_previously_posted_projects

In [49]:
```
univariate_barplots(project_data, 'teacher_number_of_previously_posted_
projects',
'project_is_approved', top=20)
```



```
   teacher_number_of_previously_posted_projects  project_is_approved  t
otal  \
0                                             0                24652  3
0014
1                                             1                13329  1
6058
2                                             2                 8705  1
0350
3                                             3                 5997
7110
4                                             4                 4452
5266

        Avg
0  0.821350
1  0.830054
2  0.841063
```

```
3  0.843460
4  0.845423
==================================================
    teacher_number_of_previously_posted_projects  project_is_approved
total  \
15                                             15                  818
  942
16                                             16                  769
  894
17                                             17                  712
  803
18                                             18                  666
  772
19                                             19                  632
  710

         Avg
15  0.868365
16  0.860179
17  0.886675
18  0.862694
19  0.890141
```

SUMMARY :

1. There is alot of variability in the number of projects previously proposed by the teacher varying from 0 to more than 20.
2. We observe that it is not mandatory for a teacher to have proposed any project prior. Maximum number of teachers, nearly 82% of the approved projects have been submitted by teachers with no prior project proposals. New talent and efforts are well appreciated.
3. Very few teachers who have proposed more than 20 projects have got approval. But the rate of approval is Higher given the teacher has proposed atleast 19 different projects.

1.2.10 Univariate Analysis: project_resource_summary

```
In [50]: ## Let us separate the data and carry out our work only on the required
          Project Resource Summaries

         summaries = []
         for a in project_data["project_resource_summary"] :summaries.append(a)
         summaries[0:10]
```

```
Out[50]: ['My students need opportunities to practice beginning reading skills i
         n English at home.',
          'My students need a projector to help with viewing educational program
         s',
          'My students need shine guards, athletic socks, Soccer Balls, goalie g
         loves, and training materials for the upcoming Soccer season.',
          'My students need to engage in Reading and Math in a way that will ins
         pire them with these Mini iPads!',
          'My students need hands on practice in mathematics. Having fun and per
         sonalized journals and charts will help them be more involved in our da
         ily Math routines.',
          'My students need movement to be successful. Being that I have a varie
         ty of students that have all different types of needs, flexible seating
         would assist not only these students with special needs, but all studen
         ts.',
          'My students need some dependable laptops for daily classroom use for
         reading and math.',
          'My students need ipads to help them access a world of online resource
         s that will spark their interest in learning.',
          "My students need three devices and three management licenses for smal
         l group's easy access to newly-implemented online programs--Go Noodle P
         lus, for increased in-class physical activity and Light Sail, an intera
         ctive reading program.",
          'My students need great books to use during Independent Reading, Read
         Alouds, Partner Reading and Author Studies.']
```

```
In [ ]: The length of the obtained list of Project summaries should match the t
        otal number of project s
        ummaries in the project data
```

```
In [51]: len(summaries)
```

Out[51]: 109248

In [52]:
```
###### Identifying the numbers from the project summaries and storing t
he values as a key valupair in a dictionary to avoid the position of th
e value within huge value of summary data

numeric_summary_values = {}
for x in tqdm(range(len(summaries))):
    for s in summaries[x].split():
        if s.isdigit:
            numeric_summary_values[x] = int()
```

```
100%|██████████████████████████████| 109248/109248 [00:01<00:00, 7369
0.33it/s]
```

In [53]:
```
numeric_summary_values[14]
```

Out[53]: 0

In [54]:
```
# now we have only key values pairs for summaries containing numeric va
lue,so
numeric_digits = {}
for c in range(len(summaries)):
    if c in numeric_summary_values.keys():
        numeric_digits[c]= numeric_summary_values[c]
    else:
        numeric_digits[c]=0
```

In [55]:
```
len(numeric_digits)
```

Out[55]: 109248

In [56]:
```
## Converting the key value pairs to 1 or 0 based on presence of Numeri
c Values.
digit_in_summary = []
```

```
for a in numeric_digits.values():
    if a > 0 :
        digit_in_summary.append(1)
    else :
        digit_in_summary.append(0)
```

In [57]:
```
digit_in_summary[0:20]
```

Out[57]:
```
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
```

In [58]:
```
project_data['digit_in_summary']= digit_in_summary
```

In [59]:
```
project_data.head(20)
```

Out[59]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	
2	21895	p182444	3465aaf82da834c0582ebd0ef8040ca0	Ms.	AZ	

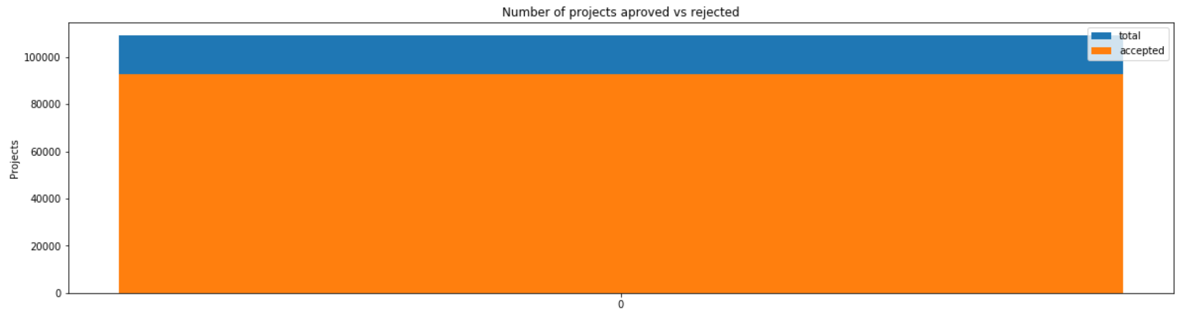
	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project
3	45	p246581	f3cb9bffbba169bef1a77b243e620b60	Mrs.	KY	
4	172407	p104768	be1f7507a41f8479dc06f047086a39ec	Mrs.	TX	
5	141660	p154343	a50a390e8327a95b77b9e495b58b9a6e	Mrs.	FL	
6	21147	p099819	9b40170bfa65e399981717ee8731efc3	Mrs.	CT	
7	94142	p092424	5bfd3d12fae3d2fe88684bbac570c9d2	Ms.	GA	
8	112489	p045029	487448f5226005d08d36bdd75f095b31	Mrs.	SC	

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project
9	158561	p001713	140eeac1885c820ad5592a409a3a8994	Ms.	NC	
10	43184	p040307	363788b51d40d978fe276bcb1f8a2b35	Mrs.	CA	
11	127083	p251806	4ba7c721133ef651ca54a03551746708	Ms.	CA	
12	19090	p051126	5e52c92b7e3c472aad247a239d345543	Mrs.	NY	
13	15126	p003874	178f6ae765cd4e0fb143a77c47fd65e2	Mrs.	OK	
14	62232	p233127	424819801de22a60bba7d0f4354d0258	Ms.	MA	
15	67303	p132832	bb6d6d054824fa01576ab38dfa2be160	Ms.	TX	

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project
16	127215	p174627	4ad7e280fddff889e1355cc9f29c3b89	Mrs.	FL	
17	157771	p152491	e39abda057354c979c5b075cffbe5f88	Ms.	NV	
18	122186	p196421	fcd9b003fc1891383f340a89da02a1a6	Mrs.	GA	
19	146331	p058343	8e07a98deb1bc74c75b97521e05b1691	Ms.	OH	

20 rows × 21 columns

In [60]:
```
univariate_barplots(project_data,'digit_in_summary','project_is_approve
d',top=2)
```



```
   digit_in_summary  project_is_approved   total       Avg
0                 0                92706  109248  0.848583
==================================================
   digit_in_summary  project_is_approved   total       Avg
0                 0                92706  109248  0.848583
```

1.3 Text preprocessing

1.3.1 Essay Text

In [61]:
```
project_data.head(2)
```

Out[61]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_s
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2

2 rows × 21 columns

In [62]:
```
# 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)
```

```
My students are English learners that are working on English as their s
econd or third languages. We are a melting pot of refugees, immigrants,
and native-born Americans bringing the gift of language to our school.
\r\n\r\n We have over 24 languages represented in our English Learner p
rogram with students at every level of mastery.  We also have over 40 c
ountries represented with the families within our school.  Each student
brings a wealth of knowledge and experiences to us that open our eyes t
o new cultures, beliefs, and respect.\"The limits of your language are
the limits of your world.\"-Ludwig Wittgenstein  Our English learner's
have a strong support system at home that begs for more resources.  Man
y times our parents are learning to read and speak English along side o
f their children.  Sometimes this creates barriers for parents to be ab
le to help their child learn phonetics, letter recognition, and other r
eading skills.\r\n\r\nBy providing these dvd's and players, students ar
e able to continue their mastery of the English language even if no one
at home is able to assist.  All families with students within the Level
1 proficiency status, will be a offered to be a part of this program.
These educational videos will be specially chosen by the English Learne
r Teacher and will be sent home regularly to watch.  The videos are to
help the child develop early reading skills.\r\n\r\nParents that do not
have access to a dvd player will have the opportunity to check out a dv
d player to use for the year.  The plan is to use these videos and educ
ational dvd's for the years to come for other EL students.\r\nnannan
==================================================
The 51 fifth grade students that will cycle through my classroom this y
ear all love learning, at least most of the time. At our school, 97.3%
of the students receive free or reduced price lunch. Of the 560 student
s, 97.3% are minority students. \r\nThe school has a vibrant community
that loves to get together and celebrate. Around Halloween there is a w
hole school parade to show off the beautiful costumes that students wea
r. On Cinco de Mayo we put on a big festival with crafts made by the st
```

```
udents, dances, and games. At the end of the year the school hosts a ca
rnival to celebrate the hard work put in during the school year, with a
dunk tank being the most popular activity.My students will use these fi
ve brightly colored Hokki stools in place of regular, stationary, 4-leg
ged chairs. As I will only have a total of ten in the classroom and not
enough for each student to have an individual one, they will be used in
a variety of ways. During independent reading time they will be used as
special chairs students will each use on occasion. I will utilize them
in place of chairs at my small group tables during math and reading tim
es. The rest of the day they will be used by the students who need the
highest amount of movement in their life in order to stay focused on sc
hool.\r\n\r\nWhenever asked what the classroom is missing, my students
always say more Hokki Stools. They can't get their fill of the 5 stools
we already have. When the students are sitting in group with me on the
Hokki Stools, they are always moving, but at the same time doing their
work. Anytime the students get to pick where they can sit, the Hokki St
ools are the first to be taken. There are always students who head over
to the kidney table to get one of the stools who are disappointed as th
ere are not enough of them. \r\n\r\nWe ask a lot of students to sit for
7 hours a day. The Hokki stools will be a compromise that allow my stud
ents to do desk work and move at the same time. These stools will help
students to meet their 60 minutes a day of movement by allowing them to
activate their core muscles for balance while they sit. For many of my
students, these chairs will take away the barrier that exists in school
s for a child who can't sit still.nannan
==================================================
How do you remember your days of school? Was it in a sterile environmen
t with plain walls, rows of desks, and a teacher in front of the room?
A typical day in our room is nothing like that. I work hard to create a
warm inviting themed room for my students look forward to coming to eac
h day.\r\n\r\nMy class is made up of 28 wonderfully unique boys and gir
ls of mixed races in Arkansas.\r\nThey attend a Title I school, which m
eans there is a high enough percentage of free and reduced-price lunch
to qualify. Our school is an \"open classroom\" concept, which is very
unique as there are no walls separating the classrooms. These 9 and 10
year-old students are very eager learners; they are like sponges, absor
bing all the information and experiences and keep on wanting more.With
these resources such as the comfy red throw pillows and the whimsical n
autical hanging decor and the blue fish nets, I will be able to help cr
```

```
eate the mood in our classroom setting to be one of a themed nautical e
nvironment. Creating a classroom environment is very important in the s
uccess in each and every child's education. The nautical photo props wi
ll be used with each child as they step foot into our classroom for the
first time on Meet the Teacher evening. I'll take pictures of each chil
d with them, have them developed, and then hung in our classroom ready
for their first day of 4th grade.  This kind gesture will set the tone
before even the first day of school! The nautical thank you cards will
be used throughout the year by the students as they create thank you ca
rds to their team groups.\r\n\r\nYour generous donations will help me t
o help make our classroom a fun, inviting, learning environment from da
y one.\r\n\r\nIt costs lost of money out of my own pocket on resources
to get our classroom ready. Please consider helping with this project t
o make our new school year a very successful one. Thank you!nannan
==================================================
My kindergarten students have varied disabilities ranging from speech a
nd language delays, cognitive delays, gross/fine motor delays, to autis
m. They are eager beavers and always strive to work their hardest worki
ng past their limitations. \r\n\r\nThe materials we have are the ones I
seek out for my students. I teach in a Title I school where most of the
students receive free or reduced price lunch.  Despite their disabiliti
es and limitations, my students love coming to school and come eager to
learn and explore.Have you ever felt like you had ants in your pants an
d you needed to groove and move as you were in a meeting? This is how m
y kids feel all the time. The want to be able to move as they learn or
so they say.Wobble chairs are the answer and I love then because they d
evelop their core, which enhances gross motor and in Turn fine motor sk
ills. \r\nThey also want to learn through games, my kids don't want to
sit and do worksheets. They want to learn to count by jumping and playi
ng. Physical engagement is the key to our success. The number toss and
color and shape mats can make that happen. My students will forget they
are doing work and just have the fun a 6 year old deserves.nannan
==================================================
The mediocre teacher tells. The good teacher explains. The superior tea
cher demonstrates. The great teacher inspires. -William A. Ward\r\n\r\n
My school has 803 students which is makeup is 97.6% African-American, m
aking up the largest segment of the student body. A typical school in D
allas is made up of 23.2% African-American students. Most of the studen
ts are on free or reduced lunch. We aren't receiving doctors, lawyers,
or engineers children from rich backgrounds or neighborhoods. As an edu
cator I am inspiring minds of young children and we focus not only on a
cademics but one smart, effective, efficient, and disciplined students
with good character.In our classroom we can utilize the Bluetooth for s
wift transitions during class. I use a speaker which doesn't amplify th
e sound enough to receive the message. Due to the volume of my speaker
my students can't hear videos or books clearly and it isn't making the
lessons as meaningful. But with the bluetooth speaker my students will
be able to hear and I can stop, pause and replay it at any time.\r\nThe
cart will allow me to have more room for storage of things that are nee
ded for the day and has an extra part to it I can use.  The table top c
hart has all of the letter, words and pictures for students to learn ab
out different letters and it is more accessible.nannan
==================================================
```

In [63]:

```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 [64]:

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

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

In [65]:

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

```
My kindergarten students have varied disabilities ranging from speech a
nd language delays, cognitive delays, gross/fine motor delays, to autis
m. They are eager beavers and always strive to work their hardest worki
ng past their limitations.     The materials we have are the ones I see
k out for my students. I teach in a Title I school where most of the st
udents receive free or reduced price lunch.  Despite their disabilities
and limitations, my students love coming to school and come eager to le
arn and explore.Have you ever felt like you had ants in your pants and
you needed to groove and move as you were in a meeting? This is how my
kids feel all the time. The want to be able to move as they learn or so
they say.Wobble chairs are the answer and I love then because they deve
lop their core, which enhances gross motor and in Turn fine motor skill
s.   They also want to learn through games, my kids do not want to sit
```

```
and do worksheets. They want to learn to count by jumping and playing.
Physical engagement is the key to our success. The number toss and colo
r and shape mats can make that happen. My students will forget they are
doing work and just have the fun a 6 year old deserves.nannan
```

In [66]:
```
#remove spacial character: https://stackoverflow.com/a/5843547/4084039
sent = re.sub('[^A-Za-z0-9]+', ' ', sent)
print(sent)
```

```
My kindergarten students have varied disabilities ranging from speech a
nd language delays cognitive delays gross fine motor delays to autism T
hey are eager beavers and always strive to work their hardest working p
ast their limitations The materials we have are the ones I seek out for
my students I teach in a Title I school where most of the students rece
ive free or reduced price lunch Despite their disabilities and limitati
ons my students love coming to school and come eager to learn and explo
re Have you ever felt like you had ants in your pants and you needed to
groove and move as you were in a meeting This is how my kids feel all t
he time The want to be able to move as they learn or so they say Wobble
chairs are the answer and I love then because they develop their core w
hich enhances gross motor and in Turn fine motor skills They also want
to learn through games my kids do not want to sit and do worksheets The
y want to learn to count by jumping and playing Physical engagement is
the key to our success The number toss and color and shape mats can mak
e that happen My students will forget they are doing work and just have
the fun a 6 year old deserves nannan
```

In [67]:
```
# https://gist.github.com/sebleier/554280
# we are removing the words from the stop words list: 'no', 'nor', 'no
t'
stopwords =['i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ourselves'
, 'you', "you're", "you've",\
            "you'll", "you'd", 'your', 'yours', 'yourself', 'yourselve
s', 'he', 'him', 'his', 'himself', \
            'she', "she's", 'her', 'hers', 'herself', 'it', "it's", 'it
s', 'itself', 'they', 'them', 'their',\
            'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'th
is', 'that', "that'll", 'these', 'those', \
            'am', 'is', 'are', 'was', 'were', 'be', 'been', 'being', 'h
ave', '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', 'h
ow', 'all', 'any', 'both', 'each', 'few', 'more',\
            'most', 'other', 'some', 'such', 'only', 'own', 'same', 's
o', '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', "doesn't", 'hadn',\
            "hadn't", 'hasn', "hasn't", 'haven', "haven't", 'isn', "is
n'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 [68]:
```
# 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 [01:52<00:00, 97
0.03it/s]
```

In [69]:
```
# after preprocesing
```

```
preprocessed_essays[15000]
```

Out[69]:
```
'you bring horse water not make drink however expose students world tec
hnology not able stop exploring how cool would children exposed simple
technology ipad classroom my students reside small town hearts shape wo
rld they limited resources prepare real world it statistically proven s
tudents not prepared real world they might able text play game however
skills needed capable surviving work force today involve technology int
egration among multiple curricula science technology reading multimedia
it integral part students education tools capable striving advanced lea
rning environment assist providing appropriate instruction effectively
my students opportunity exposure endless resources simply not available
classroom computer it said app everything i mind blown amount education
al apps available educators students apps allow student developmental d
isability effectively communicate classroom teacher device need charged
24 7 app serve additional means instruction literacy centers 100 full e
ngagement app allow students interactively enact founding country direc
tional journey europe america list goes the purchase ipad also assist d
evelopment classroom support newest initiative county school district t
itled byod bring your own device nannan'
```

1.3.2 Project title Text

In [70]:
```python
# printing some random essays.
print(project_data['project_title'].values[0])
print("="*50)
print(project_data['project_title'].values[150])
print("="*50)
print(project_data['project_title'].values[1000])
print("="*50)
print(project_data['project_title'].values[20000])
print("="*50)
print(project_data['project_title'].values[99999])
print("="*50)
```

```
Educational Support for English Learners at Home
==================================================
More Movement with Hokki Stools
```

```
==================================================
Sailing Into a Super 4th Grade Year
==================================================
We Need To Move It While We Input It!
==================================================
Inspiring Minds by Enhancing the Educational Experience
==================================================
```

In [71]:
```python
preprocessed_titles = []
for titles in tqdm(project_data["project_title"]):
    title = decontracted(titles)
    title = title.replace('\\r', ' ')
    title = title.replace('\\"', ' ')
    title = title.replace('\\n', ' ')
    title = re.sub('[^A-Za-z0-9]+', ' ', title)
    title = ' '.join(f for f in title.split() if f not in stopwords)
    preprocessed_titles.append(title.lower().strip())
```

```
100%|████████████████████████████████| 109248/109248 [00:06<00:00, 1805
2.00it/s]
```

In [72]:
```python
print(preprocessed_titles[0])
print("="*50)
print(preprocessed_titles[50])
print("="*50)
print(preprocessed_titles[500])
print("="*50)
print(preprocessed_titles[5000])
print("="*50)
print(preprocessed_titles[10000])
print("="*50)
```

```
educational support english learners home
==================================================
be active be energized
==================================================
classroom chromebooks college bound seniors
==================================================
bouncing our wiggles worries away
```

```
==================================================
family book clubs
==================================================
```

1. 4 Preparing data for models

In [73]:
```
project_data.columns
```

Out[73]:
```
Index(['Unnamed: 0', 'id', 'teacher_id', 'teacher_prefix', 'school_stat
e',
       'project_submitted_datetime', 'project_grade_category', 'project
_title',
       'project_essay_1', 'project_essay_2', 'project_essay_3',
       'project_essay_4', 'project_resource_summary',
       'teacher_number_of_previously_posted_projects', 'project_is_appr
oved',
       'clean_categories', 'clean_subcategories', 'essay', 'price', 'qu
antity',
       'digit_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

In [ ]:
```
#we will follow this link for vectorizing
#https://www.appliedaicourse.com/course/applied-ai-course-online/lesson
s/handling-categorical-and-numerical-features/

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


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

In [75]:
```
# we use count vectorizer to convert the values into one hot encoded fe
atures
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_subca
tegories'].values)
print("Shape of matrix after one hot encodig ",sub_categories_one_hot.s
hape)
```

```
['Economics', 'CommunityService', 'FinancialLiteracy', 'ParentInvolveme
nt', 'Extracurricular', 'Civics_Government', 'ForeignLanguages', 'Nutri
tionEducation', 'Warmth', 'Care_Hunger', 'SocialSciences', 'PerformingA
rts', 'CharacterEducation', 'TeamSports', 'Other', 'College_CareerPre
p', 'Music', 'History_Geography', 'Health_LifeScience', 'EarlyDevelopme
nt', 'ESL', 'Gym_Fitness', 'EnvironmentalScience', 'VisualArts', 'Healt
h_Wellness', 'AppliedSciences', 'SpecialNeeds', 'Literature_Writing',

'Mathematics', 'Literacy']
Shape of matrix after one hot encodig  (109248, 30)
```

school states

In [76]:
```
my_counter = Counter()
for state in project_data['school_state'].values:
    my_counter.update(state.split())
```

In [77]:
```
school_state_cat_dict = dict(my_counter)
sorted_school_state_cat_dict = dict(sorted(school_state_cat_dict.items
(), key=lambda kv: kv[1]))
```

In [78]:
```
## we use count vectorizer to convert the values into one hot encoded f
eatures
vectorizer = CountVectorizer(vocabulary=list(sorted_school_state_cat_di
ct.keys()), lowercase=False
, binary=True)
vectorizer.fit(project_data['school_state'].values)
print(vectorizer.get_feature_names())
school_state_categories_one_hot = vectorizer.transform(project_data['sc
hool_state'].values)
print("Shape of matrix after one hot encoding ",school_state_categories
_one_hot.shape)
```

```
['VT', 'WY', 'ND', 'MT', 'RI', 'SD', 'NE', 'DE', 'AK', 'NH', 'WV', 'M
E', 'HI', 'DC', 'NM', 'KS', 'IA', '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 encoding  (109248, 51)
```

One hot encode Teacher Prefix

In [79]:
```
my_counter = Counter()
for teacher_prefix in project_data['teacher_prefix'].values:
    teacher_prefix = str(teacher_prefix)
    my_counter.update(teacher_prefix.split())
```

In [80]:
```
teacher_prefix_cat_dict = dict(my_counter)
sorted_teacher_prefix_cat_dict = dict(sorted(teacher_prefix_cat_dict.it
ems(), key=lambda kv: kv[1])
)
```

we use count vectorizer to convert the values into one hot encoded features unlike

the previous catageries this catagery returns a value error :np.nan invalid document ref- https://stackoverflow.com/questions/39303912/tfidfvectorizer-in-scikit-learn-valueerror-np-nanis-an-invalid-document/39308809#39308809

In [81]:
```
vectorizer = CountVectorizer(vocabulary=list(sorted_teacher_prefix_cat_
dict.keys()), lowercase=False,binary=True)

vectorizer.fit(project_data['teacher_prefix'].values.astype("U"))
print(vectorizer.get_feature_names())
teacher_prefix_categories_one_hot = vectorizer.transform(project_data[
'teacher_prefix'].values.astype("U"))
print("Shape of matrix after one hot encoding ",teacher_prefix_categori
es_one_hot.shape)
```

```
['nan', 'Dr.', 'Teacher', 'Mr.', 'Ms.', 'Mrs.']
Shape of matrix after one hot encoding  (109248, 6)
```

One Hot Encode - Project Grade Category

In [82]:
```
my_counter = Counter()
for project_grade in project_data['project_grade_category'].values:
    my_counter.update(project_grade.split())
```

In [83]:
```
project_grade_cat_dict = dict(my_counter)
sorted_project_grade_cat_dict = dict(sorted(project_grade_cat_dict.item
s(), key=lambda kv: kv[1]))
```

In [84]:
```
## we use count vectorizer to convert the values into one hot encoded f
eatures
vectorizer = CountVectorizer(vocabulary=list(sorted_project_grade_cat_d
ict.keys()), lowercase=False, binary=True)
vectorizer.fit(project_data['project_grade_category'].values)
print(vectorizer.get_feature_names())
project_grade_categories_one_hot = vectorizer.transform(project_data['p
roject_grade_category'].values)
print("Shape of matrix after one hot encoding ",project_grade_categorie
s_one_hot.shape)
```

```
['9-12', '6-8', '3-5', 'PreK-2', 'Grades']
Shape of matrix after one hot encoding  (109248, 5)
```

1.4.2 Vectorizing Text data

1.4.2 Vectorizing Text data

In [85]:
```
# We are considering only the words which appeared in at least 10 docum
ents(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)
```

In [86]:
```
print("There are{} unique words among the {} number of Project essays,c
onsidering atleast 10 different projects has the same word".format(text
_bow.shape[1],text_bow.shape[0]))
```

```
There are16623 unique words among the 109248 number of Project essays,c
onsidering atleast 10 different projects has the same word
```

1.4.2.2 Bag of Words on `project_title`

In [87]:
```
vectorizer = CountVectorizer(min_df=10)
title_bow = vectorizer.fit_transform(preprocessed_titles)
print("Shape of matrix after one hot encoding ",title_bow.shape)
```

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

In [88]:
```
print("There are{} unique words among the {} number of Project titles,c
onsidering atleast 10 different projects has the same word".format(text
_bow.shape[1],text_bow.shape[0]))
```

```
There are16623 unique words among the 109248 number of Project titles,c
onsidering atleast 10 different projects has the same word
```

1.4.2.3 TFIDF vectorizer

In [89]:
```
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 [90]:
```
from sklearn.feature_extraction.text import TfidfVectorizer
vectorizer = TfidfVectorizer(min_df=10)
title_tfidf = vectorizer.fit_transform(preprocessed_titles)
print("Shape of matrix after one hot encodig ",title_tfidf.shape)
```

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

1.4.2.5 Using Pretrained Models: Avg W2V

In [91]:
```
'''
# Reading glove vectors in python: https://stackoverflow.com/a/3823034
9/4084039
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 preproced_texts:
    words.extend(i.split(' '))

for i in preproced_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 o
ur 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-save-and-load-variables-in-python/

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


'''
```

Out[91]:

```
'\n# Reading glove vectors in python: https://stackoverflow.com/a/38230
349/4084039\ndef loadGloveModel(gloveFile):\n    print ("Loading Glove
Model")\n    f = open(gloveFile,\'r\', encoding="utf8")\n    model = {}
\n    for line in tqdm(f):\n        splitLine = line.split()\n        w
ord = splitLine[0]\n        embedding = np.array([float(val) for val in
splitLine[1:]])\n        model[word] = embedding\n    print ("Done.",le
n(model)," words loaded!")\n    return model\nmodel = loadGloveModel
(\'glove.42B.300d.txt\')\n\n# ============================\nOutput:\n
  \nLoading Glove Model\n1917495it [06:32, 4879.69it/s]\nDone. 1917495
words loaded!\n\n# ============================\n\nwords = []\nfor i in
preproced_texts:\n    words.extend(i.split(\' \'))\n\nfor i in preproce
d_titles:\n    words.extend(i.split(\' \'))\nprint("all the words in th
e coupus", len(words))\nwords = set(words)\nprint("the unique words in
the coupus", len(words))\n\ninter_words = set(model.keys()).intersectio
n(words)\nprint("The number of words that are present in both glove vec
tors and our coupus",       len(inter_words),"(",np.round(len(inter_wor
ds)/len(words)*100,3),"%)")\n\nwords_courpus = {}\nwords_glove = set(mo
del.keys())\nfor i in words:\n    if i in words_glove:\n        words_c
ourpus[i] = model[i]\nprint("word 2 vec length", len(words_courpus))\n

\n\n# stronging variables into pickle files python: http://www.jessicay
ung.com/how-to-use-pickle-to-save-and-load-variables-in-python/\n\nimpo
rt pickle\nwith open(\'glove_vectors\', \'wb\') as f:\n    pickle.dump
(words_courpus, f)\n\n\n'
```

In [93]:

```
# stronging variables into pickle files python: http://www.jessicayung.
com/how-to-use-pickle-to-save-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 [95]:

```
# average Word2Vec
# compute average word2vec for each review.
avg_w2v_vectors_essays = []; # 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/re
view
    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_essays.append(vector)

print(len(avg_w2v_vectors_essays))
print(len(avg_w2v_vectors_essays[0]))
```

```
100%|████████████████████████████████| 109248/109248 [01:06<00:00, 164
0.52it/s]
```

```
109248
300
```

1.4.2.6 Using Pretrained Models: AVG W2V on `project_title`

In [96]:
```
avg_w2v_vectors_title = []; # the avg-w2v for each sentence/review is s
tored in this list
for sentence in tqdm(preprocessed_titles): # for each review/sentence
    vector = np.zeros(300) # as word vectors are of zero length
    cnt_words =0; # num of words with a valid vector in the sentence/re
view
    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_title.append(vector)

print(len(avg_w2v_vectors_title))
print(len(avg_w2v_vectors_title[0]))
```

```
100%|██████████████████████████████| 109248/109248 [00:07<00:00, 1467
4.09it/s]
```

```
109248
300
```

1.4.2.7 Using Pretrained Models: TFIDF weighted W2V

In [97]:
```
# 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 v
alue
dictionary = dict(zip(tfidf_model.get_feature_names(), list(tfidf_model
.idf_)))
tfidf_words = set(tfidf_model.get_feature_names())
```

In [98]:
```
# average Word2Vec
# compute average word2vec for each review.
tfidf_w2v_vectors_essay = []; # 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 sentenc
e/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 t
he tf value((sentence.count(word)/len(sentence.split())))
            tf_idf = dictionary[word]*(sentence.count(word)/len(sentenc
e.split())) # getting the tfidf 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_essay.append(vector)

print(len(tfidf_w2v_vectors_essay))
print(len(tfidf_w2v_vectors_essay[0]))
```

```
100%|██████████████████████████████| 109248/109248 [09:26<00:00, 20
8.24it/s]
```

```
109248
300
```

1.4.2.9 Using Pretrained Models: TFIDF weighted W2V on `project_title

In [99]:
```
# Similarly we can vectorize for title also
tfidf_model = TfidfVectorizer()
tfidf_model.fit(preprocessed_titles)
# we are converting a dictionary with word as a key, and the idf as a v
alue
dictionary = dict(zip(tfidf_model.get_feature_names(), list(tfidf_model
.idf_)))
tfidf_words = set(tfidf_model.get_feature_names())
```

In [100]:

```
# average Word2Vec
# compute average word2vec for each review.
tfidf_w2v_vectors_title = []; # the avg-w2v for each sentence/review is
 stored in this list
for sentence in tqdm(preprocessed_titles): # for each review/sentence
    vector = np.zeros(300) # as word vectors are of zero length
    tf_idf_weight =0; # num of words with a valid vector in the sentenc
e/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 t
he tf value((sentence.count(word)/len(sentence.split())))
            tf_idf = dictionary[word]*(sentence.count(word)/len(sentenc
e.split())) # getting the tfidf 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_title.append(vector)

print(len(tfidf_w2v_vectors_title))
print(len(tfidf_w2v_vectors_title[0]))
```

```
100%|██████████████████████████████| 109248/109248 [00:10<00:00, 1076
1.39it/s]
```

```
109248
300
```

1.4.3 Vectorizing Numerical features

In [101]:

```
# after observing this: https://www.youtube.com/watch?v=0HOqOcln3Z4&t=5
30s
# standardization sklearn: https://scikit-learn.org/stable/modules/gene
```

```
rated/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 21
3.03 329.   ... 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(p
rice_scalar.var_[0])}")

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

```
Mean : 298.1193425966608, Standard deviation : 367.49634838483496
```

In [102]:
```
price_standardized
```

Out[102]:
```
array([[-0.3905327 ],
       [ 0.00239637],
       [ 0.59519138],
       ...,
       [-0.15825829],
       [-0.61243967],
       [-0.51216657]])
```

Summary :

1. We observe that on an average Each project costs nearly 298 Dollars. With a Standard Deviation of 368 dollars. So , mostly majority of the projects are less than 1000 Dollars.

Vectorizing - Quantity (Numerical Data)

In [103]:
```
import warnings
warnings.filterwarnings("ignore")
from sklearn.preprocessing import StandardScaler
quantity_scalar = StandardScaler()
quantity_scalar.fit(project_data['quantity'].values.reshape(-1,1)) # fi
nding the mean and standard deviation of this data
print(f"Mean : {quantity_scalar.mean_[0]}, Standard deviation : {np.sqr
t(quantity_scalar.var_[0])}")

# Now standardize the data with above maen and variance.
quantity_standardized = quantity_scalar.transform(project_data['quantit
y'].values.reshape(-1, 1))
```

```
Mean : 16.965610354422964, Standard deviation : 26.182821919093175
```

In [104]:
```
quantity_standardized
```

Out[104]:
```
array([[ 0.23047132],
       [-0.60977424],
       [ 0.19227834],
       ...,
       [-0.4951953 ],
       [-0.03687954],
       [-0.45700232]])
```

Summary :

1. The projects on an average require atleast 17 Different of similar items. We observe that the Price paid is generally for the purchase of these Items. Donors can choose on projects to donate based on the Items provided to aid the Students of any Grade.

Vectorizing - Number of Projects Proposed Previously by the Teacher

(Numerical Data)

In [105]:
```
prev_projects_scalar = StandardScaler()
## Finding the mean and standard deviation of this data
prev_projects_scalar.fit(project_data['teacher_number_of_previously_pos
ted_projects'].values.reshape(-1,1))
print("Mean : {}".format(prev_projects_scalar.mean_[0]))
print("Standard deviation : {}".format(np.sqrt(prev_projects_scalar.var
_[0])))
# Now standardize the data with above maen and variance.
prev_projects_standardized = prev_projects_scalar.transform(project_dat
a['teacher_number_of_previously_posted_projects'].values.reshape(-1, 1
))
```

```
Mean : 11.153165275336848
Standard deviation : 27.77702641477403
```

In [106]:
```
prev_projects_standardized
```

Out[106]:
```
array([[-0.40152481],
       [-0.14951799],
       [-0.36552384],
       ...,
       [-0.29352189],
       [-0.40152481],
       [-0.40152481]])
```

Summary:

```
We observe that Teachers usually on a median propose atleast 11
 completely different
projects.
The Teachers area unit so actively seeking facilitate to help fo
r the betterment
of the students in their neighborhood.
```

1.4.4 Merging all the above features

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

In [107]:
```
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)
```

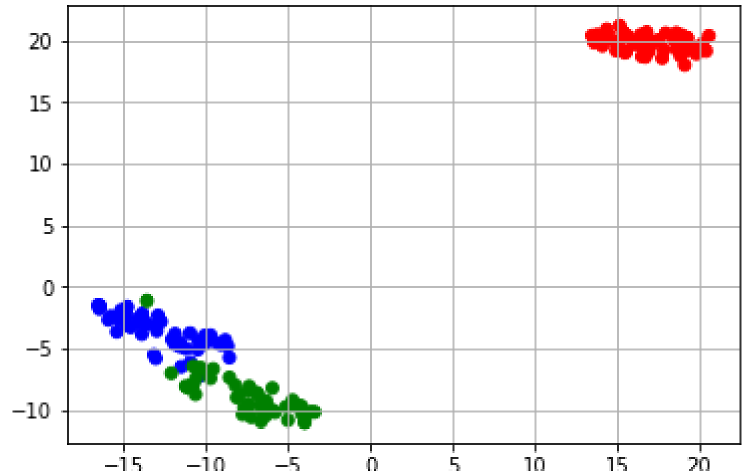
In [108]:
```
# merge two sparse matrices: https://stackoverflow.com/a/19710648/40840
39
from scipy.sparse import hstack
# with the same hstack function we are concatinating a sparse matrix an
d a dense matirx :)
X = hstack((categories_one_hot, sub_categories_one_hot, text_bow, price
_standardized))
X.shape
```

Out[108]:
```
(109248, 16663)
```

now we are going to use one of the most powerful technique for dimentiaonally reduction i.e. t-SNE.which is very intuitively geometrically elegamnt solution for dimentionaly reduction for visualition of data basically tSNE is Neighbourhood Preserving Embedding

2.1 TSNE with `BOW` encoding of `project_title` feature (5000 Data Entries)

In [109]:
```
# https://github.com/pavlin-policar/fastTSNE
# http://colah.github.io/posts/2014-10-Visualizing-MNIST
# this is the example code for TSNE
import numpy as np
from sklearn.manifold import TSNE
from sklearn import datasets
import pandas as pd
import matplotlib.pyplot as plt

iris = datasets.load_iris()
x = iris['data']
y = iris['target']
tsne = TSNE(n_components=2, perplexity=30, learning_rate=200)

X_embedding = tsne.fit_transform(x)
# if x is a sparse matrix you need to pass it as X_embedding = tsne.fit
_transform(x.toarray()) , .toarray() will convert the sparse matrix int
o dense matrix

for_tsne = np.hstack((X_embedding, y.reshape(-1,1)))
for_tsne_df = pd.DataFrame(data=for_tsne, columns=['Dimension_x','Dimen
sion_y','Score'])
colors = {0:'red', 1:'blue', 2:'green'}
plt.scatter(for_tsne_df['Dimension_x'], for_tsne_df['Dimension_y'], c=f
or_tsne_df['Score'].apply(lambda x: colors[x]))
plt.grid()
plt.show()
```



In [110]:
```
print("The Shape of Data matrices for Categorical Data are :")
print("\n")
print("The Shape of Data Matrix for different Categories of projects is
 :{}".format(categories_one_hot.shape))
print("The Shape of Data Matrix for different Sub-categories of project
s is : {}".format(sub_categories_one_hot.shape))
print("The Shape of Data Matrix with respect to Projects from a particu
lar State in the United States is : {}".format(school_state_categories_
one_hot.shape))
print("The Shape of the Data Matrix of the different projects with resp
ect to the Grades of the students is : {} ".format(project_grade_catego
ries_one_hot.shape))
print("The Shape of the Data Matrix with respect to title of the Teache
r proposing the Teacher is: {}".format(teacher_prefix_categories_one_ho
t.shape))
print("\n")
print("="*100)
print("\n")
print("The Shape of Data matrices for Numerical Data are :")
print("\n")
print("The Shape of the Data Matrix for price of the projects is : {}".
format(price_standardized.shape))
print("The Shape of the Data Matrix for Quantity of the items for the p
rojects is : {}".format(quantity_standardized.shape))
print("The Shape of the Data Matrix for the Number of Projects Proposed
 Previously by the Teacher is : {}".format(prev_projects_standardized.s
hape))
print("\n")
print("="*100)
print("\n")
print("TITLE BOW : {}".format(title_bow.shape))
print("\n")
print("TITLE TFIDF : {}".format(title_tfidf.shape))
print("\n")
print("TITLE AVG W2V : ({}, {})".format(len(avg_w2v_vectors_title), len
(avg_w2v_vectors_title[0])))
print("\n")
```

```python
print("TITLE TFIDF W2V : ({}, {})".format(len(tfidf_w2v_vectors_title),
len(tfidf_w2v_vectors_title[0])))
```

```
The Shape of Data matrices for Categorical Data are :



The Shape of Data Matrix for different Categories of projects is :(1092
48, 9)
The Shape of Data Matrix for different Sub-categories of projects is :
(109248, 30)
The Shape of Data Matrix with respect to Projects from a particular Sta
te in the United States is : (109248, 51)
The Shape of the Data Matrix of the different projects with respect to
the Grades of the students is : (109248, 5)
The Shape of the Data Matrix with respect to title of the Teacher propo
sing the Teacher is: (109248, 6)


========================================================================
=============================



The Shape of Data matrices for Numerical Data are :


The Shape of the Data Matrix for price of the projects is : (109248, 1)
The Shape of the Data Matrix for Quantity of the items for the projects
is : (109248, 1)
The Shape of the Data Matrix for the Number of Projects Proposed Previo
usly by the Teacher is : (109248, 1)


========================================================================
=============================


TITLE BOW : (109248, 3329)


TITLE TFIDF : (109248, 3329)
TITLE AVG W2V : (109248, 300)


TITLE TFIDF W2V : (109248, 300)
```

In [111]:
```
X = hstack((categories_one_hot, sub_categories_one_hot, school_state_ca
tegories_one_hot,
project_grade_categories_one_hot, teacher_prefix_categories_one_hot, pr
ice_standardized,
quantity_standardized, prev_projects_standardized, title_bow))
X.shape
```

Out[111]:
```
(109248, 3433)
```

In [112]:
```
from sklearn.manifold import TSNE
X = X.tocsr()
X_new = X[0:5000,:]
```

In [113]:
```
X_new = X_new.toarray()
model = TSNE(n_components = 2, perplexity = 100.0, random_state = 0)
tsne_data_b = model.fit_transform(X_new)
```

In [114]:
```
labels = project_data["project_is_approved"]
labels_new = labels[0: 5000]
len(labels_new)
```

Out[114]:
```
5000
```

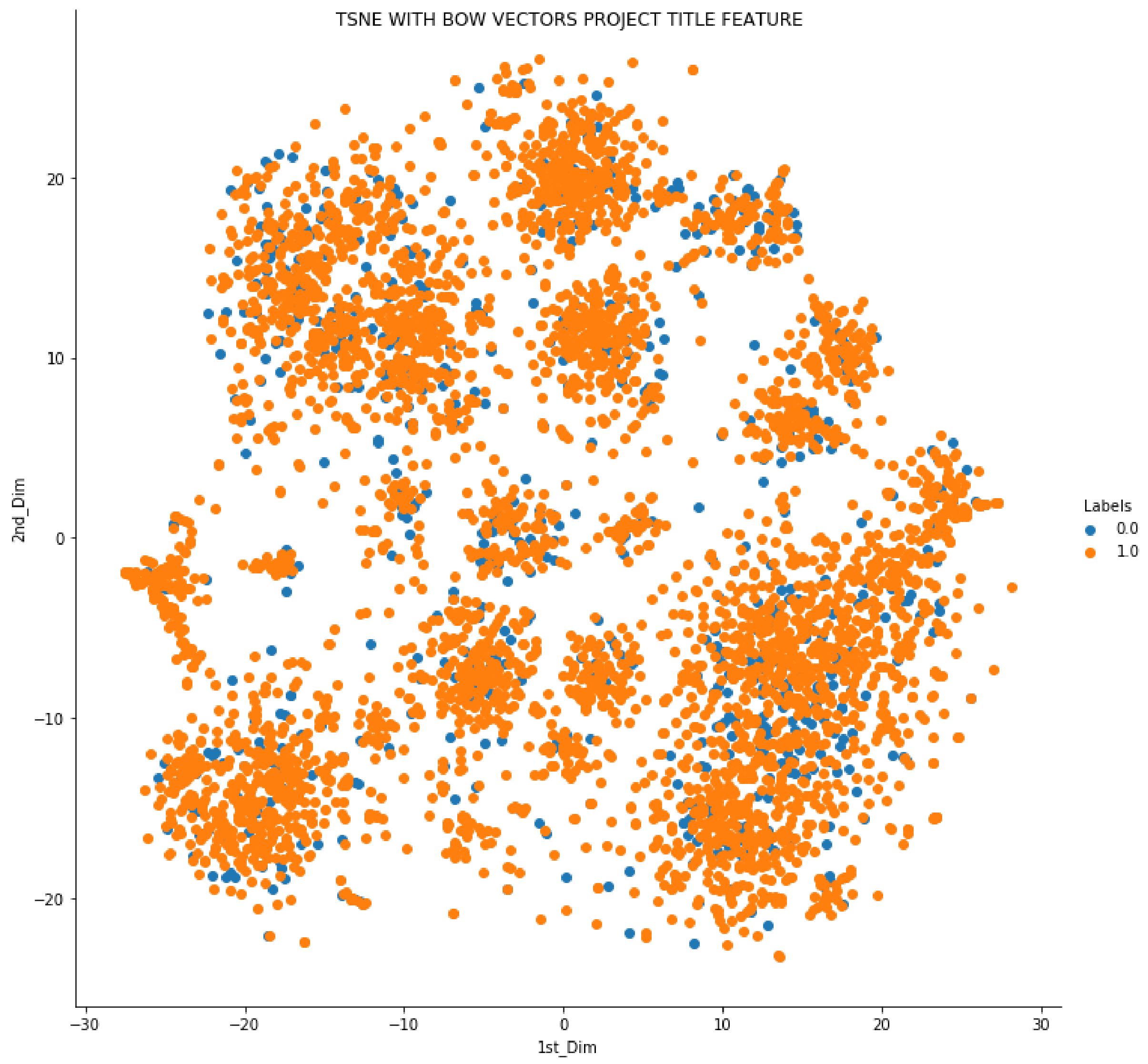
In [115]:
```
tsne_data_b = np.vstack((tsne_data_b.T, labels_new)).T
tsne_df_b = pd.DataFrame(tsne_data_b, columns = ("1st_Dim","2nd_Dim","L
abels"))
```

In [116]:
```
tsne_df_b.shape
```

Out[116]:
```
(5000, 3)
```

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

In [117]:
```
sns.FacetGrid(tsne_df_b, hue = "Labels", size = 10).map(plt.scatter, "1
st_Dim", "2nd_Dim")\
.add_legend().\
fig.suptitle("TSNE WITH BOW VECTORS PROJECT TITLE FEATURE")
plt.show()
```



Summary :

1. We can see that from above plot most of overlapping in the datapoints.
2. The points are well scattered, unable to draw any proper conclusion.

2.2 TSNE with `TFIDF` encoding of `project_title` feature (5000 Data Entries)

```
In [118]: X = hstack((categories_one_hot, sub_categories_one_hot, school_state_ca
          tegories_one_hot,
          project_grade_categories_one_hot, teacher_prefix_categories_one_hot, pr
          ice_standardized,
          quantity_standardized, prev_projects_standardized, title_tfidf))
          X.shape

Out[118]: (109248, 3433)
```

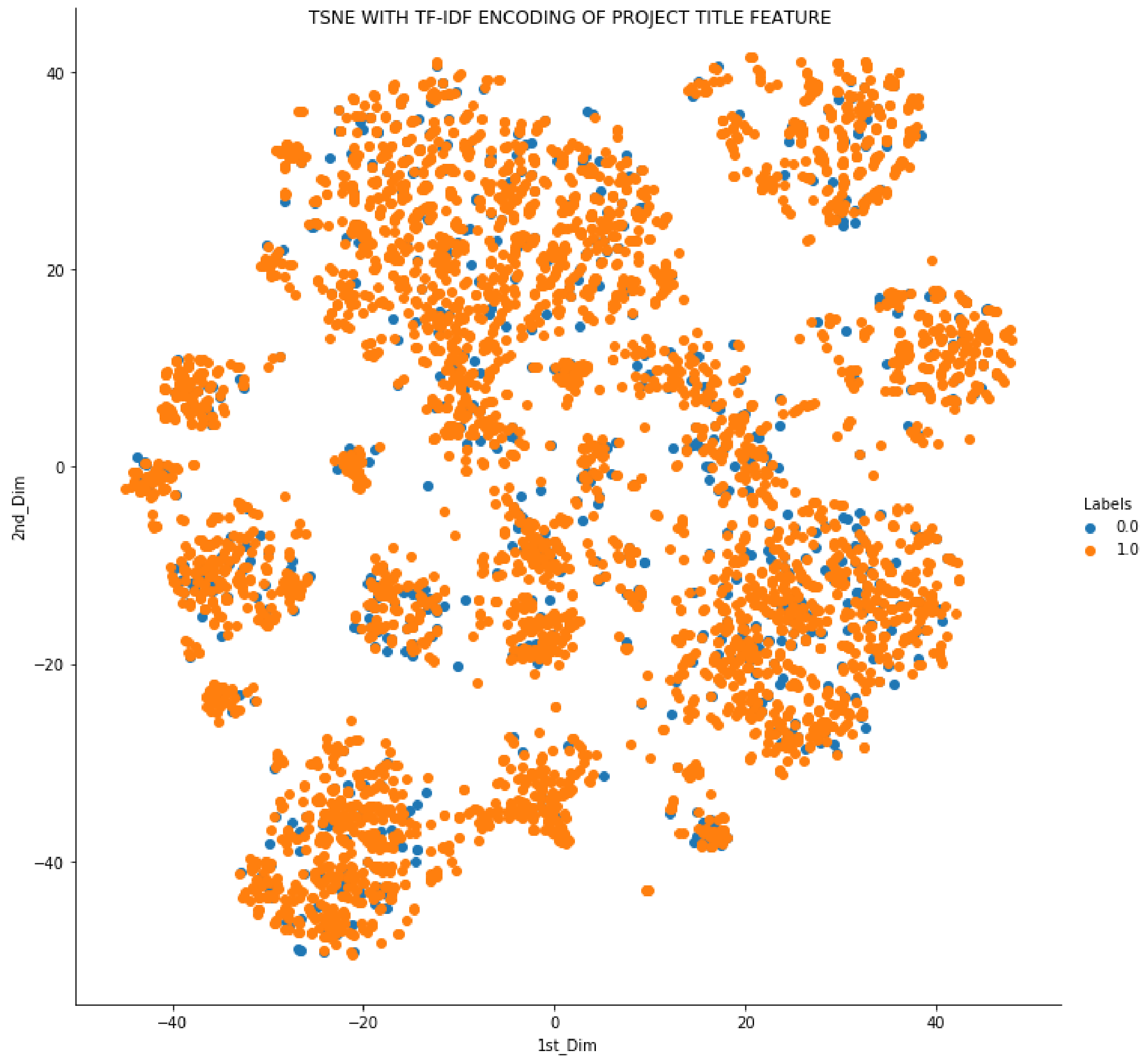
```
In [119]: X = X.tocsr()
          X_new = X[0:5000,:]
```

```
In [120]: X_new = X_new.toarray()
          model = TSNE(n_components = 2, perplexity = 100.0, random_state = 0)
          tsne_data_tfidf = model.fit_transform(X_new)
```

```
In [121]: tsne_data_tfidf = np.vstack((tsne_data_tfidf.T, labels_new)).T
          tsne_df_tfidf = pd.DataFrame(tsne_data_tfidf, columns = ("1st_Dim","2nd
          _Dim","Labels"))
```

```
In [122]: tsne_df_tfidf.shape

Out[122]: (5000, 3)
```

```
In [123]: sns.FacetGrid(tsne_df_tfidf, hue = "Labels", size = 10).map(plt.scatter
          , "1st_Dim", "2nd_Dim").\
          add_legend().fig.suptitle("TSNE WITH TF-IDF ENCODING OF PROJECT TITLE F
          EATURE")
          plt.show()
```


TSNE WITH TF-IDF ENCODING OF PROJECT TITLE FEATURE
2nd_Dim
1st_Dim
Labels
0.0
1.0
40
20
0
−20
−40
−40
−20
0
20
40

Summary :

The Blue and the Orange points do not form any clusters or accumulation of any type, Hence drawing conclusions seems to quite impossible with the current state of the T-SNE data using TF - IDF Encoding.No conclusion can be find out

2.3 TSNE with `AVG W2V` encoding of `project_title` feature (5000 Data Entries)

In [125]:
```
X = hstack((categories_one_hot, sub_categories_one_hot, school_state_ca
tegories_one_hot,
project_grade_categories_one_hot,\
teacher_prefix_categories_one_hot, price_standardized, quantity_standar
dized, prev_projects_standardized,avg_w2v_vectors_title))
X.shape
```

Out[125]:
```
(109248, 404)
```

In [126]:
```
X = X.tocsr()
X_new = X[0:5000,:]
```

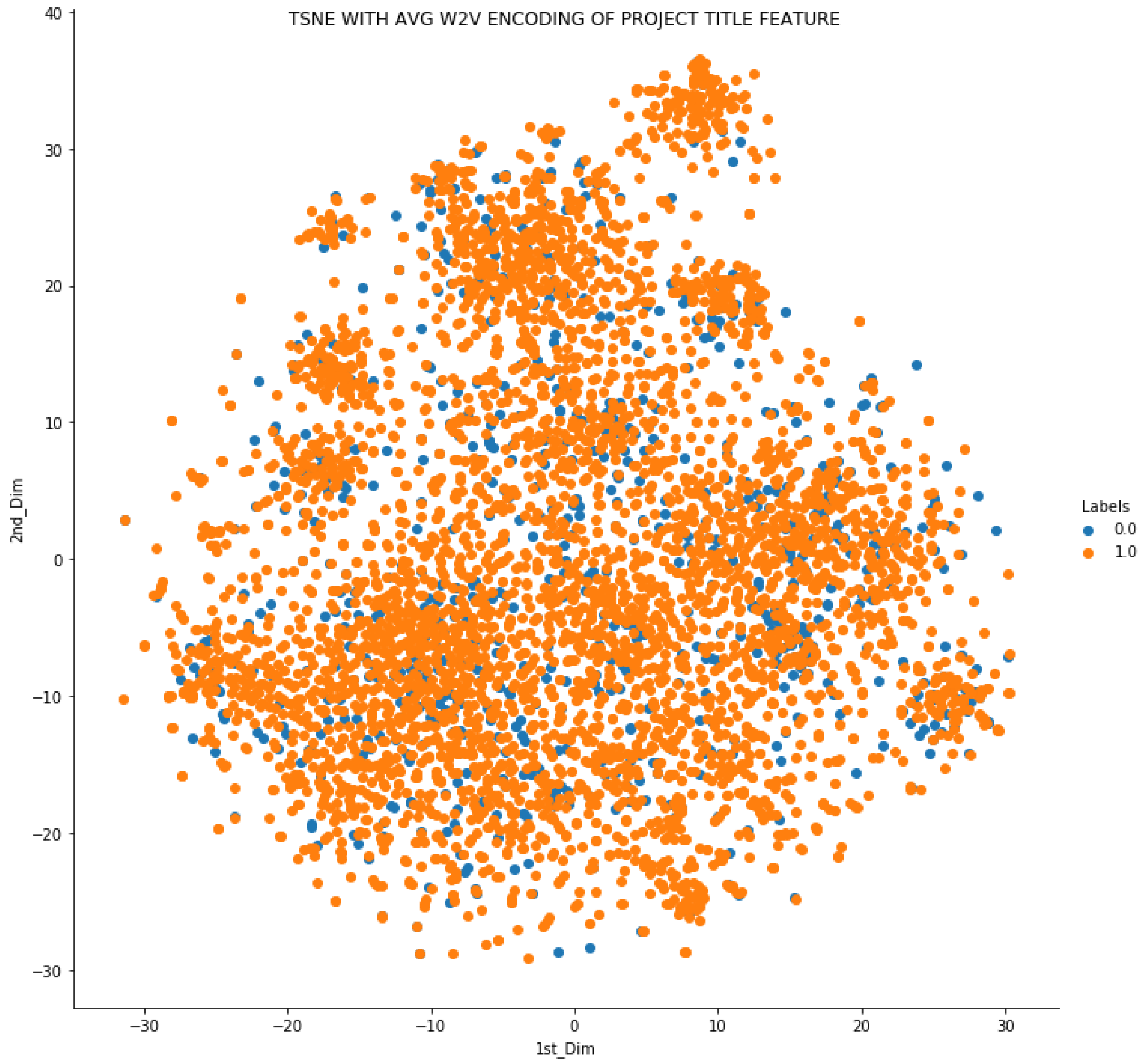
In [127]:
```
X_new = X_new.toarray()
model = TSNE(n_components = 2, perplexity = 100.0, random_state = 0)
tsne_data_avg_w2v = model.fit_transform(X_new)
```

In [128]:
```
tsne_data_avg_w2v = np.vstack((tsne_data_avg_w2v.T, labels_new)).T
tsne_df_avg_w2v = pd.DataFrame(tsne_data_avg_w2v, columns = ("1st_Dim",
"2nd_Dim","Labels"))
```

In [129]:
```
tsne_df_avg_w2v.shape
```

Out[129]:
```
(5000, 3)
```

In [130]:
```
sns.FacetGrid(tsne_df_avg_w2v, hue = "Labels", size = 10).map(plt.scatt
er, "1st_Dim", "2nd_Dim").\
add_legend().fig.suptitle("TSNE WITH AVG W2V ENCODING OF PROJECT TITLE
 FEATURE ")
plt.show()
```



Summary :

We cant observe any clusters for whether the Project is accepted or not accepted. Hence we are not able to achieve the desired result using Avg- Word2vec

2.4 TSNE with `TFIDF Weighted W2V` encoding of `project_title` feature (5000)

In [131]:
```
X = hstack((categories_one_hot, sub_categories_one_hot, school_state_ca
tegories_one_hot,
project_grade_categories_one_hot, teacher_prefix_categories_one_hot, pr
ice_standardized,
quantity_standardized, prev_projects_standardized, tfidf_w2v_vectors_ti
tle))
X.shape
```

Out[131]:
```
(109248, 404)
```

In [132]:
```
X = X.tocsr()
X_new = X[0:5000,:]
```

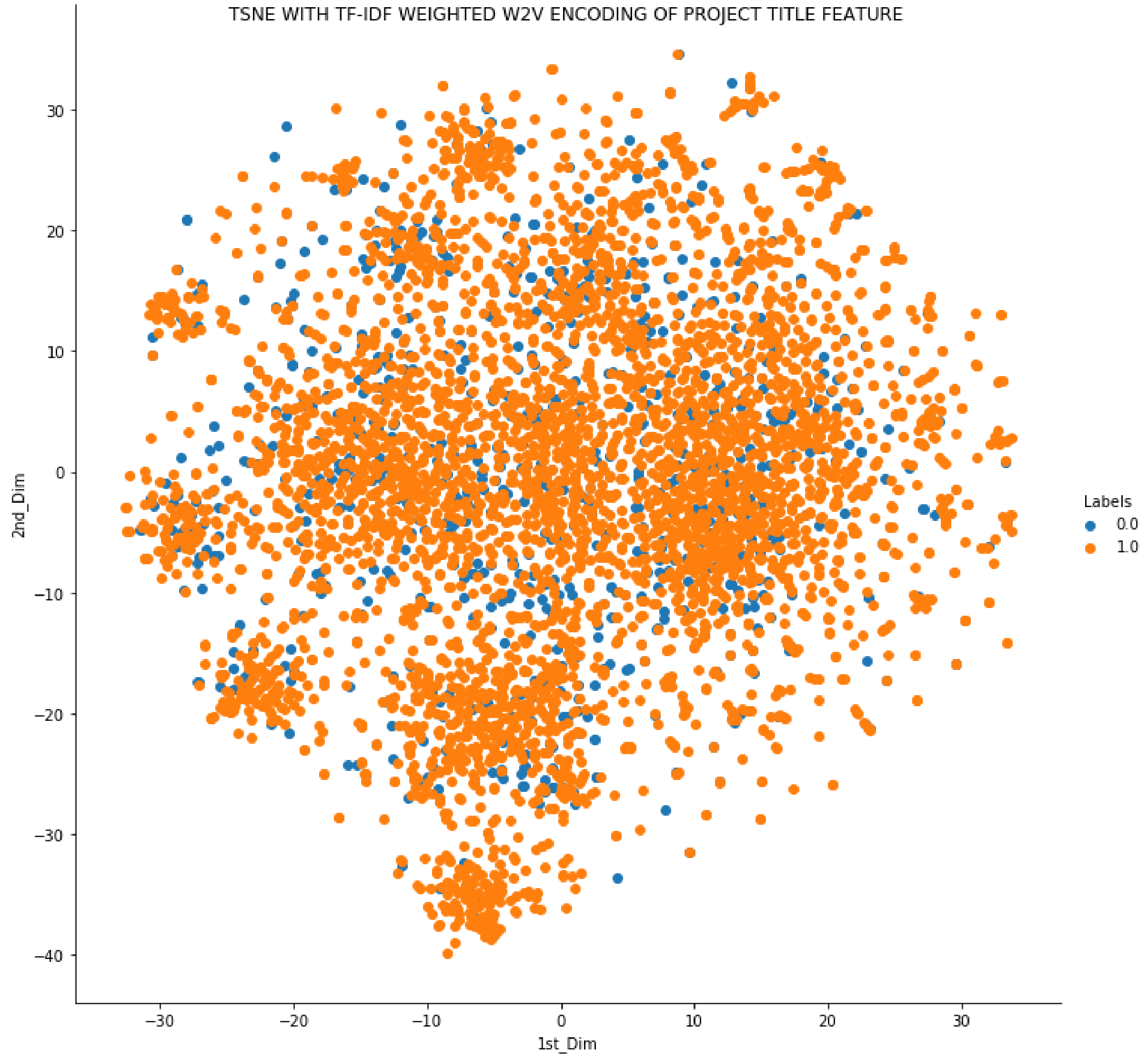
In [133]:
```
X_new = X_new.toarray()
model = TSNE(n_components = 2, perplexity = 100.0, random_state = 0)
tsne_data_tfidf_w2v = model.fit_transform(X_new)
```

In [134]:
```
tsne_data_tfidf_w2v = np.vstack((tsne_data_tfidf_w2v.T, labels_new)).T
tsne_df_tfidf_w2v = pd.DataFrame(tsne_data_tfidf_w2v, columns = ("1st_D
im","2nd_Dim","Labels"))
```

In [135]:
```
tsne_df_tfidf_w2v.shape
```

Out[135]:
```
(5000, 3)
```

In [137]:
```
sns.FacetGrid(tsne_df_tfidf_w2v, hue = "Labels", size = 10).map(plt.sca
tter, "1st_Dim", "2nd_Dim").\
add_legend().fig.suptitle("TSNE WITH TF-IDF WEIGHTED W2V ENCODING OF PR
OJECT TITLE FEATURE ")
plt.show()
```



Summary :

This visualisation of TSNE with TF-IDF Weighted Word2Vec does not seem to yield the expected result of clustering similar data points. Hence we would have to try any other method

2.5 TSNE with `BOW`, `TFIDF`, `AVG W2V`, `TFIDF Weighted W2V` encoding of `project_title` feature (5000 Data Entries)

In [140]:
```
X = hstack((categories_one_hot, sub_categories_one_hot, school_state_ca
tegories_one_hot,
project_grade_categories_one_hot, teacher_prefix_categories_one_hot, pr
ice_standardized,
quantity_standardized, prev_projects_standardized, title_bow, title_tfi
df, avg_w2v_vectors_title,
tfidf_w2v_vectors_title))
X.shape
```

Out[140]:
```
(109248, 7362)
```

In [141]:
```
X = X.tocsr()
X_new = X[0:5000,:]
```

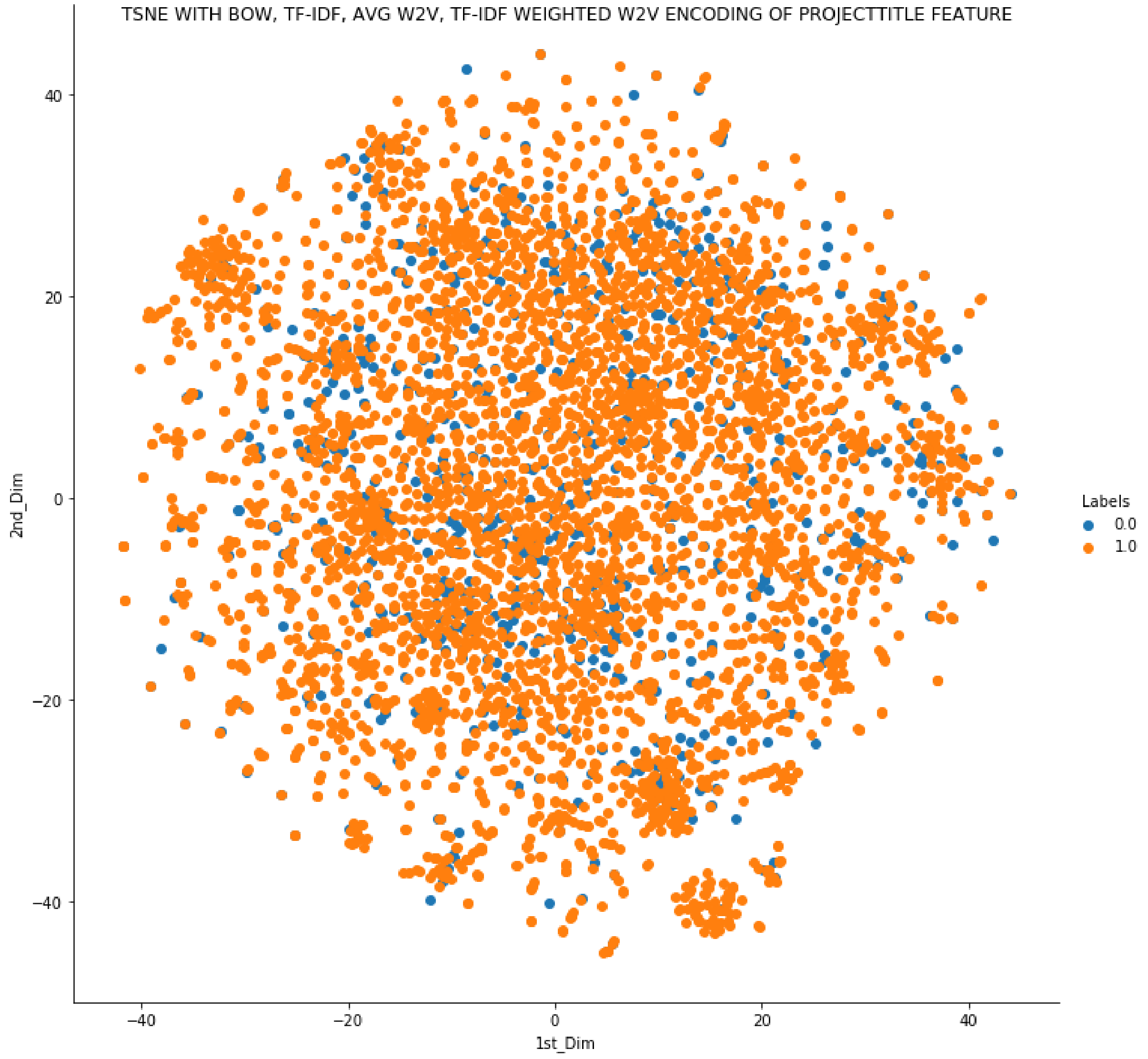
In [142]:
```
X_new = X_new.toarray()
model = TSNE(n_components = 2, perplexity = 100.0, random_state = 0)
tsne_data_complete = model.fit_transform(X_new)
```

In [143]:
```
tsne_data_complete = np.vstack((tsne_data_complete.T, labels_new)).T
tsne_df_complete = pd.DataFrame(tsne_data_complete, columns = ("1st_Di
m","2nd_Dim","Labels"))
```

In [144]:
```
tsne_df_complete.shape
```

Out[144]:
```
(5000, 3)
```

In [147]:
```
sns.FacetGrid(tsne_df_complete, hue = "Labels", size = 10).map(plt.scat
ter, "1st_Dim", "2nd_Dim").\
add_legend().fig.suptitle("TSNE WITH BOW, TF-IDF, AVG W2V, TF-IDF WEIGH
TED W2V ENCODING OF PROJECT\
TITLE FEATURE")
plt.show()
```



Summary :

This visualisation of TSNE with Bag of Words, TF-IDF, Avg Word2Vec, TF-IDF Weighted Word2Vec does not seem to yield the expected result of clustering similar data points. Hence we would have to try any other method.

2.6 CONCLUSION

From above Observations we can Conclude that

1-Averageky there were 85% of projects from total projects are approved (got funding) while remaining 15% are non funding

2-Delaware (DE) state from the United States has the highest percent of projects accepted within the whole country having almost 90% acceptance rate, followed by North Dakota (ND) and Washington(WA) nearly 89% and 88% respectively each.

3-Vermont(VT) has the lowest Approval rate with exactly 80% followed by District of Columbia (DC) and Texas(TX) with nearly 80% and 81% respectively.

4-California has supermassive no of project proposals nearly 85% whereas Vermount has low 80%

5-Female Teachers have the maximum number of projects proposed and accepted compared to the male teachers.

6-There are alot of projects proposed for the students between Pre Kindergarden and 2nd Grade while for the rest it keeps decreasing.

7-The average Acceptance rate of the project is 84% irrespective of the Grade

8-Projects belonging to the Literacy and Language categories have the highest number of projects proposed under. The maximum number of accepted projects also belong to this category, having an acceptance rate of nearly 87%.

9-There is a lot of variablity in the total number of projects proposed per Category of the project.

10-Projects belonging to both Maths and Science have acceptance rate of nearly 82% while introducing the concept of Literacy and Language to this can increase its accpetance rate to nearly 87%

11-There is also Variability in Acceptance rate, projects under the category Warmth, Care and Hunger have an acceptance rate of 93.5%.

12-The highest number of projects are registered under Literacy and Language with 52,239 projects,followed by Maths and Science having 41,421 projects whereas2.There are only 1388 projects under the category of Warmth , Care or Hunger

13-The sub-Category Literacy has the highest number of projects approved with 8371 projects. Also the acceptance rate is 88% whereas Health and Wellness have the lowest number of projects proposed with 3,583 projects only.

14-Roughly most of the projects have 3, 4 or 5 words in the title.There are hardly any project titles containing more than 10 words

15-The number of words in the Project Essays of Approved Projects are slightly more than the number of words in the Project Essays of the Rejected Projects.

16-The Maximum price for any project should be less than 10,000 dollars.The approved projects tend to have lower cost when compared to the projects that have not been approved.

17-The authorized projects tend to have reduced costs compared to non-approved projects. Looking at the percentile values,this can be noticed. For an approved project, the 50th percentile cost value is 198.99 dollars, while the cost for the unapproved projects is 263.145 dollars.

18-The project summaries containing numeric values have a very high acceptance rate of 90%. Well,proper numbered requirements suggest clarity in the proposals and hence Alot of people tend to donate for a better cause, that is to help children.

19-We notice that an average cost almost 298 dollars each project, with a standard deviation of 368 dollars. So, most of the projects are less than 750 dollars.

20-We observe that on an average Each project costs nearly 298 Dollars. The Price paid is generally for the purchase of the Items. The projects on an average require atleast 17 Different of similar items.

21-Visualisation of tSNE with Bag of Words, TF-IDF, Avg Word2Vec, TF-IDF Weighted Word2Vec does not seem to yield the expected result of clustering similar data points.Hence we have to think other method of Data Analysis.