DonorsChoose

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

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

1.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

2.How to increase the consistency of project vetting across different volunteers to improve the experience for teachers

3.How to focus volunteer time on the applications that need the most assistance

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

About the DonorsChoose Data Set

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

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

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

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

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

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

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

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

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

Notes on the Essay Data

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

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

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

- __project_essay_1:__ "Describe your students: What makes your students special? Specific details about their

background, your neighborhood, and your school are all helpful."
- __project_essay_2:__ "About your project: How will these materials make a difference in your students' learning and improve their school lives?"

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

In [1]:

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

import sqlite3
import pandas as pd
import numpy as np
import nltk
import string
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics import confusion_matrix
from sklearn import metrics
from sklearn.metrics import roc_curve, auc
from nltk.stem.porter import PorterStemmer
import re
# Tutorial about Python regular expressions: https://pymotw.com/2/re/
import string
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
from nltk.stem.wordnet import WordNetLemmatizer
from gensim.models import Word2Vec
from gensim.models import KeyedVectors
import pickle
from tqdm import tqdm
import os
from plotly import plotly
import plotly.offline as offline
import plotly.graph_objs as go
offline.init_notebook_mode()
from collections import Counter
```

1.1 Reading Data

In [2]:

```
project_data=pd.read_csv('train_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)
print("-"*50)
project_data.head(5)
```

```
Number of data points in train data{} (109248, 17)
--------------------------------------------------
The attributes of data:{} ['Unnamed: 0' 'id' 'teacher_id' 'teacher_prefix' 'school_state'
 'project_submitted_datetime' 'project_grade_category'
 'project_subject_categories' 'project_subject_subcategories'
 'project_title' 'project_essay_1' 'project_essay_2' 'project_essay_3'
 'project_essay_4' 'project_resource_summary'
 'teacher_number_of_previously_posted_projects' 'project_is_approved']
--------------------------------------------------
```

Out[3]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2016-12-05 13:43:57
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2016-10-25 09:22:10
2	21895	p182444	3465aaf82da834c0582ebd0ef8040ca0	Ms.	AZ	2016-08-31 12:03:56
3	45	p246581	f3cb9bffbba169bef1a77b243e620b60	Mrs.	KY	2016-10-06 21:16:17
4	172407	p104768	be1f7507a41f8479dc06f047086a39ec	Mrs.	TX	2016-07-11 01:10:09

In [4]:

```
print("Number of data points in resources:",resource_data.shape)
print("-"*50)
print("the attributes of resources:",resource_data.columns.values)
print("-"*50)
resource_data.head(2)
```

```
Number of data points in resources: (1541272, 4)
--------------------------------------------------
the attributes of resources: ['id' 'description' 'quantity' 'price']
--------------------------------------------------
```

Out[4]:

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

1.2 Data Analysis

Let us calculate the percentage of projects are approved and percent of projects are not approved

In [5]:

```
y_value_counts=project_data['project_is_approved'].value_counts()
```

In [6]:

```
## Let us calculate the percentage of projects are approved and percentage of projects are not approved
percent_approved=(y_value_counts[1]/(y_value_counts[1]+y_value_counts[0]))*100
percent_unapproved=(y_value_counts[0]/(y_value_counts[1]+y_value_counts[0]))*100

print("Number of projects that were approved for funding are {}, which is {}% of total projects".format
(y_value_counts[1],percent_approved))
print("-"*50)
print("Number of projects that were not approved for funding are {}, which is {}% of toal projects".for
mat(y_value_counts[0],percent_unapproved))
```

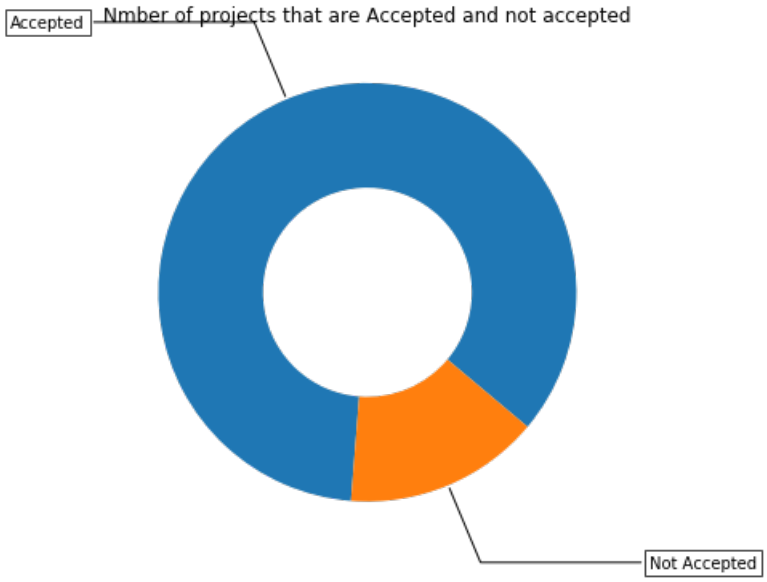
```
Number of projects that were approved for funding are 92706, which is 84.85830404217927% of total proje
cts
--------------------------------------------------
```

```
Number of projects that were not approved for funding are 16542, which is 15.141695957820739% of toal p
rojects
```

So we now know that 85% projects are approved and remaing are not approved, Well lets visualize this using the Dount Plot

In [7]:

```
## PROVIDE CITATIONS TO YOUR CODE IF YOU TAKE IT FROM ANOTHER WEBSITE.
## https://matplotlib.org/gallery/pie_and_polar_charts/pie_and_donut_labels.html#sphx-glr-gallery-pie-a
nd-polar-charts-pie-and-donut-labels-py
## This code below help us to visualize the above attained piece of information about the percentage of
projects approved

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

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

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

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

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

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

plt.show()
```



1.2.1 Univariate Analysis: School State

In [8]:

```
temp=pd.DataFrame(project_data.groupby("school_state")["project_is_approved"].apply(np.mean)).reset_ind
ex()
temp.head(5)
```

Out[8]:

	school_state	project_is_approved

	school_state	project_is_approved
0	AK	0.840580
1	AL	0.854711
2	AR	0.831268
3	AZ	0.838379
4	CA	0.858136

In [9]:

```
temp.columns=['state_code','num_proposals']
temp.head(5)
```

Out[9]:

	state_code	num_proposals
0	AK	0.840580
1	AL	0.854711
2	AR	0.831268
3	AZ	0.838379
4	CA	0.858136

In [10]:

```
'''Reference == # Google Search : How to plot US state heatmap, Best link : https://datascience.stackexchange.com/a/9620'''

scl = [[0.0, 'rgb(242,240,247)'],[0.2, 'rgb(218,218,235)'],[0.4, 'rgb(188,189,220)'],\
            [0.6, 'rgb(158,154,200)'],[0.8, 'rgb(117,107,177)'],[1.0, 'rgb(84,39,143)']]

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

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

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

In [11]:

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

```
states with lowest % approvals
   state_code  num_proposals
46         VT       0.800000
7          DC       0.802326
43         TX       0.813142
26         MT       0.816327
18         LA       0.831245
==================================================
states with highest % approvals
   state_code  num_proposals
30         NH       0.873563
35         OH       0.875152
47         WA       0.876178
28         ND       0.888112
8          DE       0.897959
```

SUMMARY:

1.Delaware(DE) state from the united states has the highest percent of projects accepted within the whole country almost 90% acceptence rate, followed by North Dakota(ND) and Washington(WA) nearly 89% and 88% respectively each.

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

In [12]:

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

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

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

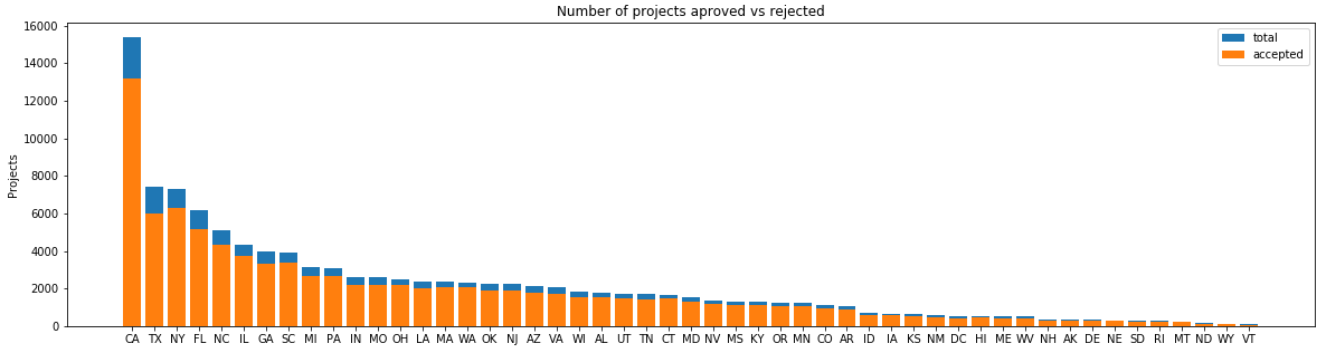
In [13]:

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

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

```
    temp['Avg'] = pd.DataFrame(project_data.groupby(col1)[col2].agg({'Avg':'mean'})).reset_index()['Avg
']

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

    if top:
        temp = temp[0:top]

    stack_plot(temp, xtick=col1, col2=col2, col3='total')
    print(temp.head(5))
    print("="*50)
    print(temp.tail(5))
```

In [14]:

```
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

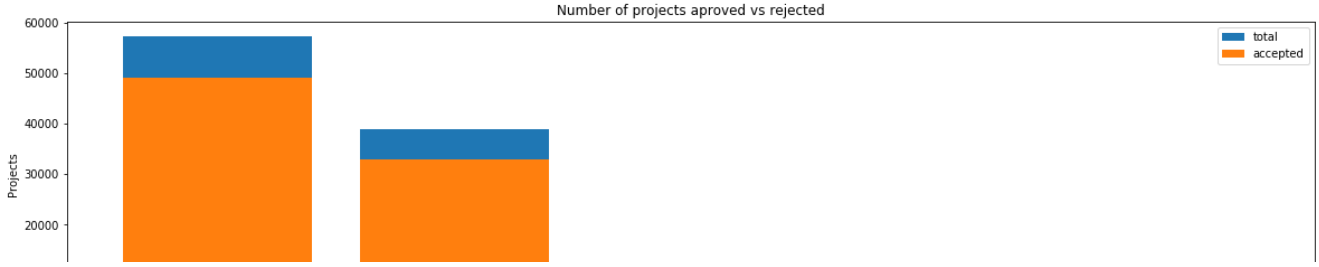
3.California(CA) has the highest number of project proposals when compared to the other States, Surprisingly, 85% of the projects gets approved on an average which is nearly 13205 out of 15388 project proposals.

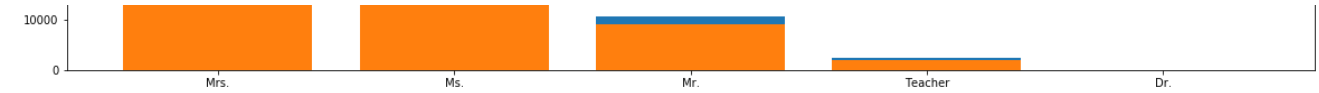
4.Vermont(VT) has the lowest number of project proposals initiated 80 and almost 80% of the project proposals gets approved(64 out of 80) and 16 were rejected.

1.2.2 Univariate Analysis: teachr_prefix

In [15]:

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






```
  teacher_prefix  project_is_approved  total       Avg
2           Mrs.                48997  57269  0.855559
3            Ms.                32860  38955  0.843537
1            Mr.                 8960  10648  0.841473
4        Teacher                 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 maximun number of projects and accepted compated to the male teachers.

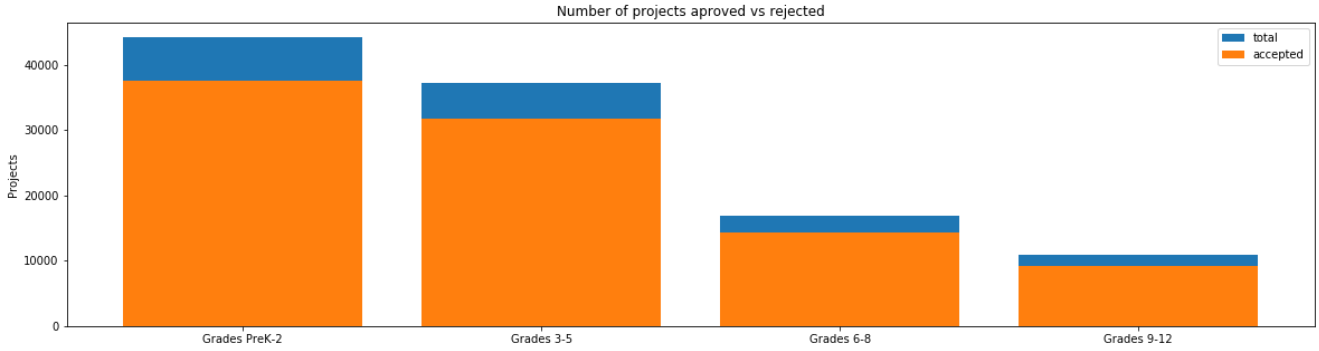
2.Teacher with prefixes Mrs.,which means Married Women as teachers have a higher number of projects Proposed as well as Accepted when compared to the younger Unmarried Women Teachers.

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 [16]:

```
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.

Univariate Analysis: project_subject_categories

In [17]:

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

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

In [18]:

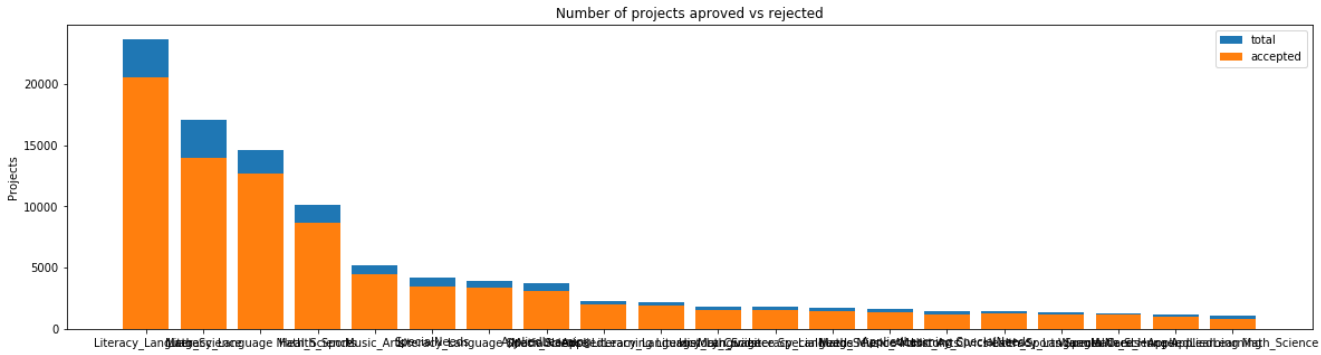
```
project_data['clean_categories'] = cat_list
project_data.drop(['project_subject_categories'], axis=1, inplace=True)
project_data.head(2)
```

Out[18]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2016-12-05 13:43:57
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2016-10-25 09:22:10

In [19]:

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




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

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

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.There is also Variability in Acceptance rate, projects under the category Warmth, Care and Hunger have an acceptance rate of 92.5%

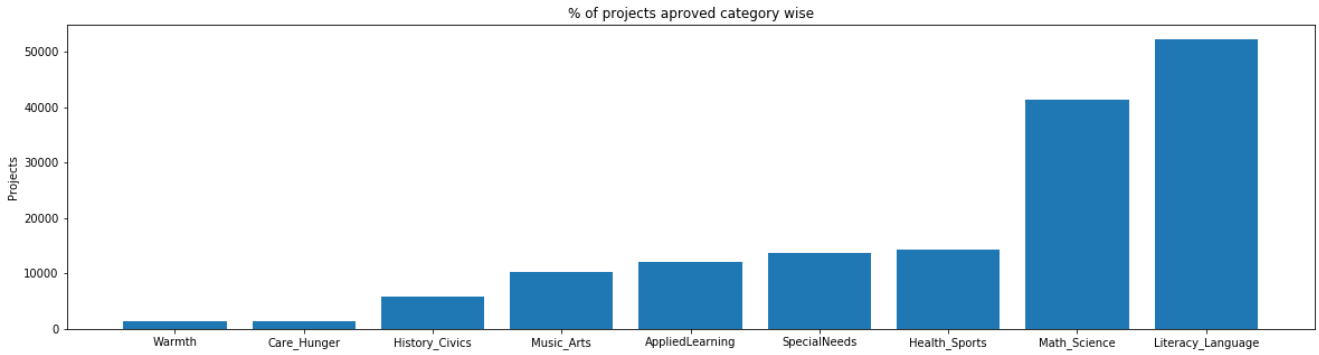
5.Projects belonging to both Maths and Science when combined with Applied Learning has the least number of projects proposed as well approved

In [20]:

```
# 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 [21]:

```
# 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 [22]:

```
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(While Considering individual Categories for each project):

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.

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

Univariate Analysis: project_subject_subcategories

In [23]:

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

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

sub_cat_list = []
for i in sub_catogories:
    temp = ""
    # consider we have text like this "Math & Science, Warmth, Care & Hunger"
    for j in i.split(','): # it will split it in three parts ["Math & Science", "Warmth", "Care & Hunge
r"]
        if 'The' in j.split(): # this will split each of the catogory based on space "Math & Science"=>
"Math","&", "Science"
            j=j.replace('The','') # if we have the words "The" we are going to replace it with ''(i.e r
emoving '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 [24]:

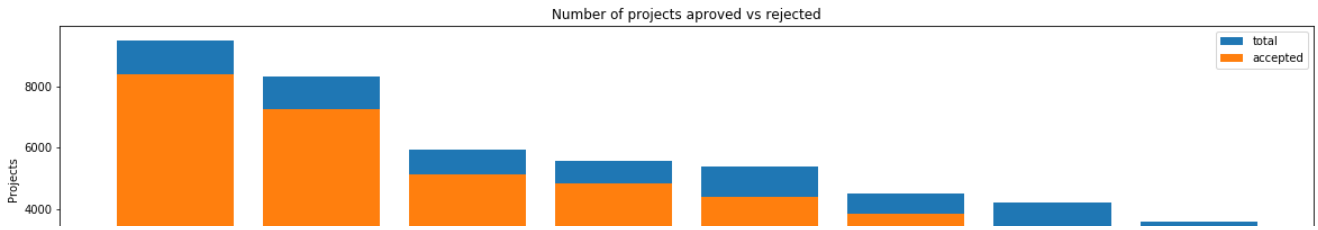
```
project_data['clean_subcategories'] = sub_cat_list
project_data.drop(['project_subject_subcategories'], axis=1, inplace=True)
project_data.head(2)
```

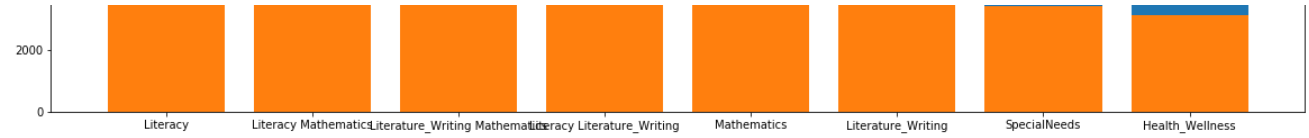
Out[24]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2016-12-05 13:43:57
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2016-10-25 09:22:10

In [25]:

```
univariate_barplots(project_data, 'clean_subcategories', 'project_is_approved', top=8)
```





	clean_subcategories	project_is_approved	total	Avg
317	Literacy	8371	9486	0.882458
319	Literacy Mathematics	7260	8325	0.872072
331	Literature_Writing Mathematics	5140	5923	0.867803
318	Literacy Literature_Writing	4823	5571	0.865733
342	Mathematics	4385	5379	0.815207

==========

	clean_subcategories	project_is_approved	total	Avg
318	Literacy Literature_Writing	4823	5571	0.865733
342	Mathematics	4385	5379	0.815207
330	Literature_Writing	3846	4501	0.854477
392	SpecialNeeds	3431	4226	0.811879
289	Health_Wellness	3131	3583	0.873849

SUMMARY:

1.The sub-Category Literacy has the highest number of projects approved with 8371 projects. Also the acceptance rate is 88%.

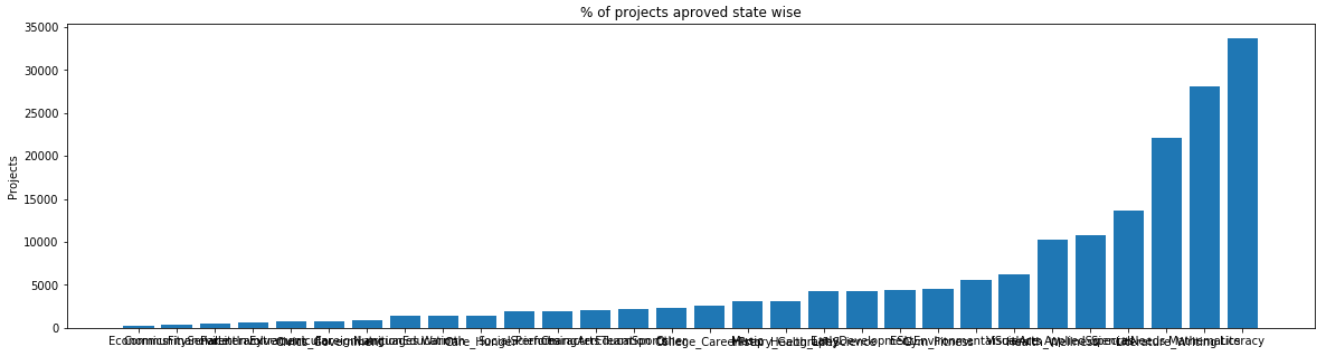
2.The sub-Category Health and Wellness have the lowest number of projects proposed with 3,583 projects only

In [26]:

```
# 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 [27]:

```
# 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 [28]:

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

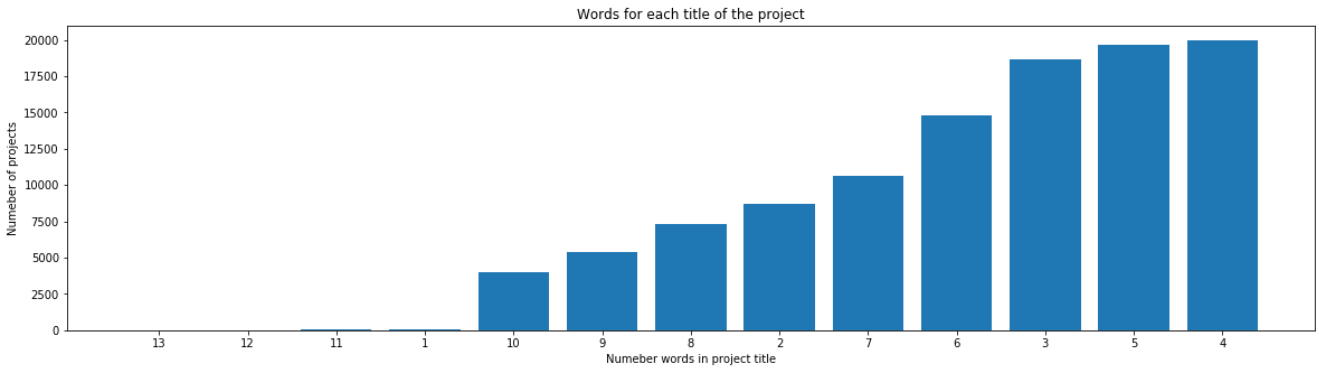
```
Economics            :       269
CommunityService     :       441
FinancialLiteracy    :       568
ParentInvolvement    :       677
Extracurricular      :       810
Civics_Government    :       815
ForeignLanguages     :       890
```

```
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
```

1.2.6 Univariate Analysis: Text features(Title)

In [29]:

```
#How to calculate number of words in a string in DataFrame: https://stackoverflow.com/a/37483537/4084039
word_count = project_data['project_title'].str.split().apply(len).value_counts()
word_dict = dict(word_count)
word_dict = dict(sorted(word_dict.items(), key=lambda kv: kv[1]))


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

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



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.

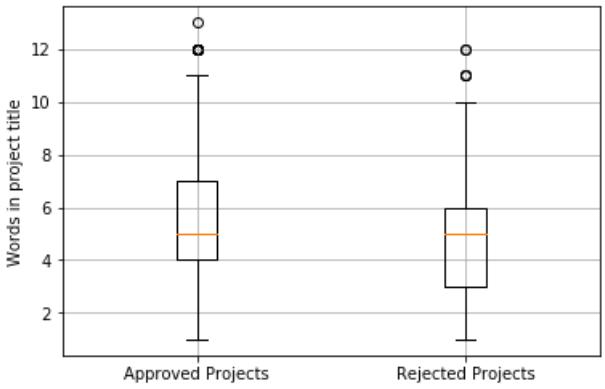
In [30]:

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

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

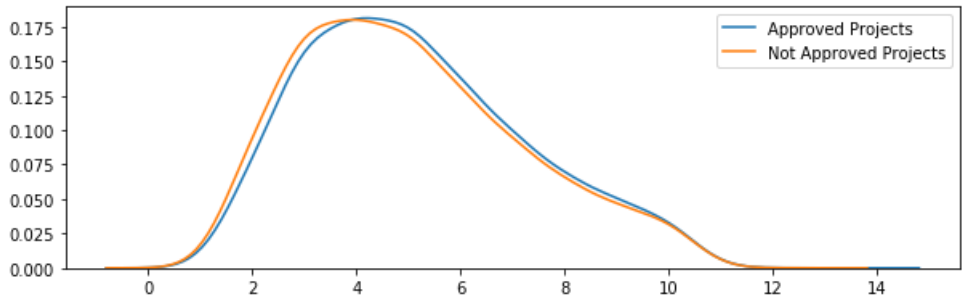
In [31]:

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



In [32]:

```
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. 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.

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

In [33]:

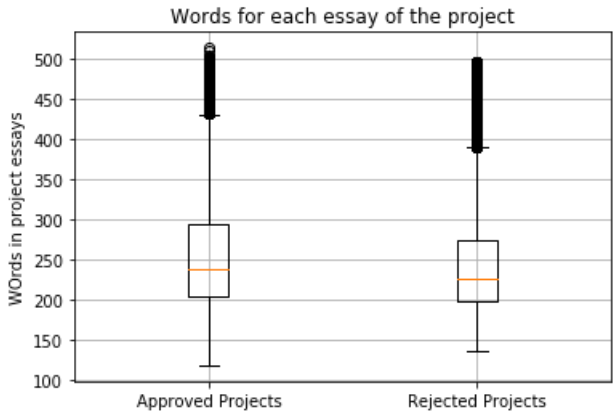
```
# merge two column text dataframe:
project_data['essay']=project_data['project_essay_1'].map(str)+\
                      project_data['project_essay_2'].map(str)+\
                      project_data['project_essay_3'].map(str)+\
                      project_data['project_essay_4'].map(str)
```

In [34]:

```
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 [35]:

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

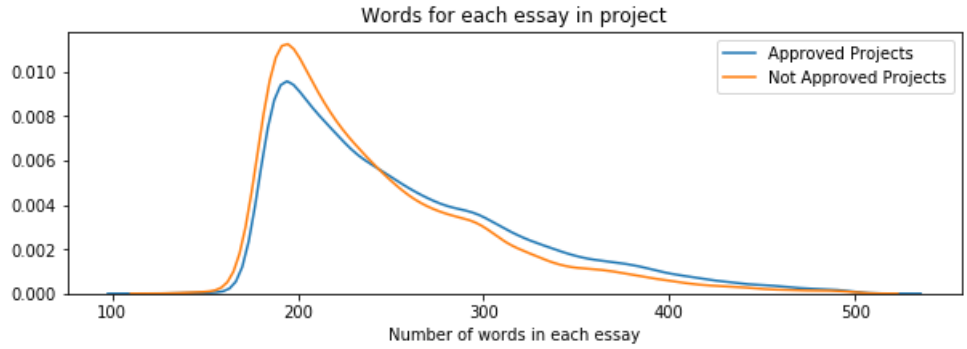


SUMMARY:

1. Approved projects have a slightly more number of words in the project essays when compared to the projects that have not been approved. This difference can be noticed in the percentile difference after the 50.0

In [36]:

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



SUMMARY:

1. 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. This can be noticed by looking at the Blue Line (PDF Curve of Approved Projects) which is denser for words more than 240 to almost 480 or 500.

1.2.8 Univariate Analysis: Cost per project

In [37]:

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

Out[37]:

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

In [38]:

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

Out[38]:

	id	price	quantity
0	p000001	459.56	7
1	p000002	515.89	21

In [39]:

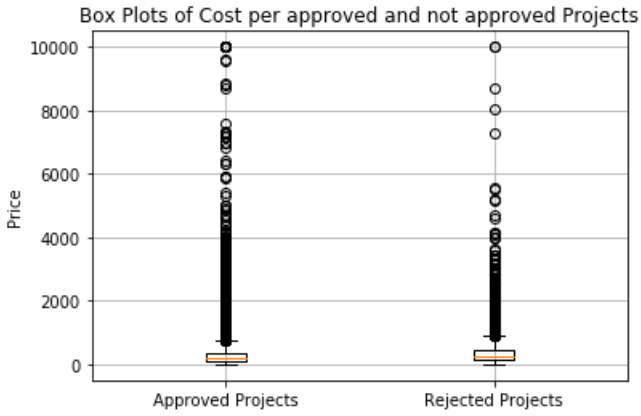
```
# join two dataframes in python:
project_data = pd.merge(project_data, price_data, on='id', how='left')
```

In [40]:

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

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

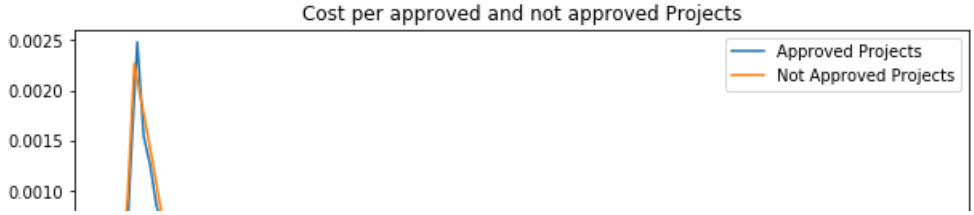
In [41]:

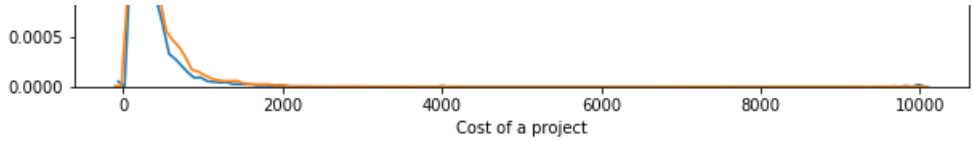
```
# https://glowingpython.blogspot.com/2012/09/boxplot-with-matplotlib.html
plt.boxplot([approved_price, rejected_price])
plt.title('Box Plots of Cost per approved and not approved Projects')
plt.xticks([1,2],('Approved Projects','Rejected Projects'))
plt.ylabel('Price')
plt.grid()
plt.show()
```



In [42]:

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





SUMMARY:

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

In [43]:

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

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

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

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

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

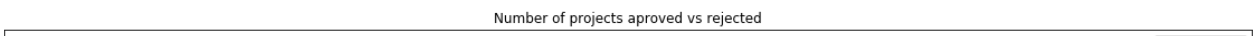
SUMMARY:

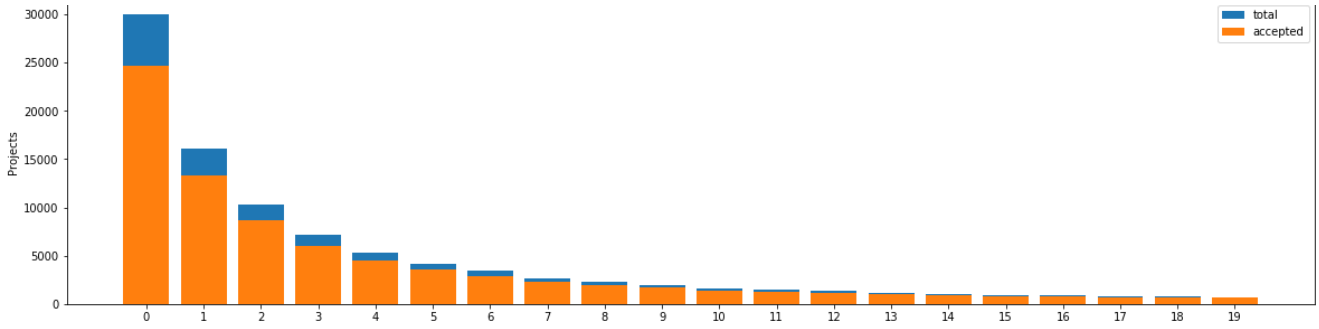
1. The approved projects tend to have lower cost when compared to the projects that have not been approved. This can be noticed by looking at the percentile values. The 50th percentile Cost value for an approved project is 199 dollars while for the cost for the not approved projects is 263 dollars.
2. 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 [44]:

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






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

        Avg
0  0.821350
1  0.830054
2  0.841063
3  0.843460
4  0.845423
==================================================
    teacher_number_of_previously_posted_projects  project_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 [45]:

```
# Lets us separate the data and carry out our work only on the required project resouce summaris
summaries=[]
for a in project_data['project_resource_summary']:
    summaries.append(a)
summaries[0:10]
```

Out[45]:

```
['My students need opportunities to practice beginning reading skills in English at home.',
 'My students need a projector to help with viewing educational programs',
 'My students need shine guards, athletic socks, Soccer Balls, goalie gloves, and training materials fo
r the upcoming Soccer season.',
 'My students need to engage in Reading and Math in a way that will inspire them with these Mini iPads!
',
 'My students need hands on practice in mathematics. Having fun and personalized journals and charts wi
ll help them be more involved in our daily Math routines.',
 'My students need movement to be successful. Being that I have a variety of students that have all dif
ferent types of needs, flexible seating would assist not only these students with special needs, but al
l students.',
```

```
 '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 resources that will spark their interest
in learning.',
 "My students need three devices and three management licenses for small group's easy access to newly-i
mplemented online programs--Go Noodle Plus, for increased in-class physical activity and Light Sail, an
interactive reading program.",
 'My students need great books to use during Independent Reading, Read Alouds, Partner Reading and Auth
or Studies.']
```

In [46]:

```
## The length of the obtained list of Project summaries should match the total number of project summar
ies in
## the project data. Just to ensure
len(summaries)
```

Out[46]:

```
109248
```

In [47]:

```
## Identifying the numbers from the project summaries and storing the values as a key value pair in a d
ictionary to
## avoid missing the position of the value within the huge ocean of summary data.
# https://github.com/harrismohammed/DonorsChoose.org---Bow-tfidf-avgw2v-tfidfw2v-tsne-EDA
numeric_summary_values={}

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

```
100%|██████████████████████████████████████████████████| 109248/109248 [00:00<00:00
, 205658.15it/s]
```

In [48]:

```
numeric_summary_values[14]
```

Out[48]:

```
5
```

In [49]:

```
# we only have the key value pairs for summaris containing Numeric values, so in this step

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 [50]:

```
for i in tqdm(range (20)) :
    print(numeric_digits[i])
```

```
  0%|                                                                                    | 0/20
[00:00<?, ?it/s]
```

```
0
0
0
0
0
0
0
0
0
0
0
0
0
0
```

```
5
0
2
0
0
7
100%|██████████| 20/20 [00:00<00:00, 640.60it/s]
```

In [51]:

```
len(numeric_digits)
```

Out[51]:

```
109248
```

In [52]:

```
## Converting the key value pairs to 1 or 0 based on presence of Numeric 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 [53]:

```
digit_in_summary[0:20]
```

Out[53]:

```
[0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1]
```

In [54]:

```
project_data['digit_in_summary']=digit_in_summary
```

In [55]:

```
project_data.head(20)
```

Out[55]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetin
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2016-12-05 13:43:57
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2016-10-25 09:22:10
2	21895	p182444	3465aaf82da834c0582ebd0ef8040ca0	Ms.	AZ	2016-08-31 12:03:56
3	45	p246581	f3cb9bffbba169bef1a77b243e620b60	Mrs.	KY	2016-10-06 21:16:17

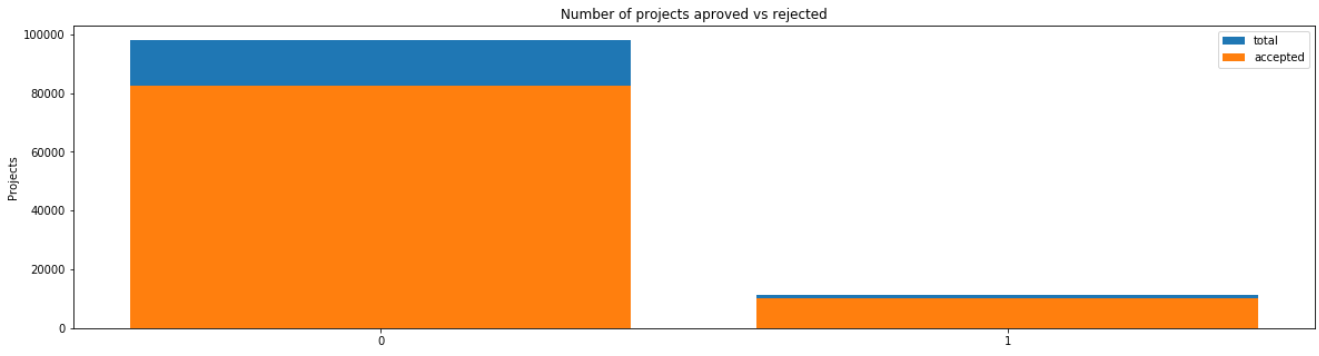
	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetin
4	172407	p104768	be1f7507a41f8479dc06f047086a39ec	Mrs.	TX	2016-07-11 01:10:09
5	141660	p154343	a50a390e8327a95b77b9e495b58b9a6e	Mrs.	FL	2017-04-08 22:40:43
6	21147	p099819	9b40170bfa65e399981717ee8731efc3	Mrs.	CT	2017-02-17 19:58:56
7	94142	p092424	5bfd3d12fae3d2fe88684bbac570c9d2	Ms.	GA	2016-09-01 00:02:15
8	112489	p045029	487448f5226005d08d36bdd75f095b31	Mrs.	SC	2016-09-25 17:00:26
9	158561	p001713	140eeac1885c820ad5592a409a3a8994	Ms.	NC	2016-11-17 18:18:56
10	43184	p040307	363788b51d40d978fe276bcb1f8a2b35	Mrs.	CA	2017-01-04 16:40:30
11	127083	p251806	4ba7c721133ef651ca54a03551746708	Ms.	CA	2016-11-14 22:57:28
12	19090	p051126	5e52c92b7e3c472aad247a239d345543	Mrs.	NY	2016-05-23 15:46:02
13	15126	p003874	178f6ae765cd4e0fb143a77c47fd65e2	Mrs.	OK	2016-10-17 09:49:27

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetin
14	82252	p233127	424819801de22a60bba7d0f4354d0258	Ms.	MA	2017-02-14 16:29:10
15	67303	p132832	bb6d6d054824fa01576ab38dfa2be160	Ms.	TX	2016-10-05 21:05:38
16	127215	p174627	4ad7e280fddff889e1355cc9f29c3b89	Mrs.	FL	2017-01-18 10:59:05
17	157771	p152491	e39abda057354c979c5b075cffbe5f88	Ms.	NV	2016-11-23 17:14:17
18	122186	p196421	fcd9b003fc1891383f340a89da02a1a6	Mrs.	GA	2016-08-28 15:04:42
19	146331	p058343	8e07a98deb1bc74c75b97521e05b1691	Ms.	OH	2016-08-06 13:05:20

20 rows × 21 columns

In [56]:

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




```
   digit_in_summary  project_is_approved  total       Avg
0                 0                82563  98012  0.842376
1                 1                10143  11236  0.902723
==================================================
   digit_in_summary  project_is_approved  total       Avg
0                 0                82563  98012  0.842376
1                 1                10143  11236  0.902723
```

SUMMARY:

1. It is obvious from the graph that majority of the projects do not have numeric values stating the requirement of certain products.¶
2. The project summaries containing numeric values have a very high acceptance rate of 90%. Well, proper numbered

2. 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.

1.3 Text Preprocessing

1.3.1 Essay Text

In [57]:

```
project_data.head(5)
```

Out[57]:

	Unnamed: 0	id	teacher_id	teacher_prefix	school_state	project_submitted_datetime
0	160221	p253737	c90749f5d961ff158d4b4d1e7dc665fc	Mrs.	IN	2016-12-05 13:43:57
1	140945	p258326	897464ce9ddc600bced1151f324dd63a	Mr.	FL	2016-10-25 09:22:10
2	21895	p182444	3465aaf82da834c0582ebd0ef8040ca0	Ms.	AZ	2016-08-31 12:03:56
3	45	p246581	f3cb9bffbba169bef1a77b243e620b60	Mrs.	KY	2016-10-06 21:16:17
4	172407	p104768	be1f7507a41f8479dc06f047086a39ec	Mrs.	TX	2016-07-11 01:10:09

5 rows × 21 columns

In [58]:

```
# 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 second or third languages. We are
```

a melting pot of refugees, immigrants, and native-born Americans bringing the gift of language to our s
chool. \r\n\r\n We have over 24 languages represented in our English Learner program with students at e
very level of mastery. We also have over 40 countries represented with the families within our school.
Each student brings a wealth of knowledge and experiences to us that open our eyes to new cultures, bel
iefs, and respect.\"The limits of your language are the limits of your world.\"-Ludwig Wittgenstein Ou
r English learner's have a strong support system at home that begs for more resources. Many times our
parents are learning to read and speak English along side of their children. Sometimes this creates ba
rriers for parents to be able to help their child learn phonetics, letter recognition, and other readin
g skills.\r\n\r\nBy providing these dvd's and players, students are able to continue their mastery of t
he English language even if no one at home is able to assist. All families with students within the Le
vel 1 proficiency status, will be a offered to be a part of this program. These educational videos wil
l be specially chosen by the English Learner Teacher and will be sent home regularly to watch. The vid
eos 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 dvd player to use for the year. The plan is to use the
se videos and educational 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 year 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
students, 97.3% are minority students. \r\nThe school has a vibrant community that loves to get togethe
r and celebrate. Around Halloween there is a whole school parade to show off the beautiful costumes tha
t students wear. On Cinco de Mayo we put on a big festival with crafts made by the students, dances, an
d games. At the end of the year the school hosts a carnival to celebrate the hard work put in during th
e school year, with a dunk tank being the most popular activity.My students will use these five brightl
y colored Hokki stools in place of regular, stationary, 4-legged chairs. As I will only have a total of
ten in the classroom and not enough for each student to have an individual one, they will be used in a
variety of ways. During independent reading time they will be used as special chairs students will each
use on occasion. I will utilize them in place of chairs at my small group tables during math and readin
g times. The rest of the day they will be used by the students who need the highest amount of movement
in their life in order to stay focused on school.\r\n\r\nWhenever asked what the classroom is missing,
my students always say more Hokki Stools. They can't get their fill of the 5 stools we already have. Wh
en the students are sitting in group with me on the Hokki Stools, they are always moving, but at the sa
me time doing their work. Anytime the students get to pick where they can sit, the Hokki Stools are the
first to be taken. There are always students who head over to the kidney table to get one of the stools
who are disappointed as there are not enough of them. \r\n\r\nWe ask a lot of students to sit for 7 hou
rs a day. The Hokki stools will be a compromise that allow my students to do desk work and move at the
same time. These stools will help students to meet their 60 minutes a day of movement by allowing them
to activate their core muscles for balance while they sit. For many of my students, these chairs will t
ake away the barrier that exists in schools for a child who can't sit still.nannan
==========
How do you remember your days of school? Was it in a sterile environment with plain walls, rows of desk
s, and a teacher in front of the room? A typical day in our room is nothing like that. I work hard to c
reate a warm inviting themed room for my students look forward to coming to each day.\r\n\r\nMy class i
s made up of 28 wonderfully unique boys and girls of mixed races in Arkansas.\r\nThey attend a Title I
school, which means there is a high enough percentage of free and reduced-price lunch to qualify. Our s
chool is an \"open classroom\" concept, which is very unique as there are no walls separating the class
rooms. These 9 and 10 year-old students are very eager learners; they are like sponges, absorbing all t
he information and experiences and keep on wanting more.With these resources such as the comfy red thro
w pillows and the whimsical nautical hanging decor and the blue fish nets, I will be able to help creat
e the mood in our classroom setting to be one of a themed nautical environment. Creating a classroom en
vironment is very important in the success in each and every child's education. The nautical photo prop
s will be used with each child as they step foot into our classroom for the first time on Meet the Teac
her evening. I'll take pictures of each child with them, have them developed, and then hung in our clas
sroom ready for their first day of 4th grade. This kind gesture will set the tone before even the firs
t day of school! The nautical thank you cards will be used throughout the year by the students as they
create thank you cards to their team groups.\r\n\r\nYour generous donations will help me to help make o
ur classroom a fun, inviting, learning environment from day one.\r\n\r\nIt costs lost of money out of m
y own pocket on resources to get our classroom ready. Please consider helping with this project to make
our new school year a very successful one. Thank you!nannan
==========
My kindergarten students have varied disabilities ranging from speech and language delays, cognitive de
lays, gross/fine motor delays, to autism. They are eager beavers and always strive to work their hardes
t working past their limitations. \r\n\r\nThe materials we have are the ones I seek out for my students
. I teach in a Title I school where most of the students receive free or reduced price lunch. Despite
their disabilities and limitations, my students love coming to school and come eager to learn and 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 the time. The want to be able to move as they learn or so they
say.Wobble chairs are the answer and I love then because they develop their core, which enhances gross
motor and in Turn fine motor skills. \r\nThey also want to learn through games, my kids don't want to s
it and do worksheets. They want to learn to count by jumping and playing. Physical engagement is the ke
y to our success. The number toss and color and shape mats can make that happen. My students will forge
t they are doing work and just have the fun a 6 year old deserves.nannan
==========
The mediocre teacher tells. The good teacher explains. The superior teacher demonstrates. The great tea
cher inspires. -William A. Ward\r\n\r\nMy school has 803 students which is makeup is 97.6% African-Amer
ican, making up the largest segment of the student body. A typical school in Dallas is made up of 23.2%
African-American students. Most of the students are on free or reduced lunch. We aren't receiving docto
rs, lawyers, or engineers children from rich backgrounds or neighborhoods. As an educator I am inspirin

g minds of young children and we focus not only on academics but one smart, effective, efficient, and d
isciplined students with good character.In our classroom we can utilize the Bluetooth for swift transit
ions during class. I use a speaker which doesn't amplify the sound enough to receive the message. Due t
o the volume of my speaker my students can't hear videos or books clearly and it isn't making the lesso
ns 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 n
eeded for the day and has an extra part to it I can use. The table top chart has all of the letter, wo
rds and pictures for students to learn about different letters and it is more accessible.nannan
==

In [59]:

```
# 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 [60]:

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

My kindergarten students have varied disabilities ranging from speech and language delays, cognitive de
lays, gross/fine motor delays, to autism. They are eager beavers and always strive to work their hardes
t working past their limitations. \r\n\r\nThe materials we have are the ones I seek out for my students
. I teach in a Title I school where most of the students receive free or reduced price lunch. Despite
their disabilities and limitations, my students love coming to school and come eager to learn and 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 the time. The want to be able to move as they learn or so they
say.Wobble chairs are the answer and I love then because they develop their core, which enhances gross
motor and in Turn fine motor skills. \r\nThey also want to learn through games, my kids do not want to
sit and do worksheets. They want to learn to count by jumping and playing. Physical engagement is the k
ey to our success. The number toss and color and shape mats can make that happen. My students will forg
et they are doing work and just have the fun a 6 year old deserves.nannan
==

In [61]:

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

My kindergarten students have varied disabilities ranging from speech and language delays, cognitive de
lays, gross/fine motor delays, to autism. They are eager beavers and always strive to work their hardes
t working past 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 receive free or reduced price lunch. Despite thei
r disabilities and limitations, my students love coming to school and come eager to learn and explore.H
ave you ever felt like you had ants in your pants and you needed to groove and move as you were in a me
eting? This is how my kids feel all the time. The want to be able to move as they learn or so they say.
Wobble chairs are the answer and I love then because they develop their core, which enhances gross moto
r and in Turn fine motor skills.   They also want to learn through games, my kids do not want to sit an
d do worksheets. They want to learn to count by jumping and playing. Physical engagement is the key to
our success. The number toss and color and shape mats can make that happen. My students will forget the
y are doing work and just have the fun a 6 year old deserves.nannan

In [62]:

```
#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 and language delays cognitive del
ays gross fine motor delays to autism They are eager beavers and always strive to work their hardest wo
rking past 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 receive free or reduced price lunch Despite their disabilitie
s and limitations my students love coming to school and come eager to learn and explore Have you ever f
elt 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 ar
e the answer and I love then because they develop their core which enhances gross motor and in Turn fin
e motor skills 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 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 [63]:

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

In [64]:

```
# 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 [01:09<00:
00, 1572.48it/s]
```

In [65]:

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

Out[65]:

```
'my kindergarten students varied disabilities ranging speech language delays cognitive delays gross fin
e motor delays autism they eager beavers always strive work hardest working past limitations the materi
als ones i seek students i teach title i school students receive free reduced price lunch despite disab
ilities limitations students love coming school come eager learn explore have ever felt like ants pants
needed groove move meeting this kids feel time the want able move learn say wobble chairs answer i love
develop core enhances gross motor turn fine motor skills they also want learn games kids not want sit w
orksheets they want learn count jumping playing physical engagement key success the number toss color s
```

```
hape mats make happen my students forget work fun 6 year old deserves nannan'
```

In [66]:

```
# 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 [67]:

```
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 [00:03<00:00, 33398.85it/s]
```

In [68]:

```
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 [69]:

```
project_data.columns
```

Out[69]:

```
Index(['Unnamed: 0', 'id', 'teacher_id', 'teacher_prefix', 'school_state',
       'project submitted datetime', 'project grade category', 'project title',
```

```
       'project_essay_1', 'project_essay_2', 'project_essay_3',
       'project_essay_4', 'project_resource_summary',
       'teacher_number_of_previously_posted_projects', 'project_is_approved',
       'clean_categories', 'clean_subcategories', 'essay', 'price', 'quantity',
       '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
```

1.4.2 Vectorizing Categorical data

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

One Hot Encoding - Clean Categories of Projects

In [70]:

```
## we use count vectorizer to convert the values into the encoded features
from sklearn.feature_extraction.text import CountVectorizer

vectorizer = CountVectorizer(vocabulary=list(sorted_cat_dict.keys()), lowercase=False, binary=True)
vectorizer.fit(project_data['clean_categories'].values)
print(vectorizer.get_feature_names())

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

```
['Warmth', 'Care_Hunger', 'History_Civics', 'Music_Arts', 'AppliedLearning', 'SpecialNeeds', 'Health_Sp
orts', 'Math_Science', 'Literacy_Language']
Shape of matrix after one hot encoding  (109248, 9)
```

One Hot Encoding - Clean Sub Categories of Projects

In [71]:

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

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

```
['Economics', 'CommunityService', 'FinancialLiteracy', 'ParentInvolvement', 'Extracurricular', 'Civics_
Government', 'ForeignLanguages', 'NutritionEducation', 'Warmth', 'Care_Hunger', 'SocialSciences', 'Perf
ormingArts', 'CharacterEducation', 'TeamSports', 'Other', 'College_CareerPrep', 'Music', 'History_Geogr
aphy', 'Health_LifeScience', 'EarlyDevelopment', 'ESL', 'Gym_Fitness', 'EnvironmentalScience', 'VisualA
rts', 'Health_Wellness', 'AppliedSciences', 'SpecialNeeds', 'Literature_Writing', 'Mathematics', 'Liter
acy']
Shape of matrix after one hot encoding (109248, 30)
```

One Hot Encoding - School States

In [72]:

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

In [73]:

```
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 [74]:

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

school_state_categories_one_hot = vectorizer.transform(project_data['school_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', 'ME', '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 - Project Grade Category

In [90]:

```
#Preprocessing the project_grade_category
project_grade_category_cleaned=[]
for grade in tqdm(project_data['project_grade_category'].values):
    grade = grade.replace(' ', '_')
    grade = grade.replace('-', '_')
    project_grade_category_cleaned.append(grade)
project_data['Project_grade_category']=project_grade_category_cleaned
```

```
100%|██████████████████████████████████████████████████████████████████████████████| 109248/109248 [00:00<00:00
, 698945.10it/s]
```

In [91]:

```
# we use count vectorizer to convert the values into one hot encoded features
#project_grade_category
#https://www.kaggle.com/naveennagari/donorschoose-eda-and-tsne/versions
vectorizer_grade_category = CountVectorizer(lowercase=False, binary=True)
vectorizer_grade_category.fit(project_grade_category_cleaned)
print(vectorizer_grade_category.get_feature_names())
grade_category_one_hot = vectorizer_grade_category.transform(project_grade_category_cleaned)
print(grade_category_one_hot.toarray()[0:1])
print("\nShape of matrix after one hot encodig for school states ",grade_category_one_hot.shape)
```

```
['Grades_3_5', 'Grades_6_8', 'Grades_9_12', 'Grades_PreK_2']
[[0 0 0 1]]

Shape of matrix after one hot encodig for school states  (109248, 4)
```

One Hot Encode - Teacher Prefix

In [80]:

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

In [81]:

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

In [82]:

```
## we use count vectorizer to convert the values into one hot encoded features
## Unlike the previous Categories this category returns a
## ValueError: np.nan is an invalid document, expected byte or unicode string.
## The link below explains h0w to tackle such discrepancies.
## https://stackoverflow.com/questions/39303912/tfidfvectorizer-in-scikit-learn-valueerror-np-nan-is-an
-invalid-
#document/39308809#39308809

vectorizer = CountVectorizer(vocabulary=list(sorted_teacher_prefix_cat_dict.keys()), lowercase=False, b
inary=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_categories_one_hot.shape)
```

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

1.4.2 Vectorizing Text data

Bag of words

In [83]:

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

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

In [161]:

```
print("There are {} unique words among the {} number of project essays, considering atleast 10 differen
t \
      projects has the same word".format(text_bow.shape[1],text_bow.shape[0]))
```

```
There are 16623 unique words among the 109248 number of project essays, considering atleast 10 differen
t       projects has the same word
```

In [85]:

```
# We are considering only the words which appeared in at least 5 documents(rows or projects).
vectorizer = CountVectorizer(min_df=5)
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, 5107)
```

In [160]:

```
print ("There are {} unique words among the {} number of project titles, considering atleast 5 differen
t \
       projects has the same word ".format(title_bow.shape[1], title_bow.shape[0]))
```

```
There are 5107 unique words among the 109248 number of project titles, considering atleast 5 different
projects has the same word
```

1.4.2.3 TFIDF Vectorizer

In [87]:

```
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 encodede",text_tfidf.shape)
```

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

In [88]:

```
# We are considering only the words which appeared in at least 10 documents(rows or projects).
```

```
vectorizer = TfidfVectorizer(min_df=5)
title_tfidf = vectorizer.fit_transform(preprocessed_titles)
print("Shape of matrix after one hot encoding ",title_tfidf.shape)
```

```
Shape of matrix after one hot encoding  (109248, 5107)
```

1.4.2.5 Using Pretrained Models: Avg W2V

In [89]:

```
# Reading glove vectors in python: https://stackoverflow.com/a/38230349/4084039
def loadGloveModel(gloveFile):
    print ("Loading Glove Model")
    f = open(gloveFile,'r', encoding="utf8")
    model = {}
    for line in tqdm(f):
        splitLine = line.split()
        word = splitLine[0]
        embedding = np.array([float(val) for val in splitLine[1:]])
        model[word] = embedding
    print ("Done.",len(model)," words loaded!")
    return model
model = loadGloveModel('glove.42B.300d.txt')
```

```
Loading Glove Model
1917495it [08:54, 3586.94it/s]
Done. 1917495  words loaded!
```

In [90]:

```
words = []

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

for i in preprocessed_titles:
    words.extend(i.split(' '))
```

In [91]:

```
print("all the words in the corpus", len(words))
```

```
all the words in the corpus 17014413
```

In [92]:

```
words=set(words)
print("the unique words in the corpus",len(words))
```

```
the unique words in the corpus 58968
```

In [93]:

```
inter_words = set(model.keys()).intersection(words)

print("The number of words that are present in both glove vectors and our coupus", \
      len(inter_words),"(",np.round(len(inter_words)/len(words)*100,3),"%)")
```

```
The number of words that are present in both glove vectors and our coupus 51503 ( 87.341 %)
```

In [94]:

```
words_corpus = {}

words_glove = set(model.keys())

for i in words:
    if i in words_glove:
        words_corpus[i] = model[i]

print("word 2 vec length", len(words_corpus))
```

```
word 2 vec length 51503
```

In [95]:

```
# 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_corpus, f)
```

In [96]:

```
# 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 [99]:

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

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

```
100%|██████████| 109248/109248 [00:36<00:00, 2983.36it/s]
```

```
109248
300
```

In [98]:

```
# Similarly you can vectorize for title also

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

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

```
100%|██████████| 109248/109248 [00:02<00:00, 44155.81it/s]
```

```
109248
300
```

Using Pretrained Models: TFIDF weighted W2V

In [100]:

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

In [101]:

In [101]:

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

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

```
100%|██████████████████████████████████████████████████████████████| 109248/109248 [04:40<00
:00, 389.67it/s]
```

```
109248
300
```

In [102]:

```
# Similarly you 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 value
dictionary = dict(zip(tfidf_model.get_feature_names(), list(tfidf_model.idf_)))
tfidf_words = set(tfidf_model.get_feature_names())
```

In [103]:

```
# average Word2Vec
# compute average word2vec for each Project Title
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 sentence/review
    for word in sentence.split(): # for each word in a review/sentence
        if (word in glove_words) and (word in tfidf_words):
            vec = model[word] # getting the vector for each word
            # here we are multiplying idf value(dictionary[word]) and the tf value
            #((sentence.count(word)/len(sentence.split())))
            tf_idf = dictionary[word]*(sentence.count(word)/len(sentence.split())) # getting the 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 [00:05<00:0
0, 18996.20it/s]
```

```
109248
300
```

1.4.3 Vectorizing Numerical features

Vectorizing - Price(Numerical Data)

In [104]:

```
# check this one: https://www.youtube.com/watch?v=0HOqOcln3Z4&t=530s
# standardization sklearn: https://scikit-learn.org/stable/modules/generated/sklearn.preprocessing.StandardScaler.html
from sklearn.preprocessing import StandardScaler
# price_standardized = standardScalar.fit(project_data['price'].values)
# this will rise the error
# ValueError: Expected 2D array, got 1D array instead: array=[725.05 213.03 329.   ... 399.   287.73 5.5 ].
# Reshape your data either using array.reshape(-1, 1)

price_scalar=StandardScaler()
price_scalar.fit(project_data['price'].values.reshape(-1,1))# finding the mean and standard deviation of this data
print("Mean : {}".format(price_scalar.mean_[0]))
print("Standard deviation : {}".format(np.sqrt(price_scalar.var_[0])))
# Now standardize the data with above maen and variance.
price_standardized = price_scalar.transform(project_data['price'].values.reshape(-1, 1))
```

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

In [105]:

```
price_standardized
```

Out[105]:

```
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 [106]:

```
import warnings
warnings.filterwarnings("ignore")

quantity_scalar = StandardScaler()

## Finding the mean and standard deviation of this data
quantity_scalar.fit(project_data['quantity'].values.reshape(-1,1))

print("Mean : {}".format(quantity_scalar.mean_[0]))

print("Standard deviation : {}".format(np.sqrt(quantity_scalar.var_[0])))

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

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

In [107]:

```
quantity_standardized
```

Out[107]:

```
array([[ 0.23047132],
       [-0.60977424],
       [ 0.19227834],
       ...,
       [-0.4951953 ],
```

```
       [-0.03687954],
       [-0.45700232]])
```

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 [157]:

```
prev_projects_scalar = StandardScaler()

## Finding the mean and standard deviation of this data
prev_projects_scalar.fit(project_data['teacher_number_of_previously_posted_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_data['teacher_number_of_previously_posted_projects'].values.reshape(-1, 1))
```

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

In [109]:

```
prev_projects_standardized
```

Out[109]:

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

1. We observe that Teachers generally on an average propose atleast 11 different projects. Well, The teachers are indeed actively seeking help to aid for the betterment of the students in their locality.

1.4.4 Merging all the above features

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

In [110]:

```
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 [111]:

```
# merge two sparse matrices: https://stackoverflow.com/a/19710648/4084039
from scipy.sparse import hstack
# with the same hstack function we are concatinating a sparse matrix and a dense matirx :)
X = hstack((categories_one_hot, sub_categories_one_hot, text_bow, price_standardized))
X.shape
```

Out[111]:

```
(109248, 16663)
```

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

In [159]:

```
## https://github.com/harrismohammed/DonorsChoose.org---Bow-tfidf-avgw2v-tfidfw2v-tsne-EDA
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 projects is : {}".format(sub_categories
_one_hot.shape))
print("The Shape of Data Matrix with respect to Projects from a particular State in the United States i
s : {}"
      .format(school_state_categories_one_hot.shape))
print("The Shape of the Data Matrix of the different projects with respect to the Grades of the student
s is : {} "
      .format(project_grade_categories_one_hot.shape))
print("The Shape of the Data Matrix with respect to title of the Teacher proposing the Teacher is : {}"
      .format(teacher_prefix_categories_one_hot.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 projects 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.shape))
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_titles), len(avg_w2v_vectors_titles[0])))
print("\n")
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 : (109248, 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 State in the United States is : (10
9248, 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 proposing 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 Previously by the Teacher is : (109248
, 1)


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


TITLE BOW : (109248, 5107)
```

```
TITLE TFIDF : (109248, 5107)


TITLE AVG W2V : (109248, 300)


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

In [156]:

```
X = hstack((categories_one_hot, sub_categories_one_hot, school_state_categories_one_hot,
            project_grade_categories_one_hot, teacher_prefix_categories_one_hot, price_standardized,
            quantity_standardized, prev_projects_standardized, title_bow))
X.shape
```

Out[156]:

```
(109248, 5211)
```

In [114]:

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

In [115]:

```
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 [116]:

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

Out[116]:

```
5000
```

In [117]:

```
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","Labels"))
```

In [118]:

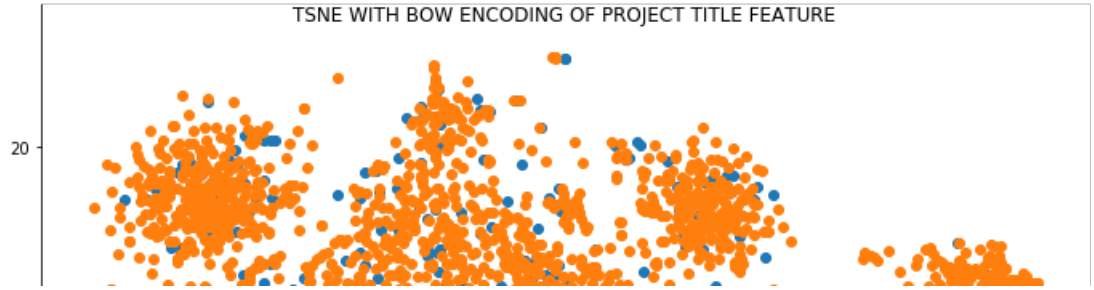
```
tsne_df_b.shape
```

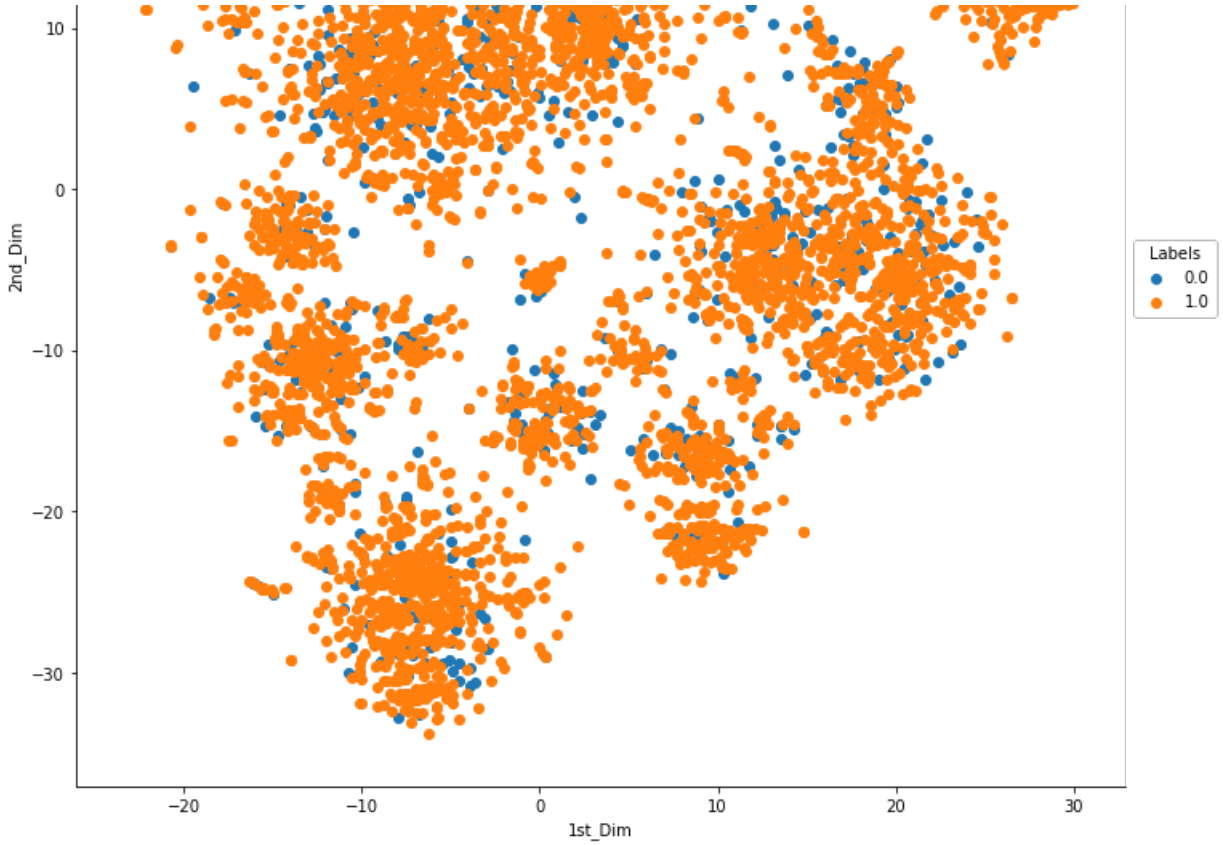
Out[118]:

```
(5000, 3)
```

In [155]:

```
# please write all of the code with proper documentation and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
    # c. X-axis label
    # d. Y-axis label

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





SUMMARY:

1. We observe alot 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 [154]:

```
X = hstack((categories_one_hot, sub_categories_one_hot, school_state_categories_one_hot,
            project_grade_categories_one_hot, teacher_prefix_categories_one_hot, price_standardized,
            quantity_standardized, prev_projects_standardized, title_tfidf))
X.shape
```

Out[154]:

```
(109248, 5211)
```

In [121]:

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

In [122]:

```
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 [123]:

```
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 [124]:

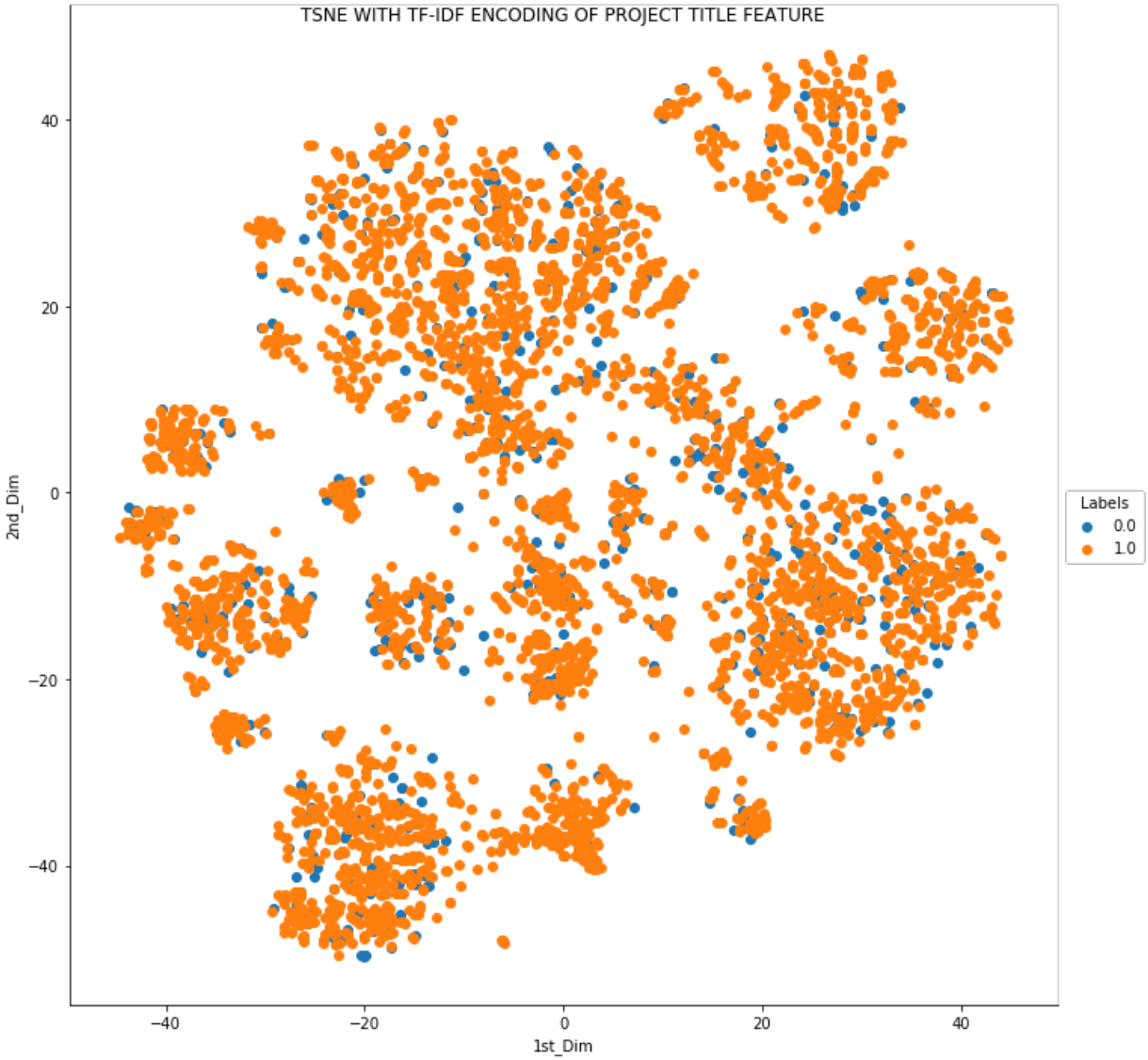
```
tsne_df_tfidf.shape
```

Out[124]:

```
(5000, 3)
```

In [153]:

```
# please write all the code with proper documentation, and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
    # c. X-axis label
    # d. Y-axis label

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 FEATURE ")
plt.show()
```



SUMMARY:

1. 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

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

In [152]:

```
X = hstack((categories_one_hot, sub_categories_one_hot, school_state_categories_one_hot,
            project_grade_categories_one_hot, teacher_prefix_categories_one_hot, price_standardized,
            quantity_standardized, prev_projects_standardized, avg_w2v_vectors_titles))
X.shape
```

Out[152]:

Out[126]:

(109248, 404)

In [127]:

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

In [128]:

```
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 [129]:

```
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 [130]:

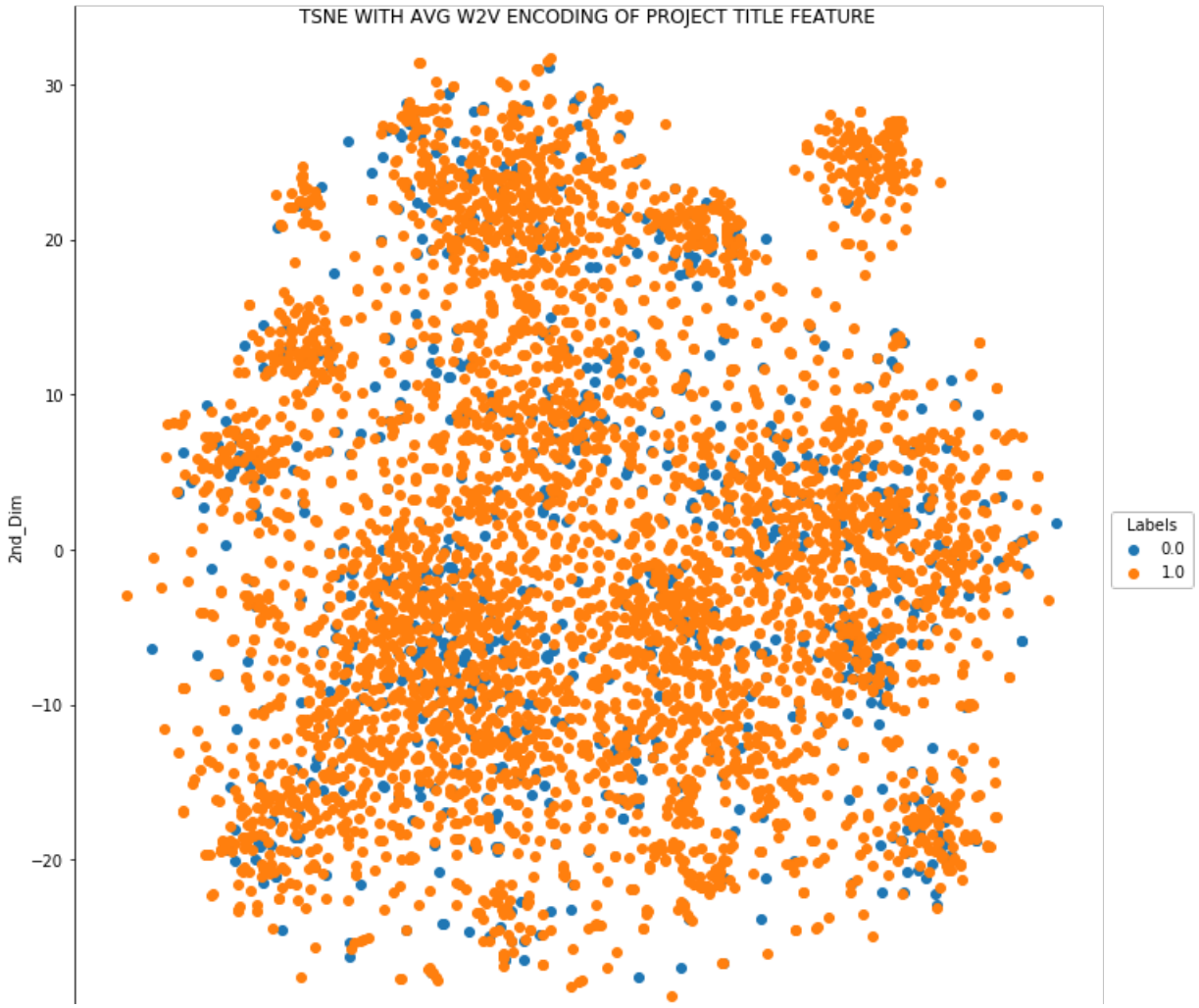
```
tsne_df_avg_w2v.shape
```

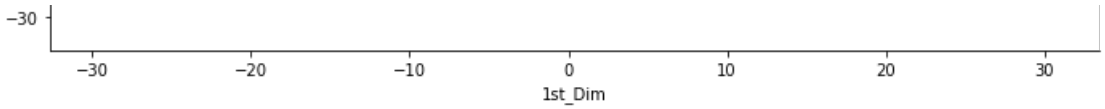
Out[130]:

(5000, 3)

In [151]:

```
# please write all the code with proper documentation, and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
    # c. X-axis label
    # d. Y-axis label

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





SUMMARY:

1. We do not 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 Data Entries)

In [150]:

```
X = hstack((categories_one_hot, sub_categories_one_hot, school_state_categories_one_hot,
            project_grade_categories_one_hot, teacher_prefix_categories_one_hot, price_standardized,
            quantity_standardized, prev_projects_standardized, tfidf_w2v_vectors_title))
X.shape
```

Out[150]:

```
(109248, 404)
```

In [134]:

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

In [135]:

```
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 [136]:

```
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_Dim","2nd_Dim","Labels"))
```

In [137]:

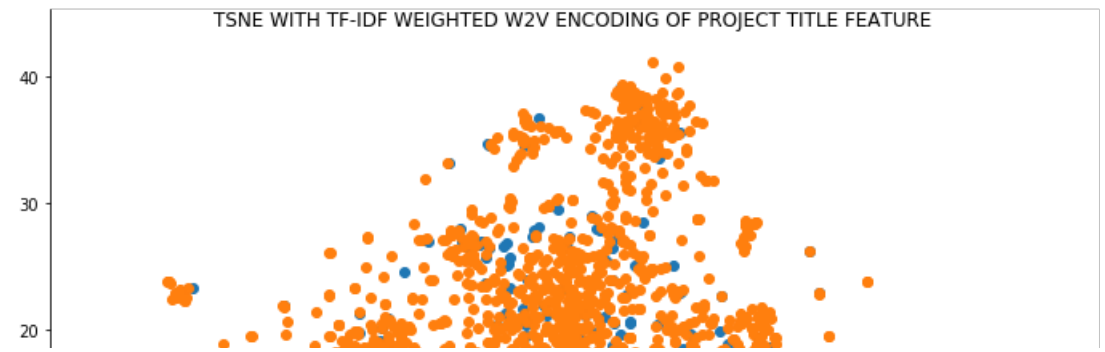
```
tsne_df_tfidf_w2v.shape
```

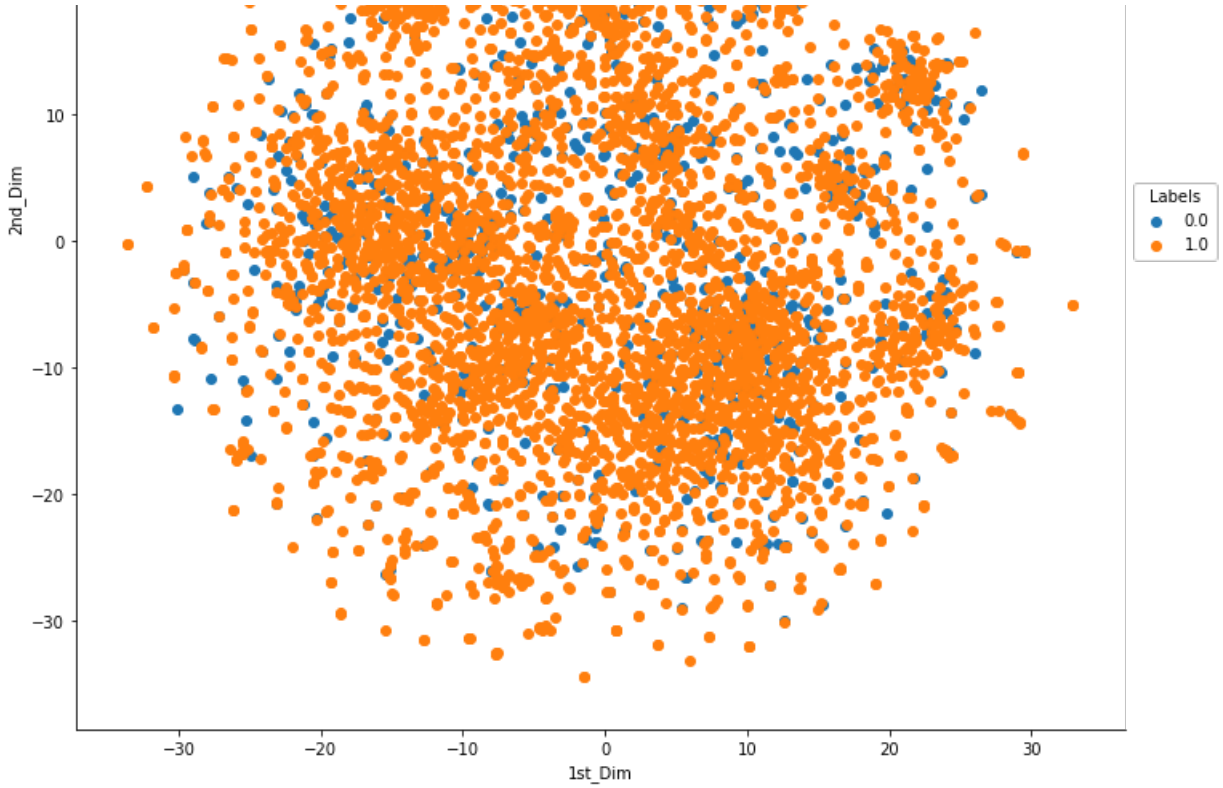
Out[137]:

```
(5000, 3)
```

In [149]:

```
# please write all the code with proper documentation, and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
    # c. X-axis label
    # d. Y-axis label

sns.FacetGrid(tsne_df_tfidf_w2v, hue = "Labels", size = 10).map(plt.scatter, "1st_Dim", "2nd_Dim")\
.add_legend().fig.suptitle("TSNE WITH TF-IDF WEIGHTED W2V ENCODING OF PROJECT TITLE FEATURE ")
plt.show()
```





SUMMARY:

1. 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_categories_one_hot,
            project_grade_categories_one_hot, teacher_prefix_categories_one_hot, price_standardized,
            quantity_standardized, prev_projects_standardized, title_bow, title_tfidf, avg_w2v_vectors_
titles,
            tfidf_w2v_vectors_title))
X.shape
```

Out[140]:

```
(109248, 10918)
```

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_Dim","2nd_Dim","Labels"))
```

In [144]:

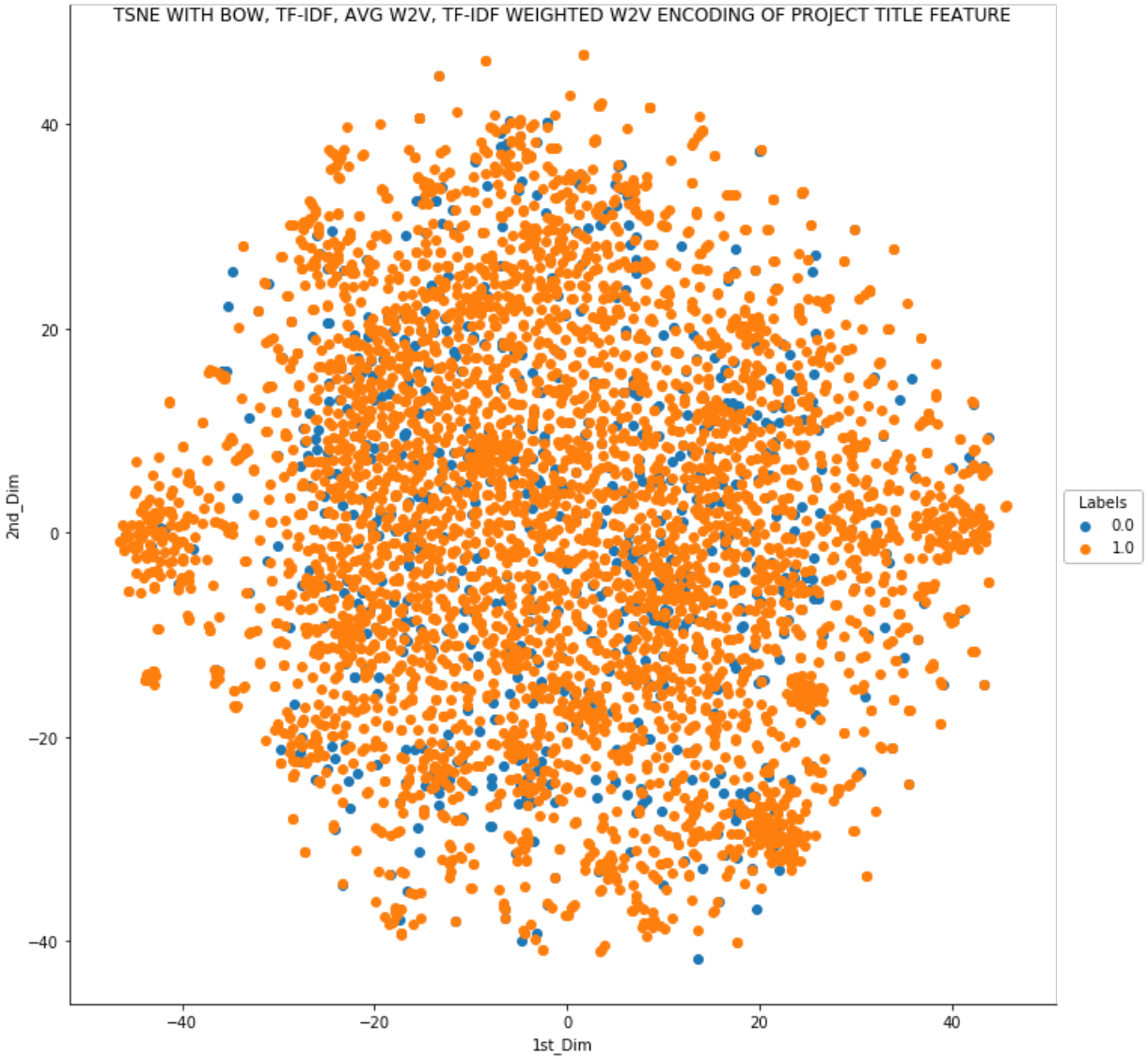
```
tsne_df_complete.shape
```

Out[144]:

```
(5000, 3)
```

In [148]:

```
# please write all the code with proper documentation, and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
    # c. X-axis label
    # d. Y-axis label

sns.FacetGrid(tsne_df_complete, hue = "Labels", size = 10).map(plt.scatter, "1st_Dim", "2nd_Dim")\
.add_legend().fig.suptitle("TSNE WITH BOW, TF-IDF, AVG W2V, TF-IDF WEIGHTED W2V ENCODING OF PROJECT TITLE FEATURE ")
plt.show()
```



1. 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

1. 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.

2. 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.

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

to the male teachers.

4. There are alot of projects proposed for the students between Pre Kindergarden and 2nd Grade while for the rest it keeps decreasing as the Grades increase.

5. We also notice that Students between the 9th Grade and 12th Grade have the lowest number of projects proposed as well as accepted.

6. 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%.

7. 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%

8. Projects belonging to both Maths and Science when combined with Applied Learning has the least number of projects proposed as well approved.

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

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

11. The sub-Category Literacy has the highest number of projects approved with 8371 projects. Also the accpetance rate is 88%.

12. The sub-Category Health and Wellness have the lowest number of projects proposed with 3,583 projects only.

13. 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.

14. 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.

15. 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.

16. 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.

17. 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.

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 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.

20. 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.