ML Model for Domian classifications based on profile summary and profile headline

In [2]:

```
import pandas as pd
import re
from sklearn.feature_selection import chi2
import numpy as np
import matplotlib.pyplot as plt
import string
import nltk
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.naive_bayes import MultinomialNB
from sklearn.metrics import accuracy_score
from sklearn.svm import SVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.ensemble import RandomForestClassifier as rm
from sklearn.tree import DecisionTreeClassifier
from sklearn.linear_model import SGDClassifier
from sklearn.neural_network import MLPClassifier
from sklearn.gaussian_process import GaussianProcessClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import LinearSVC
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import StratifiedKFold
import warnings
warnings.filterwarnings("ignore")
```

In [5]:

```
df1 = pd.read_csv('Before_BERT(Preprocessed).csv')
```

In [6]:

```
df1['ProfileHeadline'] = df1['Profile Headline']
df1['ProfileSummary'] = df1['Profile Summary']
```

In [7]:

```
df1['ProfileSummary'].isnull().value_counts()
```

Out[7]:

```
False    3465
True     1445
Name: ProfileSummary, dtype: int64
```

In [8]:

```
df1.ProfileHeadline = df1.ProfileHeadline.fillna(' ')
df1.ProfileSummary = df1.ProfileSummary.fillna(' ')
```

In [9]:

```
#df1['total'] = df1['ProfileSummary']
df1['total'] = df1['ProfileHeadline'].str.cat(df1['ProfileSummary'],sep=" ")
df1.head()
```

Out[9]:

	Unnamed: 0	Job Title	Company Name	Industry	Company Location	New Job (90 Days)	Year Started	Profile Headline	
0	0	Battery Designer	Rivian	Mechanical or Industrial Engineering	Dublin, Ohio, United States	False	2020.0	Mechanical Design Engineer, System Integration...	
1	1	Digital DevOps Engineer	HSBC	Information Technology and Services	New York City Metropolitan Area	False	2018.0	Digital DevOps Engineer at HSBC	
2	2	Product Designer	Two Point Conversions, Inc.	Information Technology and Services	Chicago, Illinois, United States	False	2018.0	Leading Product + UX at Remedy (Two Point Conv...	htt
3	3	Product Designer	udaan.com	Information Technology and Services	Bangalore Urban, Karnataka, India	False	2018.0	Product Designer at udaan	
4	4	Digital Technology Intern	GE	Information Technology and Services	Jaipur, Rajasthan, India	True	2021.0	Digital Technology Intern at General Electric ...	

5 rows × 23 columns

In [10]:

```
df1['total']=df1['total'].astype(str)
```

In [11]:

```
df1['job_category'] = df1['Domain'].str.lower()
```

In [12]:

```
# helper function to clean the text in the data
def preprocess_text(text):
    text.lower()
    # Remove urls
    text = re.sub(r"http\S+|www\S+|https\S+", '', text, flags=re.MULTILINE)
    # Remove user @ references and '#' from text
    text = re.sub(r'\@\w+|\#','', text)
    # Remove punctuations
    text = text.translate(str.maketrans('', '', string.punctuation))
    # Remove stopwords
    text_tokens = word_tokenize(text)
    filtered_words = [w for w in text_tokens if not w in stop_words]
    return " ".join(filtered_words).lower()
```

In [13]:

```
df1['total'][2]
```

Out[13]:

```
'Leading Product + UX at Remedy (Two Point Conversions, Inc.) http://aroonma
thai.com' (http://aroonmathai.com')
```

In [14]:

```
stop_words = stopwords.words('english')
```

In [15]:

```
# import nltk
# nltk.download('stopwords')
```

In [16]:

```
df1['preprocessed'] = df1['total'].apply(preprocess_text)
df1['preprocessed'][2]
```

Out[16]:

```
'leading product ux remedy two point conversions inc'
```

In [17]:

```
# creating encoded label of Domain in new column
df1['category_id'] = df1['job_category'].factorize()[0]
category_id_df = df1[['job_category', 'category_id']].drop_duplicates().sort_values('ca
category_to_id = dict(category_id_df.values)
id_to_category = dict(category_id_df[['category_id', 'job_category']].values)
df1.head()
```

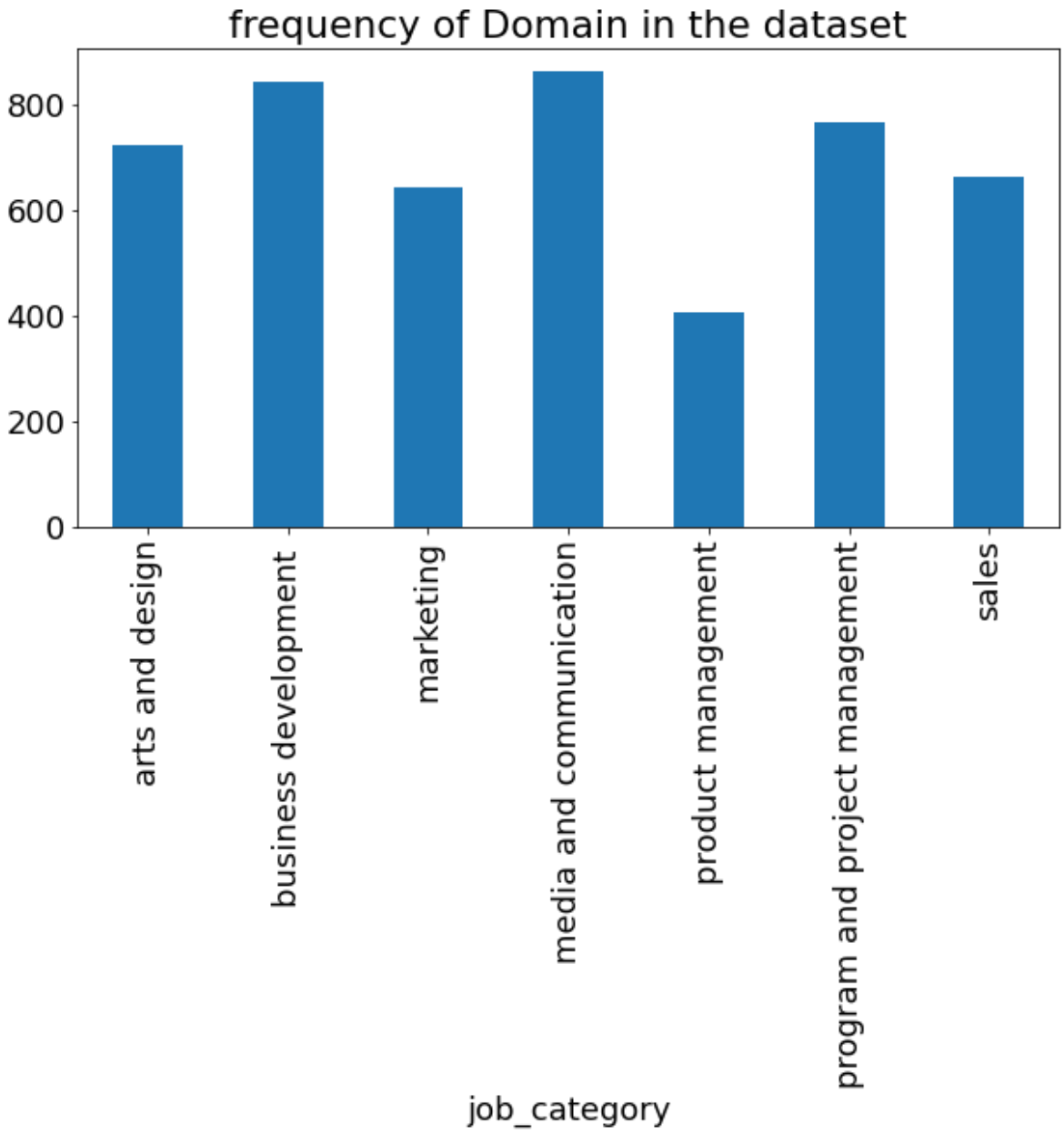
Out[17]:

	Unnamed: 0	Job Title	Company Name	Industry	Company Location	New Job (90 Days)	Year Started	Profile Headline	
0	0	Battery Designer	Rivian	Mechanical or Industrial Engineering	Dublin, Ohio, United States	False	2020.0	Mechanical Design Engineer, System Integration...	
1	1	Digital DevOps Engineer	HSBC	Information Technology and Services	New York City Metropolitan Area	False	2018.0	Digital DevOps Engineer at HSBC	
2	2	Product Designer	Two Point Conversions, Inc.	Information Technology and Services	Chicago, Illinois, United States	False	2018.0	Leading Product + UX at Remedy (Two Point Conv...	htt
3	3	Product Designer	udaan.com	Information Technology and Services	Bangalore Urban, Karnataka, India	False	2018.0	Product Designer at udaan	
4	4	Digital Technology Intern	GE	Information Technology and Services	Jaipur, Rajasthan, India	True	2021.0	Digital Technology Intern at General Electric ...	

5 rows × 26 columns

In [18]:

```
plt.rcParams.update({'font.size': 18})
fig = plt.figure(figsize=(10,5))
df1.groupby('job_category').preprocessed.count().plot.bar(ylim=0)
#plt.xticks(rotation=45)
plt.title('frequency of Domain in the dataset')
plt.show()
```



In [19]:

```
# making tfidf vector of the text in description column
tfidf = TfidfVectorizer(sublinear_tf=True, min_df=5, norm='l2', encoding='latin-1', ngr
features = tfidf.fit_transform(df1.preprocessed).toarray()
labels = df1.category_id
features.shape
```

Out[19]:

```
(4910, 7245)
```

In [20]:

```python
# findning out most common features of different Domain
from sklearn.feature_selection import chi2
import numpy as np
N = 2
for perprocessed, category_id in sorted(category_to_id.items()):
    features_chi2 = chi2(features, labels == category_id)
    indices = np.argsort(features_chi2[0])
    feature_names = np.array(tfidf.get_feature_names())[indices]
    unigrams = [v for v in feature_names if len(v.split(' ')) == 1]
    bigrams = [v for v in feature_names if len(v.split(' ')) == 2]
    print("# '{}':".format(perprocessed))
    print("  . Most correlated unigrams:\n. {}".format('\n. '.join(unigrams[-N:])))
    print("  . Most correlated bigrams:\n. {}".format('\n. '.join(bigrams[-N:])))
    print(" ")
```

```
# 'arts and design':
  . Most correlated unigrams:
. design
. designer
  . Most correlated bigrams:
. design intern
. graphic designer

# 'business development ':
  . Most correlated unigrams:
. deloitte
. analyst
  . Most correlated bigrams:
. deloitte india
. analyst deloitte

# 'marketing':
  . Most correlated unigrams:
. marketer
. marketing
  . Most correlated bigrams:
. digital marketing
. marketing intern

# 'media and communication':
  . Most correlated unigrams:
. content
. writer
  . Most correlated bigrams:
. medical writer
. content writer

# 'product management':
  . Most correlated unigrams:
. manager
. product
  . Most correlated bigrams:
. product management
. product manager

# 'program and project management':
  . Most correlated unigrams:
. manager
```

```
. project
  . Most correlated bigrams:
. program manager
. project manager

# 'sales':
  . Most correlated unigrams:
. account
. sales
  . Most correlated bigrams:
. account manager
. sales manager
```

Linear SVC

In [21]:

```
# creating word vector and model for prediction
X_train, X_test, y_train, y_test = train_test_split(df1['preprocessed'], df1['job_categ
count_vect = CountVectorizer()
X_train_counts = count_vect.fit_transform(X_train)
tfidf_transformer = TfidfTransformer()
X_train_tfidf = tfidf_transformer.fit_transform(X_train_counts)
clf = LinearSVC().fit(X_train_tfidf, y_train)
```

In [22]:

```
# checking model prediction in data
print(clf.predict(count_vect.transform(["product designer udaan"])))
```

```
['arts and design']
```

In [23]:

```
df1[df1['preprocessed'] == "product designer udaan"]
```

Out[23]:

	Unnamed: 0	Job Title	Company Name	Industry	Company Location	New Job (90 Days)	Year Started	Profile Headline	Profile Summary
3	3	Product Designer	udaan.com	Information Technology and Services	Bangalore Urban, Karnataka, India	False	2018.0	Product Designer at udaan	NaN
25	25	Product Designer	udaan.com	Information Technology and Services	Bangalore Urban, Karnataka, India	False	2018.0	Product Designer at udaan	NaN

2 rows × 26 columns

In [24]:

```
# training accuracy of the model
print(accuracy_score(y_train,clf.predict(X_train_tfidf)))
```

```
0.9098316132536665
```

In [25]:

```
# testing accuracy of the model
print(accuracy_score(y_test,clf.predict(count_vect.transform(X_test))))
```

```
0.5488599348534202
```

Multinomial Naive Bayes

In [26]:

```
clf = MultinomialNB().fit(X_train_tfidf, y_train)
```

In [27]:

```
# checking model prediction in data
print(clf.predict(count_vect.transform(["product designer udaan"])))
```

```
['arts and design']
```

In [28]:

```
# training accuracy of the model
print(accuracy_score(y_train,clf.predict(X_train_tfidf)))
```

```
0.7045084193373167
```

In [29]:

```
# testing accuracy of the model
print(accuracy_score(y_test,clf.predict(count_vect.transform(X_test))))
```

```
0.501628664495114
```

In [30]:

```
# testing some more models
CV = StratifiedKFold(n_splits=5)
models = [
    RandomForestClassifier(n_estimators=200, max_depth=3, random_state=0),
    LinearSVC(),
    MultinomialNB(),
]
#CV = 5
cv_df = pd.DataFrame(index=range(5 * len(models)))
entries = []
for model in models:
    model_name = model.__class__.__name__
    accuracies = cross_val_score(model, features, labels, scoring='accuracy', cv=CV,)
    for fold_idx, accuracy in enumerate(accuracies):
        entries.append((model_name, fold_idx, accuracy))
cv_df = pd.DataFrame(entries, columns=['model_name', 'fold_idx', 'accuracy'])
import seaborn as sns
sns.boxplot(x='model_name', y='accuracy', data=cv_df)
sns.stripplot(x='model_name', y='accuracy', data=cv_df,
              size=8, jitter=True, edgecolor="gray", linewidth=2)
plt.xticks(rotation=90)
plt.show()
```