detection-using-machine-learning

July 22, 2024

[86]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

import re
import nltk

from nltk.corpus import stopwords


from nltk.stem.porter import PorterStemmer


from sklearn.feature_extraction.text import TfidfVectorizer
```

[2]:

```
import warnings
# Ignore all warnings
warnings.filterwarnings('ignore')
```

[3]:

```
df = pd.read_csv('fake_job_postings.csv')
```

[4]:

```
df.head()
```

[4]:

```
   job_id                                      title            location  \
0       1                           Marketing Intern    US, NY, New York
1       2  Customer Service - Cloud Video Production      NZ, , Auckland
2       3    Commissioning Machinery Assistant (CMA)       US, IA, Wever
3       4          Account Executive - Washington DC  US, DC, Washington
4       5                        Bill Review Manager  US, FL, Fort Worth

  department salary_range                                    company_profile  \
0  Marketing            0  We're Food52, and we've created a groundbreaki…
1    Success            0  90 Seconds, the worlds Cloud Video Production …
2          0            0  Valor Services provides Workforce Solutions th…
3      Sales            0  Our passion for improving quality of life thro…
4          0            0  SpotSource Solutions LLC is a Global Human Cap…
```

```
                                         description  \
0  Food52, a fast-growing, James Beard Award-winn…   
1  Organised - Focused - Vibrant - Awesome!Do you…   
2  Our client, located in Houston, is actively se…   
3  THE COMPANY: ESRI – Environmental Systems Rese…   
4  JOB TITLE: Itemization Review ManagerLOCATION:…   

                                        requirements  \
0  Experience with content management systems a m…   
1  What we expect from you:Your key responsibilit…   
2  Implement pre-commissioning and commissioning …   
3  EDUCATION: Bachelor’s or Master’s in GIS, busi…   
4  QUALIFICATIONS:RN license in the State of Texa…   

                                            benefits  telecommuting  \
0                                                  0              0   
1  What you will get from usThrough being part of…              0   
2                                                  0              0   
3  Our culture is anything but corporate—we have …              0   
4                              Full Benefits Offered              0   

   has_company_logo  has_questions employment_type required_experience  \
0                 1              0           Other          Internship   
1                 1              0       Full-time      Not Applicable   
2                 1              0               0                   0   
3                 1              0       Full-time    Mid-Senior level   
4                 1              1       Full-time    Mid-Senior level   

  required_education                   industry              function  \
0                  0                          0             Marketing   
1                  0  Marketing and Advertising      Customer Service   
2                  0                          0                     0   
3  Bachelor's Degree          Computer Software                 Sales   
4  Bachelor's Degree     Hospital & Health Care  Health Care Provider   

   fraudulent  
0           0  
1           0  
2           0  
3           0  
4           0  
```

[5]:
```
df.tail()
```

[5]:
```
       job_id                                              title  \
17875   17876                   Account Director - Distribution    
```

```
17876   17877                                 Payroll Accountant
17877   17878  Project Cost Control Staff Engineer - Cost Con…
17878   17879                                   Graphic Designer
17879   17880                         Web Application Developers

                   location   department salary_range  \
17875       CA, ON, Toronto        Sales            0
17876  US, PA, Philadelphia   Accounting            0
17877       US, TX, Houston            0            0
17878         NG, LA, Lagos            0            0
17879     NZ, N, Wellington  Engineering            0

                                         company_profile  \
17875  Vend is looking for some awesome new talent to…
17876  WebLinc is the e-commerce platform and service…
17877  We Provide Full Time Permanent Positions for m…
17878                                                  0
17879  Vend is looking for some awesome new talent to…

                                             description  \
17875  Just in case this is the first time you've vis…
17876  The Payroll Accountant will focus primarily on…
17877  Experienced Project Cost Control Staff Enginee…
17878  Nemsia Studios is looking for an experienced v…
17879  Who are we?Vend is an award winning web based …

                                            requirements  \
17875  To ace this role you:Will eat comprehensive St…
17876  - B.A. or B.S. in Accounting- Desire to have f…
17877  At least 12 years professional experience.Abil…
17878  1. Must be fluent in the latest versions of Co…
17879  We want to hear from you if:You have an in-dep…

                                                benefits  telecommuting  \
17875  What can you expect from us?We have an open cu…               0
17876  Health &amp; WellnessMedical planPrescription …               0
17877                                                  0              0
17878  Competitive salary (compensation will be based…               0
17879                                                  0              0

       has_company_logo  has_questions employment_type required_experience  \
17875                 1              1       Full-time    Mid-Senior level
17876                 1              1       Full-time    Mid-Senior level
17877                 0              0       Full-time                   0
17878                 0              1        Contract      Not Applicable
17879                 1              1       Full-time    Mid-Senior level
```

```
      required_education           industry             function  fraudulent
17875                  0  Computer Software                Sales           0
17876  Bachelor's Degree           Internet  Accounting/Auditing           0
17877                  0                  0                    0           0
17878       Professional     Graphic Design               Design           0
17879                  0  Computer Software          Engineering           0
```

[6]:
```
df.shape
```

[6]:
```
(17880, 18)
```

[7]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 17880 entries, 0 to 17879
Data columns (total 18 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   job_id               17880 non-null  int64
 1   title                17880 non-null  object
 2   location             17880 non-null  object
 3   department           17880 non-null  object
 4   salary_range         17880 non-null  object
 5   company_profile      17880 non-null  object
 6   description          17880 non-null  object
 7   requirements         17880 non-null  object
 8   benefits             17880 non-null  object
 9   telecommuting        17880 non-null  int64
 10  has_company_logo     17880 non-null  int64
 11  has_questions        17880 non-null  int64
 12  employment_type      17880 non-null  object
 13  required_experience  17880 non-null  object
 14  required_education   17880 non-null  object
 15  industry             17880 non-null  object
 16  function             17880 non-null  object
 17  fraudulent           17880 non-null  int64
dtypes: int64(5), object(13)
memory usage: 2.5+ MB
```

[8]:
```
df = df.drop(columns=['job_id'])
```

[9]:
```
df.head()
```

[9]:
```
                                        title           location department  \
0                            Marketing Intern    US, NY, New York  Marketing
1   Customer Service - Cloud Video Production      NZ, , Auckland    Success
2     Commissioning Machinery Assistant (CMA)       US, IA, Wever          0
```

```
3          Account Executive - Washington DC  US, DC, Washington      Sales
4                        Bill Review Manager  US, FL, Fort Worth          0

  salary_range                                    company_profile  \
0            0  We're Food52, and we've created a groundbreaki…
1            0  90 Seconds, the worlds Cloud Video Production …
2            0  Valor Services provides Workforce Solutions th…
3            0  Our passion for improving quality of life thro…
4            0  SpotSource Solutions LLC is a Global Human Cap…

                                         description  \
0  Food52, a fast-growing, James Beard Award-winn…
1  Organised - Focused - Vibrant - Awesome!Do you…
2  Our client, located in Houston, is actively se…
3  THE COMPANY: ESRI – Environmental Systems Rese…
4  JOB TITLE: Itemization Review ManagerLOCATION:…

                                        requirements  \
0  Experience with content management systems a m…
1  What we expect from you:Your key responsibilit…
2  Implement pre-commissioning and commissioning …
3  EDUCATION: Bachelor’s or Master’s in GIS, busi…
4  QUALIFICATIONS:RN license in the State of Texa…

                                            benefits  telecommuting  \
0                                                  0              0
1  What you will get from usThrough being part of…              0
2                                                  0              0
3  Our culture is anything but corporate—we have …              0
4                              Full Benefits Offered              0

   has_company_logo  has_questions employment_type required_experience  \
0                 1              0           Other          Internship
1                 1              0       Full-time      Not Applicable
2                 1              0               0                   0
3                 1              0       Full-time    Mid-Senior level
4                 1              1       Full-time    Mid-Senior level

  required_education                   industry              function  \
0                  0                          0             Marketing
1                  0  Marketing and Advertising      Customer Service
2                  0                          0                     0
3  Bachelor's Degree          Computer Software                 Sales
4  Bachelor's Degree     Hospital & Health Care  Health Care Provider

   fraudulent
0           0
```

```
1            0
2            0
3            0
4            0
```

[10]:

```
df.describe()
```

[10]:

```
       telecommuting  has_company_logo  has_questions   fraudulent
count   17880.000000      17880.000000   17880.000000 17880.000000
mean        0.042897          0.795302       0.491723     0.048434
std         0.202631          0.403492       0.499945     0.214688
min         0.000000          0.000000       0.000000     0.000000
25%         0.000000          1.000000       0.000000     0.000000
50%         0.000000          1.000000       0.000000     0.000000
75%         0.000000          1.000000       1.000000     0.000000
max         1.000000          1.000000       1.000000     1.000000
```

1 Removing Duplicates

[11]:

```
df.duplicated().sum()
```

[11]:

```
281
```

[12]:

```
df = df.drop_duplicates()
```

[13]:

```
df.duplicated().sum()
```

[13]:

```
0
```

2 making dataframe for categorical col and num col

[14]:

```
df.select_dtypes(include='object').columns
```

[14]:

```
Index(['title', 'location', 'department', 'salary_range', 'company_profile',
       'description', 'requirements', 'benefits', 'employment_type',
       'required_experience', 'required_education', 'industry', 'function'],
      dtype='object')
```

[15]:

```
df.select_dtypes(include='object')
```

[15]:

```
                                                  title  \
0                                      Marketing Intern
1             Customer Service - Cloud Video Production
2               Commissioning Machinery Assistant (CMA)
3                     Account Executive - Washington DC
```

```
4                                    Bill Review Manager
…                                                  …
17875                   Account Director - Distribution 
17876                                 Payroll Accountant
17877  Project Cost Control Staff Engineer - Cost Con…
17878                                   Graphic Designer
17879                         Web Application Developers

                   location   department salary_range  \
0          US, NY, New York    Marketing            0
1            NZ, , Auckland      Success            0
2             US, IA, Wever            0            0
3        US, DC, Washington        Sales            0
4        US, FL, Fort Worth            0            0
…                     …          …          …
17875       CA, ON, Toronto        Sales            0
17876  US, PA, Philadelphia   Accounting            0
17877       US, TX, Houston            0            0
17878         NG, LA, Lagos            0            0
17879     NZ, N, Wellington  Engineering            0

                                         company_profile  \
0      We're Food52, and we've created a groundbreaki…
1      90 Seconds, the worlds Cloud Video Production …
2      Valor Services provides Workforce Solutions th…
3      Our passion for improving quality of life thro…
4      SpotSource Solutions LLC is a Global Human Cap…
…                                                  …
17875  Vend is looking for some awesome new talent to…
17876  WebLinc is the e-commerce platform and service…
17877  We Provide Full Time Permanent Positions for m…
17878                                                  0
17879  Vend is looking for some awesome new talent to…

                                             description  \
0      Food52, a fast-growing, James Beard Award-winn…
1      Organised - Focused - Vibrant - Awesome!Do you…
2      Our client, located in Houston, is actively se…
3      THE COMPANY: ESRI – Environmental Systems Rese…
4      JOB TITLE: Itemization Review ManagerLOCATION:…
…                                                  …
17875  Just in case this is the first time you’ve vis…
17876  The Payroll Accountant will focus primarily on…
17877  Experienced Project Cost Control Staff Enginee…
17878  Nemsia Studios is looking for an experienced v…
17879  Who are we?Vend is an award winning web based …
```

```
                                            requirements  \
0      Experience with content management systems a m…
1      What we expect from you:Your key responsibilit…
2      Implement pre-commissioning and commissioning …
3      EDUCATION: Bachelor’s or Master’s in GIS, busi…
4      QUALIFICATIONS:RN license in the State of Texa…
…                                                   …
17875  To ace this role you:Will eat comprehensive St…
17876  - B.A. or B.S. in Accounting- Desire to have f…
17877  At least 12 years professional experience.Abil…
17878  1. Must be fluent in the latest versions of Co…
17879  We want to hear from you if:You have an in-dep…

                                                benefits employment_type  \
0                                                      0           Other
1      What you will get from usThrough being part of…       Full-time
2                                                      0               0
3      Our culture is anything but corporate-we have …       Full-time
4                                  Full Benefits Offered       Full-time
…                                                   …             …
17875  What can you expect from us?We have an open cu…       Full-time
17876  Health &amp; WellnessMedical planPrescription …       Full-time
17877                                                  0       Full-time
17878  Competitive salary (compensation will be based…        Contract
17879                                                  0       Full-time

      required_experience required_education                   industry  \
0              Internship                  0                          0
1          Not Applicable                  0  Marketing and Advertising
2                       0                  0                          0
3        Mid-Senior level  Bachelor's Degree          Computer Software
4        Mid-Senior level  Bachelor's Degree     Hospital & Health Care
…                   …                …                        …
17875    Mid-Senior level                  0          Computer Software
17876    Mid-Senior level  Bachelor's Degree                   Internet
17877                   0                  0                          0
17878      Not Applicable       Professional             Graphic Design
17879    Mid-Senior level                  0          Computer Software

                   function
0                 Marketing
1          Customer Service
2                         0
3                     Sales
4      Health Care Provider
…                     …
17875                 Sales
```

```
17876   Accounting/Auditing
17877                     0
17878                Design
17879           Engineering

[17599 rows x 13 columns]
```

[16]:

```
object_columns_df = df.select_dtypes(include='object')
```

[17]:

```
object_columns_df.head()
```

[17]:

```
                                       title            location department  \
0                           Marketing Intern    US, NY, New York  Marketing
1  Customer Service - Cloud Video Production      NZ, , Auckland    Success
2    Commissioning Machinery Assistant (CMA)       US, IA, Wever          0
3          Account Executive - Washington DC  US, DC, Washington      Sales
4                        Bill Review Manager  US, FL, Fort Worth          0

  salary_range                                    company_profile  \
0            0  We're Food52, and we've created a groundbreaki…
1            0  90 Seconds, the worlds Cloud Video Production …
2            0  Valor Services provides Workforce Solutions th…
3            0  Our passion for improving quality of life thro…
4            0  SpotSource Solutions LLC is a Global Human Cap…

                                         description  \
0  Food52, a fast-growing, James Beard Award-winn…
1  Organised - Focused - Vibrant - Awesome!Do you…
2  Our client, located in Houston, is actively se…
3  THE COMPANY: ESRI - Environmental Systems Rese…
4  JOB TITLE: Itemization Review ManagerLOCATION:…

                                        requirements  \
0  Experience with content management systems a m…
1  What we expect from you:Your key responsibilit…
2  Implement pre-commissioning and commissioning …
3  EDUCATION: Bachelor’s or Master’s in GIS, busi…
4  QUALIFICATIONS:RN license in the State of Texa…

                                            benefits employment_type  \
0                                                  0           Other
1  What you will get from usThrough being part of…       Full-time
2                                                  0               0
3  Our culture is anything but corporate-we have …       Full-time
4                              Full Benefits Offered       Full-time

  required_experience required_education                   industry  \
0         Internship                 0                            0
1     Not Applicable                 0  Marketing and Advertising
2                  0                 0                            0
3   Mid-Senior level  Bachelor's Degree          Computer Software
4   Mid-Senior level  Bachelor's Degree      Hospital & Health Care

              function
0            Marketing
1     Customer Service
2                    0
3                Sales
4  Health Care Provider
```

[18]:
```
df.select_dtypes(include='number').columns
```

[18]:
```
Index(['telecommuting', 'has_company_logo', 'has_questions', 'fraudulent'],
dtype='object')
```

[19]:
```
df.select_dtypes(include='number')
```

[19]:
```
       telecommuting  has_company_logo  has_questions  fraudulent
0                  0                 1              0           0
1                  0                 1              0           0
2                  0                 1              0           0
3                  0                 1              0           0
4                  0                 1              1           0
…                …                …              …         …
17875              0                 1              1           0
17876              0                 1              1           0
17877              0                 0              0           0
17878              0                 0              1           0
17879              0                 1              1           0

[17599 rows x 4 columns]
```

[20]:
```
int_columns_df = df.select_dtypes(include='number')
```

[21]:
```
int_columns_df.head()
```

[21]:
```
   telecommuting  has_company_logo  has_questions  fraudulent
0              0                 1              0           0
1              0                 1              0           0
2              0                 1              0           0
3              0                 1              0           0
4              0                 1              1           0
```

3 Making dataframe for fake job posting // real job posting

[22]:
```
fake = df[df['fraudulent'] == 1]
```

[23]:
```
fake.head()
```

[23]:
```
                                 title                            location  \
98                     IC&E Technician                   US, , Stocton, CA
144                       Forward Cap.                                   0
173  Technician Instrument & Controls                                   US
180                    Sales Executive                     PK, SD, Karachi
215            IC&E Technician Mt Poso  US, CA, Bakersfield, CA / Mt. Poso

               department  salary_range  \
98           Oil & Energy  95000-115000
144                     0             0
173  Power Plant & Energy             0
180                 Sales             0
215          Oil & Energy  95000-115000

                                       company_profile  \
98                                                 …
144                                                  0
173  Edison International and Refined Resources hav…
180                                                  0
215                                                …

                                           description  \
98   IC&amp;E Technician | Bakersfield, CA Mt. Poso…
144  The group has raised a fund for the purchase o…
173  Technician Instrument &amp; ControlsLocation D…
180                                    Sales Executive
215  IC&amp;E Technician | Bakersfield, CA Mt. Poso…

                                          requirements  \
98   QualificationsKnowledge, Skills &amp; Abilitie…
144                                                  0
173  JOB QUALIFICATIONS-Ability to understand proce…
180                                    Sales Executive
215   QualificationsKnowledge, Skills &amp; Abiliti…

                                              benefits  telecommuting  \
98   BENEFITSWhat is offered:Competitive compensati…              0
144                                                  0              0
173  we are a team of almost 8,000 employees who he…              0
180                                    Sales Executive              0
215  BENEFITSWhat is offered:Competitive compensati…              0
```

```
     has_company_logo  has_questions employment_type required_experience  \
98                  1              1       Full-time    Mid-Senior level   
144                 0              0               0                   0   
173                 1              1       Full-time    Mid-Senior level   
180                 0              0               0                   0   
215                 1              1       Full-time    Mid-Senior level   

            required_education                             industry function  \
98   High School or equivalent                         Oil & Energy    Other   
144                          0                                    0        0   
173              Certification  Electrical/Electronic Manufacturing    Other   
180                          0                                    0    Sales   
215  High School or equivalent                         Oil & Energy    Other   

     fraudulent  
98            1  
144           1  
173           1  
180           1  
215           1  
```

```
[24]: real = df[df['fraudulent'] == 0]
```

```
[25]: real.head()
```

```
[25]:                                        title            location department  \
0                           Marketing Intern    US, NY, New York  Marketing   
1  Customer Service - Cloud Video Production      NZ, , Auckland    Success   
2    Commissioning Machinery Assistant (CMA)       US, IA, Wever          0   
3          Account Executive - Washington DC  US, DC, Washington      Sales   
4                        Bill Review Manager  US, FL, Fort Worth          0   

  salary_range                                    company_profile  \
0            0  We're Food52, and we've created a groundbreaki…   
1            0  90 Seconds, the worlds Cloud Video Production …   
2            0  Valor Services provides Workforce Solutions th…   
3            0  Our passion for improving quality of life thro…   
4            0  SpotSource Solutions LLC is a Global Human Cap…   

                                         description  \
0  Food52, a fast-growing, James Beard Award-winn…   
1  Organised - Focused - Vibrant - Awesome!Do you…   
2  Our client, located in Houston, is actively se…   
3  THE COMPANY: ESRI - Environmental Systems Rese…   
4  JOB TITLE: Itemization Review ManagerLOCATION:…   
```

```
                                        requirements  \
0  Experience with content management systems a m…
1  What we expect from you:Your key responsibilit…
2  Implement pre-commissioning and commissioning …
3  EDUCATION: Bachelor’s or Master’s in GIS, busi…
4  QUALIFICATIONS:RN license in the State of Texa…

                                            benefits  telecommuting  \
0                                                  0              0
1  What you will get from usThrough being part of…              0
2                                                  0              0
3  Our culture is anything but corporate-we have …              0
4                              Full Benefits Offered              0

   has_company_logo  has_questions employment_type required_experience  \
0                 1              0           Other          Internship
1                 1              0       Full-time      Not Applicable
2                 1              0               0                   0
3                 1              0       Full-time    Mid-Senior level
4                 1              1       Full-time    Mid-Senior level

  required_education                   industry              function  \
0                  0                          0             Marketing
1                  0  Marketing and Advertising      Customer Service
2                  0                          0                     0
3  Bachelor's Degree          Computer Software                 Sales
4  Bachelor's Degree     Hospital & Health Care  Health Care Provider

   fraudulent
0           0
1           0
2           0
3           0
4           0
```

[26]:

```
df['fraudulent'].value_counts()
```

[26]:

```
0    16743
1      856
Name: fraudulent, dtype: int64
```

[27]:

```
fake.shape
```

[27]:

```
(856, 17)
```

[28]:

```
real.shape
```

[28]:
```
(16743, 17)
```

[29]:
```
df.shape
```

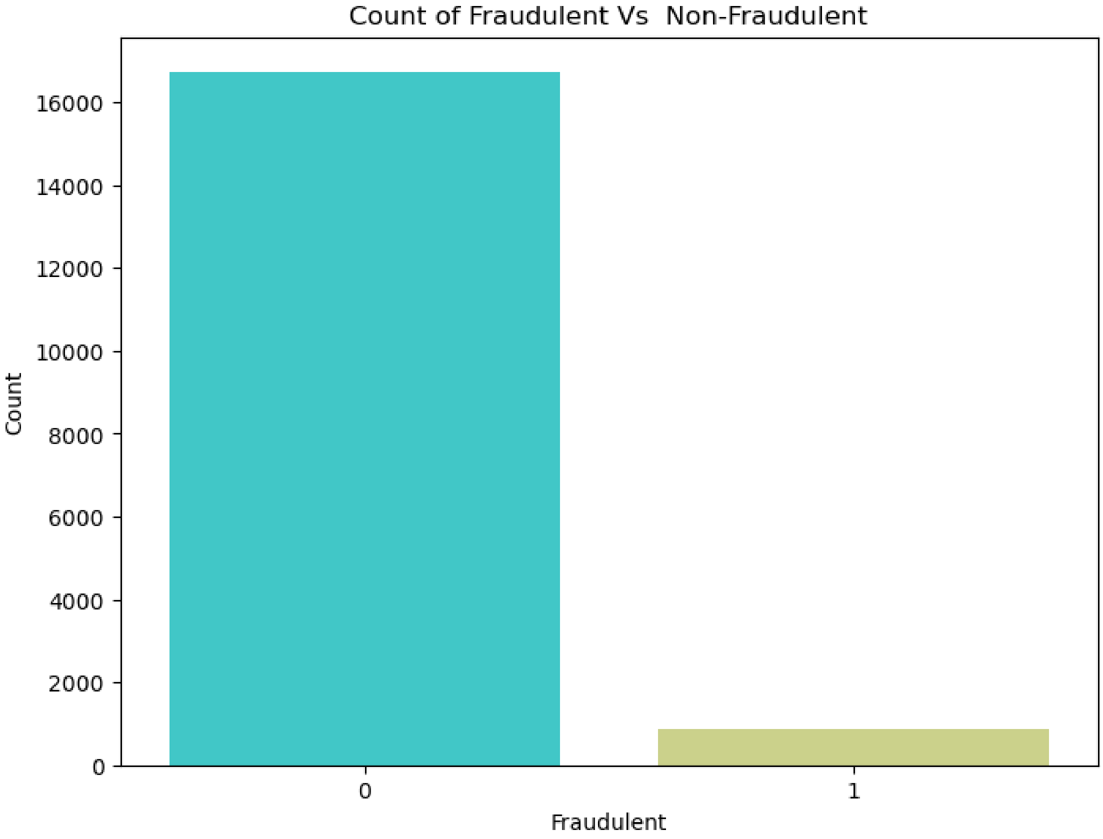
[29]:
```
(17599, 17)
```

## EDA ### Data Visualisation

[30]:
```
fraudulent_count = df['fraudulent'].value_counts()
```

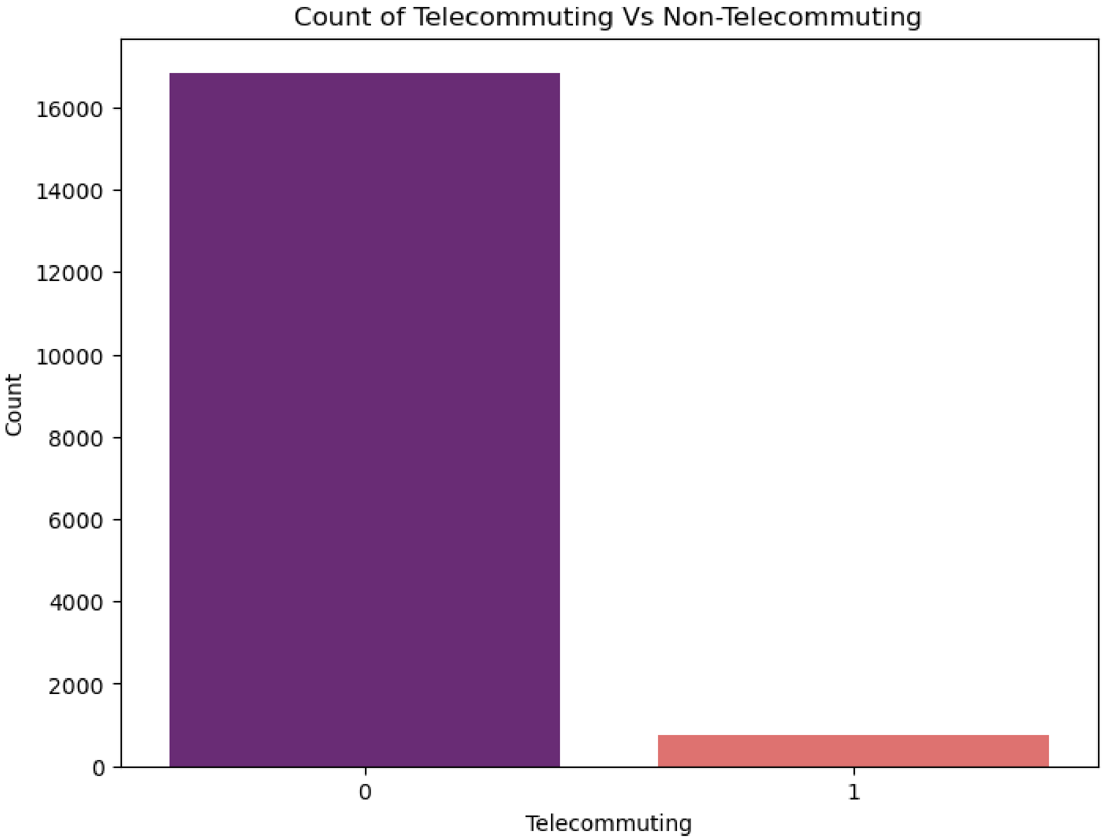
3.0.1 We have used rainbow color palette by visualisation we can see the count of fraudulent and non fraudulent data

[31]:
```
plt.figure(figsize=(8, 6))
sns.barplot(x=fraudulent_count.index, y=fraudulent_count.values,␣
 ↪palette='rainbow')
plt.xlabel('Fraudulent')
plt.ylabel('Count')
plt.title('Count of Fraudulent Vs  Non-Fraudulent')
plt.show()
```



We have used magma palette by visualisation we can see the count of telecommuting and non-telecommuting data

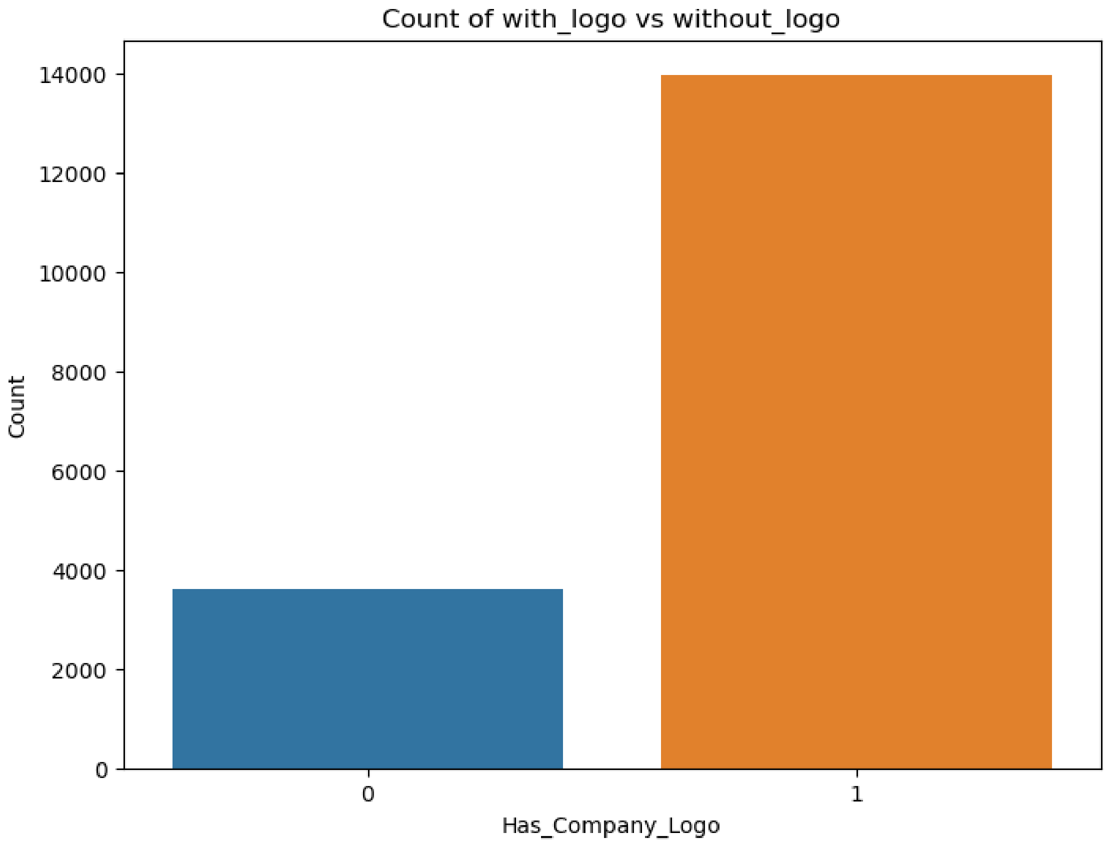
[32]:
```
telecommuting_counts = df['telecommuting'].value_counts()

plt.figure(figsize=(8, 6))
sns.barplot(x=telecommuting_counts.index, y=telecommuting_counts.values, palette='magma')
plt.xlabel('Telecommuting')
plt.ylabel('Count')
plt.title('Count of Telecommuting Vs Non-Telecommuting')
plt.show()
```



3.0.2 We have used color palette by visualisation we can see the count of with_logo and without_logo data

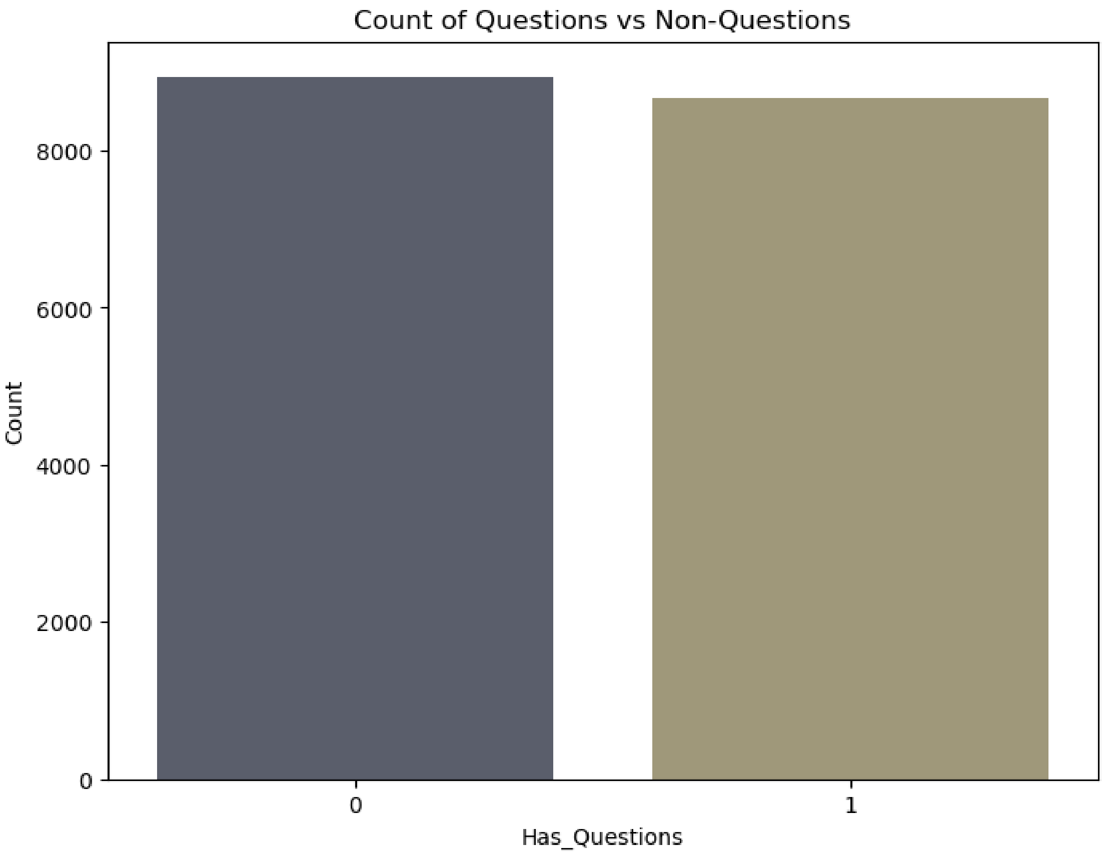
[33]:
```
has_company_logo_counts = df['has_company_logo'].value_counts()

plt.figure(figsize=(8, 6))
sns.barplot(x=has_company_logo_counts.index, y=has_company_logo_counts.values)
```

```
plt.xlabel('Has_Company_Logo')
plt.ylabel('Count')
plt.title('Count of with_logo vs without_logo')
plt.show()
```



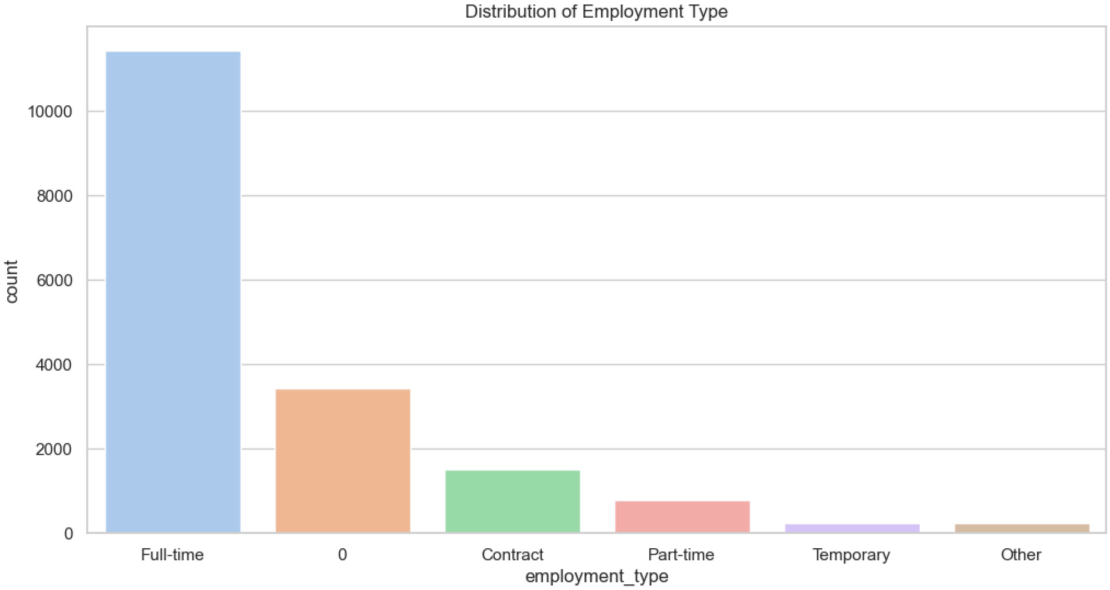
We have used color cividis by visualisation we can see the count of Ouestions and non No_Questions data

[34]:
```
has_questions_counts = df['has_questions'].value_counts()

plt.figure(figsize=(8, 6))
sns.barplot(x=has_questions_counts.index, y=has_questions_counts.values,␣
 ↪palette='cividis')
plt.xlabel('Has_Questions')
plt.ylabel('Count')
plt.title('Count of Questions vs Non-Questions')
plt.show()
```



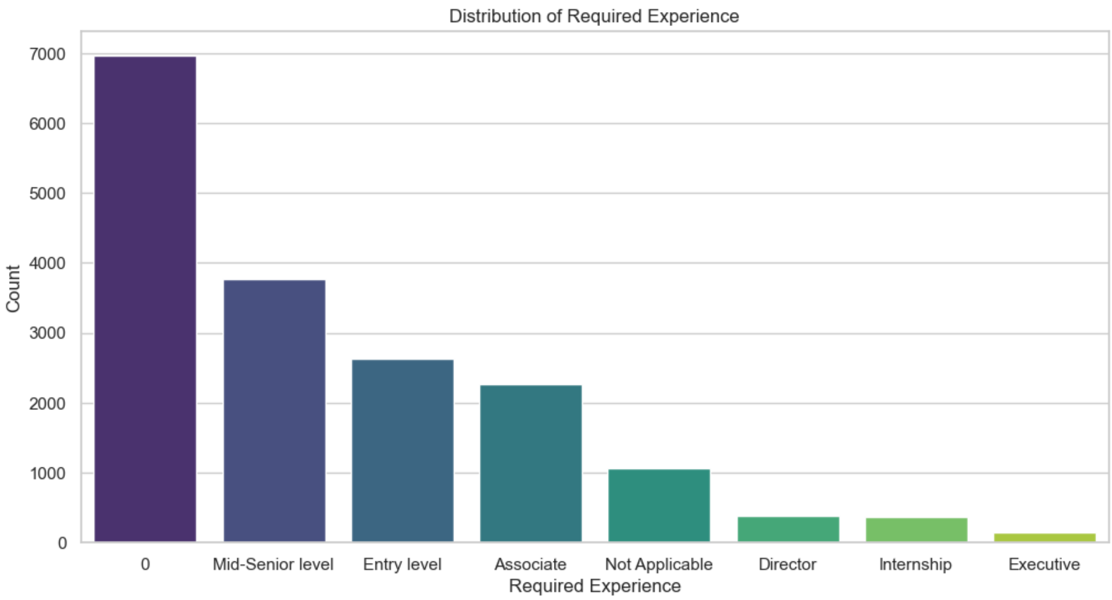
We have used pastel color palette by visualisation we can see the count of employment_type data

[35]:
```
sns.set(style="whitegrid")
plt.figure(figsize=(12, 6))

sns.countplot(x='employment_type', data=df, palette='pastel',␣
 ↪order=df['employment_type'].value_counts().index)

plt.title('Distribution of Employment Type')

plt.show()
```



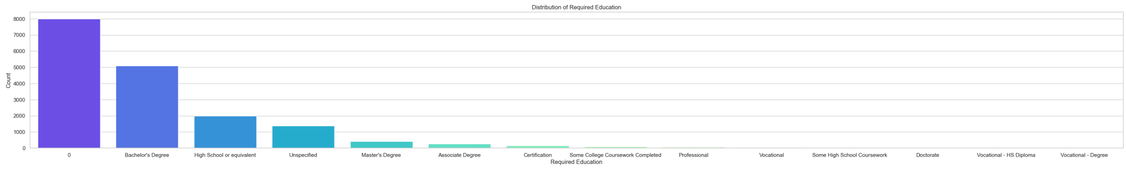
We have used viridis color palette by visualisation we can see the count of Distribution of required_experience data

[36]:
```
required_experience_counts = df['required_experience'].value_counts()

plt.figure(figsize=(12, 6))
sns.barplot(x=required_experience_counts.index, y=required_experience_counts.
 ↪values, palette='viridis')
plt.xlabel('Required Experience')
plt.ylabel('Count')
plt.title('Distribution of Required Experience')
plt.show()
```



We have used rainbow color palette by visualisation we can see the count of distribution of required_education data

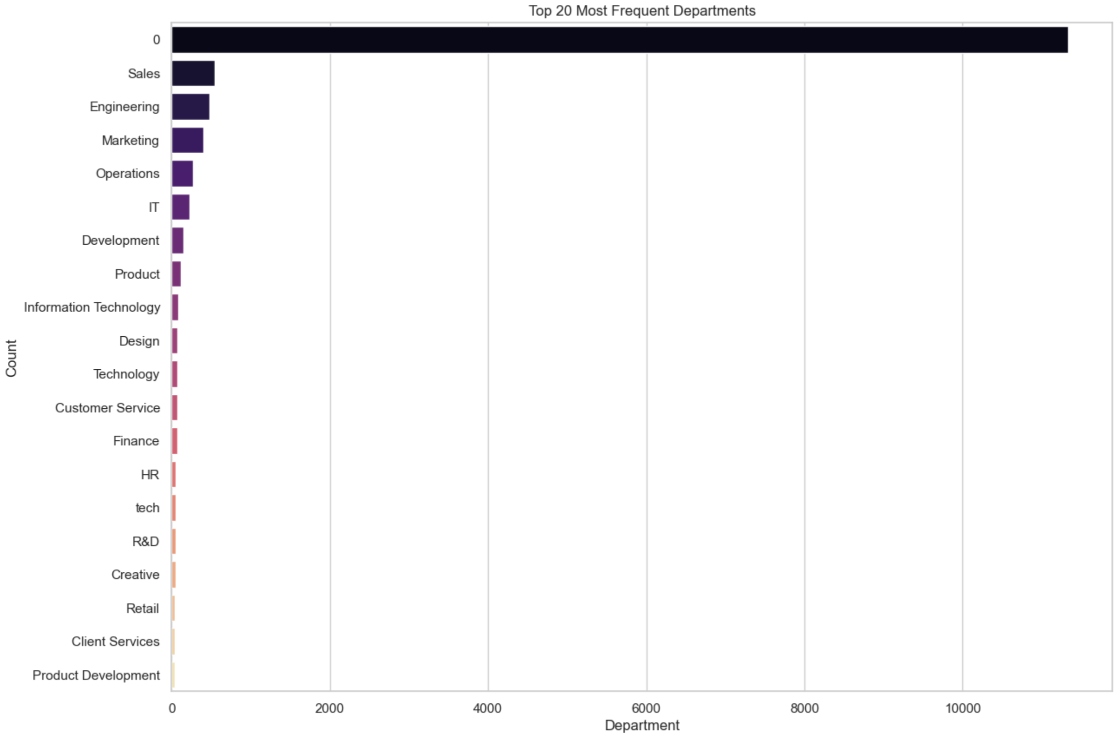
[37]:
```
required_education_counts = df['required_education'].value_counts()

plt.figure(figsize=(40, 5))
sns.barplot(x=required_education_counts.index, y=required_education_counts.
 ↪values, palette='rainbow')
plt.xlabel('Required Education')
plt.ylabel('Count')
plt.title('Distribution of Required Education')
plt.show()
```



We have used magma color palette by visualisation we can see the count of top 20 most frequent departments data

[38]:
```
department_counts = df['department'].value_counts()

top_20_departments = department_counts.head(20)
```

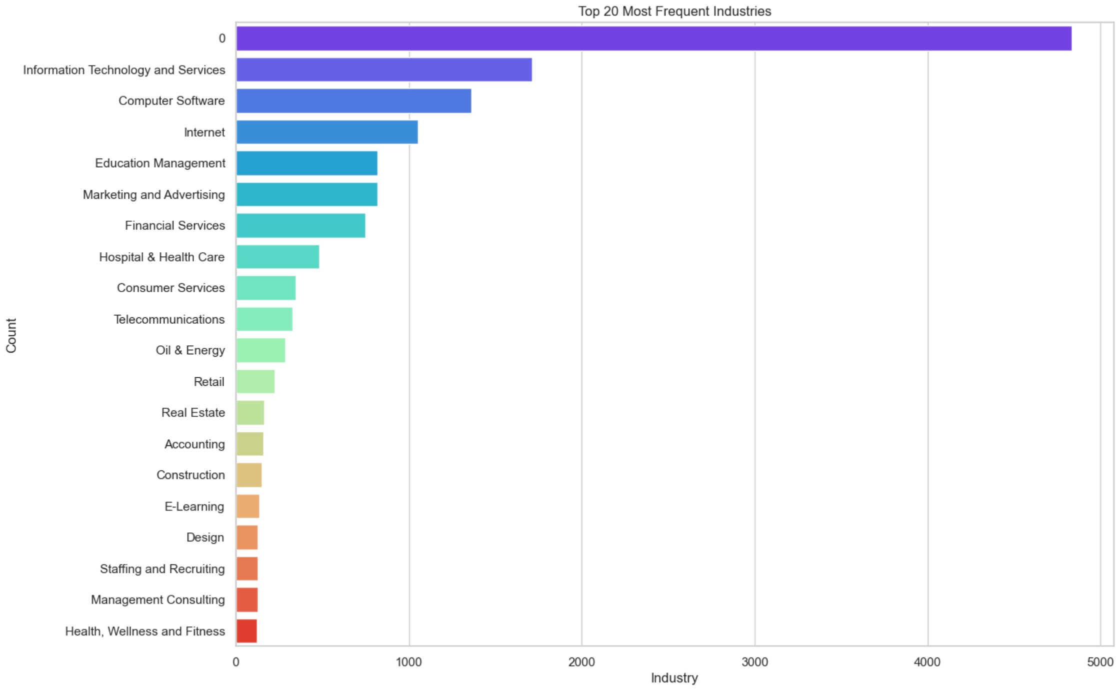
```
plt.figure(figsize=(14, 10))
sns.barplot(y=top_20_departments.index, x=top_20_departments.values,␣
 ↪palette='magma')
plt.xlabel('Department')
plt.ylabel('Count')
plt.title('Top 20 Most Frequent Departments')
plt.show()
```



3.0.3 We have used rainbow color palette by visualisation we can see the count of top 20 most frequent industries data

[39]:

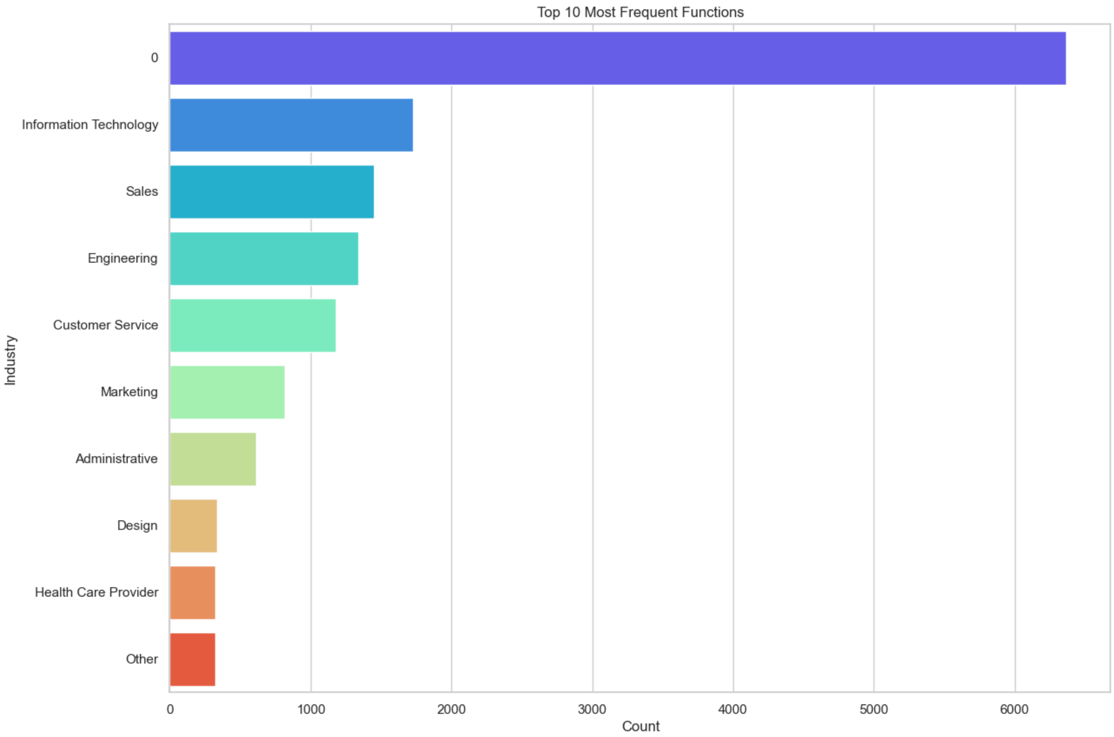
```
industry_counts = df['industry'].value_counts()

top_20_industry = industry_counts.head(20)

plt.figure(figsize=(14, 10))
sns.barplot(y=top_20_industry.index, x=top_20_industry.values,␣
 ↪palette='rainbow')
plt.xlabel('Industry')
plt.ylabel('Count')
plt.title('Top 20 Most Frequent Industries')
plt.show()
```



### We have used rainbow color palette by visualisation we can see the count of top 10 most frequent function data

[40]:

```
function_counts = df['function'].value_counts()

top_10_function = function_counts.head(10)

plt.figure(figsize=(14, 10))
sns.barplot(y=top_10_function.index, x=top_10_function.values, palette =␣
  ↪'rainbow')
plt.ylabel('Industry')
plt.xlabel('Count')
plt.title('Top 10 Most Frequent Functions')
plt.show()
```



4 We will split the location column into separte columns for country and city

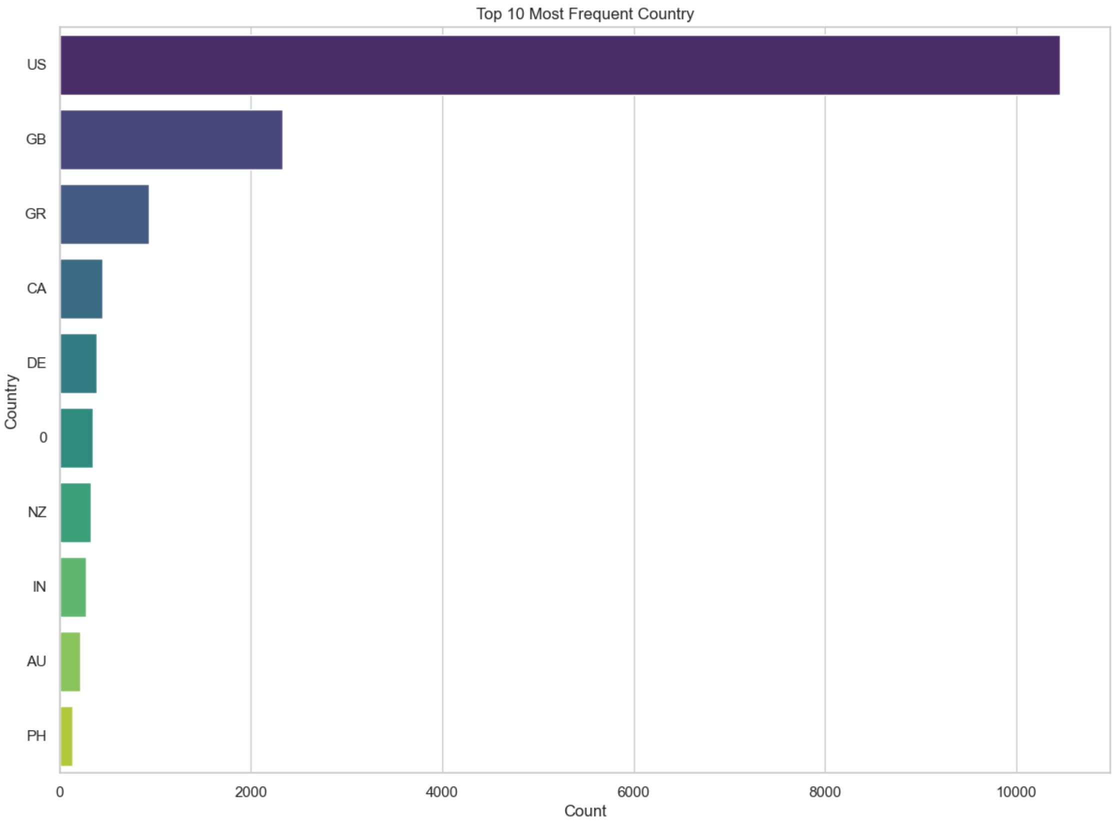
[41]:
```
location_split = df['location'].str.split(',', expand=True)
df['country'] = location_split[0]
df['city'] = location_split[1]
```

[42]:
```
df.head(2)
```

[42]:
```
                                           title          location department  \
0                               Marketing Intern  US, NY, New York  Marketing
1  Customer Service - Cloud Video Production    NZ, , Auckland    Success

  salary_range                                    company_profile  \
0            0  We're Food52, and we've created a groundbreaki…
1            0  90 Seconds, the worlds Cloud Video Production …

                                         description  \
0  Food52, a fast-growing, James Beard Award-winn…
1  Organised - Focused - Vibrant - Awesome!Do you…

                                        requirements  \
0  Experience with content management systems a m…
1  What you will get from usThrough being part of…

                                            benefits  telecommuting  \
0                                                  0              0
1  What you will get from usThrough being part of…              0

   has_company_logo  has_questions employment_type required_experience  \
0                 1              0           Other          Internship
1                 1              0       Full-time      Not Applicable

  required_education                  industry          function  fraudulent  \
0                  0                         0         Marketing           0
1                  0  Marketing and Advertising  Customer Service           0

  country city
0      US   NY
1      NZ
```

We have used color palette viridis by visualisation we can see the count of Top 10 Most Frequent Country data

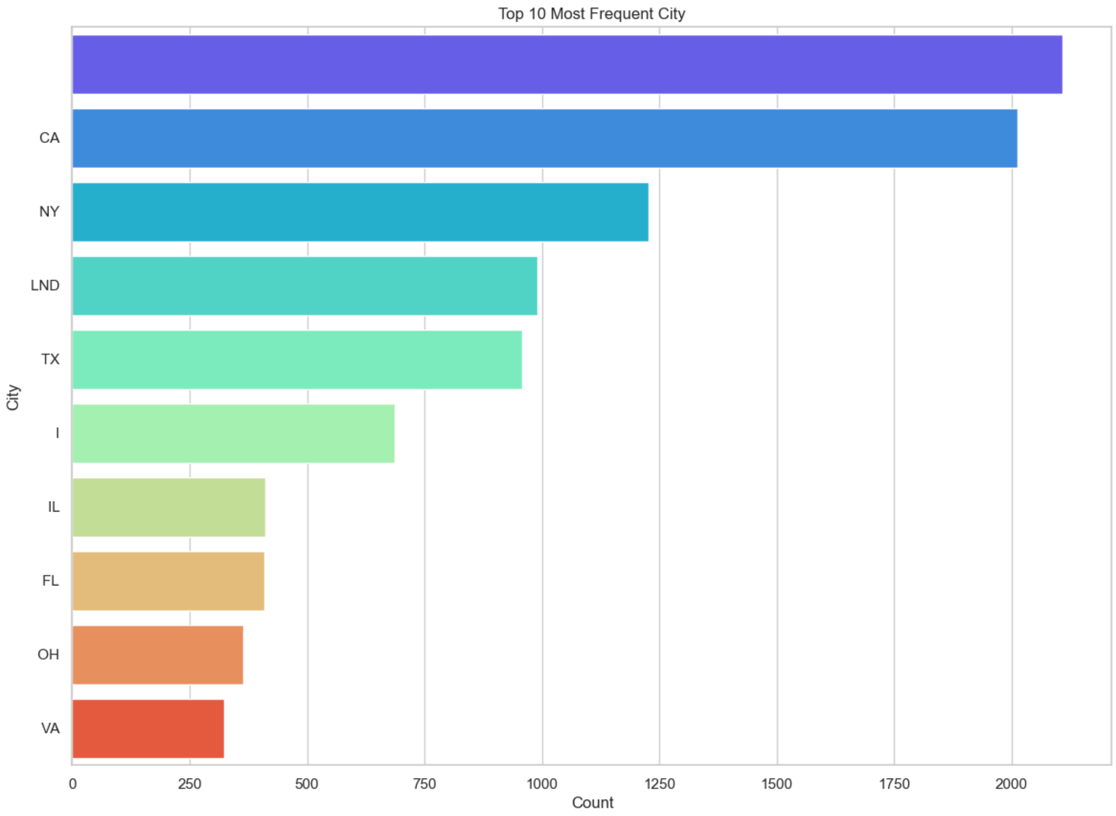
[43]:
```python
Country_counts = df['country'].value_counts()

top_10_Country = Country_counts.head(10)

plt.figure(figsize=(14, 10))
sns.barplot(y=top_10_Country.index, x=top_10_Country.values, palette='viridis')
plt.ylabel('Country')
plt.xlabel('Count')
plt.title('Top 10 Most Frequent Country')
plt.show()
```



We have used rainbow color palette by visualisation we can see the count of Top 10 Most Frequent City data

[44]:
```
City_counts = df['city'].value_counts()

top_10_City = City_counts.head(10)

plt.figure(figsize=(14, 10))
sns.barplot(y=top_10_City.index, x=top_10_City.values, palette='rainbow')
plt.ylabel('City')
plt.xlabel('Count')
plt.title('Top 10 Most Frequent City')
plt
```

[44]:
```
<module 'matplotlib.pyplot' from 'C:\\Users\\lenovo\\anaconda3\\Lib\\site-
packages\\matplotlib\\pyplot.py'>
```



```
[45]: df
```

```
[45]:                                                 title  \
      0                                      Marketing Intern
      1                Customer Service - Cloud Video Production
      2                  Commissioning Machinery Assistant (CMA)
      3                        Account Executive - Washington DC
      4                                   Bill Review Manager
      …                                                     …
      17875                      Account Director - Distribution
      17876                                 Payroll Accountant
      17877  Project Cost Control Staff Engineer - Cost Con…
      17878                                   Graphic Designer
      17879                           Web Application Developers

                          location   department salary_range  \
      0            US, NY, New York   Marketing            0
      1              NZ, , Auckland     Success            0
      2                US, IA, Wever            0            0
      3          US, DC, Washington       Sales            0
      4          US, FL, Fort Worth            0            0
```

```
…                     …          …          …
17875       CA, ON, Toronto        Sales            0
17876  US, PA, Philadelphia   Accounting            0
17877       US, TX, Houston            0            0
17878         NG, LA, Lagos            0            0
17879     NZ, N, Wellington  Engineering            0

                                         company_profile  \
0      We're Food52, and we've created a groundbreaki…
1      90 Seconds, the worlds Cloud Video Production …
2      Valor Services provides Workforce Solutions th…
3      Our passion for improving quality of life thro…
4      SpotSource Solutions LLC is a Global Human Cap…
…                                                   …
17875  Vend is looking for some awesome new talent to…
17876  WebLinc is the e-commerce platform and service…
17877  We Provide Full Time Permanent Positions for m…
17878                                                0
17879  Vend is looking for some awesome new talent to…

                                             description  \
0      Food52, a fast-growing, James Beard Award-winn…
1      Organised - Focused - Vibrant - Awesome!Do you…
2      Our client, located in Houston, is actively se…
3      THE COMPANY: ESRI - Environmental Systems Rese…
4      JOB TITLE: Itemization Review ManagerLOCATION:…
…                                                   …
17875  Just in case this is the first time you've vis…
17876  The Payroll Accountant will focus primarily on…
17877  Experienced Project Cost Control Staff Enginee…
17878  Nemsia Studios is looking for an experienced v…
17879  Who are we?Vend is an award winning web based …

                                            requirements  \
0      Experience with content management systems a m…
1      What we expect from you:Your key responsibilit…
2      Implement pre-commissioning and commissioning …
3      EDUCATION: Bachelor's or Master's in GIS, busi…
4      QUALIFICATIONS:RN license in the State of Texa…
…                                                   …
17875  To ace this role you:Will eat comprehensive St…
17876  - B.A. or B.S. in Accounting- Desire to have f…
17877  At least 12 years professional experience.Abil…
17878  1. Must be fluent in the latest versions of Co…
17879  We want to hear from you if:You have an in-dep…

                                                benefits  telecommuting  \
0                                                      0              0
1      What you will get from usThrough being part of…              0
2                                                      0              0
3      Our culture is anything but corporate-we have …              0
4                                 Full Benefits Offered              0
…                                                   …            …
17875  What can you expect from us?We have an open cu…              0
17876  Health &amp; WellnessMedical planPrescription …              0
17877                                                  0              0
17878  Competitive salary (compensation will be based…              0
17879                                                  0              0

       has_company_logo  has_questions employment_type required_experience  \
0                     1              0           Other          Internship
1                     1              0       Full-time      Not Applicable
2                     1              0               0                   0
3                     1              0       Full-time    Mid-Senior level
4                     1              1       Full-time    Mid-Senior level
…                   …            …             …                 …
17875                 1              1       Full-time    Mid-Senior level
17876                 1              1       Full-time    Mid-Senior level
17877                 0              0       Full-time                   0
17878                 0              1        Contract      Not Applicable
17879                 1              1       Full-time    Mid-Senior level

      required_education                   industry              function  \
0                      0                          0             Marketing
1                      0  Marketing and Advertising      Customer Service
2                      0                          0                     0
3      Bachelor's Degree          Computer Software                 Sales
4      Bachelor's Degree     Hospital & Health Care  Health Care Provider
…                     …                         …                     …
17875                  0          Computer Software                 Sales
17876  Bachelor's Degree                   Internet   Accounting/Auditing
17877                  0                          0                     0
17878       Professional             Graphic Design                Design
17879                  0          Computer Software           Engineering

       fraudulent country city
0               0      US   NY
1               0      NZ
2               0      US   IA
3               0      US   DC
4               0      US   FL
…            …      …  …
17875           0      CA   ON
17876           0      US   PA
```

```
17877           0      US   TX
17878           0      NG   LA
17879           0      NZ    N

[17599 rows x 19 columns]
```

[46]:
```
df.isnull().sum()
```

[46]:
```
title                    0
location                 0
department               0
salary_range             0
company_profile          0
description              0
requirements             0
benefits                 0
telecommuting            0
has_company_logo         0
has_questions            0
employment_type          0
required_experience      0
required_education       0
industry                 0
function                 0
fraudulent               0
country                  0
city                   432
dtype: int64
```

5 We will fill the null-values with space -> ' '

[47]:
```
df.fillna(' ', inplace=True)
```

[48]:
```
df.isnull().sum()
```

[48]:
```
title                  0
location               0
department             0
salary_range           0
company_profile        0
description            0
requirements           0
benefits               0
telecommuting          0
has_company_logo       0
has_questions          0
```

```
employment_type        0
required_experience    0
required_education     0
industry               0
function               0
fraudulent             0
country                0
city                   0
dtype: int64
```

[49]:

```
df.head()
```

[49]:

```
                                       title            location department  \
0                           Marketing Intern    US, NY, New York  Marketing
1  Customer Service - Cloud Video Production      NZ, , Auckland    Success
2    Commissioning Machinery Assistant (CMA)       US, IA, Wever          0
3          Account Executive - Washington DC  US, DC, Washington      Sales
4                        Bill Review Manager  US, FL, Fort Worth          0

  salary_range                                    company_profile  \
0            0  We're Food52, and we've created a groundbreaki…
1            0  90 Seconds, the worlds Cloud Video Production …
2            0  Valor Services provides Workforce Solutions th…
3            0  Our passion for improving quality of life thro…
4            0  SpotSource Solutions LLC is a Global Human Cap…

                                         description  \
0  Food52, a fast-growing, James Beard Award-winn…
1  Organised - Focused - Vibrant - Awesome!Do you…
2  Our client, located in Houston, is actively se…
3  THE COMPANY: ESRI - Environmental Systems Rese…
4  JOB TITLE: Itemization Review ManagerLOCATION:…

                                        requirements  \
0  Experience with content management systems a m…
1  What we expect from you:Your key responsibilit…
2  Implement pre-commissioning and commissioning …
3  EDUCATION: Bachelor's or Master's in GIS, busi…
4  QUALIFICATIONS:RN license in the State of Texa…

                                            benefits  telecommuting  \
0                                                  0              0
1  What you will get from usThrough being part of…             0
2                                                  0              0
3  Our culture is anything but corporate-we have …             0
4                              Full Benefits Offered              0
```

```
   has_company_logo  has_questions employment_type required_experience  \
0                 1              0           Other          Internship
1                 1              0       Full-time      Not Applicable
2                 1              0               0                   0
3                 1              0       Full-time    Mid-Senior level
4                 1              1       Full-time    Mid-Senior level

  required_education                   industry              function  \
0                  0                          0             Marketing
1                  0  Marketing and Advertising      Customer Service
2                  0                          0                     0
3  Bachelor's Degree          Computer Software                 Sales
4  Bachelor's Degree     Hospital & Health Care  Health Care Provider

   fraudulent country city
0           0      US   NY
1           0      NZ
2           0      US   IA
3           0      US   DC
4           0      US   FL
```

6 concatenating the needed object columns for job posting in one column

[50]:
```
columns_to_concat =␣
 ↪['title','location','department','salary_range','company_profile','description','requiremen

df['job_posting'] = df[columns_to_concat].apply(lambda x: ' '.join(x), axis=1)

new_df = df[['job_posting','fraudulent']].copy()
```

[51]:
```
new_df.head(10)
```

[51]:
```
                                        job_posting  fraudulent
0  Marketing Intern US, NY, New York Marketing 0 …           0
1  Customer Service - Cloud Video Production NZ, …           0
2  Commissioning Machinery Assistant (CMA) US, IA…           0
3  Account Executive - Washington DC US, DC, Wash…           0
4  Bill Review Manager US, FL, Fort Worth 0 0 Spo…           0
5  Accounting Clerk US, MD,  0 0 0 Job OverviewAp…           0
6  Head of Content (m/f) DE, BE, Berlin ANDROIDPI…           0
7  Lead Guest Service Specialist    US, CA, San F…           0
8  HP BSM SME US, FL, Pensacola 0 0 Solutions3 is…           0
9  Customer Service Associate - Part Time  US, AZ…           0
```

6.0.1 We will clean the data using NLP

```
[52]: def preprocess_text(text):
        text = text.lower()
        text = re.sub(r"http\S+|www\S+|https\S+", "", text, flags=re.MULTTLINE)
        text = re.sub(r'\d', '', text)
        text = re.sub(r'[^\w\s]', '', text)
        text = re.sub(r'[^a-zA-Z0-9\s]', '', text)

        stop_words = set(stopwords.words('english'))
        words =  [word for word in text.split() if word not in stop_words]
        text = ' '.join(words)

        return text

        new_df['job_posting'] = new_df['job_posting'].apply(preprocess_text)
```

```
[53]: new_df.head(10)
```

```
[53]:                                          job_posting  fraudulent
      0  Marketing Intern US, NY, New York Marketing 0 …           0
      1  Customer Service - Cloud Video Production NZ, …           0
      2  Commissioning Machinery Assistant (CMA) US, IA…           0
      3  Account Executive - Washington DC US, DC, Wash…           0
      4  Bill Review Manager US, FL, Fort Worth 0 0 Spo…           0
      5  Accounting Clerk US, MD,  0 0 0 Job OverviewAp…           0
      6  Head of Content (m/f) DE, BE, Berlin ANDROIDPI…           0
      7  Lead Guest Service Specialist    US, CA, San F…           0
      8  HP BSM SME US, FL, Pensacola 0 0 Solutions3 is…           0
      9  Customer Service Associate - Part Time  US, AZ…           0
```

```
[54]: Fake = new_df[new_df['fraudulent'] == 1]
      Real = new_df[new_df['fraudulent'] == 0]
```

```
[55]: Fake.head()
```

```
[55]:                                            job_posting  fraudulent
      98   IC&E Technician US, , Stocton, CA Oil & Energy…           1
      144  Forward Cap. 0 0 0 0 The group has raised a fu…           1
      173  Technician Instrument & Controls  US Power Pla…           1
      180  Sales Executive PK, SD, Karachi Sales 0 0 Sale…           1
      215  IC&E Technician Mt Poso US, CA, Bakersfield, C…           1
```

```
[56]: Real.head()
```

```
[56]:                                          job_posting  fraudulent
      0  Marketing Intern US, NY, New York Marketing 0 …           0
```

```
1  Customer Service - Cloud Video Production NZ, …          0
2  Commissioning Machinery Assistant (CMA) US, IA…          0
3  Account Executive - Washington DC US, DC, Wash…          0
4  Bill Review Manager US, FL, Fort Worth 0 0 Spo…          0
```

### we will see frequency of the words with wordcloud for both Non-Fraudulent job and Fraudulent job

[57]:

```
text_Real = ' '.join(Real['job_posting']) # here we will concatenate all job␣
  ↪postings into a single string
```

[58]:

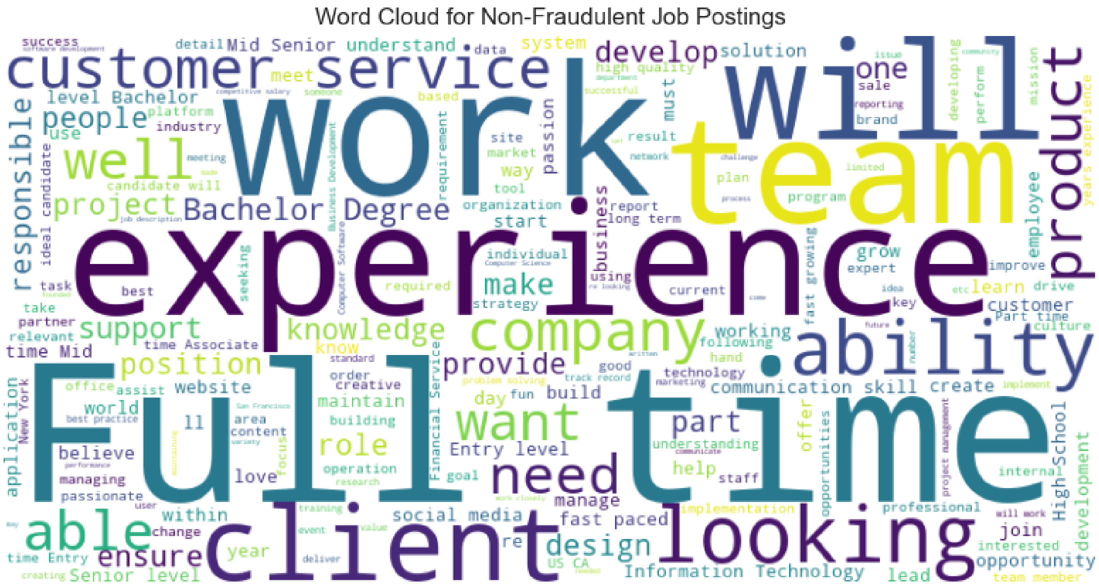
```
text_Real[:500]
```

[58]:

```
"Marketing Intern US, NY, New York Marketing 0 We're Food52, and we've created a
groundbreaking and award-winning cooking site. We support, connect, and
celebrate home cooks, and give them everything they need in one place.We have a
top editorial, business, and engineering team. We're focused on using technology
to find new and better ways to connect people around their specific food
interests, and to offer them superb, highly curated information about food and
cooking. We attract the most talent"
```

[59]:

```
from wordcloud import WordCloud

wordcloud = WordCloud(width=800, height=400, background_color='white').
  ↪generate(text_Real)

plt.figure(figsize=(10, 8))
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis('off')
plt.title('Word Cloud for Non-Fraudulent Job Postings')
plt.show()
```



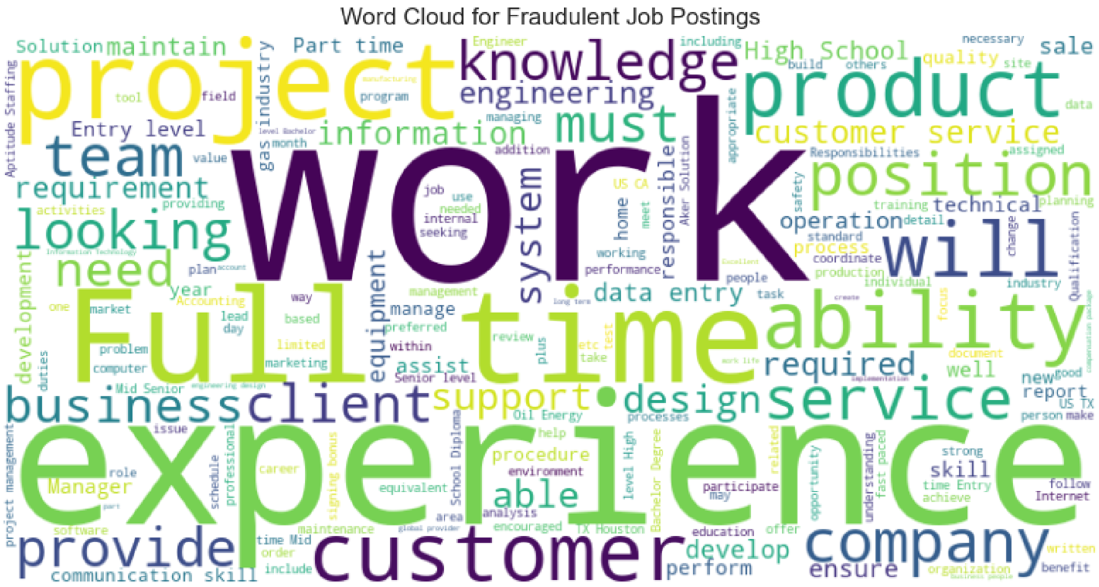
Word Cloud for Non-Fraudulent Job Postings

```
[60]: text_Fake = ''.join(Fake['job_posting'])
```

```
[61]: text_Fake[:500]
```

```
[61]: 'IC&E Technician US, , Stocton, CA Oil & Energy 95000-115000 \xa0 \xa0 \xa0 \xa0
\xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0
\xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0 \xa0
\xa0 \xa0 \xa0 \xa0 \xa0Staffing &amp; Recruiting done right for the Oil &amp;
Energy Industry!Represented candidates are automatically granted the following
perks: Expert negotiations on your behalf, maximizing your compensation package
and implimenting ongoing increases\xa0Significant signing bonus by Refined
Resources (in addition to any potential signing bonuses our client compan'
```

```
[62]: wordcloud = WordCloud(width=800, height=400, background_color='white').
       ↪generate(text_Fake)

      plt.figure(figsize=(10, 8))
      plt.imshow(wordcloud, interpolation='bilinear')
      plt.axis('off')
      plt.title('Word Cloud for Fraudulent Job Postings')
      plt.show()
```



6.0.2 Tokenization

[63]:
```
from nltk.tokenize import word_tokenize, sent_tokenize
```

[64]:
```
import nltk
nltk.download('punkt')
```

```
[nltk_data] Downloading package punkt to
[nltk_data]     C:\Users\lenovo\AppData\Roaming\nltk_data…
[nltk_data]   Package punkt is already up-to-date!
```

[64]:
```
True
```

[65]:
```
new_df['job_posting_tokens'] = new_df['job_posting'].apply(word_tokenize)

new_df['job_posting_sentences'] = new_df['job_posting'].apply(sent_tokenize)
```

[66]:
```
new_df.head()
```

[66]:
```
                                         job_posting  fraudulent  \
0  Marketing Intern US, NY, New York Marketing 0 …           0
1  Customer Service - Cloud Video Production NZ, …           0
2  Commissioning Machinery Assistant (CMA) US, IA…           0
3  Account Executive - Washington DC US, DC, Wash…           0
4  Bill Review Manager US, FL, Fort Worth 0 0 Spo…           0

                                  job_posting_tokens  \
0  [Marketing, Intern, US, ,, NY, ,, New, York, M…
1  [Customer, Service, -, Cloud, Video, Productio…
2  [Commissioning, Machinery, Assistant, (, CMA, …
3  [Account, Executive, -, Washington, DC, US, ,,…
4  [Bill, Review, Manager, US, ,, FL, ,, Fort, Wo…

                              job_posting_sentences
0  [Marketing Intern US, NY, New York Marketing O…
1  [Customer Service - Cloud Video Production NZ,…
2  [Commissioning Machinery Assistant (CMA) US, I…
3  [Account Executive - Washington DC US, DC, Was…
4  [Bill Review Manager US, FL, Fort Worth 0 0 Sp…
```

6.0.3 Part of Speech

[67]:

```python
!pip install nltk pandas
import pandas as pd
from nltk import pos_tag, word_tokenize

import nltk
nltk.download('punkt')
nltk.download('averaged_perceptron_tagger')

def pos_tagging(sentence):
    tokens = word_tokenize(sentence)
    tagged_tokens = pos_tag(tokens)
    return tagged_tokens

    new_df['job_posting_pos_tagged'] = new_df['job_posting_sentences'].apply(lambda x: [pos_tagging(sentence) for sentence in x])
```

```
Requirement already satisfied: nltk in c:\users\lenovo\anaconda3\lib\site-
packages (3.8.1)
Requirement already satisfied: pandas in c:\users\lenovo\anaconda3\lib\site-
packages (1.5.3)
Requirement already satisfied: click in c:\users\lenovo\anaconda3\lib\site-
packages (from nltk) (8.0.4)
Requirement already satisfied: joblib in c:\users\lenovo\anaconda3\lib\site-
packages (from nltk) (1.2.0)
Requirement already satisfied: regex>=2021.8.3 in
c:\users\lenovo\anaconda3\lib\site-packages (from nltk) (2022.7.9)
Requirement already satisfied: tqdm in c:\users\lenovo\anaconda3\lib\site-
packages (from nltk) (4.65.0)
Requirement already satisfied: python-dateutil>=2.8.1 in
c:\users\lenovo\anaconda3\lib\site-packages (from pandas) (2.8.2)
Requirement already satisfied: pytz>=2020.1 in
c:\users\lenovo\anaconda3\lib\site-packages (from pandas) (2022.7)
```

```
Requirement already satisfied: numpy>=1.21.0 in
c:\users\lenovo\anaconda3\lib\site-packages (from pandas) (1.24.3)
Requirement already satisfied: six>=1.5 in c:\users\lenovo\anaconda3\lib\site-
packages (from python-dateutil>=2.8.1->pandas) (1.16.0)
Requirement already satisfied: colorama in c:\users\lenovo\anaconda3\lib\site-
packages (from click->nltk) (0.4.6)
```

```
[nltk_data] Downloading package punkt to
[nltk_data]     C:\Users\lenovo\AppData\Roaming\nltk_data…
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package averaged_perceptron_tagger to
[nltk_data]     C:\Users\lenovo\AppData\Roaming\nltk_data…
[nltk_data]   Package averaged_perceptron_tagger is already up-to-
[nltk_data]       date!
```

[68]:

```python
new_df.head()
```

[68]:

```
                                         job_posting  fraudulent  \
0  Marketing Intern US, NY, New York Marketing 0 …           0
1  Customer Service - Cloud Video Production NZ, …           0
2  Commissioning Machinery Assistant (CMA) US, IA…           0
3  Account Executive - Washington DC US, DC, Wash…           0
4  Bill Review Manager US, FL, Fort Worth 0 0 Spo…           0

                                  job_posting_tokens  \
0  [Marketing, Intern, US, ,, NY, ,, New, York, M…
1  [Customer, Service, -, Cloud, Video, Productio…
2  [Commissioning, Machinery, Assistant, (, CMA, …
3  [Account, Executive, -, Washington, DC, US, ,…
4  [Bill, Review, Manager, US, ,, FL, ,, Fort, Wo…

                               job_posting_sentences
0  [Marketing Intern US, NY, New York Marketing 0…
1  [Customer Service - Cloud Video Production NZ,…
2  [Commissioning Machinery Assistant (CMA) US, I…
3  [Account Executive - Washington DC US, DC, Was…
4  [Bill Review Manager US, FL, Fort Worth 0 0 Sp…
```

6.0.4 N-Grams

[69]:

```python
from nltk.util import ngrams

def generate_ngrams(tokens, n):
    return list(ngrams(tokens, n))

n = 2
```

```
new_df['job_posting_ngrams'] = new_df['job_posting_tokens'].apply(lambda x:␣
 ↪generate_ngrams(x, n))
```

```
[70]: new_df.head()
```

```
[70]:                                         job_posting  fraudulent  \
      0  Marketing Intern US, NY, New York Marketing 0 ...           0
      1  Customer Service - Cloud Video Production NZ, ...           0
      2  Commissioning Machinery Assistant (CMA) US, IA...           0
      3  Account Executive - Washington DC US, DC, Wash...           0
      4  Bill Review Manager US, FL, Fort Worth 0 0 Spo...           0

                                        job_posting_tokens  \
      0  [Marketing, Intern, US, ,, NY, ,, New, York, M...
      1  [Customer, Service, -, Cloud, Video, Productio...
      2  [Commissioning, Machinery, Assistant, (, CMA, ...
      3  [Account, Executive, -, Washington, DC, US, ,,...
      4  [Bill, Review, Manager, US, ,, FL, ,, Fort, Wo...

                                     job_posting_sentences  \
      0  [Marketing Intern US, NY, New York Marketing 0...
      1  [Customer Service - Cloud Video Production NZ,...
      2  [Commissioning Machinery Assistant (CMA) US, I...
      3  [Account Executive - Washington DC US, DC, Was...
      4  [Bill Review Manager US, FL, Fort Worth 0 0 Sp...

                                        job_posting_ngrams
      0  [(Marketing, Intern), (Intern, US), (US, ,), (...
      1  [(Customer, Service), (Service, -), (-, Cloud)...
      2  [(Commissioning, Machinery), (Machinery, Assis...
      3  [(Account, Executive), (Executive, -), (-, Was...
      4  [(Bill, Review), (Review, Manager), (Manager, ...
```

```
[71]: new_df.columns
```

```
[71]: Index(['job_posting', 'fraudulent', 'job_posting_tokens',
             'job_posting_sentences', 'job_posting_ngrams'],
            dtype='object')
```

```
[72]: from sklearn.model_selection import train_test_split

      X_train, X_test, y_train, y_test =␣
       ↪train_test_split(new_df['job_posting_tokens'], new_df['fraudulent'],␣
       ↪test_size=0.2, random_state=42)
```

6.0.5 Vectorize the text data

[73]:
```
from sklearn.feature_extraction.text import CountVectorizer

X_train_flattened = [' '.join(sublist) for sublist in X_train]

vectorizer = CountVectorizer()
X_train_vec = vectorizer.fit_transform(X_train_flattened)

X_test_flattened = [' '.join(sublist) for sublist in X_test]
X_test_vec = vectorizer.transform(X_test_flattened)
```

[74]:
```
X_train_flattened[0]
```

[74]:
```
"Medium/Heavy duty gas and diesel technician US , MA , Bourne service
41600-62400 0 Major 's RV the premier RV service center for the south shore ,
cape and islands is accepting applications for a medium/heavy duty gas and
diesel technician to fill a full time year round position . Superior mechanical
aptitude with sound diagnostic and reasoning skillsMassachusetts CDL . Class A
or B , or willingness to attain oneMassachusetts State Inspection license , or
willingness to attain oneAttention to detail and computer literacystrong
customer service and communication skillsExcellent work , driving and safety
recordwith a minimum of 5 years experience pr very aggressive pay package for
the right candidatehealth insurance , uniforms and 401k matching controbution
after two years Full-time Mid-Senior level Vocational Automotive Other"
```

[75]:
```
X_train
```

[75]:
```
5054     [Medium/Heavy, duty, gas, and, diesel, technic…
10649    [Junior, Account, Manager, GR, ,, I, ,, ATHENS…
10262    [Customer, Service, Associate, -, Part, Time, …
7750     [Project, Manager, US, ,, CA, ,, San, Francisc…
17514    [Web, Graphic, Designer, GB, ,, NYK, ,, Scarbo…
                                …
11415    [Online, Performance, Analyst, IL, ,, ,, Tel, …
12107    [Database, Developer, SE, ,, I, ,, Visby, 0, 0…
5415     [Delivery, Driver, CA, ,, ON, ,, Concord, 0, 3…
863      [Python, ,, Oracle, ,, Teradata, ,, Java, (, J…
16035    [Reporter, ,, Agri, Investor, US, ,, NY, ,, Ne…
Name: job_posting_tokens, Length: 14079, dtype: object
```

[76]:
```
print("Shape of X_train_vec:", X_train_vec.shape)
print("Number of samples in X_train:", X_train.shape[0])


print("Shape of X_test_vec:", X_test_vec.shape)
print("Number of samples in X_test:", X_test.shape[0])
```

```
Shape of X_train_vec: (14079, 93111)
Number of samples in X_train: 14079
Shape of X_test_vec: (3520, 93111)
Number of samples in X_test: 3520
```

[ ]:

```

```

[77]:

```
X_train, X_test, y_train, y_test = train_test_split(X_train_vec, y_train,␣
  ↪test_size=0.2, random_state=42)
```

[ ]:

```
print(X_)
```

6.1 LogisticRegression

[79]:

```
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, classification_report,␣
  ↪confusion_matrix

logistic_regression = LogisticRegression()
logistic_regression.fit(X_train, y_train)

y_pred = logistic_regression.predict(X_test)

accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)

print(classification_report(y_test, y_pred))

print("Confusion Matrix:")
print(confusion_matrix(y_test, y_pred))
```

```
Accuracy: 0.984375
              precision    recall  f1-score   support

           0       0.99      1.00      0.99      2692
           1       0.93      0.69      0.80       124

    accuracy                           0.98      2816
   macro avg       0.96      0.85      0.89      2816
weighted avg       0.98      0.98      0.98      2816

Confusion Matrix:
[[2686    6]
 [  38   86]]
```

[80]:

```
X_test
```

```
[80]: <2816x93111 sparse matrix of type '<class 'numpy.int64'>'
              with 616574 stored elements in Compressed Sparse Row format>
```

```
[81]: print(X_test[972])
```

```
  (0, 5285)     3
  (0, 86041)    1
  (0, 71399)    1
  (0, 80821)    5
  (0, 32452)    3
  (0, 41013)    2
  (0, 81766)    7
  (0, 81417)    2
  (0, 88942)    2
  (0, 53946)    2
  (0, 52516)    2
  (0, 87031)    1
  (0, 38461)    3
  (0, 49822)    1
  (0, 4623)     1
  (0, 11860)    1
  (0, 62353)    1
  (0, 4989)     2
  (0, 42726)    1
  (0, 88671)    2
  (0, 54641)    1
  (0, 35973)    1
  (0, 51884)    1
  (0, 90159)    3
  (0, 88765)    2
  :     :
  (0, 34238)    4
  (0, 72027)    1
  (0, 68367)    1
  (0, 12650)    4
  (0, 80801)    1
  (0, 29319)    1
  (0, 1432)     3
  (0, 49069)    1
  (0, 52959)    2
  (0, 33149)    1
  (0, 86043)    1
  (0, 36260)    1
  (0, 18815)    1
  (0, 48898)    2
  (0, 89768)    1
  (0, 20810)    1
  (0, 126)	1
  (0, 74494)	1
  (0, 69910)	1
  (0, 87042)	1
  (0, 77462)	1
  (0, 78818)	1
  (0, 45859)	1
  (0, 86026)	1
  (0, 57231)	1
```

[87]:

```
X_test.shape
```

[87]:

```
(2816, 93111)
```

[82]:

```
input_text=["customer service associate us, ca, san francisco novitex␣
 ↪enterprise solutions, formerly pitney bowes management services, delivers␣
 ↪innovative document communications management solutions help companies␣
 ↪around world drive business process efficiencies, increase productivity,␣
 ↪reduce costs improve customer satisfaction. almost 30 years, clients turned␣
 ↪us integrate optimize enterprise-wide business processes empower employees,␣
 ↪increase productivity maximize results. trusted partner, continually focus␣
 ↪delivering secure, technology-enabled document communications solutions␣
 ↪improve clients' work processes, enhance customer interactions drive growth.␣
 ↪customer service associate based san francisco, ca. right candidate integral␣
 ↪part talented team, supporting continued growth.responsibilities:perform␣
 ↪various mail center activities (sorting, metering, folding, inserting,␣
 ↪delivery, pickup, etc.)lift heavy boxes, files paper neededmaintain highest␣
 ↪levels customer care demonstrating friendly cooperative attitudedemonstrate␣
 ↪flexibility satisfying customer demands high volume, production␣
 ↪environmentconsistently adhere business procedure guidelinesadhere safety␣
 ↪procedurestake direction supervisor site managermaintain logs reporting␣
 ↪documentation; attention detailparticipate cross-training perform duties␣
 ↪assigned (filing, outgoing shipments, etc)operating mailing, copy scanning␣
 ↪equipmentshipping & receivinghandle time-sensitive material like␣
 ↪confidential, urgent packagesperform tasks assignedscanning incoming mail␣
 ↪recipientsperform file purges pullscreate files ship filesprovide backfill␣
 ↪neededenter information daily spreadsheetsidentify charges match billingsort␣
 ↪deliver mail, small packages minimum requirements:minimum 6 months customer␣
 ↪service related experience requiredhigh school diploma equivalent (ged)␣
 ↪requiredpreferred qualifications:keyboarding windows environment pc skills␣
 ↪required (word, excel powerpoint preferred)experience running mail posting␣
 ↪equipment plusexcellent communication skills verbal writtenlifting 55 lbs␣
 ↪without accommodationswillingness availability work additional hours␣
 ↪assignedwillingness submit pre-employment drug screening criminal background␣
 ↪checkability effectively work individually team environmentcompetency␣
 ↪performing multiple functional tasksability meet employer's attendance␣
 ↪policy computer software"]
```

[83]:

```
from sklearn.feature_extraction.text import TfidfVectorizer
vect = TfidfVectorizer()
vect.fit(Real['job_posting'])
```

[83]:

```
TfidfVectorizer()
```

6.2 Decision Tree

[84]:

```
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.tree import DecisionTreeClassifier

vect = TfidfVectorizer()
vect.fit(Real['job_posting'])

input_data_features = vect.transform(input_text)


dt = DecisionTreeClassifier()

y = Real['fraudulent']
dt.fit(vect.transform(Real['job_posting']), y)

prediction = dt.predict(input_data_features)
print(prediction)


if (prediction[0]==1):
  print('Fraudulant Job')

else:
  print('Real Job')
```

```
[0]
Real Job
```

[85]:

```
conf_matrix = confusion_matrix(y_test, y_pred)
print('Confusion Matrix:')
print(conf_matrix)

print('Classification Report:')
print(classification_report(y_test, y_pred))
```

```
Confusion Matrix:
[[2686    6]
 [  38   86]]
Classification Report:
              precision    recall  f1-score   support
```

```
           0       0.99      1.00      0.99      2692
           1       0.93      0.69      0.80       124

    accuracy                           0.98      2816
   macro avg       0.96      0.85      0.89      2816
weighted avg       0.98      0.98      0.98      2816
```

[ ]:

[ ]:

[ ]: