Data collection through Webscraping

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Introduction

Collecting data and preparing it for a project is one of the most important tasks in any data science or machine learning project. There are many sources from where we can collect data for a project, such as

- Connecting to a SQL database server
- Data Source Websites such as Kaggle, Google Dataset Search, UCI Machine Learning Repo etc
- Web Scraping with Beautiful Soup
- Using Python API

Data Source Websites

Data source websites mainly falls into two categories such as data repositories and data science competitions. There are many such websites.

1. The UCI Machine Learning Repository

2. The Harvard Dataverse
3. The Mendeley Data Repository
4. The 538
5. The New Yourk Times

6. The International Data Analysis Olympiad
7. Kaggle Competition

Example of collecting data from UCI Machine Learning Repository

```python
from ucimlrepo import fetch_ucirepo

# fetch dataset
iris = fetch_ucirepo(id=53)

# data (as pandas dataframes)
X = iris.data.features
y = iris.data.targets

# metadata
print(iris.metadata)

# variable information
print(iris.variables)
```

```
{'uci_id': 53, 'name': 'Iris', 'repository_url': 'https://archive.ics.uci.edu/dataset/53/iris
           name     role         type demographic  \
0  sepal length  Feature   Continuous        None
1   sepal width  Feature   Continuous        None
2  petal length  Feature   Continuous        None
3   petal width  Feature   Continuous        None
4         class   Target  Categorical        None

                                         description units missing_values
0                                               None    cm             no
1                                               None    cm             no
2                                               None    cm             no
3                                               None    cm             no
4  class of iris plant: Iris Setosa, Iris Versico...  None             no
```

you may need to install the UCI Machine Learning Repository as a package using pip.

```
pip install ucimlrepo
```

```
X.head()
```

	sepal length	sepal width	petal length	petal width
0	5.1	3.5	1.4	0.2
1	4.9	3.0	1.4	0.2
2	4.7	3.2	1.3	0.2
3	4.6	3.1	1.5	0.2
4	5.0	3.6	1.4	0.2

Web Scraping

We scrapping is another way of collecting the data for the research if the data is not available in any repositiory. We can collect the data from a website using a library called `BeautifulSoup` if the website has permision for other people to collect data from the website.

```
import bs4                           # library for BeautifulSoup
from bs4 import BeautifulSoup        # import the BeautifulSoup object
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from seaborn import set_style
set_style("whitegrid")
```

Now let's make a html object using `BeautifulSoup`. Let's say we have a html website that looks like below

```
html_doc="""
<!DOCTYPE html>
<html lang="en">
<head>
    <title>My Dummy HTML Document</title>
</head>
<body>
    <h1>Welcome to My Dummy HTML Document</h1>
    <p>This is a paragraph in my dummy HTML document.</p>
    <a href="https://mrislambd.github.io/blog" class="blog" id="blog"> Blog </a>
    <a href="htpps://mrislambd.github.io/research" class="research" id="research"> Research <
```

```
</body>
</html>
"""
```

Now we want to grab information from the dummy html documnet above.

```
soup=BeautifulSoup(html_doc, features='html.parser')
```

Now that we have the object `soup` we can walk through each elements in this object. For example, if we want to grab the title element,

```
soup.html.head.title
```

```
<title>My Dummy HTML Document</title>
```

Since the html document has only one title, therefore, we can simply use the following command

```
soup.title
```

```
<title>My Dummy HTML Document</title>
```

or this command to get the text only

```
soup.title.text
```

```
'My Dummy HTML Document'
```

This `soup` object is like a family tree. It has parents, children, greatgrand parents etc.

```
soup.title.parent
```

```
<head>
<title>My Dummy HTML Document</title>
</head>
```

Now to grab an attribute from the `soup` object we can use

```
soup.a
```

```
<a class="blog" href="https://mrislambd.github.io/blog" id="blog"> Blog </a>
```

or any particular thing from the attribute

```
soup.a['class']
```

```
['blog']
```

We can also find multiple attribute of the same kind

```
soup.findAll('a')
```

```
[<a class="blog" href="https://mrislambd.github.io/blog" id="blog"> Blog </a>,
 <a class="research" href="htpps://mrislambd.github.io/research" id="research"> Research </a
```

Then if we want any particular object from all `a` attribute

```
soup.findAll('a')[0]['id']
```

```
'blog'
```

For any `p` tag

```
soup.p.text
```

```
'This is a paragraph in my dummy HTML document.'
```

Similarly, if we want to grab all the `href`s from the `a` tags

```
[h['href'] for h in soup.findAll('a')]
```

```
['https://mrislambd.github.io/blog', 'htpps://mrislambd.github.io/research']
```

Example of Webscraping from a real website

In this example we want to obtain some information from NVIDIA Graduate Fellowship Program. Before accessing this website we need to know if we have permision to access their data through webscraping.

```
import requests
response = requests.get(url="https://research.nvidia.com/graduate-fellowships/archive")
response.status_code
```

```
200
```

The `status_code` 200 ensures that we have enough permision to acccess their website data. However, if we obtain `status_code` of 403, 400, or 500 then we do not permision or a `bad request`. For more about the status codes click here.

```
soup = BeautifulSoup(response.text, 'html.parser')
```

We want to make an analysis based on the institution of the past graduate fellows. Insepecting the elements in this website we see that the `div` those have `class="archive-group"` contains the information of the past graduate fellows.

```
pf = soup.find_all("div", class_="archive-group")
```

and the first element of this `pf` contains the information of the graduate fellows in the year of 2021.

```
pf[0]
```

```
<div class="archive-group">
<h4 class="archive-group__title">2021 Grad Fellows</h4>
<div class="views-row"><div class="views-field views-field-title"><span class="field-content
<div class="views-row"><div class="views-field views-field-title"><span class="field-content
<div class="views-row"><div class="views-field views-field-title"><span class="field-content
<div class="views-row"><div class="views-field views-field-title"><span class="field-content
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<div class="views-row"><div class="views-field views-field-title"><span class="field-content
<div class="views-row"><div class="views-field views-field-title"><span class="field-content
</div>
```

Now let's make a `pandas` dataframe using the information in this page. We can make an use of the output from the above chunk. To grab the year, we see that `archive-group__title` class with a `h4` tag contains the year for all years. With `strip=True`, the text is cleaned by removing extra whitespace from the beginning and end. We need the first element so a `split()[0]` will do the job. Then we make another group called `fellows` that contains the fellows in a certian year by using the `div` and `class"views-row"`. Once the new group created, we then iterate through this group to extract their names and corresponding institutions.

```
data=[]

for group in pf:
    year = group.find(
        "h4",class_="archive-group__title"
        ).get_text(strip=True).split()[0]

    fellows = group.find_all("div", class_="views-row")
    for fellow in fellows:
        name = fellow.find(
            "div", class_="views-field-title"
            ).get_text(strip=True)
        institute = fellow.find(
            "div", class_="views-field-field-grad-fellow-institution"
            ).get_text(strip=True)

        data.append({"Name": name, "Year": year, "Institute": institute})

data=pd.DataFrame(data)
data.head()
```

	Name	Year	Institute
0	Alexander Sax	2021	University of California, Berkeley
1	Hanrui Wang	2021	Massachusetts Institute of Technology
2	Ji Lin	2021	Massachusetts Institute of Technology
3	Krishna Murthy Jatavallabhula	2021	University of Montreal
4	Rohan Sawhney	2021	Carnegie Mellon University

Now let's perform some Exploratory Data Analysis (EDA). First, we analyze the unique values and distributions.

```
# Count the number of fellows each year
year_counts = data['Year'].value_counts().sort_values(ascending=False)
# Create a DataFrame where years are columns and counts are values in the next row
year_data = {
    'Year': year_counts.index,
    'Count': year_counts.values
}
# Create the DataFrame
year_data_counts = pd.DataFrame(year_data)

# Transpose the DataFrame and reset index to get years as columns
year_data_counts = year_data_counts.set_index('Year').T

# Display the DataFrame
print(year_data_counts)
```

```
Year   2006  2018  2017  2007  2013  2012  2011  2008  2019  2021  2003  2009  \
Count    12    11    11    11    11    11    11    10    10    10    10    10

Year   2010  2005  2015  2004  2016  2002  2020  2014
Count     9     8     7     7     6     6     5     5
```

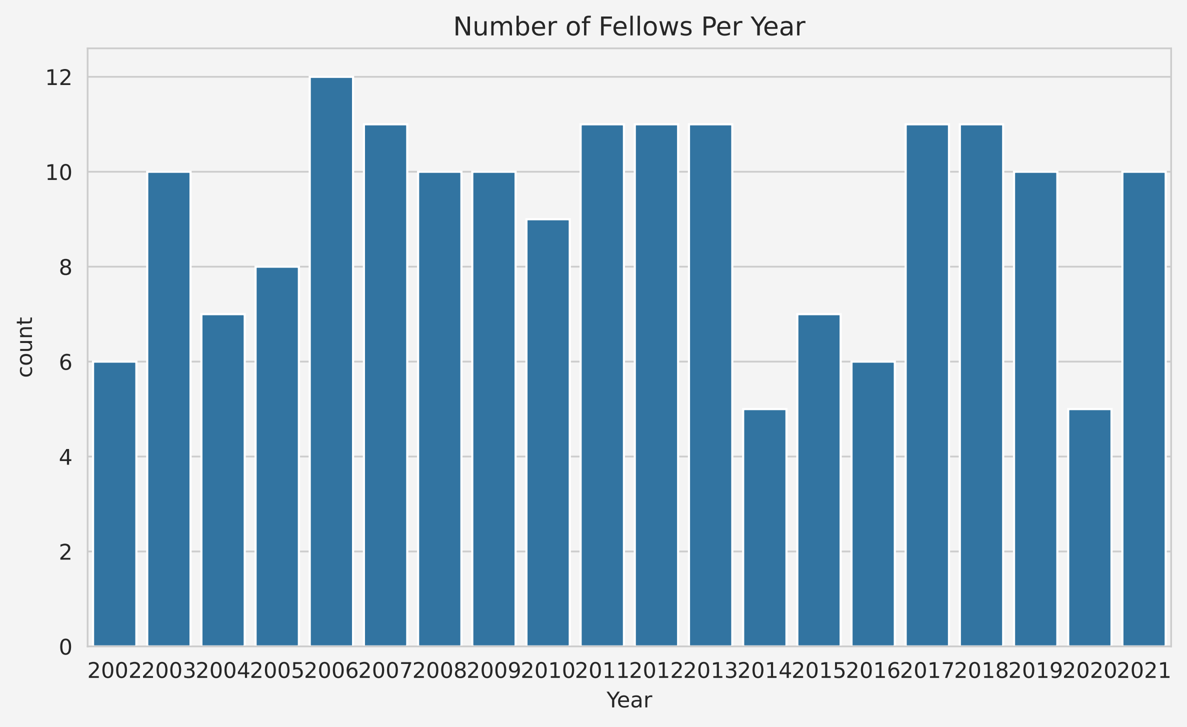
Next we see that most represented universities

```
university_counts = data['Institute'].value_counts()
print(university_counts.head(10))  # Display the top 10 universities
```

```
Institute
Stanford University                          24
Massachusetts Institute of Technology        15
University of California, Berkeley           14
Carnegie Mellon University                   13
University of Utah                           10
University of Washington                      9
University of Illinois, Urbana-Champaign      9
University of California, Davis               8
Georgia Institute of Technology               8
University of North Carolina, Chapel Hill     6
Name: count, dtype: int64
```

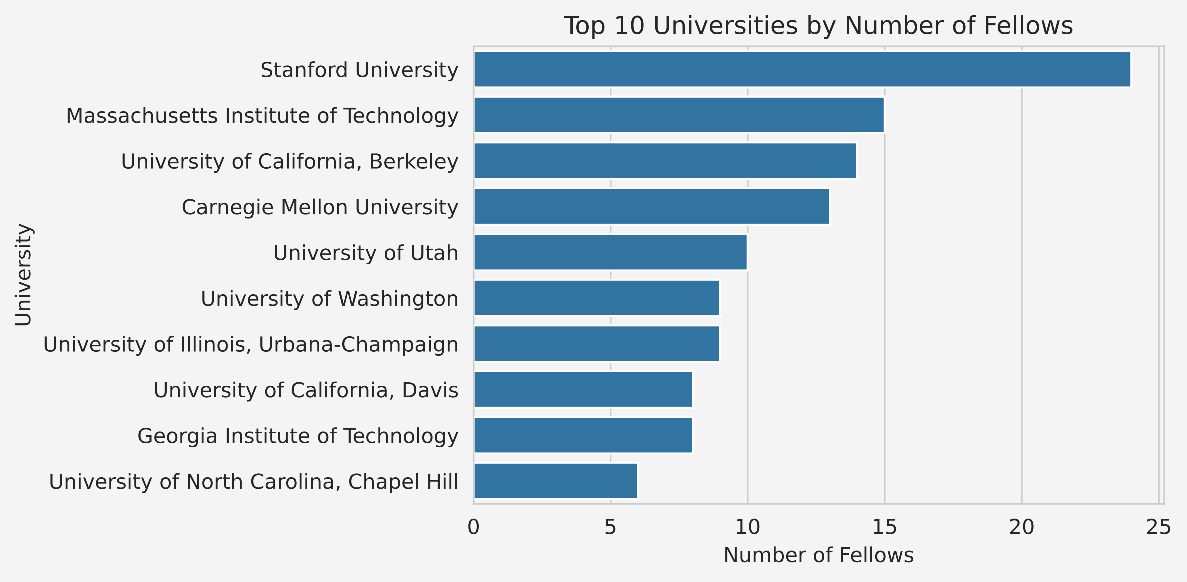
To visualize the award distributions per year,

```
plt.figure(figsize=(9,5))
sns.countplot(x='Year', data=data, order=sorted(data['Year'].unique()))
plt.gca().set_facecolor('#f4f4f4')
plt.gcf().patch.set_facecolor('#f4f4f4')
plt.title('Number of Fellows Per Year')
plt.show()
```



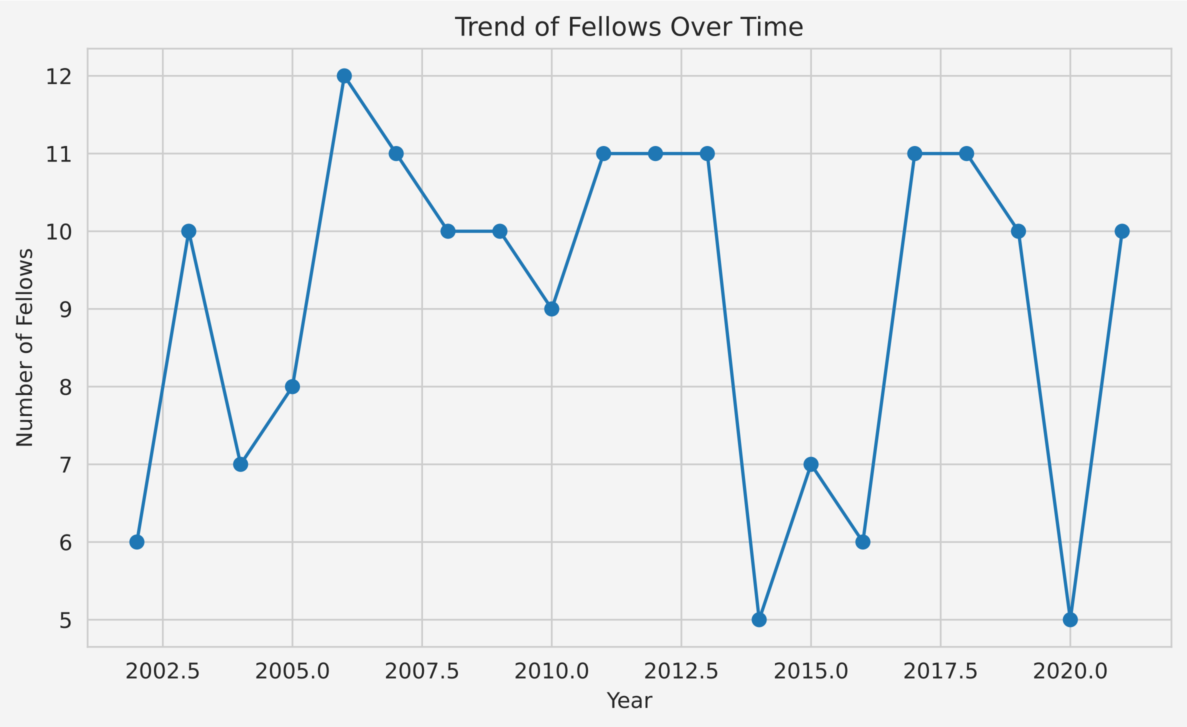
Top 10 universities visualization

```
plt.figure(figsize=(6,4))
top_universities = data['Institute'].value_counts().head(10)
sns.barplot(y=top_universities.index, x=top_universities.values)
plt.gca().set_facecolor('#f4f4f4')
plt.gcf().patch.set_facecolor('#f4f4f4')
plt.title('Top 10 Universities by Number of Fellows')
plt.xlabel('Number of Fellows')
plt.ylabel('University')
plt.show()
```



Trend over time

```
plt.figure(figsize=(9,5))
data['Year'] = data['Year'].astype(int)
yearly_trend = data.groupby('Year').size()
yearly_trend.plot(kind='line', marker='o')
plt.gca().set_facecolor('#f4f4f4')
plt.gcf().patch.set_facecolor('#f4f4f4')
plt.title('Trend of Fellows Over Time')
plt.xlabel('Year')
plt.ylabel('Number of Fellows')
plt.show()
```



This is just a simple example of collecting data through webscraping. This `BeautifulSoup` has endless potentials to use in many projects to collect the data that are not publicly available in cleaned or organized form. Thank you for reading.

References

- Fisher,R. A.. (1988). Iris. UCI Machine Learning Repository.

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