DataWrangling

October 21, 2021

[1]:

```
# Import pandas and numpy
import pandas as pd
import numpy as np

# Import visualization libraries
import matplotlib.pyplot as plt
%matplotlib inline
import plotly.express as px

# Pandas setting
pd.options.plotting.backend = "plotly"
pd.options.mode.chained_assignment = None
```

[2]:

```
# Import dataset
df = pd.read_csv('datasets/theses_v2.csv', encoding='latin-1', low_memory=False)
```

[3]:

```
import re

# Pre-processing
df.replace('', np.NaN, inplace=True)
df['Auteur'] = df['Auteur'].apply(lambda s: re.sub('\([^\)]+\)', '', s.title()).
 ↪rstrip())

df['Identifiant auteur'] = df['Identifiant auteur'].apply(lambda x: str(x).
 ↪replace(',', ''))
df['Identifiant auteur'].replace({'nan' : np.nan, '' : np.nan}, inplace = True)

df['Identifiant directeur'] = df['Identifiant directeur'].apply(lambda x:␣
 ↪str(x).replace(',', ''))
df['Identifiant directeur'].replace({'na' : np.nan, '' : np.nan}, inplace =␣
 ↪True)

df['Supervisor'] = df['Directeur de these (nom prenom)'].str.title()
df['Supervisor'].replace({'Directeur De These Inconnu' : np.nan}, inplace =␣
 ↪True)
df.drop(columns=['Directeur de these', 'Directeur de these (nom prenom)'],␣
 ↪inplace=True)
```

1 Missing Data

Create number of pages column

[4]:
```
from scipy.stats import bernoulli as bn

mu, sigma = 200, 50
pages = sigma * np.random.randn(1, df.shape[0]) + mu

flag = bn.rvs(p = 0.8, size = (1, df.shape[0]))
pages[flag == 0] = np.nan

df['nb_pages'] = pages.ravel() # Number of pages column
```

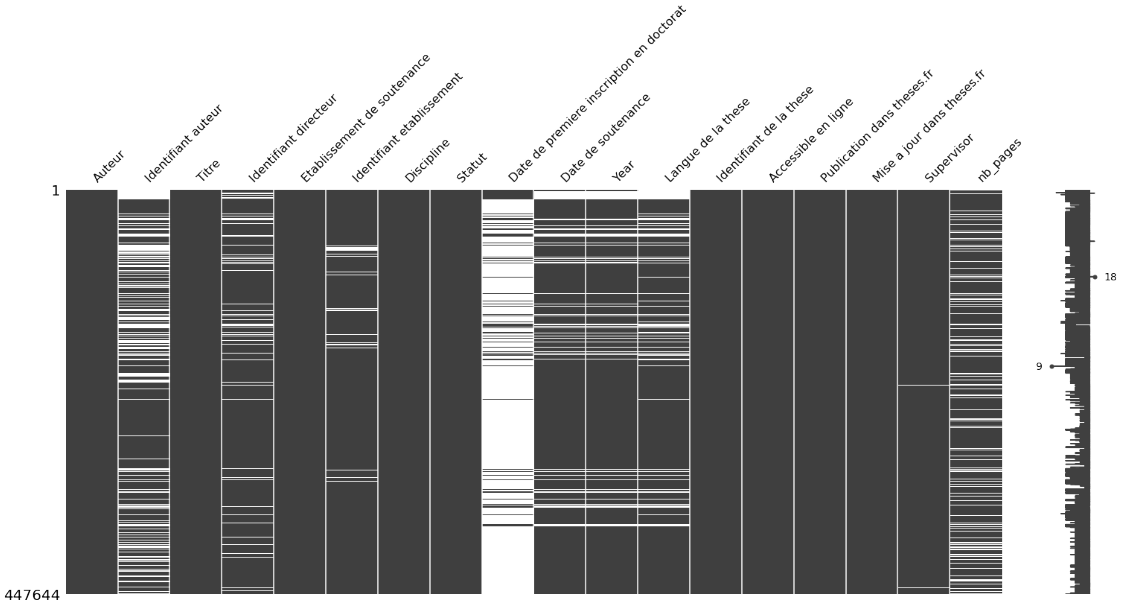
[5]:
```
print(df.isna().mean().round(4) * 100)
```

```
Auteur                                       0.00
Identifiant auteur                          29.14
Titre                                        0.00
Identifiant directeur                       10.98
Etablissement de soutenance                  0.00
Identifiant etablissement                    3.82
Discipline                                   0.00
Statut                                       0.00
Date de premiere inscription en doctorat    85.71
Date de soutenance                          12.68
Year                                        12.68
Langue de la these                          14.24
Identifiant de la these                      0.00
Accessible en ligne                          0.00
Publication dans theses.fr                   0.00
Mise a jour dans theses.fr                   0.04
Supervisor                                   0.16
nb_pages                                    20.13
dtype: float64
```

Missing data plot

[6]:
```
import missingno as msno

msno.matrix(df)
plt.savefig("plots/missing_plot.png")
```



Dealing with missing data using imputation technique

[7]:
```
from sklearn.impute import SimpleImputer

imp = SimpleImputer(missing_values=np.nan, strategy='mean')
df['nb_pages'] = imp.fit_transform(df[['nb_pages']]).ravel()
df['nb_pages'] = df['nb_pages'].apply(int)
```

2 Common issues

[8]:
```
df_defences = df.dropna(subset=['Date de soutenance'])
df_defences['Date de soutenance'] = pd.DatetimeIndex(df_defences['Date de␣
 ↪soutenance'])
df_defences['Month'] = df_defences['Date de soutenance'].apply(lambda x: x.
 ↪month)

years = df_defences.groupby('Year').count().reset_index().reindex(['Year',␣
 ↪'Titre'], axis=1).set_index('Year')
```

2.0.1 How common are the defences on the first of January?

[9]:
```
df_0101 = df_defences[df_defences['Date de soutenance'].apply(lambda x: np.
 ↪logical_and(x.day == 1, x.month == 1))]

percentage_thesis_0101 = np.round(df_0101.shape[0] / df_defences.shape[0], 4) *␣
 ↪100
```

```
print(percentage_thesis_0101, '%')
```

```
71.89 %
```

2.0.2 How did the proportion of defences at the first of january evolve over the years ?

[10]:
```
# Calculate percentage
df_0101 = df_0101.groupby('Year').count().reset_index().reindex(['Year',␣
↪'Titre'], axis=1)
df_0101.rename(columns={'Titre' : 'nb_Thesis'}, inplace=True)
df_0101['nb_Thesis_byyear'] = df_0101['Year'].apply(lambda x: years.loc[x])
df_0101['Percentage'] = df_0101['nb_Thesis'] / df_0101['nb_Thesis_byyear'] * 100
```

[11]:
```
fig = df_0101.plot(x='Year', y='Percentage', title='Percentage of thesis␣
↪defended on New Year\'s Day')
fig.write_image('plots/thesis_newyeareve.png')
fig.show()
```

2.0.3 In the Author name, how common are homonyms ? Check for Cecile Martin. Investigate her case and try to figure out what happened.

[12]:
```
print(df['Auteur'].duplicated(keep=False).mean().round(4) * 100,'%')
```

```
7.66 %
```

[13]:
```
df['Auteur'].value_counts().head(10)
```

[13]:
```
Philippe Martin    16
Nicolas Martin     16
Philippe Michel    13
Yang Liu           12
Franck Martin      12
Laurent Martin     11
Jing Wang          11
Pierre Martin      11
Olivier Martin     11
Yu Wang            11
Name: Auteur, dtype: int64
```

[14]:
```
df[df['Auteur']== 'Cecile Martin'][['Identifiant auteur', 'Auteur', 'Year',␣
↪'Supervisor']]
```

[14]:
```
       Identifiant auteur         Auteur    Year         Supervisor
61289           203208145  Cecile Martin  2017.0     Jullier Laurent
166820           81323557  Cecile Martin  2000.0      Lossouarn Jean
267565          179423568  Cecile Martin  2014.0    Dormont Brigitte
410228           81323557  Cecile Martin  2001.0     Antonini Gerard
```

```
414771           81323557  Cecile Martin  1991.0       Mironneau Jean
426351           81323557  Cecile Martin  1994.0          Briand Yves
432070          182118703  Cecile Martin  1989.0  Vautherin Dominique
```

There is a sudden drop in the number of PhD defended in 2019 and 2020. Propose 3 hypotheses to explain this phenomenon.

```
[15]: temp = df_defences.groupby('Year').count().reset_index().reindex(['Year',␣
       ↪'Titre'], axis=1)
      temp.rename(columns={'Titre' : 'Number Thesis'}, inplace=True)
      fig = temp.plot(x='Year', y='Number Thesis', title='Thesis defended by Year')
      fig.write_image('plots/nb_thesis_by_year.png')
      fig.show()
```

```
[16]: # Latest defense in dataset
      df_defences['Date de soutenance'].max()
```

```
[16]: Timestamp('2020-12-06 00:00:00')
```

3 Outliers

Check Supervisor ID

```
[17]: df['Identifiant directeur'].value_counts().head(10)
```

```
[17]: 1           1057
      7            718
      3            712
      8            618
      6            557
      2            517
      9            284
      59375140     208
      26730774     205
      26756625     193
      Name: Identifiant directeur, dtype: int64
```

```
[18]: df_outliers = df[df['Identifiant directeur'].str.len() == 1]
      print(df_outliers.shape[0]) # Number of thesis supervised by top 7 ID
```

```
4587
```

```
[19]: print(df_outliers.groupby('Supervisor').count().shape[0]) # Number of different␣
       ↪supervisors attached to 7 ID
```

```
4504
```

Investigate ID 59375140

[20]:

```
df[df['Identifiant directeur'] == '59375140'].head(10)[['Identifiant␣
↪directeur', 'Supervisor', 'Auteur', 'Titre', 'Year']]
```

[20]:

```
       Identifiant directeur              Supervisor                   Auteur  \
90380               59375140  Scherrmann Jean-Michel           Ramzi Shawahna
91570               59375140  Scherrmann Jean-Michel            Leonor Vignol
97927               59375140  Scherrmann Jean-Michel   Anne J. Moulin Paccaly
98808               59375140  Scherrmann Jean-Michel          Sandrine Dauchy
103898              59375140  Scherrmann Jean-Michel            Severine Piot
104937              59375140  Scherrmann Jean-Michel           Sandrine Brami
107340              59375140  Scherrmann Jean-Michel  Frederique Stain Texier
112724              59375140  Scherrmann Jean-Michel               Pierre Got
141777              59375140  Scherrmann Jean-Michel         Christophe Junot
144232              59375140  Scherrmann Jean-Michel            Stephane Lamy

                                                    Titre    Year
90380   Expression genomique et proteomique quantitati…  2011.0
91570   Influence des variabilites pharmacocinetique e…  2001.0
97927   Approches pharmacocinetiques/pharmacodynamique…  2005.0
98808   Expression, localisation et regulation des tra…  2008.0
103898  Evaluation de 2 associations comportant du doc…  1999.0
104937  Les interactions medicamenteuses avec les inhi…  1999.0
107340  Contribution a la recherche du mecanime de l'a…  1999.0
112724  Immuno-analyse et chiralite. Facteurs influenc…  1997.0
141777  Le tetrapeptide acetyl-seryl-aspartyl-lysyl-pr…  2000.0
144232  Mise au point et validation d'une methode d'ul…  1999.0
```

Check Author ID

[21]:

```
df['Identifiant auteur'].value_counts().head(10)
```

[21]:

```
05990190X    12
69413916      7
85924660      6
069632472     6
60151013      6
56833776      5
27013340      5
34296565      5
78079365      5
66761999      5
Name: Identifiant auteur, dtype: int64
```

Investigate ID 05990190X

[22]:

```
df[df['Identifiant auteur'] == '05990190X'][['Identifiant auteur', 'Auteur',␣
↪'Titre', 'Year', 'Supervisor']]
```

```
[22]:        Identifiant auteur                                              Auteur  \
      198300          05990190X                 Olivier Costerousse,Philippe Ascher
      366482          05990190X             Mohcine Bennani Mechita,Philippe Ascher
      373880          05990190X            Catherine Genevee-Gaudin,Philippe Ascher
      377636          05990190X                      Armelle Helene,Philippe Ascher
      378116          05990190X                       Cecile Dufour,Philippe Ascher
      389849          05990190X                       Thierry Galli,Philippe Ascher
      401866          05990190X                   Veronique Taupin,Philippe Ascher
      407053          05990190X                    Aymeric Duclert,Philippe Ascher
      417726          05990190X  Sylvie Dumas Milne Edwards De Vitry D'Avaucour…
      418298          05990190X                   Mohamed Machwate,Philippe Ascher
      428206          05990190X                   Jean-Marc Chatel,Philippe Ascher
      428622          05990190X                            Lei Wei,Philippe Ascher

                                                           Titre    Year  \
      198300  Regulation de l'expression du gene de l'enzyme…  1993.0
      366482  Analyse de la contribution de diverses regions…  1994.0
      373880  Methodes d'etude du recepteur des lymphocytes …  1993.0
      377636  Analyse structurale du site actif de trois met…  1993.0
      378116  Heterogeneite genetique de la cardiomyopathie …  1995.0
      389849  N-acetyl-aspartyl-glutamate et ganglions de la…  1992.0
      401866  Modulation de la production de cytokines pro-i…  1992.0
      407053  Contribution a l'etude de la regulation des ge…  1994.0
      417726  Diversite des regulations de l'expression de l…  1993.0
      418298  Etude de la formation osseuse dans un modele d…  1994.0
      428206  Un compartiment d'acetylcholinesterase inactiv…  1993.0
      428622  Biosynthese et proprietes enzymatiques et phar…  1991.0

                         Supervisor
      198300  Alhenc-Gelas Francois
      366482          Elion Jacques
      373880       Triebel Frederic
      377636              Roques B.
      378116            Schwartz K.
      389849      Glowinski Jacques
      401866           Zavala Flora
      407053   Changeux Jean-Pierre
      417726         Mallet Jacques
      418298               Marie P.
      428206         Massoulie Jean
      428622           Clauser Eric
```

4 Preliminary Results

4.1 Languages and Defense day

[23]:

```
# Extract only thesis that has language record from 2000
df_lang = df_defences.drop(df_defences[df_defences['Langue de la these'].
 ↪isna()].index)
df_lang.drop(df_lang[df_lang['Year'] < 2000].index, inplace=True)

years = df_lang.groupby('Year').count().reset_index().reindex(['Year',␣
 ↪'Titre'], axis=1).set_index('Year')
```

[24]:

```
# Categorize language column to English, French, Multilingual and Others.
df_lang['Langue de la these'] = df_lang['Langue de la these'].str.lower()

conditions  = [ df_lang['Langue de la these'] == 'en', df_lang['Langue de la␣
 ↪these'] == 'fr',
                df_lang['Langue de la these'].str.len() > 2]
choices     = [ "English", 'French', 'Multilingual']

df_lang['Langue de la these'] = np.select(conditions, choices, default =␣
 ↪'Others')
years = df_lang.groupby('Year').count().reset_index().reindex(['Year',␣
 ↪'Titre'], axis=1).set_index('Year')
```

[25]:

```
# Calculate percentage
df_lang = df_lang.groupby(['Year', 'Langue de la these']).count().reset_index().
 ↪reindex(['Year', 'Langue de la these', 'Titre'], axis=1)
df_lang.rename(columns={'Titre' : 'nb_Thesis', 'Langue de la these' :␣
 ↪'Language'}, inplace=True)
df_lang['nb_Thesis_byyear'] = df_lang['Year'].apply(lambda x: years.loc[x])
df_lang['Percentage'] = df_lang['nb_Thesis'] / df_lang['nb_Thesis_byyear'] * 100
```

[26]:

```
fig = px.bar(df_lang, x="Year", y="Percentage", color="Language",␣
 ↪title="Language of thesis by Year")
fig.write_image("plots/language_by_year.png")
fig.show()
```

What period of the year do PhD candidates tend to defend?

[27]:

```
# Extract only thesis that's defended from 2011
df_months = df_defences[df_defences['Date de soutenance'].apply(lambda x: np.
 ↪logical_and(x.year > 2010, np.logical_or(x.day != 1, x.month != 1)))]

years = df_months.groupby('Year').count().reset_index().reindex(['Year',␣
 ↪'Titre'], axis=1).set_index('Year')
```

[28]:

```
# Calculate percentage
df_months = df_months.groupby(['Year', 'Month']).count().reset_index().
 ↪reindex(['Year', 'Month', 'Titre'], axis=1)
```

```
df_months.rename(columns={'Titre' : 'nb_Thesis'}, inplace=True)
df_months['nb_Thesis_byyear'] = df_months['Year'].apply(lambda x: years.loc[x])
df_months['Percentage'] = df_months['nb_Thesis'] /␣
 ↪df_months['nb_Thesis_byyear'] * 100
df_months['Time'] = pd.to_datetime(df_months[['Year', 'Month']].assign(day=1))
```

[29]:
```
fig = df_months.plot(x='Time', y='Percentage', title='Percentage of thesis␣
 ↪defended by month')
fig.write_image("plots/thesis_by_month.png")
fig.show()
```

[30]:
```
fig = df_months.groupby('Month').mean().reset_index().plot.bar(x='Month',␣
 ↪y='Percentage', title='Percentage of thesis defended during the year')
fig.write_image("plots/percentage_thesis_during_year.png")
fig.show()
```

4.2 Gender

[31]:
```
import gender_guesser.detector as gender

# Extract only thesis that's defended from 2000
df_gender = df_defences.drop(df_defences[df_defences['Year'] < 2000].index)

detector = gender.Detector()
df_gender[['first_name','last_name']] = df_gender['Auteur'].str.split(' ', 1,␣
 ↪expand=True)
df_gender['Gender'] = df_gender['first_name'].apply(lambda s: detector.
 ↪get_gender(s))
rename_dict = {'mostly_female': 'Female', 'mostly_male': 'Male', 'male' :␣
 ↪'Male', 'female' : 'Female'}
df_gender['Gender'].replace(rename_dict, inplace=True)
df_gender.drop(df_gender[np.logical_or(df_gender['Gender'] == 'unknown',␣
 ↪df_gender['Gender'] == 'andy')].index, inplace=True)

years = df_gender.groupby('Year').count().reset_index().reindex(['Year',␣
 ↪'Titre'], axis=1).set_index('Year')
```

[32]:
```
# Calculate percentage
df_gender = df_gender.groupby(['Year', 'Gender']).count().reset_index().
 ↪reindex(['Year', 'Gender', 'Titre'], axis=1)
df_gender.rename(columns={'Titre' : 'nb_Thesis'}, inplace=True)
df_gender['nb_Thesis_byyear'] = df_gender['Year'].apply(lambda x: years.loc[x])
df_gender['Percentage'] = df_gender['nb_Thesis'] /␣
 ↪df_gender['nb_Thesis_byyear'] * 100
```

```
[33]: fig = px.bar(df_gender, x="Year", y="Percentage", color="Gender", title="Gender␣
       ↪of PhD candidates by Year")
      fig.write_image("plots/gender_by_year.png")
      fig.show()
```

```
[ ]:
```