# Data visualisation lab 6

## Made by: Paulius Lapienis

In [ ]:
```
from labs.definitions import DATA_DIR
import pandas as pd

DATA_PATH = DATA_DIR / "anime_filtered.csv"
df = pd.read_csv(DATA_PATH)
df
```

Out[ ]:

| | anime_id | title | title_english | title_japanese | title_synonyms | ima |
|---|---|---|---|---|---|---|
| **0** | 11013 | Inu x Boku SS | Inu X Boku Secret Service | 妖狐×僕SS | Youko x Boku SS | https://myanimelidena.com/images/ar |
| **1** | 2104 | Seto no Hanayome | My Bride is a Mermaid | 瀬戸の花嫁 | The Inland Sea Bride | https://myanimelidena.com/images/ar |
| **2** | 5262 | Shugo Chara!! Doki | Shugo Chara!! Doki | しゅごキャラ！！どきっ | Shugo Chara Ninenme, Shugo Chara! Second Year | https://myanimelidena.com/images/ar |
| **3** | 721 | Princess Tutu | Princess Tutu | プリンセスチュチュ | NaN | https://myanimelidena.com/images/ar |
| **4** | 12365 | Bakuman. 3rd Season | Bakuman. | バクマン。 | Bakuman Season 3 | https://myanimelidena.com/images/ar |
| **...** | ... | ... | ... | ... | ... | |
| **14469** | 26089 | Gutchonpa Omoshiro Hanashi | NaN | グッチョンパおもしろ話 | NaN | https://myanimelidena.com/images/ar |
| **14470** | 21525 | Geba Geba Shou Time! | NaN | ゲバゲバ笑タイム! | NaN | https://myanimelidena.com/images/ar |
| **14471** | 37897 | Godzilla: Hoshi wo Kuu Mono | NaN | GODZILLA -星を喰う者- | Godzilla Part 3, Godzilla: Eater of Stars | https://myanimelidena.com/images/ar |
| **14472** | 34193 | Nippon Mukashibanashi: Sannen Netarou | NaN | 日本昔ばなし 三ねん寝太郎 | NaN | https://myanimelidena.com/images/ar |
| **14473** | 37908 | Senjou no Valkyria Special | NaN | 戦場のヴァルキュリア Valkyria Chronicles | Senjou no Valkyria Fake Movie Promo | https://myanimelidena.com/images/ar |

14474 rows × 31 columns

In [ ]:
```
df.columns
```

Out[ ]:
```
Index(['anime_id', 'title', 'title_english', 'title_japanese',
       'title_synonyms', 'image_url', 'type', 'source', 'episodes', 'statu
s',
       'airing', 'aired_string', 'aired', 'duration', 'rating', 'score',
       'scored_by', 'rank', 'popularity', 'members', 'favorites', 'backgrou
nd',
       'premiered', 'broadcast', 'related', 'producer', 'licensor', 'studi
o',
       'genre', 'opening_theme', 'ending_theme'],
      dtype='object')
```

In [ ]:
```
df.describe()
```

Out[ ]:

| | anime_id | episodes | score | scored_by | rank | popularity | |
|---|---|---|---|---|---|---|---|
| **count** | 14474.000000 | 14474.000000 | 14474.000000 | 1.447400e+04 | 12901.000000 | 14474.000000 | 1.4 |
| **mean** | 17371.948183 | 11.310971 | 6.144179 | 1.146319e+04 | 6439.625068 | 7220.277256 | 2.2 |
| **std** | 13163.266015 | 43.449161 | 1.460617 | 4.311072e+04 | 3719.462602 | 4168.959000 | 7.4 |
| **min** | 1.000000 | 0.000000 | 0.000000 | 0.000000e+00 | 0.000000 | 0.000000 | 0.0 |
| **25%** | 4387.500000 | 1.000000 | 5.550000 | 4.600000e+01 | 3218.000000 | 3613.250000 | 2.4 |
| **50%** | 15128.000000 | 1.000000 | 6.370000 | 5.010000e+02 | 6442.000000 | 7225.500000 | 1.6 |
| **75%** | 31142.000000 | 12.000000 | 7.060000 | 3.947250e+03 | 9664.000000 | 10826.750000 | 1.0 |
| **max** | 37916.000000 | 1818.000000 | 10.000000 | 1.009477e+06 | 12919.000000 | 14487.000000 | 1.4 |

First step to calculating PCA is choosing the correct features and normalizing them.

In [ ]:
```
import numpy as np
from sklearn import preprocessing
from function_pipes import pipe
from functools import partial

data = pipe(
    df.select_dtypes(include=np.number).drop(columns=["anime_id", "rank"]),
    preprocessing.MinMaxScaler().fit_transform,
    partial(
        pd.DataFrame,
        columns=df.select_dtypes(include=np.number)
        .drop(columns=["anime_id", "rank"])
        .columns,
    ),
).join(df['source']).dropna().reset_index().drop(columns=['index'])

data
```

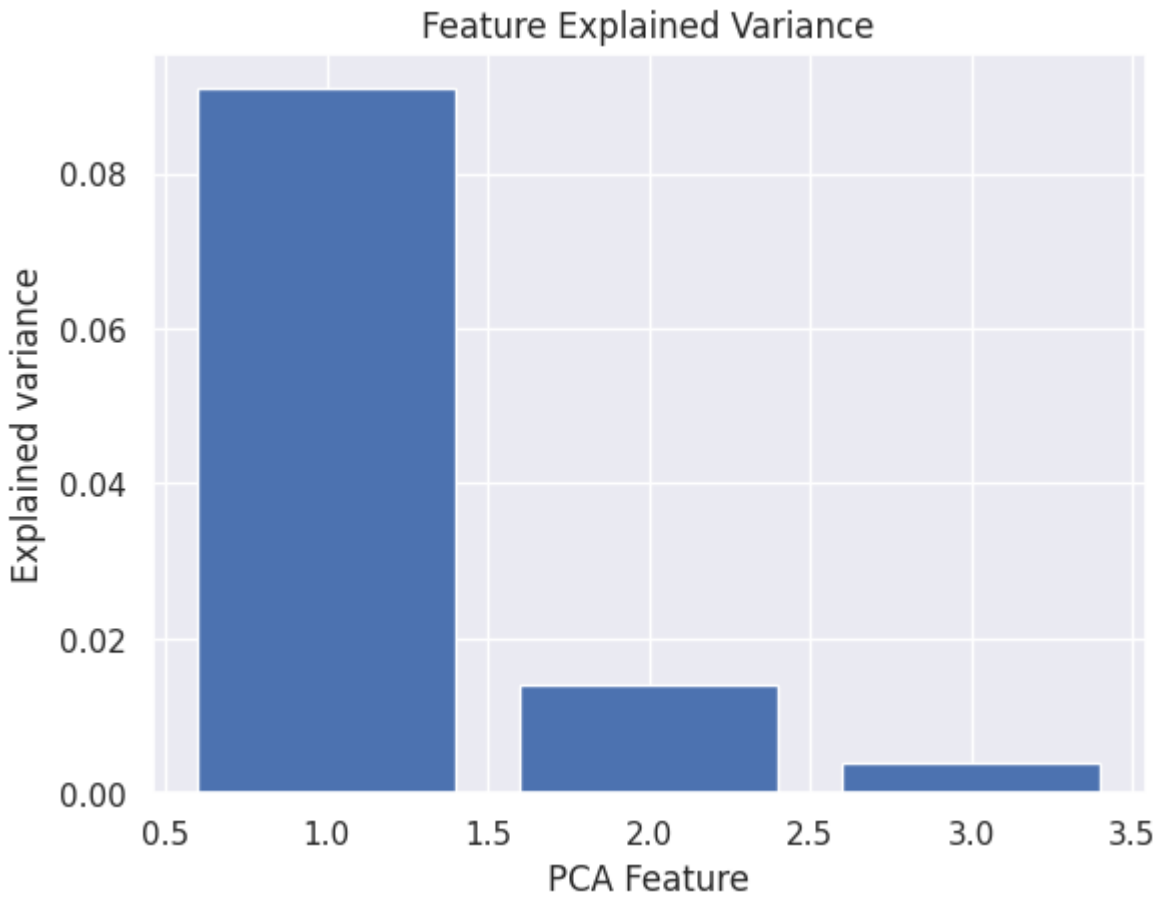
Out[ ]:

| | episodes | score | scored_by | popularity | members | favorites | source |
|---|---|---|---|---|---|---|---|
| **0** | 0.006601 | 0.763 | 1.379427e-01 | 0.015945 | 0.194923 | 0.026278 | Manga |
| **1** | 0.014301 | 0.789 | 9.034976e-02 | 0.025264 | 0.140076 | 0.024126 | Manga |
| **2** | 0.028053 | 0.755 | 3.678043e-02 | 0.080969 | 0.048152 | 0.007503 | Manga |
| **3** | 0.020902 | 0.821 | 3.615833e-02 | 0.063229 | 0.064071 | 0.031283 | Original |
| **4** | 0.013751 | 0.867 | 1.067553e-01 | 0.029406 | 0.125493 | 0.019477 | Manga |
| **...** | ... | ... | ... | ... | ... | ... | ... |
| **14469** | 0.002750 | 0.550 | 5.943672e-06 | 0.938635 | 0.000052 | 0.000000 | Unknown |
| **14470** | 0.000550 | 0.460 | 4.953060e-06 | 0.916960 | 0.000062 | 0.000000 | Unknown |
| **14471** | 0.000550 | 0.000 | 0.000000e+00 | 0.498792 | 0.001195 | 0.000000 | Other |
| **14472** | 0.000550 | 0.600 | 9.906120e-07 | 0.989439 | 0.000022 | 0.000000 | Other |
| **14473** | 0.000550 | 0.515 | 4.655876e-05 | 0.674191 | 0.000327 | 0.000000 | Unknown |

14474 rows × 7 columns

In [ ]:

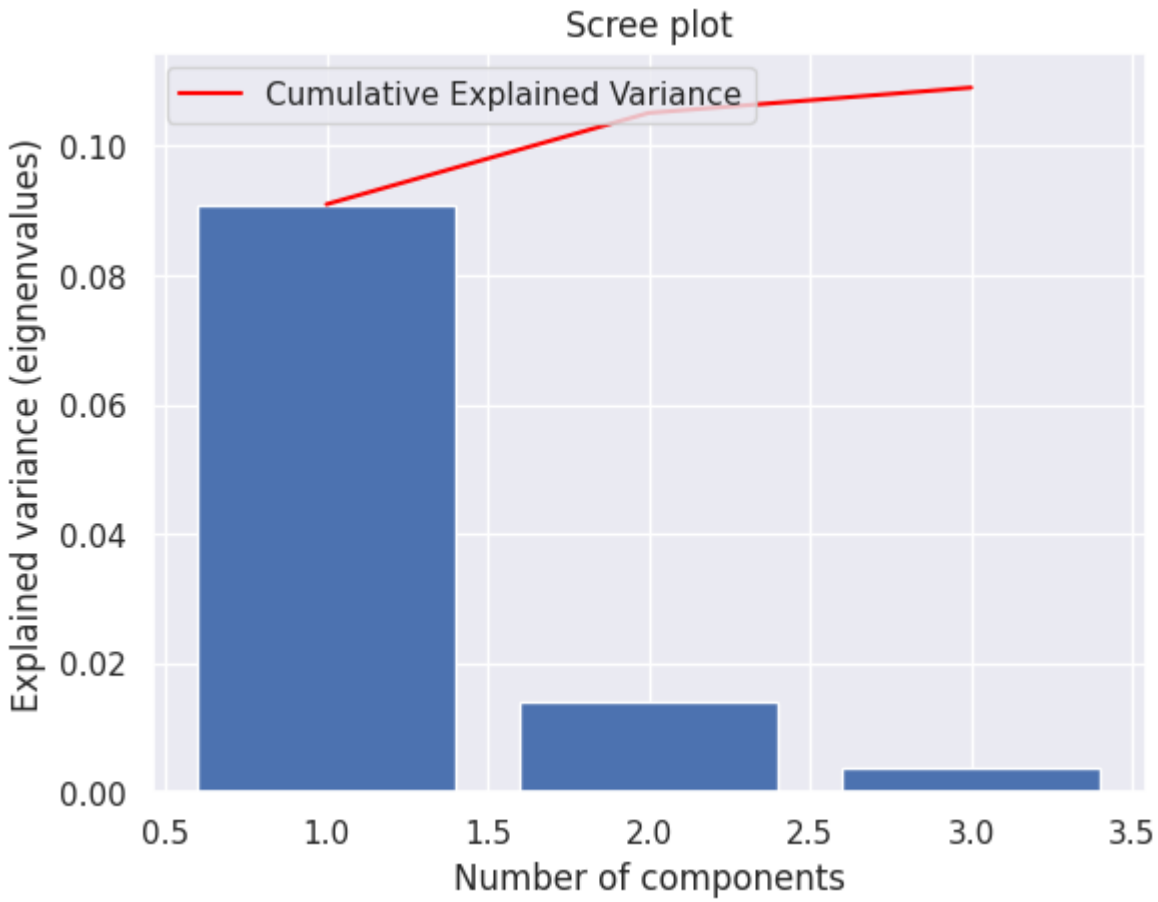
```
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.decomposition import PCA
sns.set()

pca = PCA(n_components=3)
x_features = data.drop(columns=['source'])
# Fit and transform data
pca.fit_transform(x_features)

# Bar plot of explained_variance
plt.bar(
    range(1,len(pca.explained_variance_)+1),
    pca.explained_variance_
    )


plt.xlabel('PCA Feature')
plt.ylabel('Explained variance')
plt.title('Feature Explained Variance')
plt.show()
```




In [ ]:

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

from sklearn.decomposition import PCA
sns.set()

pca = PCA(n_components=3)
# Fit and transform data
reduced_features = pca.fit_transform(x_features)

# Bar plot of explained_variance
plt.bar(
    range(1,len(pca.explained_variance_)+1),
    pca.explained_variance_
    )

plt.plot(
    range(1,len(pca.explained_variance_ )+1),
    np.cumsum(pca.explained_variance_),
    c='red',
    label='Cumulative Explained Variance')

plt.legend(loc='upper left')
plt.xlabel('Number of components')
plt.ylabel('Explained variance (eignenvalues)')
plt.title('Scree plot')
```

```
plt.show()
```




In [ ]:
```
from sklearn.decomposition import PCA

pca = PCA(n_components=2)
pca_features = pca.fit_transform(x_features)

print('Shape before PCA: ', x_features.shape)
print('Shape after PCA: ', pca_features.shape)

pca_df = pd.DataFrame(
    data=pca_features,
    columns=['PC1', 'PC2']).join(data['source'])

pca_df
```

```
Shape before PCA:  (14474, 6)
Shape after PCA:  (14474, 2)
```

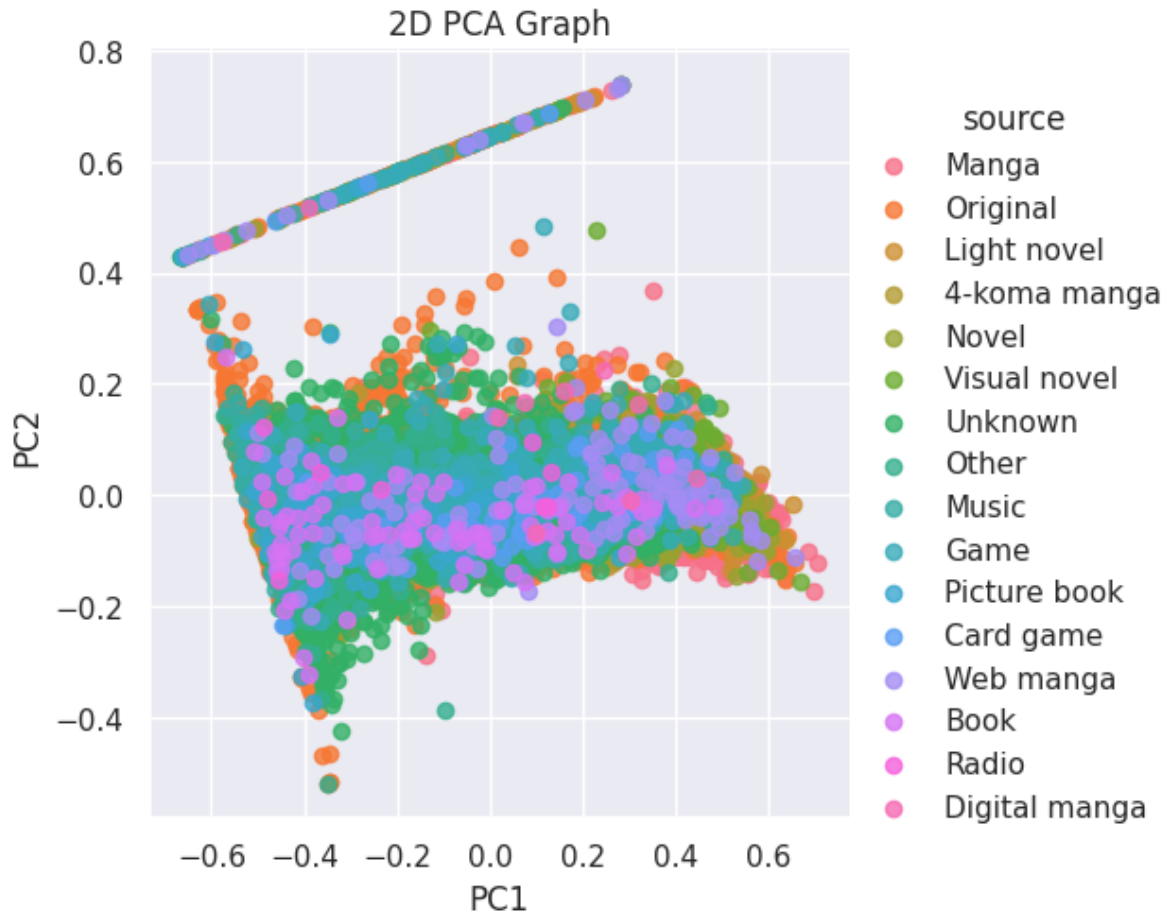
Out[ ]:

| | PC1 | PC2 | source |
|---|---|---|---|
| **0** | 0.524875 | 0.004229 | Manga |
| **1** | 0.516616 | -0.022105 | Manga |
| **2** | 0.442422 | -0.005229 | Manga |
| **3** | 0.481120 | -0.062769 | Original |
| **4** | 0.536348 | -0.097512 | Manga |
| **...** | ... | ... | ... |
| **14469** | -0.438316 | -0.074982 | Unknown |
| **14470** | -0.445426 | 0.017300 | Unknown |
| **14471** | -0.190819 | 0.584160 | Other |
| **14472** | -0.471054 | -0.138220 | Other |
| **14473** | -0.198846 | 0.040391 | Unknown |

14474 rows × 3 columns

In [ ]:

```
import seaborn as sns
import matplotlib.pyplot as plt
sns.set()

sns.lmplot(
    x='PC1',
    y='PC2',
    data=pca_df,
    hue='source',
    fit_reg=False,
    legend=True
    )

plt.title('2D PCA Graph')
plt.show()
```




In [ ]:

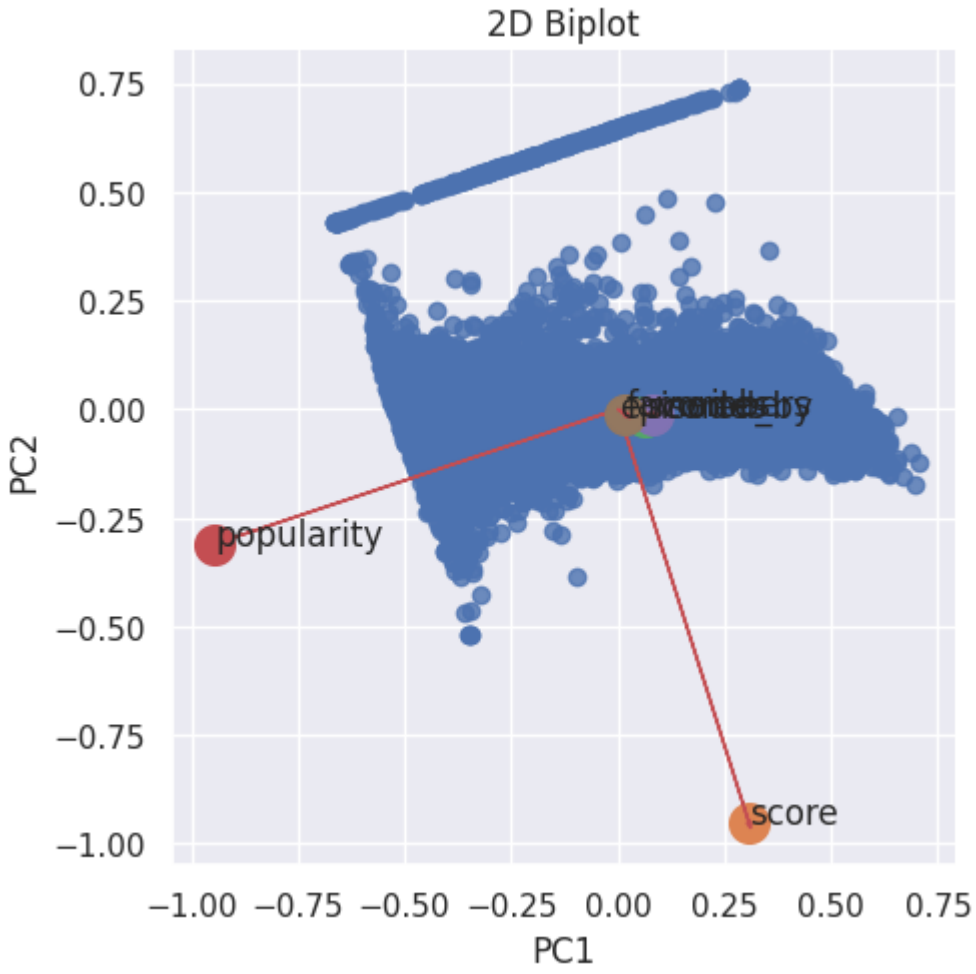
```
# Principal components correlation coefficients
loadings = pca.components_

# Number of features before PCA
n_features = pca.n_features_in_

# Feature names before PCA
feature_names = data.columns.drop('source').to_list()

# PC names
pc_list = [f'PC{i}' for i in list(range(1, n_features + 1))]

# Match PC names to loadings
pc_loadings = dict(zip(pc_list, loadings))

# Matrix of corr coefs between feature names and PCs
loadings_df = pd.DataFrame.from_dict(pc_loadings)
loadings_df['feature_names'] = feature_names
loadings_df = loadings_df.set_index('feature_names')
loadings_df
```

Out[ ]:

| feature_names | PC1 | PC2 |
|---|---|---|
| **episodes** | 0.003549 | -0.018000 |
| **score** | 0.306767 | -0.950167 |
| **scored_by** | 0.061159 | -0.015129 |
| **popularity** | -0.946097 | -0.310394 |
| **members** | 0.081981 | -0.011969 |
| **favorites** | 0.017915 | -0.011892 |

In [ ]:

```
# 2D
import matplotlib.pyplot as plt
import seaborn as sns
sns.set()

xs = loadings[0]
ys = loadings[1]

sns.lmplot(
    x='PC1',
    y='PC2',
    data=pca_df,
    fit_reg=False,
    )

for i, varnames in enumerate(feature_names):
    plt.scatter(xs[i], ys[i], s=200)
    plt.arrow(
        0, 0, # coordinates of arrow base
        xs[i], # length of the arrow along x
        ys[i], # length of the arrow along y
        color='r',
        head_width=0.01
        )
    plt.text(xs[i], ys[i], varnames)

plt.xlabel('PC1')
plt.ylabel('PC2')

plt.title('2D Biplot')
plt.show()
```


2D Biplot
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
PC2
popularity
score
−1.00 −0.75 −0.50 −0.25 0.00 0.25 0.50 0.75
PC1