

# PCA\_KNN\_python

January 22, 2021

## 1 Projet TP Groupe 3

1.1 Nous avons utilisé les étapes suivantes :

1.2 1. Réduction de la dimension des variables avec PCA

1.3 2. Utilisation de SVM pour la classification

```
[1]: # On importe les librairies

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

from sklearn.decomposition import PCA
from sklearn import preprocessing
from sklearn.pipeline import make_pipeline, Pipeline
from sklearn.preprocessing import StandardScaler
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import confusion_matrix
from sklearn.model_selection import GridSearchCV, learning_curve
```

1.3.1 On importe les données d'apprentissage

```
[2]: path_dataset = "UCI HAR Dataset/"

[3]: dataset_train = pd.read_csv(path_dataset + "train/X_train_new.txt", sep=' ',
    ↳header=None)
dataset_train
```

|   | 0        | 1         | 2         | 3         | 4         | 5         | 6         | \ |
|---|----------|-----------|-----------|-----------|-----------|-----------|-----------|---|
| 0 | 0.288585 | -0.020294 | -0.132905 | -0.995279 | -0.983111 | -0.913526 | -0.995112 |   |
| 1 | 0.278419 | -0.016411 | -0.123520 | -0.998245 | -0.975300 | -0.960322 | -0.998807 |   |
| 2 | 0.279653 | -0.019467 | -0.113462 | -0.995380 | -0.967187 | -0.978944 | -0.996520 |   |

|      |          |           |           |           |           |           |           |
|------|----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 3    | 0.279174 | -0.026201 | -0.123283 | -0.996091 | -0.983403 | -0.990675 | -0.997099 |
| 4    | 0.276629 | -0.016570 | -0.115362 | -0.998139 | -0.980817 | -0.990482 | -0.998321 |
| ...  | ...      | ...       | ...       | ...       | ...       | ...       | ...       |
| 7347 | 0.299665 | -0.057193 | -0.181233 | -0.195387 | 0.039905  | 0.077078  | -0.282301 |
| 7348 | 0.273853 | -0.007749 | -0.147468 | -0.235309 | 0.004816  | 0.059280  | -0.322552 |
| 7349 | 0.273387 | -0.017011 | -0.045022 | -0.218218 | -0.103822 | 0.274533  | -0.304515 |
| 7350 | 0.289654 | -0.018843 | -0.158281 | -0.219139 | -0.111412 | 0.268893  | -0.310487 |
| 7351 | 0.351503 | -0.012423 | -0.203867 | -0.269270 | -0.087212 | 0.177404  | -0.377404 |

|      |           |           |           |     |           |           |           |   |
|------|-----------|-----------|-----------|-----|-----------|-----------|-----------|---|
|      | 7         | 8         | 9         | ... | 553       | 554       | 555       | \ |
| 0    | -0.983185 | -0.923527 | -0.934724 | ... | -0.710304 | -0.112754 | 0.030400  |   |
| 1    | -0.974914 | -0.957686 | -0.943068 | ... | -0.861499 | 0.053477  | -0.007435 |   |
| 2    | -0.963668 | -0.977469 | -0.938692 | ... | -0.760104 | -0.118559 | 0.177899  |   |
| 3    | -0.982750 | -0.989302 | -0.938692 | ... | -0.482845 | -0.036788 | -0.012892 |   |
| 4    | -0.979672 | -0.990441 | -0.942469 | ... | -0.699205 | 0.123320  | 0.122542  |   |
| ...  | ...       | ...       | ...       | ... | ...       | ...       | ...       |   |
| 7347 | 0.043616  | 0.060410  | 0.210795  | ... | -0.880324 | -0.190437 | 0.829718  |   |
| 7348 | -0.029456 | 0.080585  | 0.117440  | ... | -0.680744 | 0.064907  | 0.875679  |   |
| 7349 | -0.098913 | 0.332584  | 0.043999  | ... | -0.304029 | 0.052806  | -0.266724 |   |
| 7350 | -0.068200 | 0.319473  | 0.101702  | ... | -0.344314 | -0.101360 | 0.700740  |   |
| 7351 | -0.038678 | 0.229430  | 0.269013  | ... | -0.740738 | -0.280088 | -0.007739 |   |

|      |           |           |           |          |           |     |     |
|------|-----------|-----------|-----------|----------|-----------|-----|-----|
|      | 556       | 557       | 558       | 559      | 560       | 561 | 562 |
| 0    | -0.464761 | -0.018446 | -0.841247 | 0.179941 | -0.058627 | 1   | 5   |
| 1    | -0.732626 | 0.703511  | -0.844788 | 0.180289 | -0.054317 | 1   | 5   |
| 2    | 0.100699  | 0.808529  | -0.848933 | 0.180637 | -0.049118 | 1   | 5   |
| 3    | 0.640011  | -0.485366 | -0.848649 | 0.181935 | -0.047663 | 1   | 5   |
| 4    | 0.693578  | -0.615971 | -0.847865 | 0.185151 | -0.043892 | 1   | 5   |
| ...  | ...       | ...       | ...       | ...      | ...       | ... | ... |
| 7347 | 0.206972  | -0.425619 | -0.791883 | 0.238604 | 0.049819  | 30  | 2   |
| 7348 | -0.879033 | 0.400219  | -0.771840 | 0.252676 | 0.050053  | 30  | 2   |
| 7349 | 0.864404  | 0.701169  | -0.779133 | 0.249145 | 0.040811  | 30  | 2   |
| 7350 | 0.936674  | -0.589479 | -0.785181 | 0.246432 | 0.025339  | 30  | 2   |
| 7351 | -0.056088 | -0.616956 | -0.783267 | 0.246809 | 0.036695  | 30  | 2   |

[7352 rows x 563 columns]

```
[4]: X_train = dataset_train.values[:, 0:561]
      print("La dimension de X train est : {}".format(X_train.shape))
```

La dimension de X train est : (7352, 561)

```
[5]: y_train = dataset_train.values[:, 562]
      print("La dimension de y train est : {}".format(y_train.shape))
```

La dimension de y train est : (7352,)

### 1.3.2 On importe les données de test

```
[6]: dataset_test = pd.read_csv(path_dataset + "test/X_test_new.txt", sep=' ',
    ↪header=None)
dataset_test
```

```
[6]:
```

|      | 0         | 1         | 2         | 3         | 4         | 5         | 6         | \   |
|------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----|
| 0    | 0.257178  | -0.023285 | -0.014654 | -0.938404 | -0.920091 | -0.667683 | -0.952501 |     |
| 1    | 0.286027  | -0.013163 | -0.119083 | -0.975415 | -0.967458 | -0.944958 | -0.986799 |     |
| 2    | 0.275485  | -0.026050 | -0.118152 | -0.993819 | -0.969926 | -0.962748 | -0.994403 |     |
| 3    | 0.270298  | -0.032614 | -0.117520 | -0.994743 | -0.973268 | -0.967091 | -0.995274 |     |
| 4    | 0.274833  | -0.027848 | -0.129527 | -0.993852 | -0.967445 | -0.978295 | -0.994111 |     |
| ...  | ...       | ...       | ...       | ...       | ...       | ...       | ...       |     |
| 2942 | 0.310155  | -0.053391 | -0.099109 | -0.287866 | -0.140589 | -0.215088 | -0.356083 |     |
| 2943 | 0.363385  | -0.039214 | -0.105915 | -0.305388 | 0.028148  | -0.196373 | -0.373540 |     |
| 2944 | 0.349966  | 0.030077  | -0.115788 | -0.329638 | -0.042143 | -0.250181 | -0.388017 |     |
| 2945 | 0.237594  | 0.018467  | -0.096499 | -0.323114 | -0.229775 | -0.207574 | -0.392380 |     |
| 2946 | 0.153627  | -0.018437 | -0.137018 | -0.330046 | -0.195253 | -0.164339 | -0.430974 |     |
| ...  | ...       | ...       | ...       | ...       | ...       | ...       | ...       |     |
|      | 7         | 8         | 9         | ...       | 553       | 554       | 555       | \   |
| 0    | -0.925249 | -0.674302 | -0.894088 | ...       | -0.705974 | 0.006462  | 0.162920  |     |
| 1    | -0.968401 | -0.945823 | -0.894088 | ...       | -0.594944 | -0.083495 | 0.017500  |     |
| 2    | -0.970735 | -0.963483 | -0.939260 | ...       | -0.640736 | -0.034956 | 0.202302  |     |
| 3    | -0.974471 | -0.968897 | -0.938610 | ...       | -0.736124 | -0.017067 | 0.154438  |     |
| 4    | -0.965953 | -0.977346 | -0.938610 | ...       | -0.846595 | -0.002223 | -0.040046 |     |
| ...  | ...       | ...       | ...       | ...       | ...       | ...       | ...       |     |
| 2942 | -0.148775 | -0.232057 | 0.185361  | ...       | -0.750809 | -0.337422 | 0.346295  |     |
| 2943 | -0.030036 | -0.270237 | 0.185361  | ...       | -0.700274 | -0.736701 | -0.372889 |     |
| 2944 | -0.133257 | -0.347029 | 0.007471  | ...       | -0.467179 | -0.181560 | 0.088574  |     |
| 2945 | -0.279610 | -0.289477 | 0.007471  | ...       | -0.617737 | 0.444558  | -0.819188 |     |
| 2946 | -0.218295 | -0.229933 | -0.111527 | ...       | -0.436940 | 0.598808  | -0.287951 |     |
| ...  | ...       | ...       | ...       | ...       | ...       | ...       | ...       |     |
|      | 556       | 557       | 558       | ...       | 559       | 560       | 561       | 562 |
| 0    | -0.825886 | 0.271151  | -0.720009 | 0.276801  | -0.057978 | 2         | 5         |     |
| 1    | -0.434375 | 0.920593  | -0.698091 | 0.281343  | -0.083898 | 2         | 5         |     |
| 2    | 0.064103  | 0.145068  | -0.702771 | 0.280083  | -0.079346 | 2         | 5         |     |
| 3    | 0.340134  | 0.296407  | -0.698954 | 0.284114  | -0.077108 | 2         | 5         |     |
| 4    | 0.736715  | -0.118545 | -0.692245 | 0.290722  | -0.073857 | 2         | 5         |     |
| ...  | ...       | ...       | ...       | ...       | ...       | ...       | ...       |     |
| 2942 | 0.884904  | -0.698885 | -0.651732 | 0.274627  | 0.184784  | 24        | 2         |     |
| 2943 | -0.657421 | 0.322549  | -0.655181 | 0.273578  | 0.182412  | 24        | 2         |     |
| 2944 | 0.696663  | 0.363139  | -0.655357 | 0.274479  | 0.181184  | 24        | 2         |     |
| 2945 | 0.929294  | -0.008398 | -0.659719 | 0.264782  | 0.187563  | 24        | 2         |     |
| 2946 | 0.876030  | -0.024965 | -0.660080 | 0.263936  | 0.188103  | 24        | 2         |     |

[2947 rows x 563 columns]

```
[7]: X_test = dataset_test.values[:, 0:561]
print("La dimension de X test est : {}".format(X_test.shape))
```

La dimension de X test est : (2947, 561)

```
[8]: y_test = dataset_test.values[:, 562]
print("La dimension de y test est : {}".format(y_test.shape))
```

La dimension de y test est : (2947,)

### 1.3.3 Utilisation de PCA pour réduire la dimension des données (Nous allons utiliser la librairie SKLearn)

```
[9]: # choix du nombre de composantes à calculer
n_comp = X_train.shape[1]
print(n_comp)
```

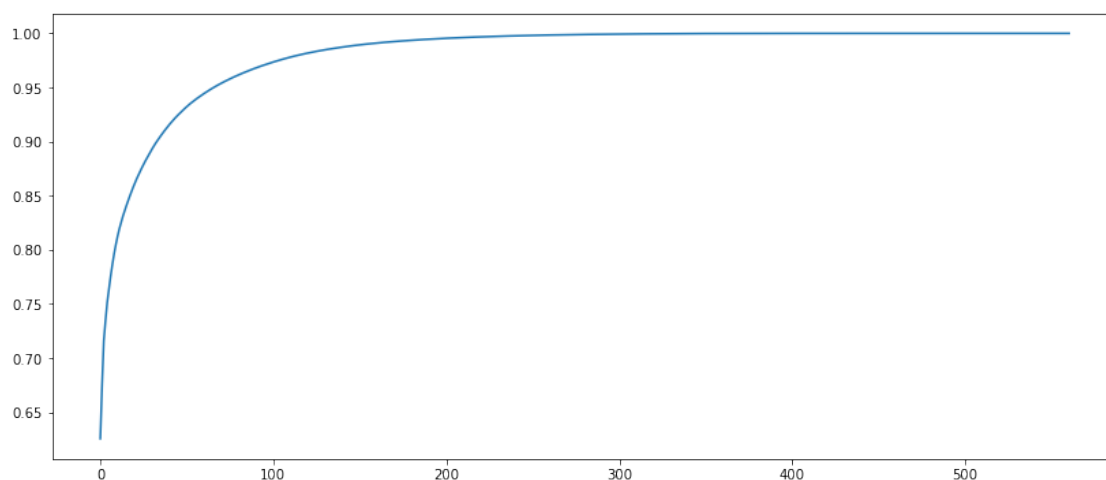
561

```
[10]: # Calcul des composantes principales
pca = PCA(n_components=n_comp)
pca.fit(X_train)
```

```
[10]: PCA(n_components=561)
```

```
[11]: fig, axes = plt.subplots(nrows=1, ncols=1, figsize=(14, 6))
plt.plot(np.cumsum(pca.explained_variance_ratio_))
```

```
[11]: [ <matplotlib.lines.Line2D at 0x7fea106bc790>]
```



```
[12]: np.argmax(np.cumsum(pca.explained_variance_ratio_) >= 0.99)
```

```
[12]: 154
```

```
[13]: print("Nous pouvons donc réduire à 155 dimension pour conserver 99% de la  
      ↪ variance")
```

Nous pouvons donc réduire à 155 dimension pour conserver 99% de la variance

```
[14]: # choix du nombre de composantes à calculer  
      n_comp = 155
```

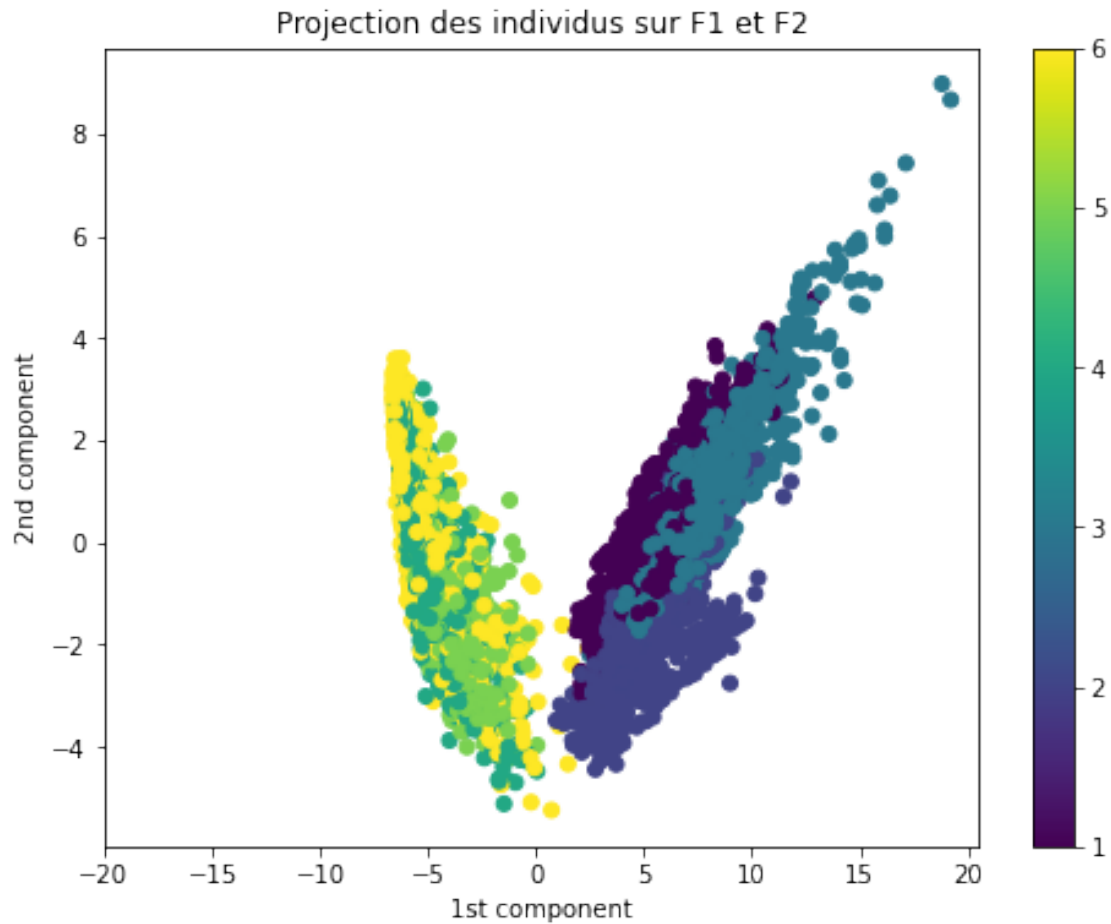
```
[15]: # Calcul des composantes principales  
      pca = PCA(n_components=n_comp)  
      pca.fit(X_train)
```

```
[15]: PCA(n_components=155)
```

```
[16]: # Projection des individus  
      X_projected = pca.transform(X_train)
```

```
[17]: # Projection des composantes 1 et 2  
  
      plt.figure(figsize=(8,6))  
  
      plt.scatter(X_projected[:,0], X_projected[:,1], c=y_train)  
      plt.title('Projection des individus sur F1 et F2')  
      plt.xlim(-20)  
      plt.colorbar()  
      plt.xlabel("1st component")  
      plt.ylabel("2nd component")
```

```
[17]: Text(0, 0.5, '2nd component')
```



## 2 utilisation du modèle SVM pour la classification

```
[18]: model_knn= make_pipeline(StandardScaler(), KNeighborsClassifier(n_neighbors=3))

params = {'kneighborsclassifier__n_neighbors': range(2,10)}

grid = GridSearchCV(model_knn, params, cv=5)

print(grid)
```

```
GridSearchCV(cv=5,
             estimator=Pipeline(steps=[('standardscaler', StandardScaler()),
                                       ('kneighborsclassifier',
                                        KNeighborsClassifier(n_neighbors=3))]),
             param_grid={'kneighborsclassifier__n_neighbors': range(2, 10)})
```

```
[19]: # Formation du model
```

```
X_train_pca = pca.transform(X_train)

grid.fit(X_train_pca, y_train)
```

```
[19]: GridSearchCV(cv=5,
                  estimator=Pipeline(steps=[('standardscaler', StandardScaler()),
                                             ('kneighborsclassifier',
                                              KNeighborsClassifier(n_neighbors=3))]),
                  param_grid={'kneighborsclassifier__n_neighbors': range(2, 10)})
```

```
[20]: # Affichage des meilleurs paramètres du modèle
grid.best_params_
```

```
[20]: {'kneighborsclassifier__n_neighbors': 3}
```

```
[21]: # Score sur les données d'entraînement
grid.score(X_train_pca, y_train)
```

```
[21]: 0.9819096844396082
```

```
[22]: # Score sur les données de test
```

```
X_test_pca = pca.transform(X_test)

grid.score(X_test_pca, y_test)
```

```
[22]: 0.652188664404479
```

```
[23]: # Matrice de confusion sur les données de test
confusion = confusion_matrix(y_test, grid.predict(X_test_pca))
confusion
```

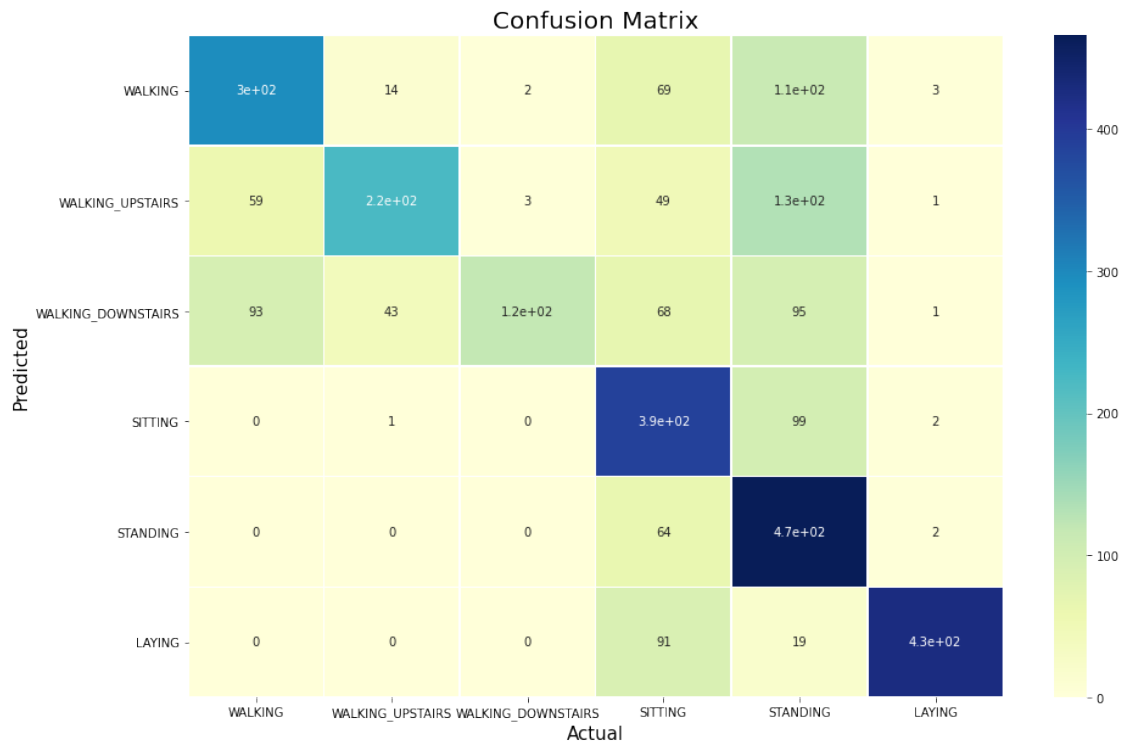
```
[23]: array([[295, 14, 2, 69, 113, 3],
         [ 59, 225, 3, 49, 134, 1],
         [ 93, 43, 120, 68, 95, 1],
         [ 0, 1, 0, 389, 99, 2],
         [ 0, 0, 0, 64, 466, 2],
         [ 0, 0, 0, 91, 19, 427]])
```

```
[24]: labels = ['WALKING', 'WALKING_UPSTAIRS', "WALKING_DOWNSTAIRS", "SITTING",
             ↪ "STANDING", "LAYING"]
```

```
df_cm = pd.DataFrame(confusion, index = labels, columns = labels)

plt.figure(figsize = (15,10))
```

```
plt.title('Confusion Matrix', fontsize = 20)
sns.heatmap(df_cm, annot=True, cmap="YlGnBu", linewidths=.5)
plt.xlabel('Actual', fontsize = 15)
plt.ylabel('Predicted', fontsize = 15)
plt.show()
```



[ ]: