KNN em python

October 18, 2022

[1]:
```python
from IPython.display import Image
%matplotlib inline
```

[3]:
```python
from sklearn import datasets
import numpy as np

iris = datasets.load_iris()
X = iris.data[:, [2, 3]]
y = iris.target
```

[4]:
```python
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(
X, y, test_size=0.3, random_state=1, stratify=y)
```

[5]:
```python
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()

sc.fit(X_train)
```

[5]:
```
StandardScaler()
```

[6]:
```python
X_train_std = sc.transform(X_train)
X_test_std = sc.transform(X_test)
```

[12]:
```python
X_test_std
```

[12]:
```
array([[ 0.89820289,  1.44587881],
       [-1.16537974, -1.04507821],
       [-1.33269725, -1.17618121],
       [ 0.39625036,  0.65926081],
       [ 0.34047786,  0.2659518 ],
       [ 0.11738784,  0.1348488 ],
       [ 1.12129291,  0.79036381],
       [ 0.39625036,  0.3970548 ],
       [ 0.84243039,  0.92146681],
       [-1.38846976, -1.04507821],
```

```
       [-1.27692475, -1.04507821],
       [ 0.61934037,  0.79036381],
       [-1.33269725, -1.30728421],
       [-0.27301968, -0.2584602 ],
       [-1.33269725, -1.30728421],
       [ 0.56356787,  0.2659518 ],
       [ 0.73088538,  1.44587881],
       [ 0.39625036,  0.3970548 ],
       [ 0.28470535,  0.1348488 ],
       [ 0.78665788,  1.05256981],
       [ 1.17706541,  1.18367281],
       [-1.33269725, -1.43838721],
       [ 0.34047786,  0.2659518 ],
       [ 0.61934037,  1.05256981],
       [ 0.22893285,  0.1348488 ],
       [ 0.50779537,  0.5281578 ],
       [-0.4403372 , -0.1273572 ],
       [ 1.0655204 ,  1.70808482],
       [-1.22115225, -0.78287221],
       [ 0.67511288,  1.05256981],
       [-1.22115225, -1.30728421],
       [-1.33269725, -1.30728421],
       [ 0.11738784, -0.2584602 ],
       [ 0.11738784,  0.1348488 ],
       [ 1.40015543,  0.79036381],
       [ 0.9539754 ,  1.18367281],
       [-1.33269725, -1.43838721],
       [-1.22115225, -1.30728421],
       [-1.33269725, -1.30728421],
       [ 0.50779537,  0.2659518 ],
       [ 1.0655204 ,  1.44587881],
       [ 0.73088538,  0.79036381],
       [ 0.45202286,  0.3970548 ],
       [-1.27692475, -1.30728421],
       [-1.27692475, -1.43838721]])
```

[14]:
```
X_combined_std = np.vstack((X_train_std, X_test_std))
y_combined_std = np.hstack((y_train, y_test))
```

[8]:
```
from matplotlib.colors import ListedColormap
import matplotlib.pyplot as plt

# To check recent matplotlib compatibility
import matplotlib
from distutils.version import LooseVersion
```

```python
def plot_decision_regions(X, y, classifier, test_idx=None, resolution=0.02):

    # setup marker generator and color map
    markers = ('s', 'x', 'o', '^', 'v')
    colors = ('red', 'blue', 'lightgreen', 'gray', 'cyan')
    cmap = ListedColormap(colors[:len(np.unique(y))])

    # plot the decision surface
    x1_min, x1_max = X[:, 0].min() - 1, X[:, 0].max() + 1
    x2_min, x2_max = X[:, 1].min() - 1, X[:, 1].max() + 1
    xx1, xx2 = np.meshgrid(np.arange(x1_min, x1_max, resolution),
                           np.arange(x2_min, x2_max, resolution))
    Z = classifier.predict(np.array([xx1.ravel(), xx2.ravel()]).T)
    Z = Z.reshape(xx1.shape)
    plt.contourf(xx1, xx2, Z, alpha=0.3, cmap=cmap)
    plt.xlim(xx1.min(), xx1.max())
    plt.ylim(xx2.min(), xx2.max())

    for idx, cl in enumerate(np.unique(y)):
        plt.scatter(x=X[y == cl, 0],
                    y=X[y == cl, 1],
                    alpha=0.8,
                    color=colors[idx],
                    marker=markers[idx],
                    label=cl,
                    edgecolor='black')

    # highlight test examples
    if test_idx:
        # plot all examples
        X_test, y_test = X[test_idx, :], y[test_idx]


        if LooseVersion(matplotlib.__version__) < LooseVersion('0.3.4'):
            plt.scatter(X_test[:, 0],
                        X_test[:, 1],
                        c='',
                        edgecolor='black',
                        alpha=1.0,
                        linewidth=1,
                        marker='o',
                        s=100,
                        label='test set')
        else:
            plt.scatter(X_test[:, 0],
                        X_test[:, 1],
                        c='none',
```

```
                                edgecolor='black',
                                alpha=1.0,
                                linewidth=1,
                                marker='o',
                                s=100,
                                label='test set')
```

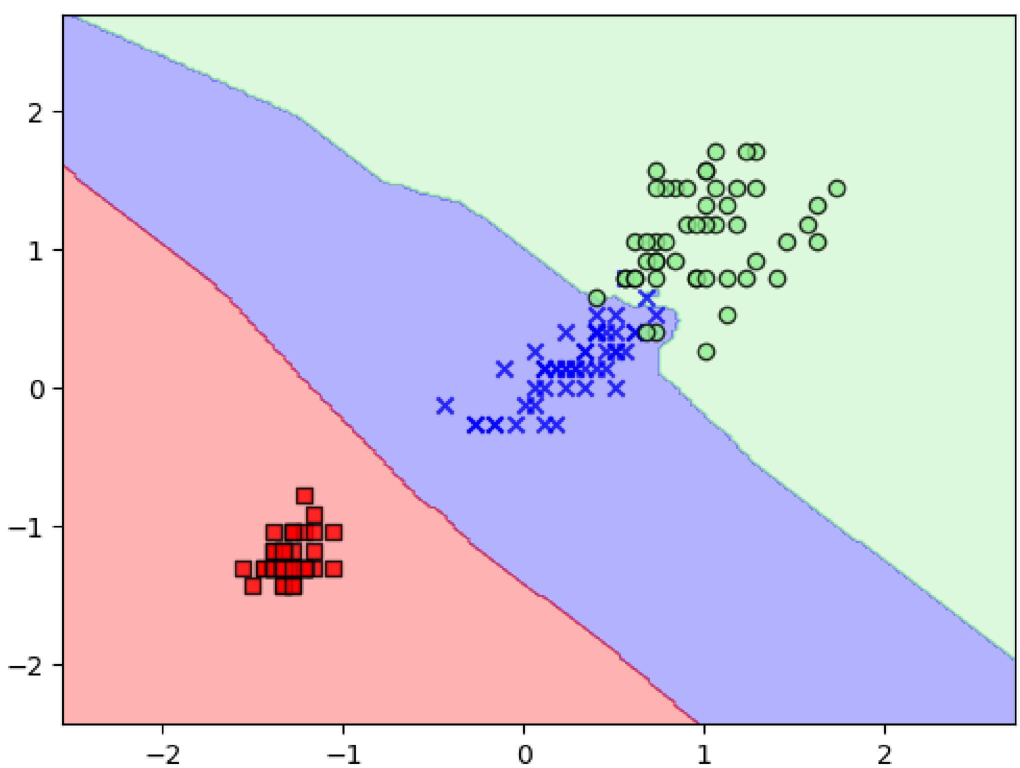
[9]:
```
from sklearn.neighbors import KNeighborsClassifier

KNN = KNeighborsClassifier(n_neighbors=5, p=2, metric='minkowski')
```

[10]:
```
KNN.fit(X_train_std, y_train)
```

[10]:
```
KNeighborsClassifier()
```

[15]:
```
plot_decision_regions(X_combined_std, y_combined_std, classifier=KNN)
```

```
/tmp/ipykernel_178950/3366577703.py:28: UserWarning: You passed a
edgecolor/edgecolors ('black') for an unfilled marker ('x').  Matplotlib is
ignoring the edgecolor in favor of the facecolor.  This behavior may change in
the future.
  plt.scatter(x=X[y == cl, 0],
```



[16]:
```python
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
```

[31]:
```python
data = pd.read_csv('ClassificaDados', index_col=0)
```

[32]:
```python
data.head(20)
```

[32]:
```
         WTT       PTI       EQW       SBI       LQE       QWG       FDJ  \
0   0.913917  1.162073  0.567946  0.755464  0.780862  0.352608  0.759697
1   0.635632  1.003722  0.535342  0.825645  0.924109  0.648450  0.675334
2   0.721360  1.201493  0.921990  0.855595  1.526629  0.720781  1.626351
3   1.234204  1.386726  0.653046  0.825624  1.142504  0.875128  1.409708
4   1.279491  0.949750  0.627280  0.668976  1.232537  0.703727  1.115596
5   0.833928  1.523302  1.104743  1.021139  1.107377  1.010930  1.279538
6   0.944705  1.251761  1.074885  0.286473  0.996440  0.428860  0.910805
7   0.816174  1.088392  0.895343  0.243860  0.943123  1.045131  1.146536
8   0.776551  1.463812  0.783825  0.337278  0.742215  1.072756  0.880300
9   0.772280  0.515111  0.891596  0.940862  1.430568  0.885876  1.205231
10  1.284999  1.331018  0.618910  0.657017  1.037191  0.717346  0.778501
11  1.064356  1.414885  0.896798  0.629088  1.447704  0.791923  0.921676
12  0.682953  1.254723  0.998870  0.397701  1.011621  0.567863  1.335120
13  0.953318  1.318987  0.562921  0.905503  1.248314  0.677795  1.017305
14  0.801268  0.936390  0.696960  0.972440  0.851299  1.443119  1.194476
15  1.061691  1.044892  0.599729  0.465285  0.930288  0.974341  1.213450
16  0.715645  1.378594  0.997797  0.674996  1.228928  1.223293  0.589346
17  0.899792  1.225875  1.330887  0.335989  1.273570  1.100361  1.019617
18  0.883813  1.275891  0.924066  0.668814  1.269021  1.382093  0.728286
19  0.768311  1.394304  0.823118  0.612072  1.267414  0.881943  1.104178

         PJF       HQE       NXJ  TARGET CLASS
0   0.643798  0.879422  1.231409             1
1   1.013546  0.621552  1.492702             0
2   1.154483  0.957877  1.285597             0
3   1.380003  1.522692  1.153093             1
4   0.646691  1.463812  1.419167             1
5   1.280677  0.510350  1.528044             0
6   0.755305  1.111800  1.110842             0
7   1.341886  1.225324  1.425784             0
8   1.312951  1.118165  1.225922             0
9   0.596858  1.542580  0.981879             1
10  0.599317  1.245676  1.441695             1
11  1.237249  0.564281  1.423668             0
12  1.093735  0.847015  1.374779             0
13  0.528065  1.541712  1.118960             1
```

```
14  1.641496  1.118737  1.426573             0
15  1.247551  1.217625  1.623154             1
16  1.559900  0.845324  1.248714             0
17  1.223891  1.113441  1.490151             0
18  0.726723  0.975833  1.653815             0
19  1.660998  0.742885  1.098704             0
```

[33]:
```
data.info()
```

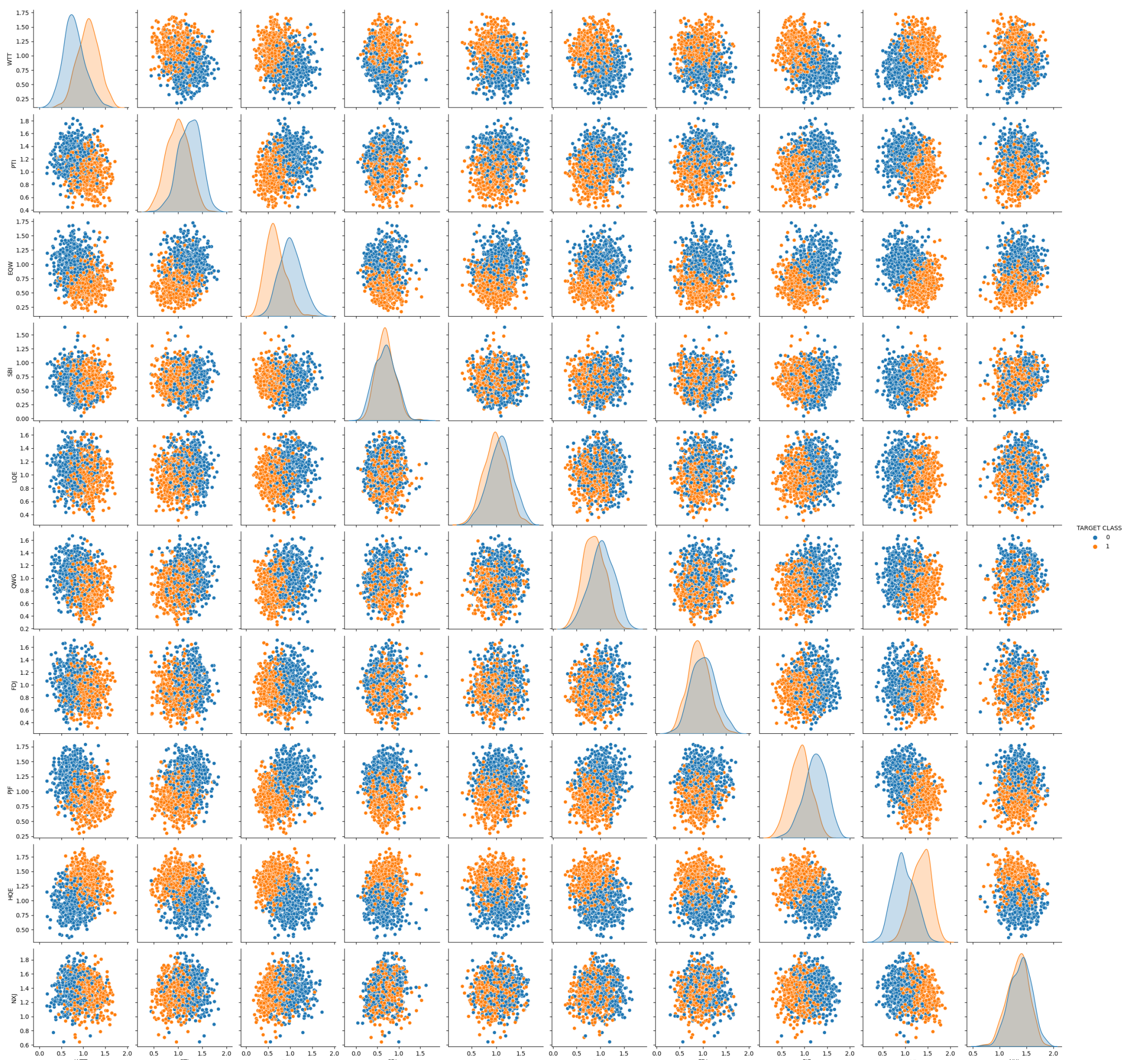
```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1000 entries, 0 to 999
Data columns (total 11 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   WTT           1000 non-null   float64
 1   PTI           1000 non-null   float64
 2   EQW           1000 non-null   float64
 3   SBI           1000 non-null   float64
 4   LQE           1000 non-null   float64
 5   QWG           1000 non-null   float64
 6   FDJ           1000 non-null   float64
 7   PJF           1000 non-null   float64
 8   HQE           1000 non-null   float64
 9   NXJ           1000 non-null   float64
 10  TARGET CLASS  1000 non-null   int64
dtypes: float64(10), int64(1)
memory usage: 93.8 KB
```

[34]:
```
data.columns
```

[34]:
```
Index(['WTT', 'PTI', 'EQW', 'SBI', 'LQE', 'QWG', 'FDJ', 'PJF', 'HQE', 'NXJ',
       'TARGET CLASS'],
      dtype='object')
```

[22]:
```
sns.pairplot(data, hue='TARGET CLASS')
```

[22]:
```
<seaborn.axisgrid.PairGrid at 0x7fc4d3712110>
```



[35]:
```
from sklearn.preprocessing import StandardScaler

sc = StandardScaler()

sc.fit(data.drop('TARGET CLASS', axis=1))
```

[35]:
```
StandardScaler()
```

[36]:
```
dados=sc.transform(data.drop('TARGET CLASS', axis=1))
```

[26]:
```
dados
```

[26]:
```
array([[-0.12354188,  0.18590747, -0.91343069, …, -1.48236813,
        -0.9497194 , -0.64331425],
       [-1.08483602, -0.43034845, -1.02531333, …, -0.20224031,
```

```
        -1.82805088,  0.63675862],
       [-0.78870217,  0.33931821,  0.30151137, …,  0.28570652,
        -0.68249379, -0.37784986],
       …,
       [ 0.64177714, -0.51308341, -0.17920486, …, -2.36249443,
        -0.81426092,  0.11159651],
       [ 0.46707241, -0.98278576, -1.46519359, …, -0.03677699,
         0.40602453, -0.85567   ],
       [-0.38765353, -0.59589427, -1.4313981 , …, -0.56778932,
         0.3369971 ,  0.01034996]])
```

[37]:
```python
DF = pd.DataFrame(dados, columns = data.columns[:-1])
```

[38]:
```python
DF.head()
```

[38]:
```
        WTT       PTI       EQW       SBI       LQE       QWG       FDJ  \
0 -0.123542  0.185907 -0.913431  0.319629 -1.033637 -2.308375 -0.798951
1 -1.084836 -0.430348 -1.025313  0.625388 -0.444847 -1.152706 -1.129797
2 -0.788702  0.339318  0.301511  0.755873  2.031693 -0.870156  2.599818
3  0.982841  1.060193 -0.621399  0.625299  0.452820 -0.267220  1.750208
4  1.139275 -0.640392 -0.709819 -0.057175  0.822886 -0.936773  0.596782

        PJF       HQE       NXJ
0 -1.482368 -0.949719 -0.643314
1 -0.202240 -1.828051  0.636759
2  0.285707 -0.682494 -0.377850
3  1.066491  1.241325 -1.026987
4 -1.472352  1.040772  0.276510
```

0.1 Divisão Treino e Teste

[39]:
```python
from sklearn.model_selection import train_test_split
```

[41]:
```python
X_train, X_test, y_train, y_test = train_test_split(dados, data['TARGET CLASS'],
                                                    test_size=0.3,␣
 ↪random_state=1)
```

[42]:
```python
y_train
```

[42]:
```
731    1
716    0
640    1
804    1
737    1
      ..
767    1
72     1
```

```
908    1
235    1
37     1
Name: TARGET CLASS, Length: 700, dtype: int64
```

[43]:
```
X_train
```

[43]:
```
array([[ 2.05621551, -0.32655566,  0.2186274 , …, -0.41322254,
         0.09995974,  1.31436215],
       [-0.66162431,  1.2943079 , -0.15774655, …, -0.71699735,
        -1.3585909 , -0.56024653],
       [ 0.39523395, -2.09199987, -1.38109288, …, -0.67612905,
         0.21135605,  0.11393259],
       …,
       [ 0.90344929,  0.00424662, -1.01972037, …, -0.34549064,
        -0.09885529,  1.19270428],
       [-0.00962074,  1.24838194, -0.78177643, …, -1.4002669 ,
         0.49192358, -0.1189531 ],
       [ 0.10483098,  1.27975307, -0.13195213, …, -1.28654429,
         1.13589455, -0.29048815]])
```

[44]:
```
from sklearn.neighbors import KNeighborsClassifier
```

[45]:
```
KNN = KNeighborsClassifier(n_neighbors=1)
```

[46]:
```
KNN.fit(X_train, y_train)
```

[46]:
```
KNeighborsClassifier(n_neighbors=1)
```

[47]:
```
predicao = KNN.predict(X_test)
```

[48]:
```
predicao
```

[48]:
```
array([0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 1, 1, 1, 1, 0, 1,
       1, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 0, 1,
       1, 1, 1, 0, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 1, 1, 0, 0, 0, 1,
       0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0,
       0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0,
       1, 1, 0, 1, 0, 1, 0, 0, 1, 1, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 0, 1,
       1, 0, 1, 0, 0, 1, 1, 1, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0,
       0, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 1,
       0, 0, 0, 1, 0, 0, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 0, 1, 1, 0, 1, 0,
       1, 0, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 1, 1, 1, 0,
       0, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0,
       0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0,
       1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 0,
       1, 0, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 1])
```

0.2 Avaliando os resultados

[49]:
```
from sklearn.metrics import classification_report, confusion_matrix
```

[50]:
```
print(confusion_matrix(y_test, predicao))
```

```
[[147  14]
 [ 10 129]]
```

[51]:
```
prob=(147+129)/(24)
```

[52]:
```
prob
```

[52]:
```
11.5
```

[53]:
```
print(classification_report(y_test, predicao))
```

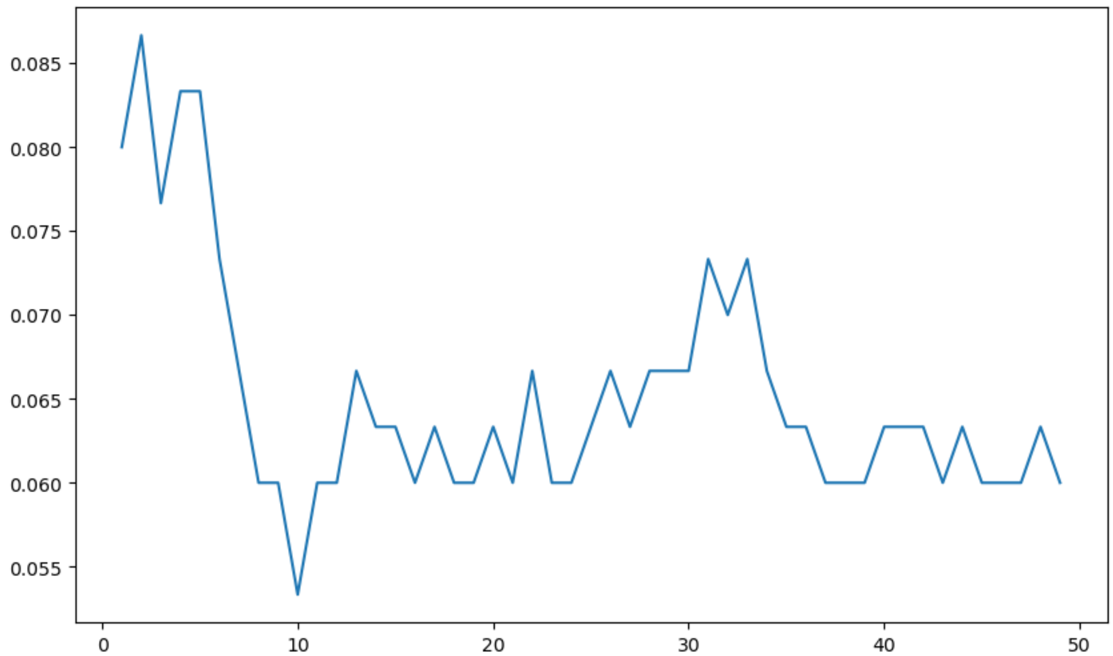
```
              precision    recall  f1-score   support

           0       0.94      0.91      0.92       161
           1       0.90      0.93      0.91       139

    accuracy                           0.92       300
   macro avg       0.92      0.92      0.92       300
weighted avg       0.92      0.92      0.92       300
```

0.3 Técnica do Cotovelo

[54]:
```
error_rate = []

for i in range(1, 50):
    KNN = KNeighborsClassifier(n_neighbors= i)
    KNN.fit(X_train, y_train)
    preditor_i = KNN.predict(X_test)
    error_rate.append(np.mean(preditor_i != Y_test))
```

[56]:
```
plt.figure(figsize=(10,6))
plt.plot(range(1, 50), error_rate)
```

[56]:
```
[<matplotlib.lines.Line2D at 0x7fc4cae473a0>]
```



[63]:
```
KNN = KNeighborsClassifier(n_neighbors=8)
KNN.fit(X_train, y_train)
predicao = KNN.predict(X_test)
print(confusion_matrix(y_test, predicao))
print(classification_report(y_test, predicao))
```

```
[[151  10]
 [  8 131]]
              precision    recall  f1-score   support

           0       0.95      0.94      0.94       161
           1       0.93      0.94      0.94       139

    accuracy                           0.94       300
   macro avg       0.94      0.94      0.94       300
weighted avg       0.94      0.94      0.94       300
```

0.4 Criando um grid de busca de parametros para KNN

[64]:
```
from sklearn.model_selection import GridSearchCV
```

[65]:
```
k_list = list(range(1,30))
weight_list = ['uniform', 'distance']
p_list=[1, 2]
```

[66]:
```
parametros = dict(n_neighbors=k_list, weights = weight_list, p = p_list)
```

[67]:
```
grid = GridSearchCV(KNN, parametros, cv=5, scoring='accuracy')
```

[68]:
```
grid.fit(dados, data['TARGET CLASS'])
```

[68]:
```
GridSearchCV(cv=5, estimator=KNeighborsClassifier(n_neighbors=8),
             param_grid={'n_neighbors': [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12,
                                         13, 14, 15, 16, 17, 18, 19, 20, 21, 22,
                                         23, 24, 25, 26, 27, 28, 29],
                         'p': [1, 2], 'weights': ['uniform', 'distance']},
             scoring='accuracy')
```

[69]:
```
grid.cv_results_
```

[69]:
```
{'mean_fit_time': array([0.00256987, 0.00158482, 0.00161514, 0.00160398,
0.00153265,
        0.00170612, 0.00157261, 0.00155387, 0.0016531 , 0.00157886,
        0.00158052, 0.00151086, 0.00161533, 0.00160589, 0.00166326,
        0.00155201, 0.0018312 , 0.00145826, 0.00162272, 0.00158086,
        0.00167294, 0.00145693, 0.00166698, 0.00160575, 0.00153966,
        0.0014771 , 0.00154181, 0.00157194, 0.00149183, 0.00142994,
        0.0014338 , 0.00144963, 0.00152264, 0.00159183, 0.0014524 ,
        0.00150628, 0.001477  , 0.00144978, 0.00149322, 0.00151243,
        0.00151029, 0.00157022, 0.00164232, 0.00162706, 0.00162735,
        0.00167584, 0.00159202, 0.00172853, 0.00148149, 0.00161514,
        0.00164971, 0.00157037, 0.00160623, 0.00164814, 0.00158591,
        0.00156779, 0.00172362, 0.00170765, 0.00156975, 0.00158496,
        0.00161757, 0.00176916, 0.00155387, 0.00164461, 0.00173125,
        0.0016912 , 0.00160313, 0.00173221, 0.00153127, 0.00161176,
        0.00158257, 0.001579  , 0.0017725 , 0.00157952, 0.00157762,
        0.00163813, 0.00151839, 0.00164914, 0.00163121, 0.00169916,
        0.00159836, 0.00157557, 0.00165982, 0.00158558, 0.00153351,
        0.00146618, 0.0016294 , 0.00147524, 0.0014411 , 0.00142436,
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        0.935, 0.935, 0.935, 0.935, 0.945, 0.945, 0.935, 0.93 , 0.94 ,
        0.935, 0.925, 0.925, 0.935, 0.935, 0.93 , 0.925, 0.94 , 0.935,
        0.935, 0.935, 0.935, 0.935, 0.94 , 0.925, 0.94 , 0.94 , 0.925,
        0.925, 0.935, 0.935, 0.935, 0.93 , 0.94 , 0.94 , 0.935, 0.935,
        0.94 , 0.94 , 0.94 , 0.93 , 0.94 , 0.945, 0.93 , 0.93 , 0.94 ,
        0.94 , 0.93 , 0.93 , 0.935, 0.94 , 0.935, 0.935, 0.945, 0.945,
        0.935, 0.935, 0.94 , 0.94 , 0.935, 0.935, 0.94 , 0.94 ]),
 'split1_test_score': array([0.89 , 0.89 , 0.9  , 0.9  , 0.905, 0.89 , 0.915,
0.9  , 0.91 ,
        0.91 , 0.92 , 0.92 , 0.92 , 0.925, 0.93 , 0.92 , 0.915, 0.915,
        0.92 , 0.92 , 0.915, 0.915, 0.915, 0.92 , 0.915, 0.915, 0.925,
        0.925, 0.91 , 0.915, 0.925, 0.925, 0.915, 0.92 , 0.91 , 0.91 ,
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        0.91 , 0.92 , 0.925, 0.91 , 0.91 , 0.92 , 0.92 , 0.915, 0.92 ,
        0.92 , 0.92 , 0.92 , 0.92 , 0.915, 0.915, 0.92 , 0.915, 0.91 ,
        0.92 , 0.93 , 0.93 , 0.905, 0.91 , 0.925, 0.92 , 0.905, 0.905,
        0.92 , 0.92 , 0.905, 0.905, 0.915, 0.92 , 0.905, 0.905, 0.915,
        0.915, 0.905, 0.905, 0.92 , 0.92 , 0.905, 0.915, 0.915, 0.915,
        0.91 , 0.915, 0.915, 0.915, 0.91 , 0.91 , 0.91 , 0.91 , 0.915,
        0.92 , 0.915, 0.91 , 0.91 , 0.915, 0.915, 0.915, 0.92 , 0.92 ,
        0.915, 0.915, 0.92 , 0.92 , 0.91 , 0.91 , 0.92 , 0.92 ]),
 'split2_test_score': array([0.845, 0.845, 0.89 , 0.89 , 0.87 , 0.845, 0.895,
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        0.89 , 0.89 , 0.92 , 0.885, 0.9  , 0.895, 0.92 , 0.92 , 0.91 ,
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        0.92 , 0.915, 0.905, 0.9  , 0.92 , 0.92 , 0.92 , 0.92 , 0.92 ,
        0.91 , 0.905, 0.905, 0.93 , 0.93 , 0.915, 0.915, 0.92 , 0.91 ,
        0.91 , 0.905, 0.93 , 0.93 , 0.905, 0.905, 0.93 , 0.925, 0.92 ,
        0.905, 0.935, 0.935, 0.915, 0.915, 0.94 , 0.93 , 0.915, 0.905,
```

```
       0.935, 0.935, 0.915, 0.915, 0.93 , 0.925, 0.92 , 0.915, 0.93 ,
       0.93 , 0.915, 0.915, 0.925, 0.92 , 0.915, 0.915, 0.93 , 0.93 ,
       0.92 , 0.92 , 0.94 , 0.93 , 0.93 , 0.92 , 0.935, 0.935, 0.92 ,
       0.92 , 0.935, 0.925, 0.93 , 0.92 , 0.935, 0.935, 0.92 , 0.92 ,
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 'split3_test_score': array([0.885, 0.885, 0.93 , 0.93 , 0.9  , 0.885, 0.9  ,
0.93 , 0.925,
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       0.93 , 0.935, 0.92 , 0.935, 0.93 , 0.945, 0.925, 0.93 , 0.94 ,
       0.94 , 0.915, 0.93 , 0.945, 0.945, 0.935, 0.935, 0.94 , 0.94 ,
       0.935, 0.945, 0.935, 0.94 , 0.935, 0.935, 0.935, 0.935, 0.94 ,
       0.945, 0.94 , 0.94 , 0.935, 0.935, 0.94 , 0.94 , 0.93 , 0.935,
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       0.94 , 0.94 , 0.945, 0.945, 0.94 , 0.945, 0.95 , 0.945, 0.945,
       0.945, 0.945, 0.945, 0.955, 0.945, 0.955, 0.94 , 0.945, 0.95 ,
       0.945, 0.945, 0.96 , 0.96 , 0.955, 0.95 , 0.95 , 0.955, 0.95 ,
       0.945, 0.95 , 0.955, 0.95 , 0.945, 0.95 , 0.95 , 0.945, 0.945,
       0.95 , 0.95 , 0.95 , 0.945, 0.945, 0.95 , 0.935, 0.935]),
 'split4_test_score': array([0.915, 0.915, 0.94 , 0.94 , 0.905, 0.915, 0.935,
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       0.96 , 0.96 , 0.965, 0.965, 0.965, 0.96 , 0.955, 0.96 , 0.97 ,
       0.975, 0.965, 0.97 , 0.97 , 0.975, 0.965, 0.97 , 0.96 , 0.965,
       0.96 , 0.975, 0.97 , 0.97 , 0.96 , 0.96 , 0.965, 0.97 , 0.97 ,
       0.965, 0.965, 0.97 , 0.965, 0.97 , 0.97 , 0.97 , 0.96 , 0.965,
       0.975, 0.97 , 0.96 , 0.965, 0.97 , 0.97 , 0.955, 0.965, 0.97 ,
       0.975, 0.96 , 0.965, 0.96 , 0.97 , 0.965, 0.965, 0.97 , 0.97 ,
       0.96 , 0.965, 0.965, 0.965, 0.96 , 0.965, 0.965, 0.965, 0.955,
       0.96 , 0.96 , 0.96 , 0.955, 0.965, 0.96 , 0.96 , 0.965, 0.97 ,
       0.965, 0.97 , 0.965, 0.965, 0.97 , 0.97 , 0.96 , 0.96 , 0.97 ,
       0.97 , 0.97 , 0.97 , 0.97 , 0.97 , 0.97 , 0.97 , 0.97 , 0.97 ,
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       0.924, 0.925, 0.927, 0.924, 0.924, 0.927, 0.928, 0.93 , 0.933,
       0.934, 0.925, 0.925, 0.937, 0.936, 0.931, 0.933, 0.93 , 0.931,
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       0.933, 0.933, 0.935, 0.934, 0.935, 0.937, 0.937, 0.931, 0.932,
       0.936, 0.934, 0.937, 0.938, 0.934, 0.934, 0.934, 0.936, 0.935,
       0.934, 0.938, 0.939, 0.93 , 0.933, 0.943, 0.937, 0.934, 0.931,
       0.938, 0.939, 0.933, 0.933, 0.937, 0.936, 0.936, 0.934, 0.934,
       0.935, 0.932, 0.932, 0.938, 0.936, 0.935, 0.934, 0.938, 0.94 ,
       0.936, 0.938, 0.944, 0.94 , 0.941, 0.939, 0.937, 0.938, 0.939,
       0.939, 0.94 , 0.938, 0.939, 0.938, 0.941, 0.941, 0.94 , 0.94 ,
       0.94 , 0.94 , 0.943, 0.939, 0.937, 0.938, 0.938, 0.938]),
```

```
 'std_test_score': array([0.02289105, 0.02289105, 0.01886796, 0.01886796,
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        0.02059126, 0.02059126, 0.01655295, 0.02315167, 0.02712932,
        0.01949359, 0.02009975, 0.02073644, 0.02244994, 0.02280351,
        0.01913113, 0.02615339, 0.02267157, 0.02293469, 0.014     ,
        0.01581139, 0.02088061, 0.02267157, 0.02073644, 0.02607681,
        0.01913113, 0.02332381, 0.01854724, 0.01964688, 0.01897367,
        0.02059126, 0.01691153, 0.02244994, 0.02227106, 0.02267157,
        0.01691153, 0.01691153, 0.0156205 , 0.01749286, 0.0204939 ,
        0.02111871, 0.02014944, 0.0212132 , 0.01772005, 0.01949359,
        0.01939072, 0.01939072, 0.0156205 , 0.01860108, 0.02222611,
        0.02177154, 0.0132665 , 0.0150333 , 0.02289105, 0.02289105,
        0.01157584, 0.0174356 , 0.0204939 , 0.02332381, 0.01208305,
        0.01392839, 0.01897367, 0.02111871, 0.0150333 , 0.01630951,
        0.02267157, 0.02437212, 0.0128841 , 0.01462874, 0.02135416,
        0.02135416, 0.01469694, 0.0168523 , 0.02130728, 0.02154066,
        0.01428286, 0.01581139, 0.01989975, 0.01989975, 0.01469694,
        0.01714643, 0.02167948, 0.01714643, 0.01661325, 0.01870829,
        0.01933908, 0.01964688, 0.01772005, 0.01923538, 0.02059126,
        0.02154066, 0.01720465, 0.01805547, 0.02009975, 0.01854724,
        0.01870829, 0.02158703, 0.02009975, 0.01964688, 0.01827567,
        0.01827567, 0.01870829, 0.01870829, 0.0167332 , 0.01870829,
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        0.01749286]),
 'rank_test_score': array([114, 114, 108, 108, 113, 114, 112, 108, 106, 106,
94,  94, 105,
        108,  69,  96, 101,  96, 101,  96,  92, 101, 101,  92,  91,  88,
         69,  57,  96,  96,  39,  45,  84,  69,  88,  84,  77,  45,  77,
         57,  77,  77,  42,  33,  51,  69,  69,  51,  57,  51,  39,  39,
         84,  77,  45,  57,  33,  21,  57,  57,  57,  42,  51,  57,  29,
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         45,  57,  57,  51,  77,  77,  21,  45,  51,  57,  21,   7,  45,
         29,   1,   7,   4,  17,  33,  21,  17,  17,   7,  21,  14,  29,
          4,   4,   7,   7,   7,   7,   2,  17,  33,  21,  21,  21],
       dtype=int32)}
```

[70]:
```
print("Melhores parametros {} com valor de acuracia {}".format(grid.
 ↪best_params_, grid.best_score_))
```

```
Melhores parametros {'n_neighbors': 24, 'p': 1, 'weights': 'uniform'} com valor
de acuracia 0.944
```

Parametros importantes em **KNN**:

- **n_neighbors**= Nũmero de vizinhos;
- **weights**= Peso da amostra dos vizinhos (padrão = uniform);
- **metric**= Métrica usada para o calculo da distância (padrão = minkowski);

- **p**= Parâmetro de poder da métrica (padrão = 2);
- **n_jobs** = Número de threads que podem ser paralelizados durante a busca dos vizinhos (padrão = 1).

```
[ ]:
```