Source: https://scikit-learn.org/stable/modules/generated/sklearn.datasets.loa (https://scikit-learn.org/stable/modules/generated/sklearn.datasets.loa

In [1]:

```
from sklearn.datasets import load_breast_cancer
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

#load_breast_cancer()
pd.set_option('display.max_rows', 15)
pd.set_option('display.max_columns', 10)

breast_cancer = load_breast_cancer()
df = pd.DataFrame(breast_cancer["data"], columns = breast_cancer['feature_names'])
df['target'] = breast_cancer['target']
df.to_csv("breast_cancer.csv", encoding = 'utf-8', index = False)
df
```

Out[1]:

	mean radius	mean texture	mean perimeter	mean area	mean smoothness	...	worst concavity	worst concave points	worst symmetry	wo frac dimens
0	17.99	10.38	122.80	1001.0	0.11840	...	0.7119	0.2654	0.4601	0.11
1	20.57	17.77	132.90	1326.0	0.08474	...	0.2416	0.1860	0.2750	0.08
2	19.69	21.25	130.00	1203.0	0.10960	...	0.4504	0.2430	0.3613	0.08
3	11.42	20.38	77.58	386.1	0.14250	...	0.6869	0.2575	0.6638	0.17
4	20.29	14.34	135.10	1297.0	0.10030	...	0.4000	0.1625	0.2364	0.07
5	12.45	15.70	82.57	477.1	0.12780	...	0.5355	0.1741	0.3985	0.12
6	18.25	19.98	119.60	1040.0	0.09463	...	0.3784	0.1932	0.3063	0.08
...	...	...	...	...	...	...	...	...	...	
562	15.22	30.62	103.40	716.9	0.10480	...	1.1700	0.2356	0.4089	0.14
563	20.92	25.09	143.00	1347.0	0.10990	...	0.6599	0.2542	0.2929	0.09
564	21.56	22.39	142.00	1479.0	0.11100	...	0.4107	0.2216	0.2060	0.07
565	20.13	28.25	131.20	1261.0	0.09780	...	0.3215	0.1628	0.2572	0.06
566	16.60	28.08	108.30	858.1	0.08455	...	0.3403	0.1418	0.2218	0.07
567	20.60	29.33	140.10	1265.0	0.11780	...	0.9387	0.2650	0.4087	0.12
568	7.76	24.54	47.92	181.0	0.05263	...	0.0000	0.0000	0.2871	0.07

569 rows × 31 columns

Data Cleaning - Whether any row has NULL value, if yes then diplay True

In [2]:

```
df.isnull().any()
```

Out[2]:

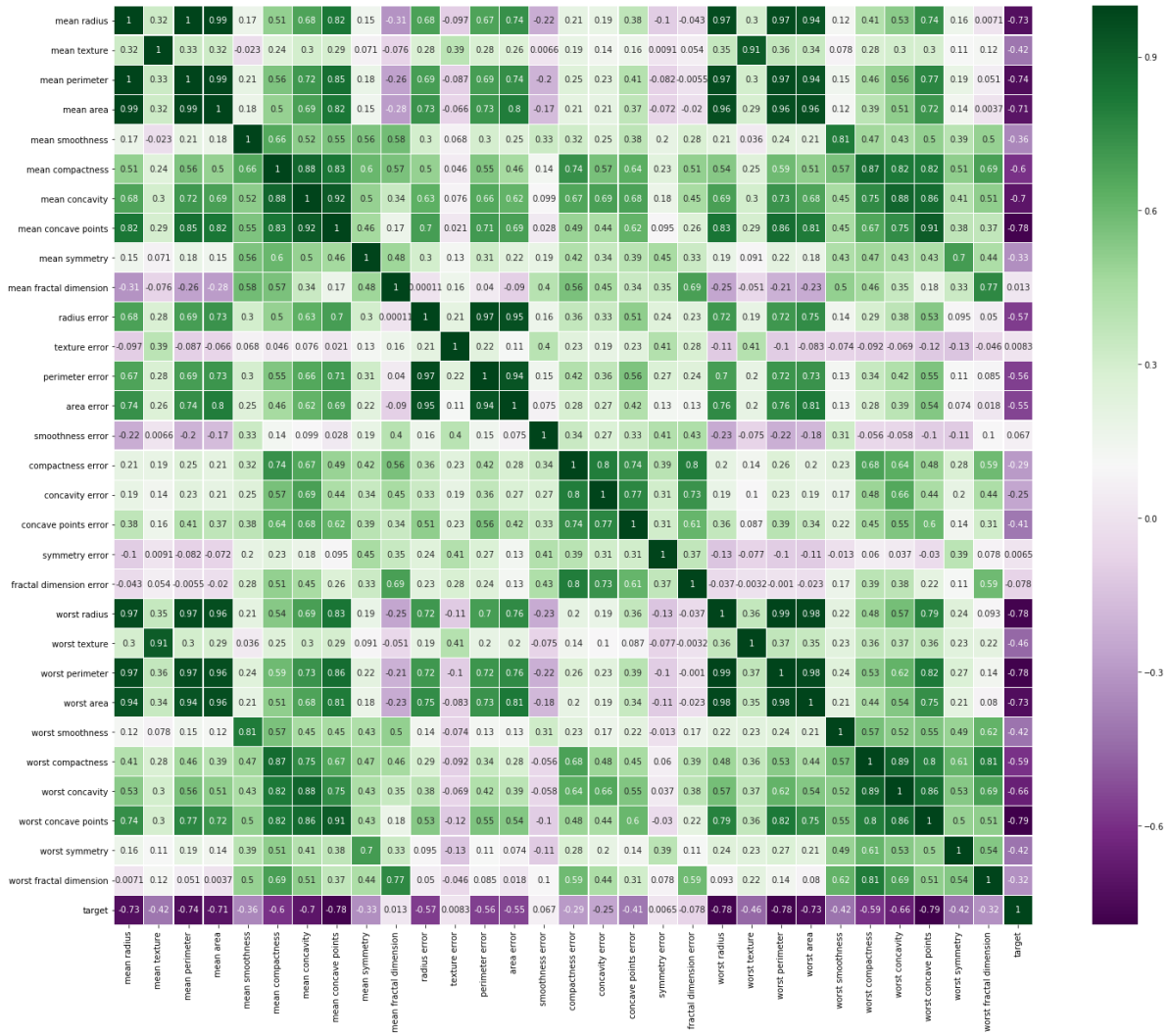
```
mean radius                False
mean texture               False
mean perimeter             False
mean area                  False
mean smoothness            False
mean compactness           False
mean concavity             False
                           ...
worst smoothness           False
worst compactness          False
worst concavity            False
worst concave points       False
worst symmetry             False
worst fractal dimension    False
target                     False
Length: 31, dtype: bool
```

In [3]:

```
%matplotlib inline

plt.figure(figsize=(25,20))
sns.heatmap(df.astype(float).corr(), cmap = 'PRGn', linewidths = 0.1, square = True,
```

Out[3]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1a0da68f98>
```



Choose the color => https://matplotlib.org/2.0.2/examples/color/colormaps_reference.html (https://matplotlib.org/2.0.2/examples/color/colormaps_reference.html)

The coefficient scores below -0.7 are much related to the breast cancer.

In [4]:

```
df.columns.shape[0]
```

Out[4]:

```
31
```

In [5]:

```
df.columns
```

Out[5]:

```
Index(['mean radius', 'mean texture', 'mean perimeter', 'mean area',
       'mean smoothness', 'mean compactness', 'mean concavity',
       'mean concave points', 'mean symmetry', 'mean fractal dimensio
n',
       'radius error', 'texture error', 'perimeter error', 'area erro
r',
       'smoothness error', 'compactness error', 'concavity error',
       'concave points error', 'symmetry error', 'fractal dimension er
ror',
       'worst radius', 'worst texture', 'worst perimeter', 'worst are
a',
       'worst smoothness', 'worst compactness', 'worst concavity',
       'worst concave points', 'worst symmetry', 'worst fractal dimens
ion',
       'target'],
      dtype='object')
```

Perform Test and Train split

I am going to adopt all of columns excluded target as Features to Predict breast cancer

In [6]:

```
from sklearn.model_selection import train_test_split
data_train, data_test, target_train, target_test = train_test_split(breast_cancer['d
                                                                    test_size = 0.3
```

Approach#1 DecisionTreeClassifier approach (Supervised)

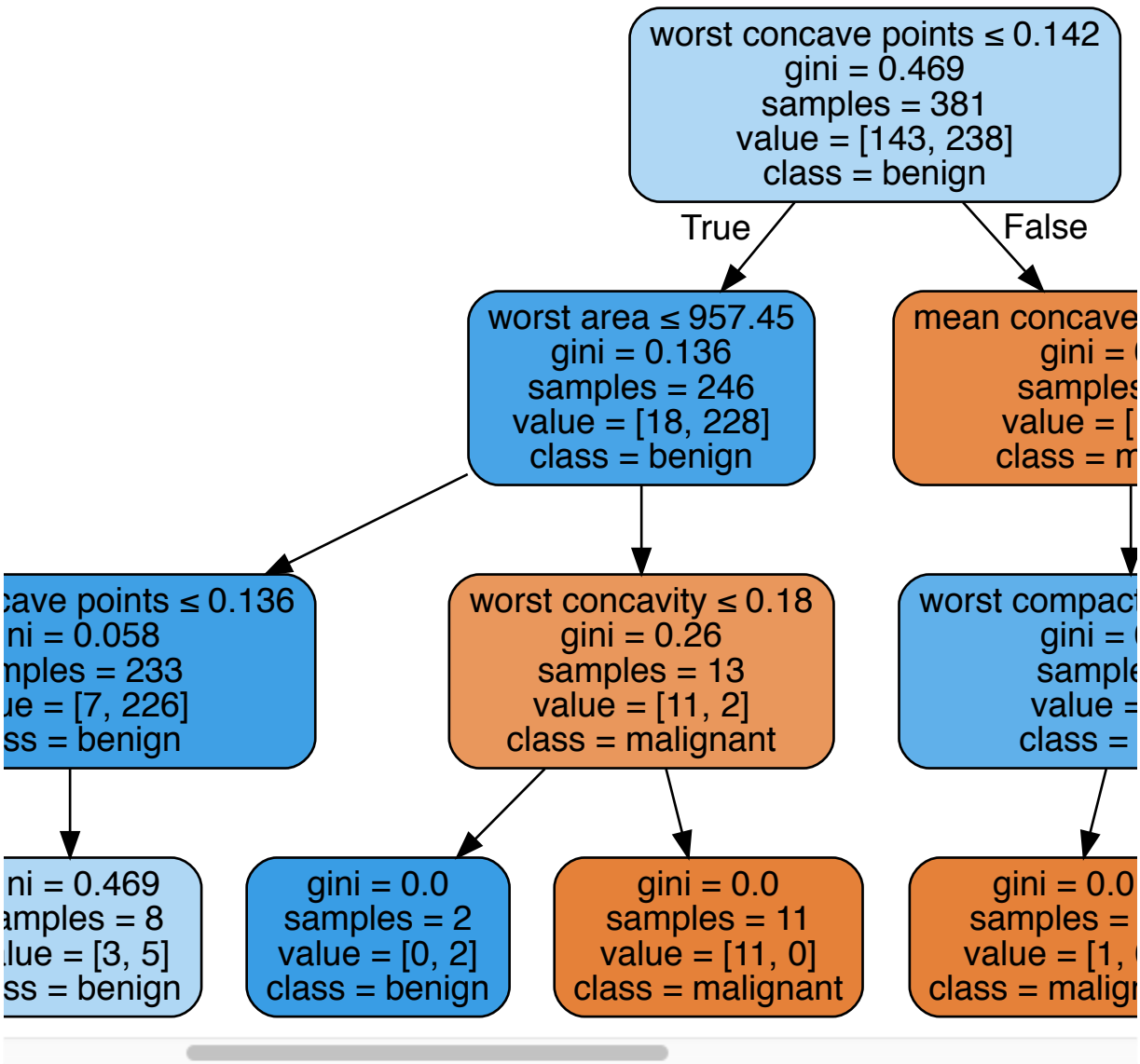
In [7]:

```
from sklearn.tree import DecisionTreeClassifier
clf = DecisionTreeClassifier(max_depth = 3)
clf = clf.fit(data_train, target_train)
```

In [8]:

```
from sklearn.tree import export_graphviz
import graphviz
tree_pattern = export_graphviz(clf, out_file = None,
                               feature_names = breast_cancer['feature_names'],
                               class_names = breast_cancer['target_names'],
                               filled = True, rounded = True,
                               special_characters = True)
g = graphviz.Source(tree_pattern)
g.render('breast_cancer_graphviz') #Export to PDF
g
```

Out[8]:



Confusion Matrix for DecisionTreeClassifier

In [9]:

```
from sklearn.metrics import confusion_matrix
result_clf = confusion_matrix(clf.predict(data_test), target_test)
pd.DataFrame(result_clf)
```

Out[9]:

	0	1
0	60	2
1	9	117

Accuracy score for DecisionTreeClassifier

In [10]:

```
from sklearn.metrics import accuracy_score
print("Predict:", list(clf.predict(data_test)))
print("True:", list(target_test))
print('Accuracy Score:', accuracy_score(clf.predict(data_test), target_test) * 100,
```

```
Predict: [0, 0, 0, 0, 1, 0, 1, 1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 0, 1, 1,
1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 1,
1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1,
1, 1, 0, 1, 0, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 1, 0, 1,
1, 0, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0,
0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0,
0, 1, 1, 0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 0, 0, 1, 1, 1, 1]
True: [0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 1, 1, 1,
1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1, 1, 1,
1, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1, 1,
1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 1, 0, 1, 0,
0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0, 0,
1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0, 0,
1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
0, 0, 1, 1, 1, 1]
Accuracy Score: 94.14893617021278 %
```

In [11]:

```
#or write in this way
accuracy_score(y_pred = clf.predict(data_test), y_true = target_test)
```

Out[11]:

```
0.9414893617021277
```

Approach#2 KNN algorithm (Supervised)

In [12]:

```
from sklearn.neighbors import KNeighborsClassifier

kclf = KNeighborsClassifier(n_neighbors = 3)
kclf = kclf.fit(data_train, target_train)
```

Cufsion matrix for KNN

In [13]:

```
from sklearn.metrics import confusion_matrix
result_kclf = confusion_matrix(kclf.predict(data_test), target_test)
pd.DataFrame(result_kclf)
```

Out[13]:

	0	1
0	61	2
1	8	117

Accuracy score for KNN

In [14]:

```
from sklearn.metrics import accuracy_score
print("Predict:", list(kclf.predict(data_test)))
print("True:", list(target_test))
print('Accuracy score:', accuracy_score(kclf.predict(data_test), target_test) * 100,
```

```
Predict: [0, 0, 0, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 0, 1, 1,
1, 1, 1, 1, 1, 1, 0, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1, 1,
1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1,
1, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1,
1, 0, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0,
0, 1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0,
0, 1, 1, 0, 0, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
1, 0, 0, 1, 1, 1, 1]
True: [0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 1, 1, 1,
1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1, 1, 1,
1, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1, 1,
1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 1, 0, 1, 0,
0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0, 0,
1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0, 0,
1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
0, 0, 1, 1, 1, 1]
Accuracy score: 94.68085106382979 %
```

Approach#3 KMeans algorithm (Unsupervised)

In [15]:

```
from sklearn.cluster import KMeans
kmeans = KMeans(n_clusters = 2)
kmeans.fit(data_train) # Due to it is unsupervised, don't need 'target_train'
```

Out[15]:

```
KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
    n_clusters=2, n_init=10, n_jobs=1, precompute_distances='auto',
    random_state=None, tol=0.0001, verbose=0)
```

Cufsion matrix for KMeans

In [16]:

```
from sklearn.metrics import confusion_matrix
result_kmeans = confusion_matrix(kmeans.predict(data_test), target_test)
pd.DataFrame(result_kmeans)
```

Out[16]:

	0	1
0	30	119
1	39	0

Accuracy score for KMeans

In [17]:

```
print("Predict:", list(kmeans.predict(data_test)))
print("True:", list(target_test))
print('Accuracy score:', accuracy_score(kmeans.predict(data_test), target_test) * 1(
```

```
Predict: [1, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0,
0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0,
0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 0, 1, 0, 1, 0,
0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0,
1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 1,
1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
0, 0, 1, 0, 0, 0, 0]
True: [0, 0, 0, 0, 1, 0, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 1, 1, 1,
1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 0, 1, 1, 1,
1, 1, 0, 1, 0, 1, 1, 1, 0, 0, 1, 0, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1, 1,
1, 0, 1, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 1, 0, 1, 0,
0, 0, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0, 0,
1, 1, 1, 1, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
0, 0, 1, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0, 0, 1, 0, 1, 1, 1, 1, 0, 0,
1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
0, 0, 1, 1, 1, 1]
Accuracy score: 15.957446808510639 %
```

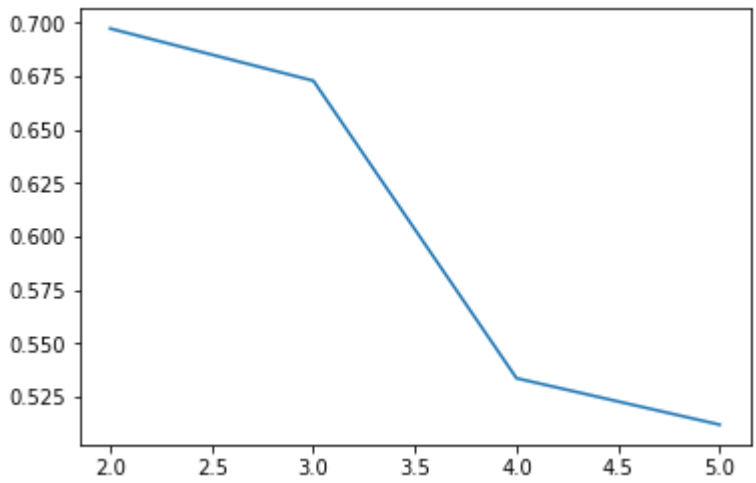
In [18]:

```
from sklearn.metrics import silhouette_score
import matplotlib.pyplot as plt
%matplotlib inline

scores = []
ks = []

for i in range (2,6):

    kmeans = KMeans(n_clusters= i)
    kmeans.fit(breast_cancer['data'])
    scores.append(silhouette_score(breast_cancer['data'], kmeans.labels_))
    ks.append(i)

print(scores)
print(ks)

plt.plot (ks, scores)
```

```
[0.6972646156059464, 0.6728663978657781, 0.533753360908508, 0.51205885
04057626]
[2, 3, 4, 5]
```

Out[18]:

```
[<matplotlib.lines.Line2D at 0x1a156d6a90>]
```



In this plot, we can notice machine judge there are two clusters (when k= 2~3 has a high value). This is make sense since we have benign and malignant in the classify.