# 4.6.5 K-Nearest Neighbors

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In [41]:
```
# conventional way to import pandas
import pandas as pd
# conventional way to import seaborn
import seaborn as sns
# conventional way to import numpy
import numpy as np

from sklearn import metrics
import matplotlib.pyplot as plt

data = pd.read_csv("https://raw.github.com/vincentarelbundock/Rdatasets/master/csv/ISL

data.head()
```

Out[41]:

| | Year | Lag1 | Lag2 | Lag3 | Lag4 | Lag5 | Volume | Today | Direction |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2001 | 0.381 | -0.192 | -2.624 | -1.055 | 5.010 | 1.1913 | 0.959 | Up |
| 2 | 2001 | 0.959 | 0.381 | -0.192 | -2.624 | -1.055 | 1.2965 | 1.032 | Up |
| 3 | 2001 | 1.032 | 0.959 | 0.381 | -0.192 | -2.624 | 1.4112 | -0.623 | Down |
| 4 | 2001 | -0.623 | 1.032 | 0.959 | 0.381 | -0.192 | 1.2760 | 0.614 | Up |
| 5 | 2001 | 0.614 | -0.623 | 1.032 | 0.959 | 0.381 | 1.2057 | 0.213 | Up |

We will split the data into data before 2005 and after. Next we will make our tranining data.

In [42]:
```
import statsmodels.api as sm
from scipy import stats
from patsy import dmatrices

MarketAfter_2005 = data.query('Year >= 2005')
MarketBefore_2005 = data.query('Year < 2005')

y_train, X_train = dmatrices('Direction~Lag1+Lag2', MarketBefore_2005, return_type =

y_test, X_test = dmatrices('Direction~Lag1+Lag2', MarketAfter_2005, return_type = 'dat
```

Import K-Nearest Neighbors

In [43]:
```
from sklearn.neighbors import KNeighborsClassifier
```

```
In [44]: neigh = KNeighborsClassifier(n_neighbors= 3) # use n_neighbors to change the # of tun

         KNN_fit = neigh.fit(X_train.iloc[:,1:3], y_train.iloc[:,1]) #learning the projection

         X_test_labels = KNN_fit.predict(X_test.iloc[:,1:3])
         X_test_prob   = KNN_fit.predict_proba(X_test.iloc[:,1:3])

         np.mean(y_test.iloc[:,1]==X_test_labels)

Out[44]: 0.53174603174603174
```

See what we can get fom the KNeighborsClassifier

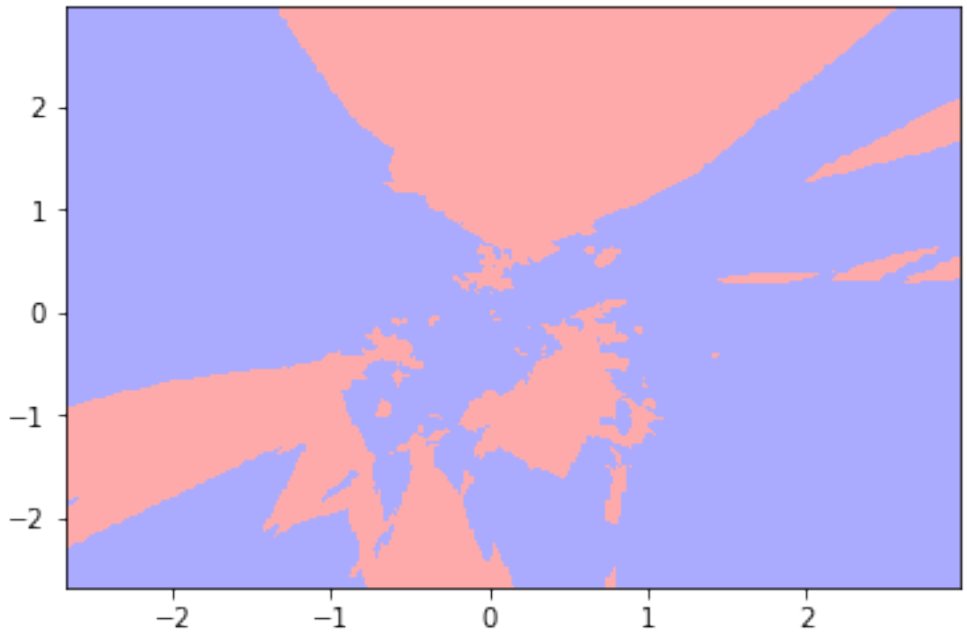
```
In [45]: dir(neigh) # use dir command to check what KNN offers

Out[45]: ['__abstractmethods__',
          '__class__',
          '__delattr__',
          '__dict__',
          '__dir__',
          '__doc__',
          '__eq__',
          '__format__',
          '__ge__',
          '__getattribute__',
          '__getstate__',
          '__gt__',
          '__hash__',
          '__init__',
          '__init_subclass__',
          '__le__',
          '__lt__',
          '__module__',
          '__ne__',
          '__new__',
          '__reduce__',
          '__reduce_ex__',
          '__repr__',
          '__setattr__',
          '__setstate__',
          '__sizeof__',
          '__str__',
          '__subclasshook__',
          '__weakref__',
          '_abc_cache',
          '_abc_negative_cache',
          '_abc_negative_cache_version',
          '_abc_registry',
          '_estimator_type',
```

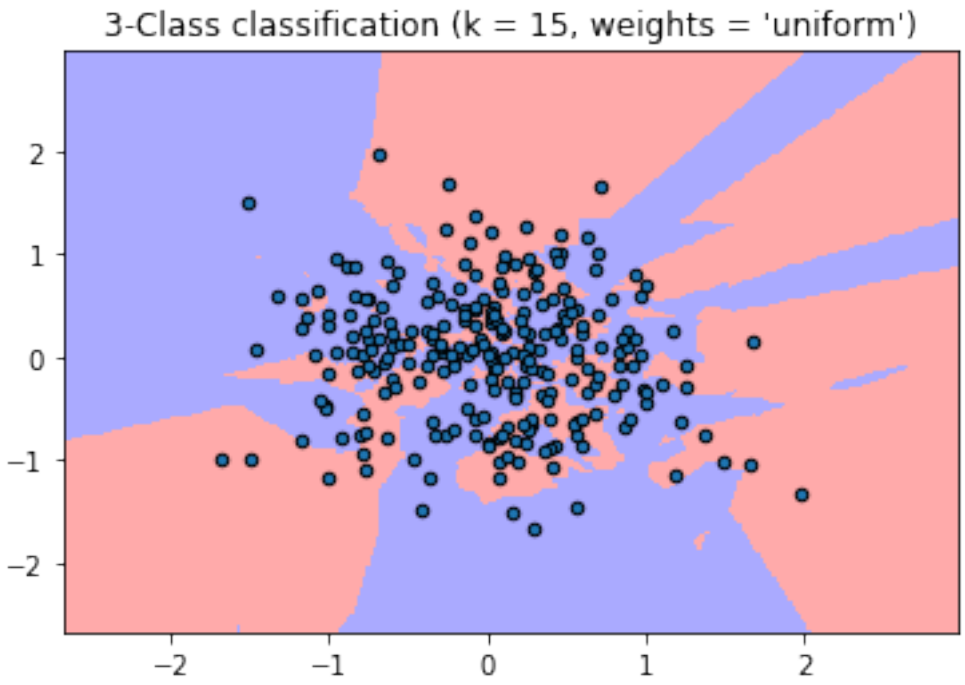
```
 '_fit',
 '_fit_X',
 '_fit_method',
 '_get_param_names',
 '_init_params',
 '_pairwise',
 '_tree',
 '_y',
 'algorithm',
 'classes_',
 'effective_metric_',
 'effective_metric_params_',
 'fit',
 'get_params',
 'kneighbors',
 'kneighbors_graph',
 'leaf_size',
 'metric',
 'metric_params',
 'n_jobs',
 'n_neighbors',
 'outputs_2d_',
 'p',
 'predict',
 'predict_proba',
 'radius',
 'score',
 'set_params',
 'weights']
```

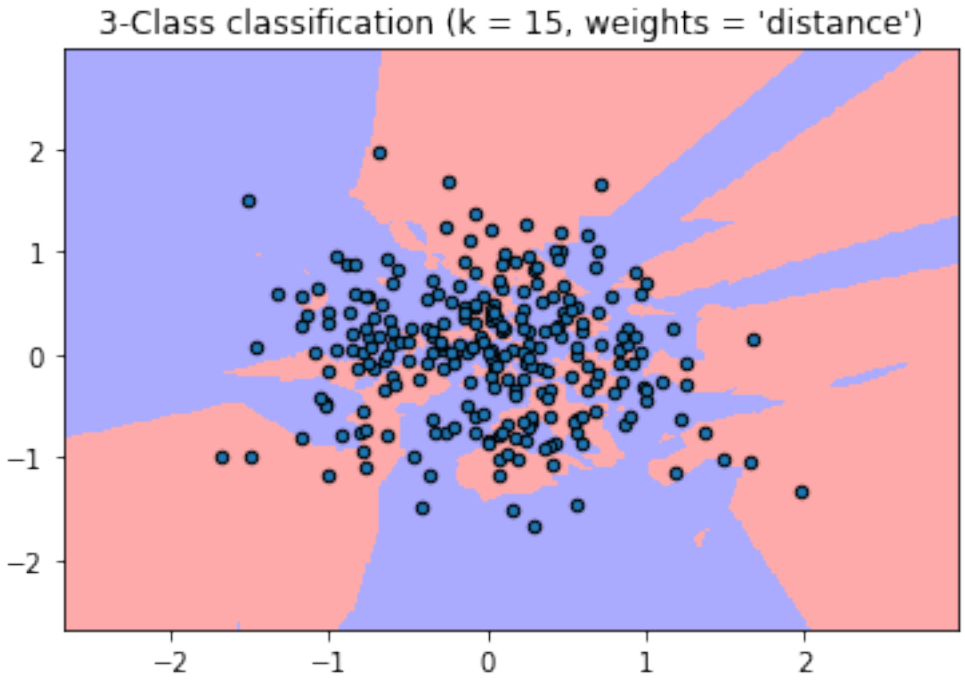
This is an attempt at ploting. But it didn't work so well. In spider or pycham is shows a image, but i don't think it is useful right now.

```
In [47]: X = X_test.iloc[:,1:3]
         y = y_test.iloc[:,1:3]
         h = .02  # step size in the mesh

         # Create color maps

         from matplotlib.colors import ListedColormap

         cmap_light = ListedColormap(['#FFAAAA', '#AAFFAA', '#AAAAFF'])
         cmap_bold = ListedColormap(['#FF0000', '#00FF00', '#0000FF'])

         for weights in ['uniform', 'distance']:
             # we create an instance of Neighbours Classifier and fit the data.
             clf = KNeighborsClassifier(3)
             clf.fit(X, y.values.ravel())
```

```
    # Plot the decision boundary. For that, we will assign a color to each
    # point in the mesh [x_min, x_max]x[y_min, y_max].
    x_min, x_max = X.min() - 1, X.max() + 1
    y_min, y_max = X.min() - 1, X.max() + 1
    xx, yy = np.meshgrid(np.arange(x_min[1], x_max[1], h), np.arange(y_min[1], y_max[
    Z = clf.predict(np.c_[xx.ravel(), yy.ravel()])

    # Put the result into a color plot
    Z = Z.reshape(xx.shape)
    plt.figure()
    plt.pcolormesh(xx, yy, Z, cmap=cmap_light)

    # Plot also the training points
    plt.scatter(X.iloc[:, 0], X.iloc[:, 1], cmap=cmap_bold, edgecolor='k', s=20)
    plt.xlim(xx.min(), xx.max())
    plt.ylim(yy.min(), yy.max())
    plt.title("3-Class classification (k = %i, weights = '%s')"% (15, weights))

plt.show()
```




3-Class classification (k = 15, weights = 'uniform')
2
1
0
−1
−2
−2
−1
0
1
2


3-Class classification (k = 15, weights = 'distance')
2
1
0
−1
−2
−2
−1
0
1
2