```
!pip install combo
```

```
Collecting combo
  Downloading combo-0.1.2.tar.gz (37 kB)
Requirement already satisfied: joblib in /usr/local/lib/python3.7/dist-packages (from combo) (1.0.1)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.7/dist-packages (from combo) (3.2.2)
Requirement already satisfied: numpy>=1.13 in /usr/local/lib/python3.7/dist-packages (from combo) (1.19.5)
Requirement already satisfied: numba>=0.35 in /usr/local/lib/python3.7/dist-packages (from combo) (0.51.2)
Collecting pyod
  Downloading pyod-0.9.2.tar.gz (108 kB)
     |████████████████████████████████| 108 kB 12.4 MB/s
Requirement already satisfied: scipy in /usr/local/lib/python3.7/dist-packages (from combo) (1.4.1)
Requirement already satisfied: scikit_learn>=0.20 in /usr/local/lib/python3.7/dist-packages (from combo) (0.22.2.post1)
Requirement already satisfied: llvmlite<0.35,>=0.34.0.dev0 in /usr/local/lib/python3.7/dist-packages (from numba>=0.35->combo) (0.34.0)
Requirement already satisfied: setuptools in /usr/local/lib/python3.7/dist-packages (from numba>=0.35->combo) (57.4.0)
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.7/dist-packages (from matplotlib->combo) (1.3.1)
Requirement already satisfied: python-dateutil>=2.1 in /usr/local/lib/python3.7/dist-packages (from matplotlib->combo) (2.8.2)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.7/dist-packages (from matplotlib->combo) (0.10.0)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in /usr/local/lib/python3.7/dist-packages (from matplotlib->combo)
Requirement already satisfied: six in /usr/local/lib/python3.7/dist-packages (from cycler>=0.10->matplotlib->combo) (1.15.0)
Requirement already satisfied: statsmodels in /usr/local/lib/python3.7/dist-packages (from pyod->combo) (0.10.2)
Requirement already satisfied: patsy>=0.4.0 in /usr/local/lib/python3.7/dist-packages (from statsmodels->pyod->combo) (0.5.1)
Requirement already satisfied: pandas>=0.19 in /usr/local/lib/python3.7/dist-packages (from statsmodels->pyod->combo) (1.1.5)
Requirement already satisfied: pytz>=2017.2 in /usr/local/lib/python3.7/dist-packages (from pandas>=0.19->statsmodels->pyod->combo) (2018.9
Building wheels for collected packages: combo, pyod
  Building wheel for combo (setup.py) ... done
  Created wheel for combo: filename=combo-0.1.2-py3-none-any.whl size=42025 sha256=14cad1a19a18fa8294889cafb041eb2de94cbc5d0b8177e88199a836
  Stored in directory: /root/.cache/pip/wheels/cf/2e/45/d4cb985fb061e3ab636d350b76114d2639d84eab16225c7776
  Building wheel for pyod (setup.py) ... done
  Created wheel for pyod: filename=pyod-0.9.2-py3-none-any.whl size=127179 sha256=a6e617f28f944bef5e340c2c1cec97677e9f2531e3f220e82d94c6a68
  Stored in directory: /root/.cache/pip/wheels/20/c3/80/4fc108b509b7221a0043444eee23fe54c8c5f5a29ba1ccaa14
Successfully built combo pyod
Installing collected packages: pyod, combo
Successfully installed combo-0.1.2 pyod-0.9.2
```

```
import os
import sys
sys.path.append(
    os.path.abspath(os.path.join(os.path.dirname("__file__"), '..')))
import warnings
warnings.filterwarnings("ignore")
import numpy as np
from numpy import percentile
import matplotlib.pyplot as plt
import matplotlib.font_manager
# Import all models
from sklearn.tree import DecisionTreeClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import AdaBoostClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.svm import SVC
from sklearn.neighbors import KNeighborsClassifier
from combo.models.classifier_comb import SimpleClassifierAggregator
from combo.models.classifier_stacking import Stacking
from combo.models.classifier_dcs import DCS_LA
from combo.models.classifier_des import DES_LA
```

```
# Define the number of class 0 and class 1
n_samples = 300
class1_fraction = 0.5
clusters_separation = [3]
# Compare given detectors under given settings
# Initialize the data
xx, yy = np.meshgrid(np.linspace(-7, 7, 100), np.linspace(-7, 7, 100))
n_class0 = int((1. - class1_fraction) * n_samples)
n_class1 = int(class1_fraction * n_samples)
ground_truth = np.zeros(n_samples, dtype=int)
ground_truth[-n_class1:] = 1
# Show the statics of the data
print('Number of Class 0: %i' % n_class0)
print('Number of Class 1: %i' % n_class1)
print('Ground truth shape is {shape}.\n'.format(shape=ground_truth.shape))
print(ground_truth, '\n')
```

```
Number of Class 0: 150
Number of Class 1: 150
Ground truth shape is (300,).
```

```
[0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
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 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1]
```
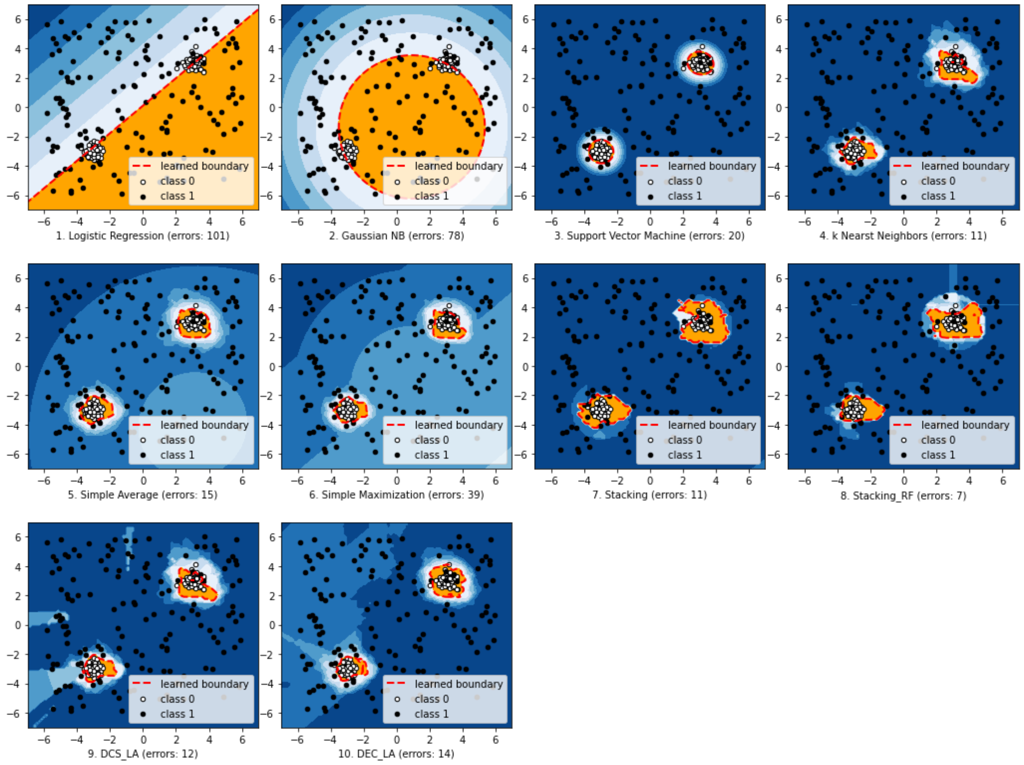

```python
random_state = np.random.RandomState(42)
classifiers = [LogisticRegression(), GaussianNB(), SVC(probability=True),
               KNeighborsClassifier()]
# Define some combination methods to be compared
classifiers = {
'Logistic Regression': LogisticRegression(),
    'Gaussian NB': GaussianNB(),
    'Support Vector Machine': SVC(probability=True),
    'k Nearst Neighbors': KNeighborsClassifier(),
    'Simple Average': SimpleClassifierAggregator(base_estimators=classifiers,
                                                 method='average'),
    'Simple Maximization': SimpleClassifierAggregator(
        base_estimators=classifiers, method='maximization'),
    'Stacking': Stacking(base_estimators=classifiers, shuffle_data=True),
    'Stacking_RF': Stacking(base_estimators=classifiers, shuffle_data=True,
                            meta_clf=RandomForestClassifier(
                                random_state=random_state)),
    'DCS_LA': DCS_LA(base_estimators=classifiers),
    'DEC_LA': DES_LA(base_estimators=classifiers)
}
# Show all classifiers
for i, clf in enumerate(classifiers.keys()):
    print('Model', i + 1, clf)
# Fit the models with the generated data and
# compare model performances
for i, offset in enumerate(clusters_separation):
    np.random.seed(42)
    # Data generation
    X1 = 0.3 * np.random.randn(n_class0 // 2, 2) - offset
    X2 = 0.3 * np.random.randn(n_class0 // 2, 2) + offset
    X = np.r_[X1, X2]
    # Add class 1
    X = np.r_[X, np.random.uniform(low=-6, high=6, size=(n_class1, 2))]
# Fit the model
    plt.figure(figsize=(15, 12))
    for i, (clf_name, clf) in enumerate(classifiers.items()):
        print(i + 1, 'fitting', clf_name)
        # fit the data and tag class 1
        clf.fit(X, ground_truth)
        scores_pred = clf.predict_proba(X)[:, 1] * -1
        y_pred = clf.predict(X)
        threshold = percentile(scores_pred, 100 * class1_fraction)
        n_errors = (y_pred != ground_truth).sum()
        # plot the levels lines and the points
        Z = clf.predict_proba(np.c_[xx.ravel(), yy.ravel()])[:, 1] * -1
        Z = Z.reshape(xx.shape)
        subplot = plt.subplot(3, 4, i + 1)
        subplot.contourf(xx, yy, Z, levels=np.linspace(Z.min(), threshold, 7),
                         cmap=plt.cm.Blues_r)
        a = subplot.contour(xx, yy, Z, levels=[threshold],
                            linewidths=2, colors='red')
        subplot.contourf(xx, yy, Z, levels=[threshold, Z.max()],
                         colors='orange')
        b = subplot.scatter(X[:-n_class1, 0], X[:-n_class1, 1], c='white',
                            s=20, edgecolor='k')
        c = subplot.scatter(X[-n_class1:, 0], X[-n_class1:, 1], c='black',
                            s=20, edgecolor='k')
        subplot.axis('tight')
        subplot.legend(
            [a.collections[0], b, c],
            ['learned boundary', 'class 0', 'class 1'],
            prop=matplotlib.font_manager.FontProperties(size=10),
            loc='lower right')
        subplot.set_xlabel("%d. %s (errors: %d)" % (i + 1, clf_name, n_errors))
        subplot.set_xlim((-7, 7))
        subplot.set_ylim((-7, 7))
    plt.subplots_adjust(0.04, 0.1, 0.96, 0.94, 0.1, 0.26)
    plt.suptitle("Model Combination")
# plt.savefig('compare_selected_classifiers.png', dpi=300)
# plt.savefig('compare_selected_classifiers.png', dpi=300)
plt.show()
```

```
Model 1 Logistic Regression
Model 2 Gaussian NB
Model 3 Support Vector Machine
Model 4 k Nearst Neighbors
Model 5 Simple Average
Model 6 Simple Maximization
Model 7 Stacking
Model 8 Stacking_RF
Model 9 DCS_LA
Model 10 DEC_LA
1 fitting Logistic Regression
2 fitting Gaussian NB
3 fitting Support Vector Machine
4 fitting k Nearst Neighbors
5 fitting Simple Average
6 fitting Simple Maximization
7 fitting Stacking
8 fitting Stacking_RF
9 fitting DCS_LA
10 fitting DEC_LA
```

Model Combination



1. Logistic Regression (errors: 101)

2. Gaussian NB (errors: 78)

3. Support Vector Machine (errors: 20)

4. k Nearst Neighbors (errors: 11)

5. Simple Average (errors: 15)

6. Simple Maximization (errors: 39)

7. Stacking (errors: 11)

8. Stacking_RF (errors: 7)

9. DCS_LA (errors: 12)

10. DEC_LA (errors: 14)