decision

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ML Lab 8: Compare Classifier Visually

0.0.1 Decision Tree

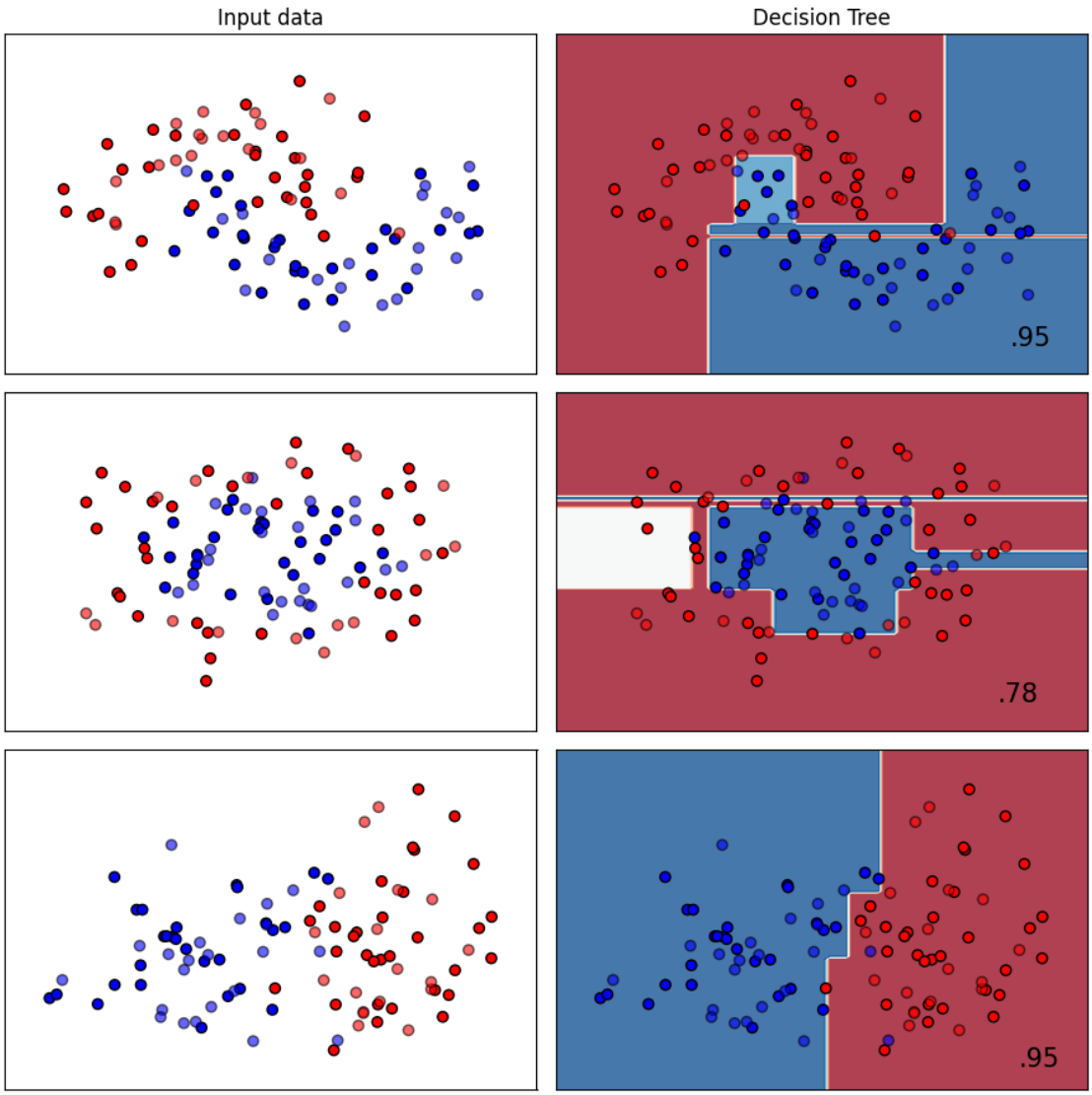
[ ]:
```
# Code source: Gaël Varoquaux
#              Andreas Müller
# Modified for documentation by Jaques Grobler
# License: BSD 3 clause

import matplotlib.pyplot as plt
import numpy as np
from matplotlib.colors import ListedColormap

from sklearn.datasets import make_circles, make_classification, make_moons
# from sklearn.discriminant_analysis import QuadraticDiscriminantAnalysis
# from sklearn.ensemble import AdaBoostClassifier, RandomForestClassifier
# from sklearn.gaussian_process import GaussianProcessClassifier
# from sklearn.gaussian_process.kernels import RBF
from sklearn.inspection import DecisionBoundaryDisplay
from sklearn.model_selection import train_test_split
# from sklearn.naive_bayes import GaussianNB
# from sklearn.neighbors import KNeighborsClassifier
# from sklearn.neural_network import MLPClassifier
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
# from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
```

[2]:
```
names = [

    "Decision Tree",

]

classifiers = [
```

```
    DecisionTreeClassifier(max_depth=5, random_state=42),

]

X, y = make_classification(
    n_features=2, n_redundant=0, n_informative=2, random_state=1,␣
 ↪n_clusters_per_class=1
)
rng = np.random.RandomState(2)
X += 2 * rng.uniform(size=X.shape)
linearly_separable = (X, y)

datasets = [
    make_moons(noise=0.3, random_state=0),
    make_circles(noise=0.2, factor=0.5, random_state=1),
    linearly_separable,
]

figure = plt.figure(figsize=(9, 9))
i = 1
# iterate over datasets
for ds_cnt, ds in enumerate(datasets):
    # preprocess dataset, split into training and test part
    X, y = ds
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.4, random_state=42
    )

    x_min, x_max = X[:, 0].min() - 0.5, X[:, 0].max() + 0.5
    y_min, y_max = X[:, 1].min() - 0.5, X[:, 1].max() + 0.5

    # just plot the dataset first
    cm = plt.cm.RdBu
    cm_bright = ListedColormap(["#FF0000", "#0000FF"])
    ax = plt.subplot(len(datasets), len(classifiers) + 1, i)
    if ds_cnt == 0:
        ax.set_title("Input data")
    # Plot the training points
    ax.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
 ↪edgecolors="k")
    # Plot the testing points
    ax.scatter(
        X_test[:, 0], X_test[:, 1], c=y_test, cmap=cm_bright, alpha=0.6,␣
 ↪edgecolors="k"
    )
    ax.set_xlim(x_min, x_max)
```

```
    ax.set_ylim(y_min, y_max)
    ax.set_xticks(())
    ax.set_yticks(())
    i += 1

    # iterate over classifiers
    for name, clf in zip(names, classifiers):
        ax = plt.subplot(len(datasets), len(classifiers) + 1, i)

        clf = make_pipeline(StandardScaler(), clf)
        clf.fit(X_train, y_train)
        score = clf.score(X_test, y_test)
        DecisionBoundaryDisplay.from_estimator(
            clf, X, cmap=cm, alpha=0.8, ax=ax, eps=0.5
        )

        # Plot the training points
        ax.scatter(
            X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k"
        )
        # Plot the testing points
        ax.scatter(
            X_test[:, 0],
            X_test[:, 1],
            c=y_test,
            cmap=cm_bright,
            edgecolors="k",
            alpha=0.6,
        )

        ax.set_xlim(x_min, x_max)
        ax.set_ylim(y_min, y_max)
        ax.set_xticks(())
        ax.set_yticks(())
        if ds_cnt == 0:
            ax.set_title(name)
        ax.text(
            x_max - 0.3,
            y_min + 0.3,
            ("%.2f" % score).lstrip("0"),
            size=15,
            horizontalalignment="right",
        )
        i += 1

plt.tight_layout()
```

```
plt.show()
```

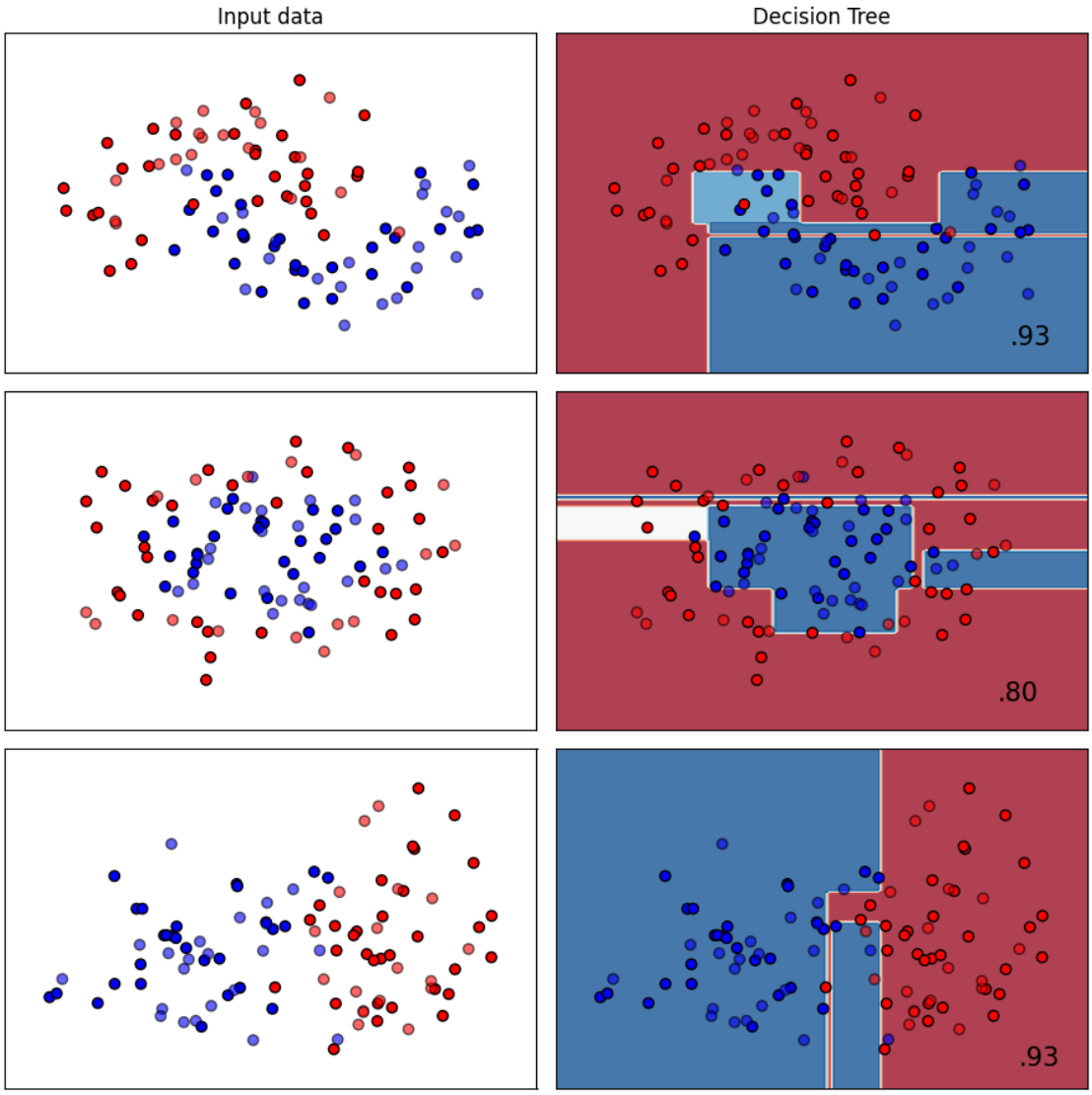


[5]:
```
#changing the maximum depth and random state. Changing criteria
names = [

    "Decision Tree",

]

classifiers = [

    DecisionTreeClassifier(max_depth=5, random_state=20,criterion='entropy'),
```

```
]
```

[6]:
```
X, y = make_classification(
    n_features=2, n_redundant=0, n_informative=2, random_state=1,␣
 ↪n_clusters_per_class=1
)
rng = np.random.RandomState(2)
X += 2 * rng.uniform(size=X.shape)
linearly_separable = (X, y)

datasets = [
    make_moons(noise=0.3, random_state=0),
    make_circles(noise=0.2, factor=0.5, random_state=1),
    linearly_separable,
]

figure = plt.figure(figsize=(9, 9))
i = 1
# iterate over datasets
for ds_cnt, ds in enumerate(datasets):
    # preprocess dataset, split into training and test part
    X, y = ds
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.4, random_state=42
    )

    x_min, x_max = X[:, 0].min() - 0.5, X[:, 0].max() + 0.5
    y_min, y_max = X[:, 1].min() - 0.5, X[:, 1].max() + 0.5

    # just plot the dataset first
    cm = plt.cm.RdBu
    cm_bright = ListedColormap(["#FF0000", "#0000FF"])
    ax = plt.subplot(len(datasets), len(classifiers) + 1, i)
    if ds_cnt == 0:
        ax.set_title("Input data")
    # Plot the training points
    ax.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
 ↪edgecolors="k")
    # Plot the testing points
    ax.scatter(
        X_test[:, 0], X_test[:, 1], c=y_test, cmap=cm_bright, alpha=0.6,␣
 ↪edgecolors="k"
    )
    ax.set_xlim(x_min, x_max)
    ax.set_ylim(y_min, y_max)
    ax.set_xticks(())
    ax.set_yticks(())
```

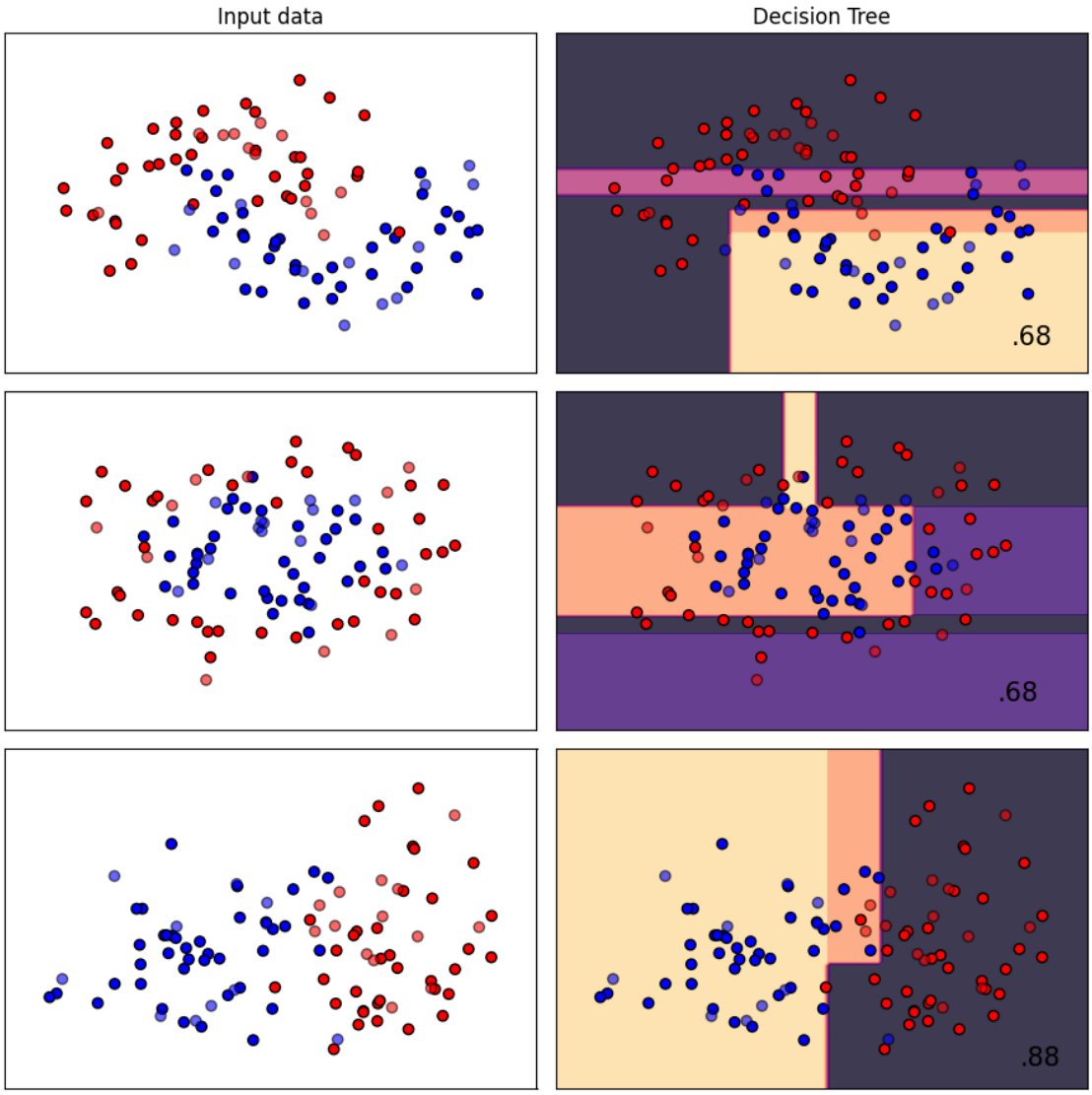
```
    i += 1

    # iterate over classifiers
    for name, clf in zip(names, classifiers):
        ax = plt.subplot(len(datasets), len(classifiers) + 1, i)

        clf = make_pipeline(StandardScaler(), clf)
        clf.fit(X_train, y_train)
        score = clf.score(X_test, y_test)
        DecisionBoundaryDisplay.from_estimator(
            clf, X, cmap=cm, alpha=0.8, ax=ax, eps=0.5
        )

        # Plot the training points
        ax.scatter(
            X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k"
        )
        # Plot the testing points
        ax.scatter(
            X_test[:, 0],
            X_test[:, 1],
            c=y_test,
            cmap=cm_bright,
            edgecolors="k",
            alpha=0.6,
        )

        ax.set_xlim(x_min, x_max)
        ax.set_ylim(y_min, y_max)
        ax.set_xticks(())
        ax.set_yticks(())
        if ds_cnt == 0:
            ax.set_title(name)
        ax.text(
            x_max - 0.3,
            y_min + 0.3,
            ("%.2f" % score).lstrip("0"),
            size=15,
            horizontalalignment="right",
        )
        i += 1

plt.tight_layout()
plt.show()
```



[11]:
```
#changing the maximum depth and random state. Changing criteria
names = [

    "Decision Tree",

]

classifiers = [

    DecisionTreeClassifier(max_depth=3, random_state=20,criterion='entropy'),

]
```

[13]:
```
X, y = make_classification(
    n_features=2, n_redundant=0, n_informative=2, random_state=1,␣
 ↪n_clusters_per_class=1
)
rng = np.random.RandomState(2)
X += 2 * rng.uniform(size=X.shape)
linearly_separable = (X, y)

datasets = [
    make_moons(noise=0.3, random_state=0),
    make_circles(noise=0.2, factor=0.5, random_state=1),
    linearly_separable,
]

figure = plt.figure(figsize=(9, 9))
i = 1
# iterate over datasets
for ds_cnt, ds in enumerate(datasets):
    # preprocess dataset, split into training and test part
    X, y = ds
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.25, random_state=20
    )

    x_min, x_max = X[:, 0].min() - 0.5, X[:, 0].max() + 0.5
    y_min, y_max = X[:, 1].min() - 0.5, X[:, 1].max() + 0.5

    # just plot the dataset first
    cm = plt.cm.magma
    cm_bright = ListedColormap(["#FF0000", "#0000FF"])
    ax = plt.subplot(len(datasets), len(classifiers) + 1, i)
    if ds_cnt == 0:
        ax.set_title("Input data")
    # Plot the training points
    ax.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
 ↪edgecolors="k")
    # Plot the testing points
    ax.scatter(
        X_test[:, 0], X_test[:, 1], c=y_test, cmap=cm_bright, alpha=0.6,␣
 ↪edgecolors="k"
    )
    ax.set_xlim(x_min, x_max)
    ax.set_ylim(y_min, y_max)
    ax.set_xticks(())
    ax.set_yticks(())
    i += 1
```

```
    # iterate over classifiers
    for name, clf in zip(names, classifiers):
        ax = plt.subplot(len(datasets), len(classifiers) + 1, i)

        clf = make_pipeline(StandardScaler(), clf)
        clf.fit(X_train, y_train)
        score = clf.score(X_test, y_test)
        DecisionBoundaryDisplay.from_estimator(
            clf, X, cmap=cm, alpha=0.8, ax=ax, eps=0.5
        )

        # Plot the training points
        ax.scatter(
            X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k"
        )
        # Plot the testing points
        ax.scatter(
            X_test[:, 0],
            X_test[:, 1],
            c=y_test,
            cmap=cm_bright,
            edgecolors="k",
            alpha=0.6,
        )

        ax.set_xlim(x_min, x_max)
        ax.set_ylim(y_min, y_max)
        ax.set_xticks(())
        ax.set_yticks(())
        if ds_cnt == 0:
            ax.set_title(name)
        ax.text(
            x_max - 0.3,
            y_min + 0.3,
            ("%.2f" % score).lstrip("0"),
            size=15,
            horizontalalignment="right",
        )
        i += 1

plt.tight_layout()
plt.show()
```


Input data
Decision Tree
.68
.68
.88

random-forest

May 9, 2024

0.0.1 Random Forest

[5]:
```
# Code source: Gaël Varoquaux
#              Andreas Müller
# Modified for documentation by Jaques Grobler
# License: BSD 3 clause

import matplotlib.pyplot as plt
import numpy as np
from matplotlib.colors import ListedColormap

from sklearn.datasets import make_circles, make_classification, make_moons
# from sklearn.discriminant_analysis import QuadraticDiscriminantAnalysis
from sklearn.ensemble import AdaBoostClassifier, RandomForestClassifier
# from sklearn.gaussian_process import GaussianProcessClassifier
# from sklearn.gaussian_process.kernels import RBF
from sklearn.inspection import DecisionBoundaryDisplay
from sklearn.model_selection import train_test_split
# from sklearn.naive_bayes import GaussianNB
# from sklearn.neighbors import KNeighborsClassifier
# from sklearn.neural_network import MLPClassifier
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
# from sklearn.svm import SVC
# from sklearn.tree import DecisionTreeClassifier
```

[2]:
```
names = [
    # "Nearest Neighbors",
    # "Linear SVM",
    # "Poly SVM",
    # "RBF SVM",
    # "Gaussian Process",
    # "Decision Tree",
    "Random Forest",
    # "Neural Net1",
    # "Neural Net2",
    # "Neural Net3",
    # "Neural Net4"
```

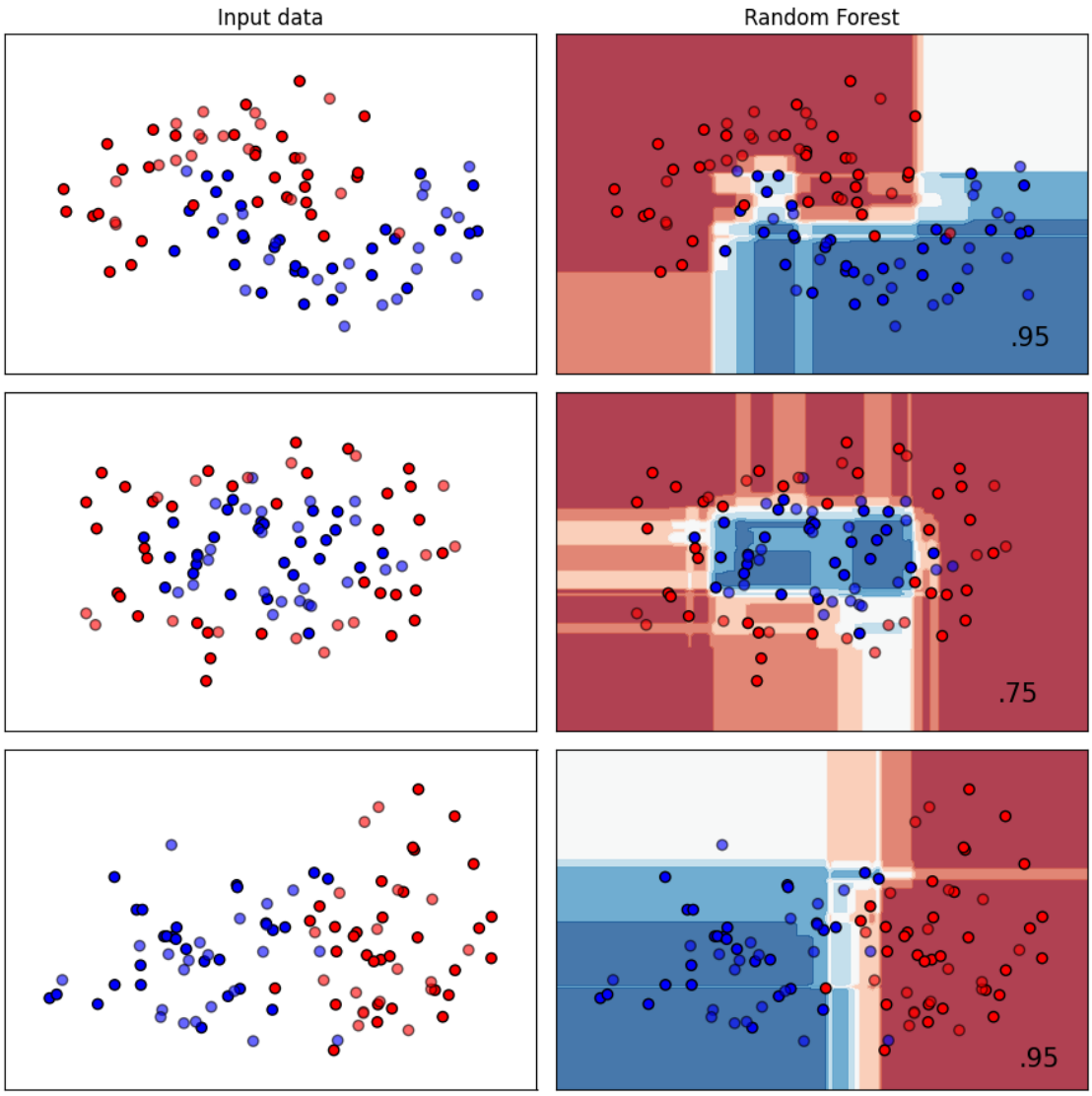
```
#     "AdaBoost",
#     "Naive Bayes",
#     "QDA",
]

classifiers = [

    RandomForestClassifier(
        max_depth=5, n_estimators=10, max_features=1, random_state=42
    )
]
```

[3]:
```
X, y = make_classification(
    n_features=2, n_redundant=0, n_informative=2, random_state=1,␣
 ↪n_clusters_per_class=1
)
rng = np.random.RandomState(2)
X += 2 * rng.uniform(size=X.shape)
linearly_separable = (X, y)

datasets = [
    make_moons(noise=0.3, random_state=0),
    make_circles(noise=0.2, factor=0.5, random_state=1),
    linearly_separable,
]
```

[7]:
```
figure = plt.figure(figsize=(9, 9))
i = 1
# iterate over datasets
for ds_cnt, ds in enumerate(datasets):
    # preprocess dataset, split into training and test part
    X, y = ds
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.4, random_state=42
    )

    x_min, x_max = X[:, 0].min() - 0.5, X[:, 0].max() + 0.5
    y_min, y_max = X[:, 1].min() - 0.5, X[:, 1].max() + 0.5

    # just plot the dataset first
    cm = plt.cm.RdBu
    cm_bright = ListedColormap(["#FF0000", "#0000FF"])
    ax = plt.subplot(len(datasets), len(classifiers) + 1, i)
    if ds_cnt == 0:
        ax.set_title("Input data")
    # Plot the training points
```

```
    ax.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k")
    # Plot the testing points
    ax.scatter(
        X_test[:, 0], X_test[:, 1], c=y_test, cmap=cm_bright, alpha=0.6,␣
↪edgecolors="k"
    )
    ax.set_xlim(x_min, x_max)
    ax.set_ylim(y_min, y_max)
    ax.set_xticks(())
    ax.set_yticks(())
    i += 1

    # iterate over classifiers
    for name, clf in zip(names, classifiers):
        ax = plt.subplot(len(datasets), len(classifiers) + 1, i)

        clf = make_pipeline(StandardScaler(), clf)
        clf.fit(X_train, y_train)
        score = clf.score(X_test, y_test)
        DecisionBoundaryDisplay.from_estimator(
            clf, X, cmap=cm, alpha=0.8, ax=ax, eps=0.5
        )

        # Plot the training points
        ax.scatter(
            X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k"
        )
                # Plot the testing points
        ax.scatter(
            X_test[:, 0],
            X_test[:, 1],
            c=y_test,
            cmap=cm_bright,
            edgecolors="k",
            alpha=0.6,
        )

        ax.set_xlim(x_min, x_max)
        ax.set_ylim(y_min, y_max)
        ax.set_xticks(())
        ax.set_yticks(())
        if ds_cnt == 0:
            ax.set_title(name)
        ax.text(
            x_max - 0.3,
```

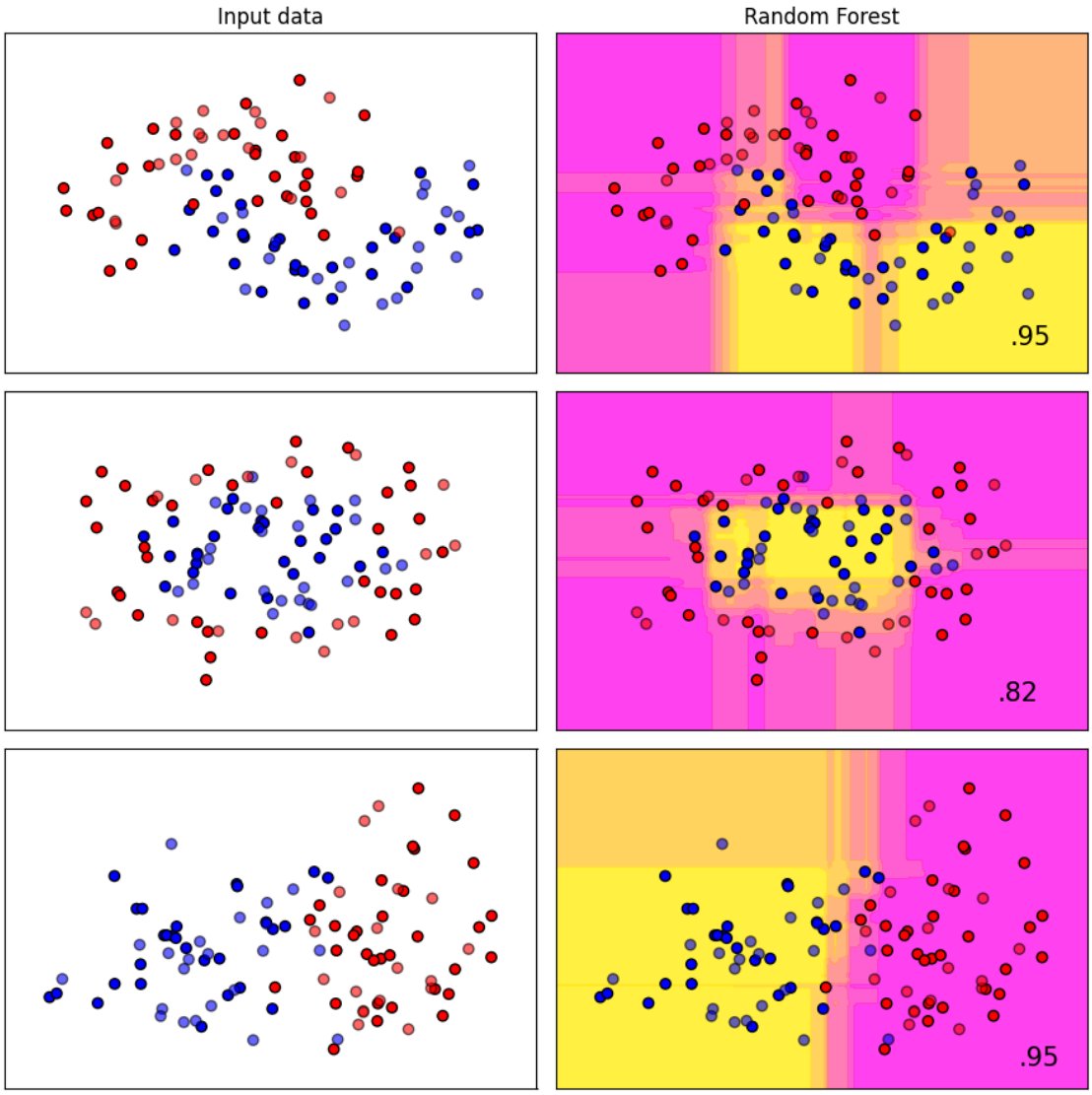
```
            y_min + 0.3,
            ("%.2f" % score).lstrip("0"),
            size=15,
            horizontalalignment="right",
        )
        i += 1

plt.tight_layout()
plt.show()
```



[9]:
```
#changing the random state, number of estimators and colour
classifiers = [
```

```
    RandomForestClassifier(
        max_depth=5, n_estimators=25, max_features=1, random_state=20
    )
]
figure = plt.figure(figsize=(9, 9))
i = 1
# iterate over datasets
for ds_cnt, ds in enumerate(datasets):
    # preprocess dataset, split into training and test part
    X, y = ds
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.4, random_state=42
    )

    x_min, x_max = X[:, 0].min() - 0.5, X[:, 0].max() + 0.5
    y_min, y_max = X[:, 1].min() - 0.5, X[:, 1].max() + 0.5

    # just plot the dataset first
    cm = plt.cm.spring
    cm_bright = ListedColormap(["#FF0000", "#0000FF"])
    ax = plt.subplot(len(datasets), len(classifiers) + 1, i)
    if ds_cnt == 0:
        ax.set_title("Input data")
    # Plot the training points
    ax.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
 ↪edgecolors="k")
    # Plot the testing points
    ax.scatter(
        X_test[:, 0], X_test[:, 1], c=y_test, cmap=cm_bright, alpha=0.6,␣
 ↪edgecolors="k"
    )
    ax.set_xlim(x_min, x_max)
    ax.set_ylim(y_min, y_max)
    ax.set_xticks(())
    ax.set_yticks(())
    i += 1

    # iterate over classifiers
    for name, clf in zip(names, classifiers):
        ax = plt.subplot(len(datasets), len(classifiers) + 1, i)

        clf = make_pipeline(StandardScaler(), clf)
        clf.fit(X_train, y_train)
        score = clf.score(X_test, y_test)
        DecisionBoundaryDisplay.from_estimator(
            clf, X, cmap=cm, alpha=0.8, ax=ax, eps=0.5
        )
```

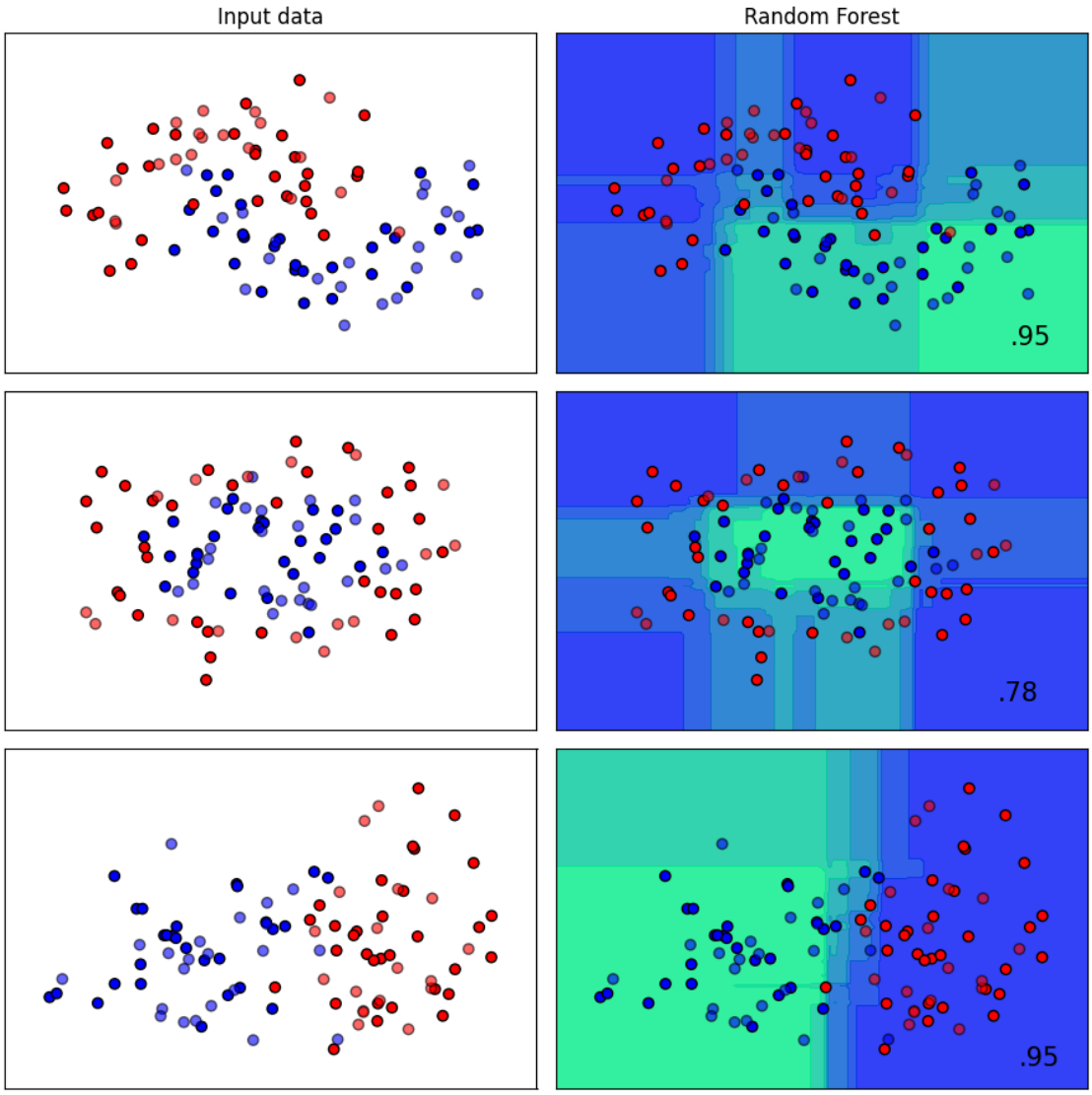
```
        # Plot the training points
        ax.scatter(
            X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k"
        )
                # Plot the testing points
        ax.scatter(
            X_test[:, 0],
            X_test[:, 1],
            c=y_test,
            cmap=cm_bright,
            edgecolors="k",
            alpha=0.6,
        )

        ax.set_xlim(x_min, x_max)
        ax.set_ylim(y_min, y_max)
        ax.set_xticks(())
        ax.set_yticks(())
        if ds_cnt == 0:
            ax.set_title(name)
        ax.text(
            x_max - 0.3,
            y_min + 0.3,
            ("%.2f" % score).lstrip("0"),
            size=15,
            horizontalalignment="right",
        )
        i += 1

plt.tight_layout()
plt.show()
```



[11]:
```
#changing the maximum depth and colour
classifiers = [

    RandomForestClassifier(
        max_depth=3, n_estimators=25, max_features=1, random_state=20
    )
]
figure = plt.figure(figsize=(9, 9))
i = 1
# iterate over datasets
for ds_cnt, ds in enumerate(datasets):
    # preprocess dataset, split into training and test part
    X, y = ds
```

```
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.4, random_state=42
    )

    x_min, x_max = X[:, 0].min() - 0.5, X[:, 0].max() + 0.5
    y_min, y_max = X[:, 1].min() - 0.5, X[:, 1].max() + 0.5

    # just plot the dataset first
    cm = plt.cm.winter
    cm_bright = ListedColormap(["#FF0000", "#0000FF"])
    ax = plt.subplot(len(datasets), len(classifiers) + 1, i)
    if ds_cnt == 0:
        ax.set_title("Input data")
    # Plot the training points
    ax.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k")
    # Plot the testing points
    ax.scatter(
        X_test[:, 0], X_test[:, 1], c=y_test, cmap=cm_bright, alpha=0.6,␣
↪edgecolors="k"
    )
    ax.set_xlim(x_min, x_max)
    ax.set_ylim(y_min, y_max)
    ax.set_xticks(())
    ax.set_yticks(())
    i += 1

    # iterate over classifiers
    for name, clf in zip(names, classifiers):
        ax = plt.subplot(len(datasets), len(classifiers) + 1, i)

        clf = make_pipeline(StandardScaler(), clf)
        clf.fit(X_train, y_train)
        score = clf.score(X_test, y_test)
        DecisionBoundaryDisplay.from_estimator(
            clf, X, cmap=cm, alpha=0.8, ax=ax, eps=0.5
        )

        # Plot the training points
        ax.scatter(
            X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k"
        )
                # Plot the testing points
        ax.scatter(
            X_test[:, 0],
            X_test[:, 1],
```

```
            c=y_test,
            cmap=cm_bright,
            edgecolors="k",
            alpha=0.6,
        )

        ax.set_xlim(x_min, x_max)
        ax.set_ylim(y_min, y_max)
        ax.set_xticks(())
        ax.set_yticks(())
        if ds_cnt == 0:
            ax.set_title(name)
        ax.text(
            x_max - 0.3,
            y_min + 0.3,
            ("%.2f" % score).lstrip("0"),
            size=15,
            horizontalalignment="right",
        )
        i += 1

plt.tight_layout()
plt.show()
```


Input data
Random Forest
.95
.78
.95

nn

May 9, 2024

0.0.1 Neural Network

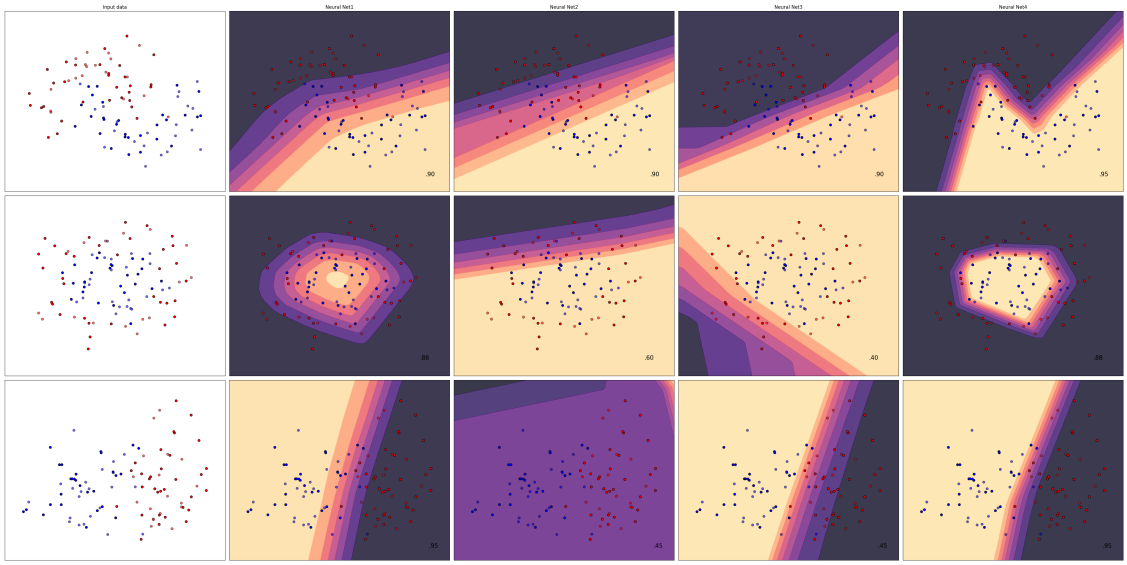
[4]:
```
# Code source: Gaël Varoquaux
#              Andreas Müller
# Modified for documentation by Jaques Grobler
# License: BSD 3 clause

import matplotlib.pyplot as plt
import numpy as np
from matplotlib.colors import ListedColormap

from sklearn.datasets import make_circles, make_classification, make_moons
# from sklearn.discriminant_analysis import QuadraticDiscriminantAnalysis
# from sklearn.ensemble import AdaBoostClassifier, RandomForestClassifier
# from sklearn.gaussian_process import GaussianProcessClassifier
# from sklearn.gaussian_process.kernels import RBF
from sklearn.inspection import DecisionBoundaryDisplay
from sklearn.model_selection import train_test_split
# from sklearn.naive_bayes import GaussianNB
# from sklearn.neighbors import KNeighborsClassifier
from sklearn.neural_network import MLPClassifier
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
# from sklearn.svm import SVC
# from sklearn.tree import DecisionTreeClassifier

names = [
    # "Nearest Neighbors",
    # "Linear SVM",
    # "Poly SVM",
    # "RBF SVM",
    # "Gaussian Process",
    # "Decision Tree",
    # "Random Forest",
    "Neural Net1",
    "Neural Net2",
    "Neural Net3",
    "Neural Net4"
```

```
#     "AdaBoost",
#     "Naive Bayes",
#     "QDA",
]

classifiers = [
    # KNeighborsClassifier(3),
    # SVC(kernel="linear", C=0.025, random_state=42),#linear
    # SVC(kernel="poly", C=0.025, random_state=42),#linear
    # SVC(gamma=2, C=1, random_state=42),
    # GaussianProcessClassifier(1.0 * RBF(1.0), random_state=42),
    # DecisionTreeClassifier(max_depth=5, random_state=42),
    # RandomForestClassifier(
    #     max_depth=5, n_estimators=10, max_features=1, random_state=42
    # ),
    MLPClassifier(alpha=1, max_iter=1000, random_state=42),
    MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(2,4,␣
 ↪2),random_state=42),
    MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(4,8,␣
 ↪2),random_state=42),
    MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(8,16,␣
 ↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(16,32,␣
 ↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(32,64,␣
 ↪2),random_state=42),

    # AdaBoostClassifier(algorithm="SAMME", random_state=42),
#     GaussianNB(),
#     QuadraticDiscriminantAnalysis(),
]

X, y = make_classification(
    n_features=2, n_redundant=0, n_informative=2, random_state=1,␣
 ↪n_clusters_per_class=1
)
rng = np.random.RandomState(2)
X += 2 * rng.uniform(size=X.shape)
linearly_separable = (X, y)

datasets = [
    make_moons(noise=0.3, random_state=0),
    make_circles(noise=0.2, factor=0.5, random_state=1),
    linearly_separable,
]
```

```
figure = plt.figure(figsize=(40, 20))
i = 1
# iterate over datasets
for ds_cnt, ds in enumerate(datasets):
    # preprocess dataset, split into training and test part
    X, y = ds
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.4, random_state=42
    )

    x_min, x_max = X[:, 0].min() - 0.5, X[:, 0].max() + 0.5
    y_min, y_max = X[:, 1].min() - 0.5, X[:, 1].max() + 0.5

    # just plot the dataset first
    cm = plt.cm.magma
    cm_bright = ListedColormap(["#FF0000", "#0000FF"])
    ax = plt.subplot(len(datasets), len(classifiers) + 1, i)
    if ds_cnt == 0:
        ax.set_title("Input data")
    # Plot the training points
    ax.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
 ↪edgecolors="k")
    # Plot the testing points
    ax.scatter(
        X_test[:, 0], X_test[:, 1], c=y_test, cmap=cm_bright, alpha=0.6,␣
 ↪edgecolors="k"
    )
    ax.set_xlim(x_min, x_max)
    ax.set_ylim(y_min, y_max)
    ax.set_xticks(())
    ax.set_yticks(())
    i += 1

    # iterate over classifiers
    for name, clf in zip(names, classifiers):
        ax = plt.subplot(len(datasets), len(classifiers) + 1, i)

        clf = make_pipeline(StandardScaler(), clf)
        clf.fit(X_train, y_train)
        score = clf.score(X_test, y_test)
        DecisionBoundaryDisplay.from_estimator(
            clf, X, cmap=cm, alpha=0.8, ax=ax, eps=0.5
        )

        # Plot the training points
        ax.scatter(
```

```
            X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k"
        )
        # Plot the testing points
        ax.scatter(
            X_test[:, 0],
            X_test[:, 1],
            c=y_test,
            cmap=cm_bright,
            edgecolors="k",
            alpha=0.6,
        )

        ax.set_xlim(x_min, x_max)
        ax.set_ylim(y_min, y_max)
        ax.set_xticks(())
        ax.set_yticks(())
        if ds_cnt == 0:
            ax.set_title(name)
        ax.text(
            x_max - 0.3,
            y_min + 0.3,
            ("%.2f" % score).lstrip("0"),
            size=15,
            horizontalalignment="right",
        )
        i += 1

plt.tight_layout()
plt.show()
```

```
c:\Users\Ardra.ks\AppData\Local\Programs\Python\Python310\lib\site-
packages\sklearn\neural_network\_multilayer_perceptron.py:691:
ConvergenceWarning: Stochastic Optimizer: Maximum iterations (1000) reached and
the optimization hasn't converged yet.
  warnings.warn(
```


Input data
Neural Net1
Neural Net2
Neural Net3
Neural Net4
.90
.90
.90
.95
.88
.60
.40
.88
.95
.45
.45
.95

guassian

May 9, 2024

0.0.1 Guassian

[7]:
```
# Code source: Gaël Varoquaux
#              Andreas Müller
# Modified for documentation by Jaques Grobler
# License: BSD 3 clause

import matplotlib.pyplot as plt
import numpy as np
from matplotlib.colors import ListedColormap

from sklearn.datasets import make_circles, make_classification, make_moons
# from sklearn.discriminant_analysis import QuadraticDiscriminantAnalysis
# from sklearn.ensemble import AdaBoostClassifier, RandomForestClassifier
from sklearn.gaussian_process import GaussianProcessClassifier
from sklearn.gaussian_process.kernels import RBF
from sklearn.inspection import DecisionBoundaryDisplay
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
# from sklearn.neighbors import KNeighborsClassifier
# from sklearn.neural_network import MLPClassifier
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
# from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
```

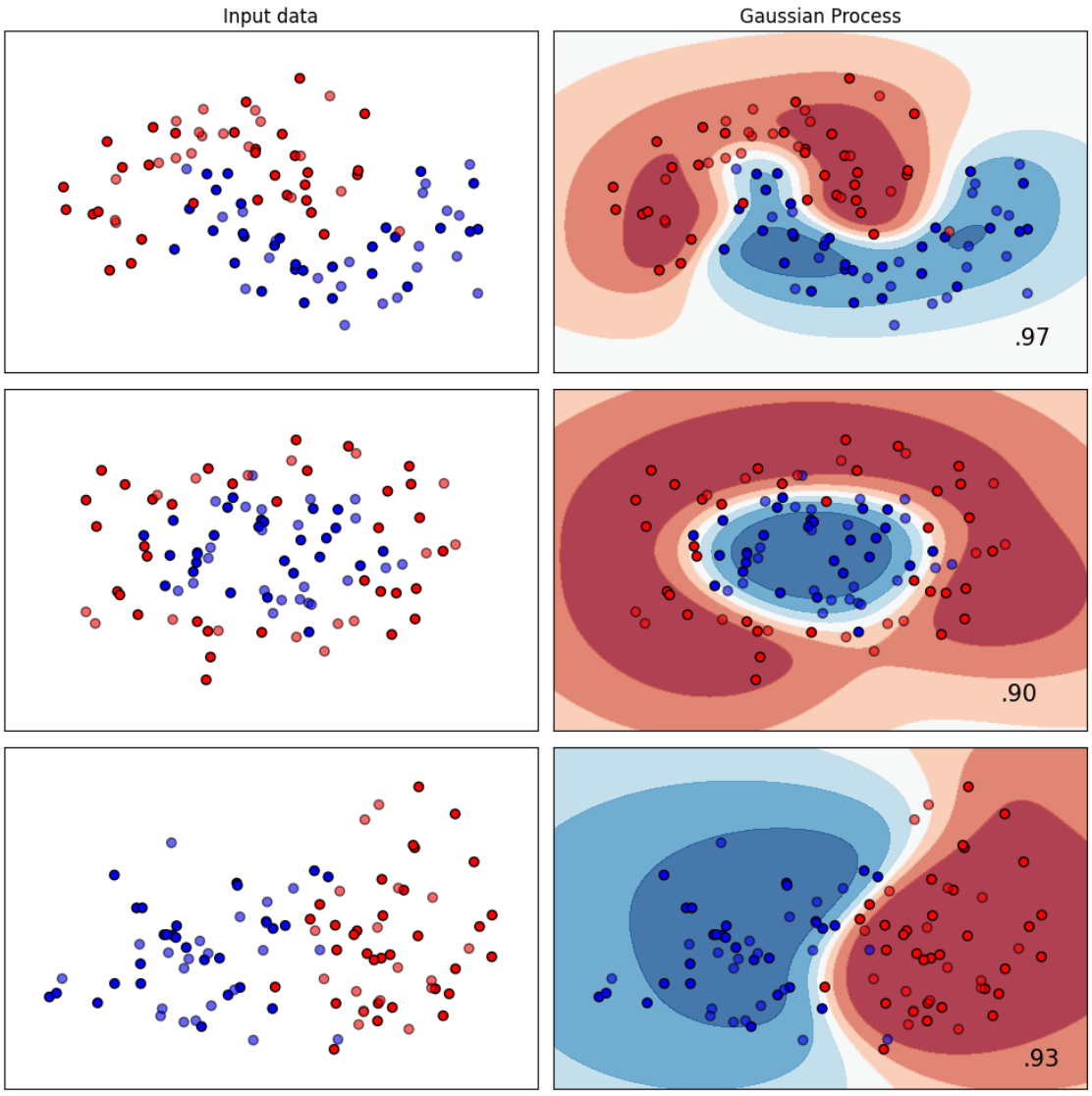
[2]:
```
names = [
    # "Nearest Neighbors",
    # "Linear SVM",
    # "Poly SVM",
    # "RBF SVM",
    "Gaussian Process"
    # "Decision Tree",
    # "Random Forest",
    # "Neural Net1",
    # "Neural Net2",
    # "Neural Net3",
    # "Neural Net4"
```

```
#     "AdaBoost",
#     "Naive Bayes",
#     "QDA",
]
```

[18]:
```
classifiers = [
    # KNeighborsClassifier(3),
    # SVC(kernel="linear", C=0.025, random_state=42),#linear
    # SVC(kernel="poly", C=0.025, random_state=42),#linear
    # SVC(gamma=2, C=1, random_state=42),
    GaussianProcessClassifier(1.0 * RBF(1.0), random_state=42),
    # DecisionTreeClassifier(max_depth=5, random_state=42),
    # RandomForestClassifier(
    #     max_depth=5, n_estimators=10, max_features=1, random_state=42
    # ),
    # MLPClassifier(alpha=1, max_iter=1000, random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(2,4,␣
 ↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(4,8,␣
 ↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(8,16,␣
 ↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(16,32,␣
 ↪2),random_state=42),

#     AdaBoostClassifier(algorithm="SAMME", random_state=42),
    # GaussianNB(),
#     QuadraticDiscriminantAnalysis(),
]

X, y = make_classification(
    n_features=2, n_redundant=0, n_informative=2, random_state=1,␣
 ↪n_clusters_per_class=1
)
rng = np.random.RandomState(2)
X += 2 * rng.uniform(size=X.shape)
linearly_separable = (X, y)

datasets = [
    make_moons(noise=0.3, random_state=0),
    make_circles(noise=0.2, factor=0.5, random_state=1),
    linearly_separable,
]

figure = plt.figure(figsize=(10, 10))
i = 1
# iterate over datasets
```

```
for ds_cnt, ds in enumerate(datasets):
    # preprocess dataset, split into training and test part
    X, y = ds
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.4, random_state=42
    )

    x_min, x_max = X[:, 0].min() - 0.5, X[:, 0].max() + 0.5
    y_min, y_max = X[:, 1].min() - 0.5, X[:, 1].max() + 0.5

    # just plot the dataset first
    cm = plt.cm.RdBu
    cm_bright = ListedColormap(["#FF0000", "#0000FF"])
    ax = plt.subplot(len(datasets), len(classifiers) + 1, i)
    if ds_cnt == 0:
        ax.set_title("Input data")
    # Plot the training points
    ax.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k")
    # Plot the testing points
    ax.scatter(
        X_test[:, 0], X_test[:, 1], c=y_test, cmap=cm_bright, alpha=0.6,␣
↪edgecolors="k"
    )
    ax.set_xlim(x_min, x_max)
    ax.set_ylim(y_min, y_max)
    ax.set_xticks(())
    ax.set_yticks(())
    i += 1

    # iterate over classifiers
    for name, clf in zip(names, classifiers):
        ax = plt.subplot(len(datasets), len(classifiers) + 1, i)

        clf = make_pipeline(StandardScaler(), clf)
        clf.fit(X_train, y_train)
        score = clf.score(X_test, y_test)
        DecisionBoundaryDisplay.from_estimator(
            clf, X, cmap=cm, alpha=0.8, ax=ax, eps=0.5
        )

        # Plot the training points
        ax.scatter(
            X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k"
        )
        # Plot the testing points
```

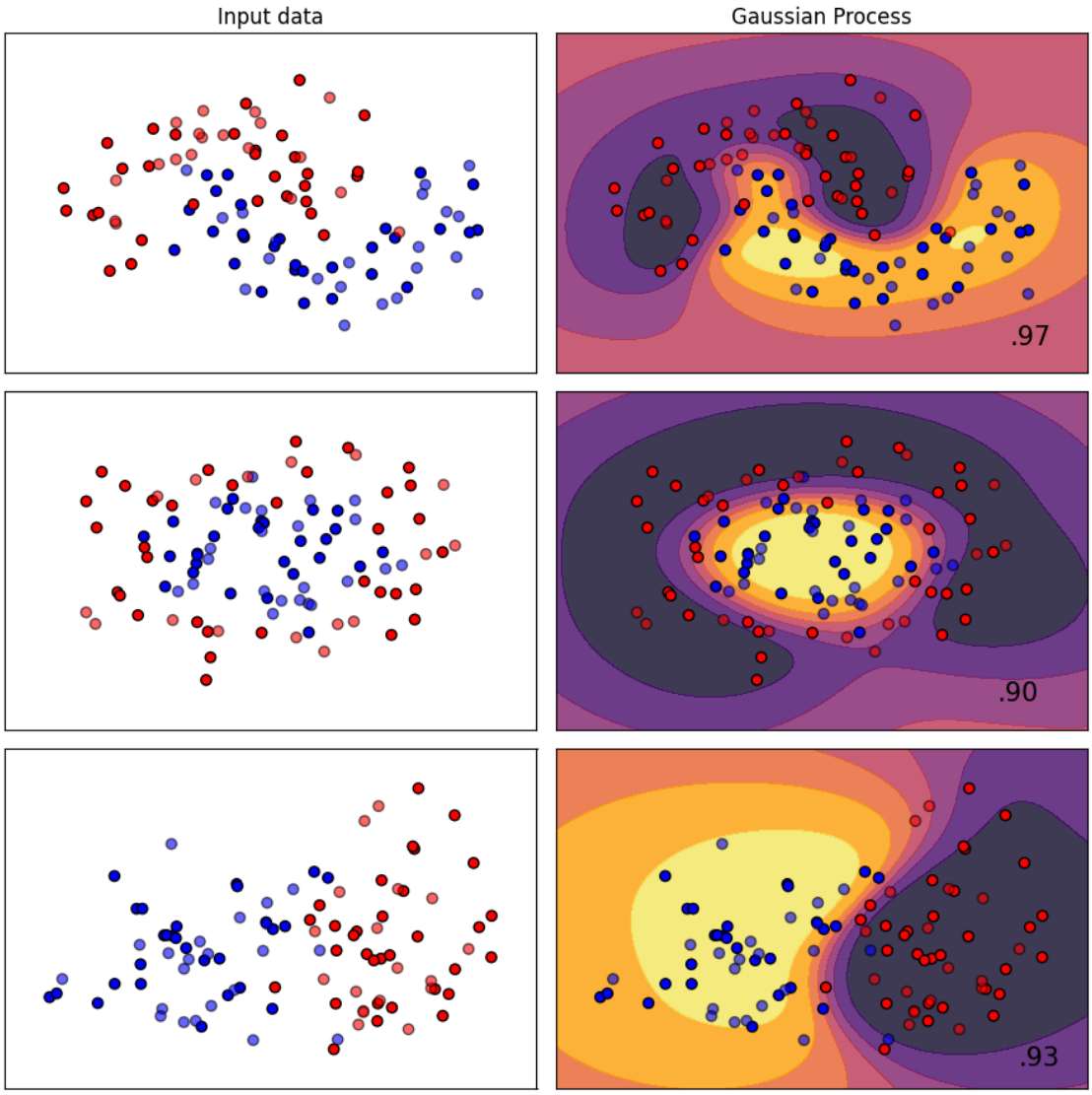
```
        ax.scatter(
            X_test[:, 0],
            X_test[:, 1],
            c=y_test,
            cmap=cm_bright,
            edgecolors="k",
            alpha=0.6,
        )

        ax.set_xlim(x_min, x_max)
        ax.set_ylim(y_min, y_max)
        ax.set_xticks(())
        ax.set_yticks(())
        if ds_cnt == 0:
            ax.set_title(name)
        ax.text(
            x_max - 0.3,
            y_min + 0.3,
            ("%.2f" % score).lstrip("0"),
            size=15,
            horizontalalignment="right",
        )
        i += 1

plt.tight_layout()
plt.show()
```



[20]:
```
classifiers = [
    GaussianProcessClassifier(1.0 * RBF(1.0), random_state=42),

]

X, y = make_classification(
    n_features=2, n_redundant=0, n_informative=2, random_state=1,␣
 ↪n_clusters_per_class=1
)
rng = np.random.RandomState(2)
X += 2 * rng.uniform(size=X.shape)
linearly_separable = (X, y)
```

```
datasets = [
    make_moons(noise=0.3, random_state=0),
    make_circles(noise=0.2, factor=0.5, random_state=1),
    linearly_separable,
]

figure = plt.figure(figsize=(9, 9))
i = 1
# iterate over datasets
for ds_cnt, ds in enumerate(datasets):
    # preprocess dataset, split into training and test part
    X, y = ds
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.4, random_state=42
    )

    x_min, x_max = X[:, 0].min() - 0.5, X[:, 0].max() + 0.5
    y_min, y_max = X[:, 1].min() - 0.5, X[:, 1].max() + 0.5

    # just plot the dataset first
    cm = plt.cm.inferno
    cm_bright = ListedColormap(["#FF0000", "#0000FF"])
    ax = plt.subplot(len(datasets), len(classifiers) + 1, i)
    if ds_cnt == 0:
        ax.set_title("Input data")
    # Plot the training points
    ax.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
 ↪edgecolors="k")
    # Plot the testing points
    ax.scatter(
        X_test[:, 0], X_test[:, 1], c=y_test, cmap=cm_bright, alpha=0.6,␣
 ↪edgecolors="k"
    )
    ax.set_xlim(x_min, x_max)
    ax.set_ylim(y_min, y_max)
    ax.set_xticks(())
    ax.set_yticks(())
    i += 1

    # iterate over classifiers
    for name, clf in zip(names, classifiers):
        ax = plt.subplot(len(datasets), len(classifiers) + 1, i)

        clf = make_pipeline(StandardScaler(), clf)
        clf.fit(X_train, y_train)
        score = clf.score(X_test, y_test)
        DecisionBoundaryDisplay.from_estimator(
```

```
            clf, X, cmap=cm, alpha=0.8, ax=ax, eps=0.5
        )

        # Plot the training points
        ax.scatter(
            X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k"
        )
        # Plot the testing points
        ax.scatter(
            X_test[:, 0],
            X_test[:, 1],
            c=y_test,
            cmap=cm_bright,
            edgecolors="k",
            alpha=0.6,
        )

        ax.set_xlim(x_min, x_max)
        ax.set_ylim(y_min, y_max)
        ax.set_xticks(())
        ax.set_yticks(())
        if ds_cnt == 0:
            ax.set_title(name)
        ax.text(
            x_max - 0.3,
            y_min + 0.3,
            ("%.2f" % score).lstrip("0"),
            size=15,
            horizontalalignment="right",
        )
        i += 1

plt.tight_layout()
plt.show()
```


Input data
Gaussian Process
.97
.90
.93

knn

May 9, 2024

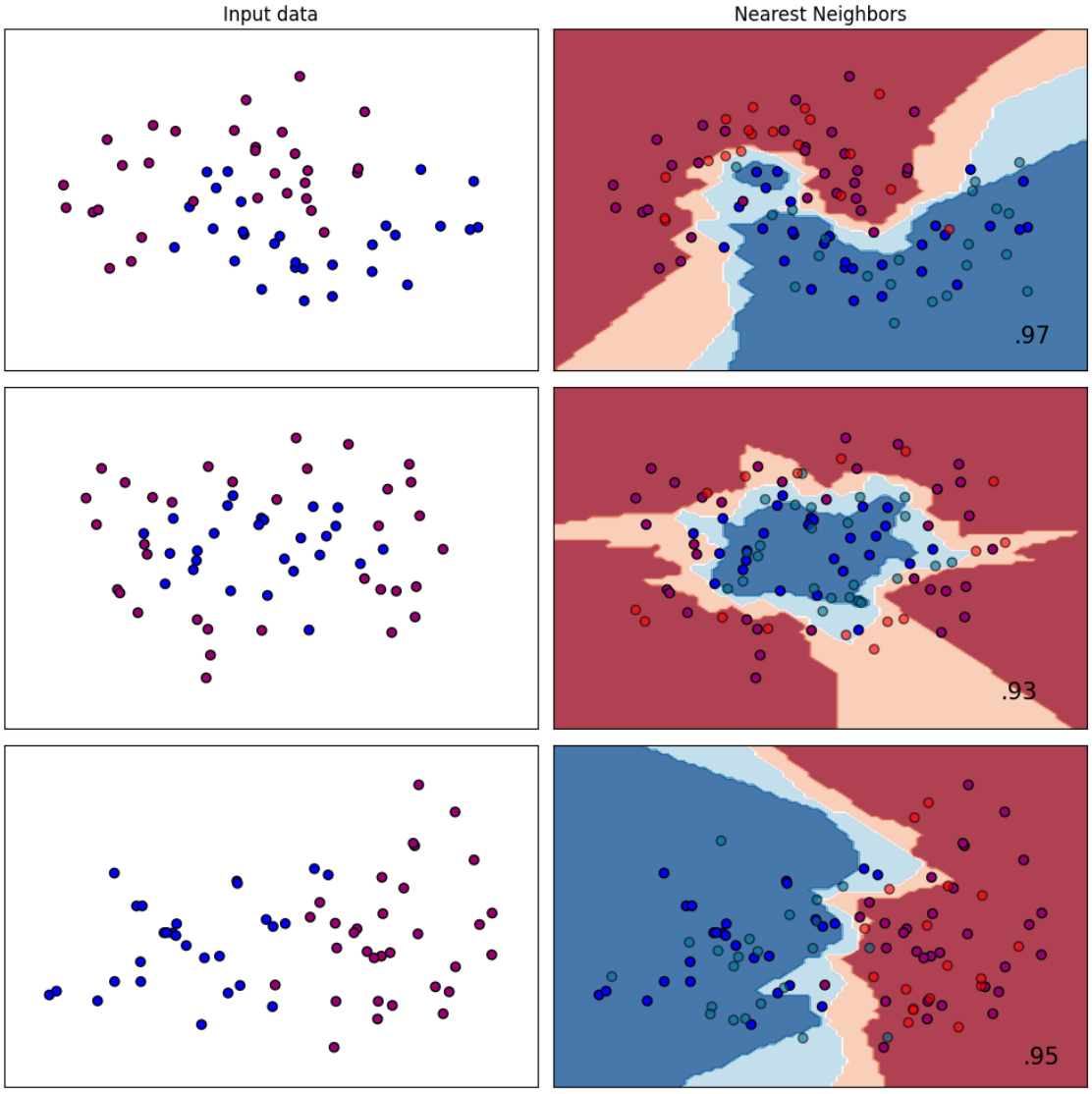
0.1 KNN

[19]:
```
# Code source: Gaël Varoquaux
#              Andreas Müller
# Modified for documentation by Jaques Grobler
# License: BSD 3 clause

import matplotlib.pyplot as plt
import numpy as np
from matplotlib.colors import ListedColormap

from sklearn.datasets import make_circles, make_classification, make_moons
# from sklearn.discriminant_analysis import QuadraticDiscriminantAnalysis
# from sklearn.ensemble import AdaBoostClassifier, RandomForestClassifier
# from sklearn.gaussian_process import GaussianProcessClassifier
# from sklearn.gaussian_process.kernels import RBF
from sklearn.inspection import DecisionBoundaryDisplay
from sklearn.model_selection import train_test_split
# from sklearn.naive_bayes import GaussianNB
from sklearn.neighbors import KNeighborsClassifier
# from sklearn.neural_network import MLPClassifier
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
from sklearn.svm import SVC
# from sklearn.tree import DecisionTreeClassifier

names = [
    "Nearest Neighbors",
    # "Linear SVM",
    # "Poly SVM",
    # "RBF SVM",
    # "Gaussian Process",
    # "Decision Tree",
    # "Random Forest",
    # "Neural Net1",
    # "Neural Net2",
    # "Neural Net3",
    # "Neural Net4"
```

```
#     "AdaBoost",
#     "Naive Bayes",
#     "QDA",
]

classifiers = [
    KNeighborsClassifier(3),
    # SVC(kernel="linear", C=0.025, random_state=42),#linear
    # SVC(kernel="poly", C=0.025, random_state=42),#linear
    # SVC(gamma=2, C=1, random_state=42),
    # GaussianProcessClassifier(1.0 * RBF(1.0), random_state=42),
    # DecisionTreeClassifier(max_depth=5, random_state=42),
    # RandomForestClassifier(
    #     max_depth=5, n_estimators=10, max_features=1, random_state=42
    # ),
    # MLPClassifier(alpha=1, max_iter=1000, random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(2,4,␣
 ↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(4,8,␣
 ↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(8,16,␣
 ↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(16,32,␣
 ↪2),random_state=42),

    # AdaBoostClassifier(algorithm="SAMME", random_state=42),
#     GaussianNB(),
#     QuadraticDiscriminantAnalysis(),
]

X, y = make_classification(
    n_features=2, n_redundant=0, n_informative=2, random_state=1,␣
 ↪n_clusters_per_class=1
)
rng = np.random.RandomState(2)
X += 2 * rng.uniform(size=X.shape)
linearly_separable = (X, y)

datasets = [
    make_moons(noise=0.3, random_state=0),
    make_circles(noise=0.2, factor=0.5, random_state=1),
    linearly_separable,
]

figure = plt.figure(figsize=(10, 10))
i = 1
# iterate over datasets
```

```
for ds_cnt, ds in enumerate(datasets):
    # preprocess dataset, split into training and test part
    X, y = ds
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.4, random_state=42
    )

    x_min, x_max = X[:, 0].min() - 0.5, X[:, 0].max() + 0.5
    y_min, y_max = X[:, 1].min() - 0.5, X[:, 1].max() + 0.5

    # just plot the dataset first
    cm = plt.cm.RdBu
    cm_bright = ListedColormap(["#990073", "#0000FF"])
    ax = plt.subplot(len(datasets), len(classifiers) + 1, i)
    if ds_cnt == 0:
        ax.set_title("Input data")
    # Plot the training points
    ax.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
 ↪edgecolors="k")
    # Plot the testing points
    ax.set_xlim(x_min, x_max)
    ax.set_ylim(y_min, y_max)
    ax.set_xticks(())
    ax.set_yticks(())
    i += 1

    # iterate over classifiers
    for name, clf in zip(names, classifiers):
        ax = plt.subplot(len(datasets), len(classifiers) + 1, i)

        clf = make_pipeline(StandardScaler(), clf)
        clf.fit(X_train, y_train)
        score = clf.score(X_test, y_test)
        DecisionBoundaryDisplay.from_estimator(
            clf, X, cmap=cm, alpha=0.8, ax=ax, eps=0.5
        )

        # Plot the training points
        ax.scatter(
            X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
 ↪edgecolors="k"
        )
        # Plot the testing points
        cm_bright1 = ListedColormap(["#ff0000", "#007399"])
        ax.scatter(
            X_test[:, 0],
            X_test[:, 1],
```

```
            c=y_test,
            cmap=cm_bright1,
            edgecolors="k",
            alpha=0.6,
        )

        ax.set_xlim(x_min, x_max)
        ax.set_ylim(y_min, y_max)
        ax.set_xticks(())
        ax.set_yticks(())
        if ds_cnt == 0:
            ax.set_title(name)
        ax.text(
            x_max - 0.3,
            y_min + 0.3,
            ("%.2f" % score).lstrip("0"),
            size=15,
            horizontalalignment="right",
        )
        i += 1

plt.tight_layout()
plt.show()
```

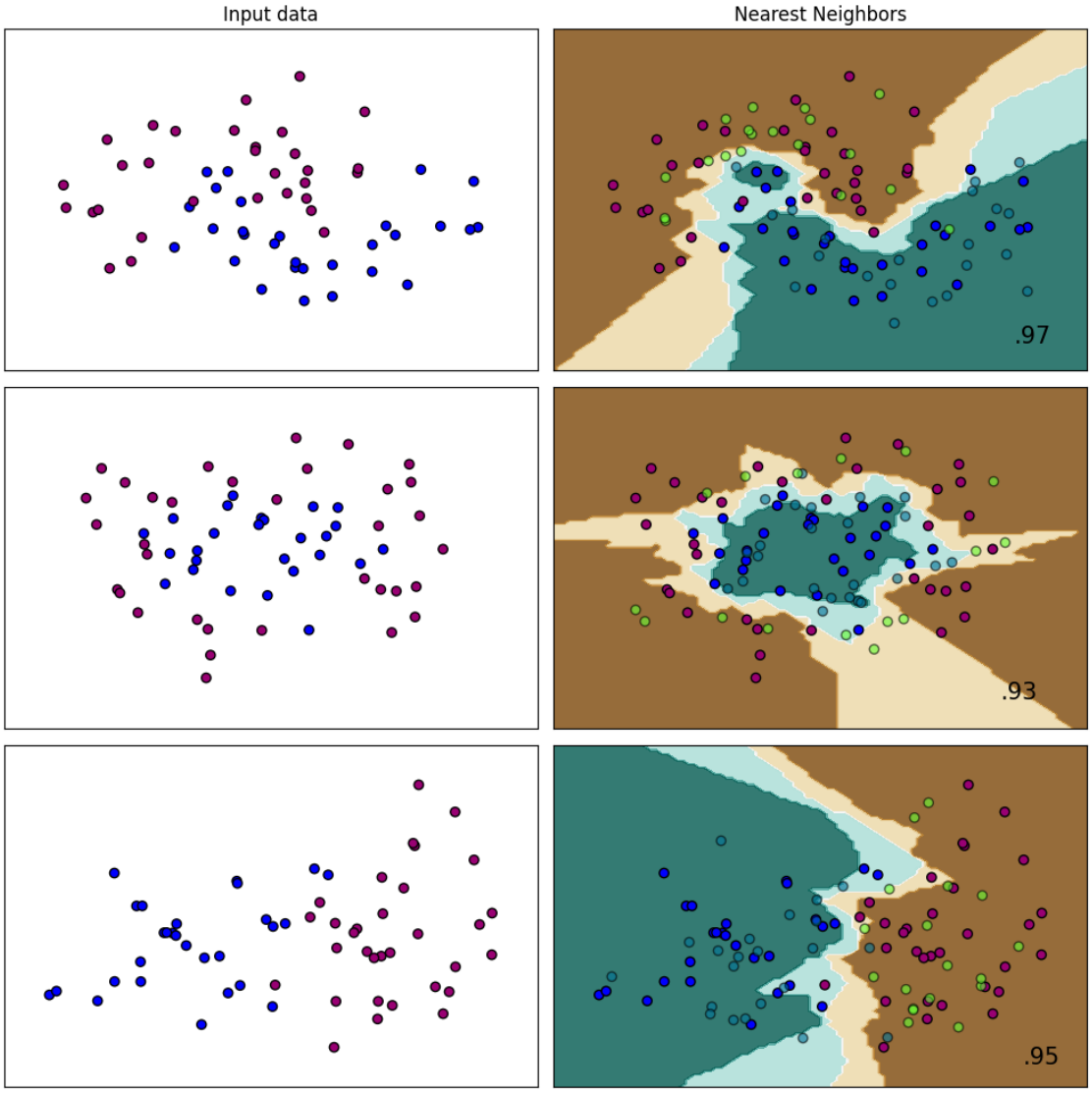


[17]:
```
# Code source: Gaël Varoquaux
#              Andreas Müller
# Modified for documentation by Jaques Grobler
# License: BSD 3 clause

import matplotlib.pyplot as plt
import numpy as np
from matplotlib.colors import ListedColormap

from sklearn.datasets import make_circles, make_classification, make_moons
# from sklearn.discriminant_analysis import QuadraticDiscriminantAnalysis
# from sklearn.ensemble import AdaBoostClassifier, RandomForestClassifier
# from sklearn.gaussian_process import GaussianProcessClassifier
```

```
# from sklearn.gaussian_process.kernels import RBF
from sklearn.inspection import DecisionBoundaryDisplay
from sklearn.model_selection import train_test_split
# from sklearn.naive_bayes import GaussianNB
from sklearn.neighbors import KNeighborsClassifier
# from sklearn.neural_network import MLPClassifier
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
from sklearn.svm import SVC
# from sklearn.tree import DecisionTreeClassifier

names = [
    "Nearest Neighbors",
    # "Linear SVM",
    # "Poly SVM",
    # "RBF SVM",
    # "Gaussian Process",
    # "Decision Tree",
    # "Random Forest",
    # "Neural Net1",
    # "Neural Net2",
    # "Neural Net3",
    # "Neural Net4"
#     "AdaBoost",
#     "Naive Bayes",
#     "QDA",
]

classifiers = [
    KNeighborsClassifier(3),
    # SVC(kernel="linear", C=0.025, random_state=42),#linear
    # SVC(kernel="poly", C=0.025, random_state=42),#linear
    # SVC(gamma=2, C=1, random_state=42),
    # GaussianProcessClassifier(1.0 * RBF(1.0), random_state=42),
    # DecisionTreeClassifier(max_depth=5, random_state=42),
    # RandomForestClassifier(
    #     max_depth=5, n_estimators=10, max_features=1, random_state=42
    # ),
    # MLPClassifier(alpha=1, max_iter=1000, random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(2,4,␣
↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(4,8,␣
↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(8,16,␣
↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(16,32,␣
↪2),random_state=42),
```

```
    # AdaBoostClassifier(algorithm="SAMME", random_state=42),
#     GaussianNB(),
#     QuadraticDiscriminantAnalysis(),
]

X, y = make_classification(
    n_features=2, n_redundant=0, n_informative=2, random_state=1,␣
 ↪n_clusters_per_class=1
)
rng = np.random.RandomState(2)
X += 2 * rng.uniform(size=X.shape)
linearly_separable = (X, y)

datasets = [
    make_moons(noise=0.3, random_state=0),
    make_circles(noise=0.2, factor=0.5, random_state=1),
    linearly_separable,
]

figure = plt.figure(figsize=(10, 10))
i = 1
# iterate over datasets
for ds_cnt, ds in enumerate(datasets):
    # preprocess dataset, split into training and test part
    X, y = ds
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.4, random_state=42
    )

    x_min, x_max = X[:, 0].min() - 0.5, X[:, 0].max() + 0.5
    y_min, y_max = X[:, 1].min() - 0.5, X[:, 1].max() + 0.5

    # just plot the dataset first
    cm = plt.cm.BrBG
    cm_bright = ListedColormap(["#990073", "#0000FF"])
    ax = plt.subplot(len(datasets), len(classifiers) + 1, i)
    if ds_cnt == 0:
        ax.set_title("Input data")
    # Plot the training points
    ax.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
 ↪edgecolors="k")
    # Plot the testing points
    ax.set_xlim(x_min, x_max)
    ax.set_ylim(y_min, y_max)
    ax.set_xticks(())
    ax.set_yticks(())
```

```
    i += 1

    # iterate over classifiers
    for name, clf in zip(names, classifiers):
        ax = plt.subplot(len(datasets), len(classifiers) + 1, i)

        clf = make_pipeline(StandardScaler(), clf)
        clf.fit(X_train, y_train)
        score = clf.score(X_test, y_test)
        DecisionBoundaryDisplay.from_estimator(
            clf, X, cmap=cm, alpha=0.8, ax=ax, eps=0.5
        )

        # Plot the training points
        ax.scatter(
            X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k"
        )
        # Plot the testing points
        cm_bright1 = ListedColormap(["#66ff33", "#007399"])
        ax.scatter(
            X_test[:, 0],
            X_test[:, 1],
            c=y_test,
            cmap=cm_bright1,
            edgecolors="k",
            alpha=0.6,
        )

        ax.set_xlim(x_min, x_max)
        ax.set_ylim(y_min, y_max)
        ax.set_xticks(())
        ax.set_yticks(())
        if ds_cnt == 0:
            ax.set_title(name)
        ax.text(
            x_max - 0.3,
            y_min + 0.3,
            ("%.2f" % score).lstrip("0"),
            size=15,
            horizontalalignment="right",
        )
        i += 1

plt.tight_layout()
plt.show()
```


Input data
Nearest Neighbors
.97
.93
.95

logistic-regression

May 9, 2024

Logistic Regression

[1]:
```
import matplotlib.pyplot as plt
import numpy as np
from matplotlib.colors import ListedColormap

from sklearn.datasets import make_circles, make_classification, make_moons
# from sklearn.discriminant_analysis import QuadraticDiscriminantAnalysis
# from sklearn.ensemble import AdaBoostClassifier, RandomForestClassifier
# from sklearn.gaussian_process import GaussianProcessClassifier
# from sklearn.gaussian_process.kernels import RBF
from sklearn.inspection import DecisionBoundaryDisplay
from sklearn.model_selection import train_test_split
# from sklearn.naive_bayes import GaussianNB
# from sklearn.neighbors import KNeighborsClassifier
# from sklearn.neural_network import MLPClassifier
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler
# from sklearn.svm import SVC
# from sklearn.tree import DecisionTreeClassifier
from sklearn.linear_model import LogisticRegression
```

[4]:
```
names = ["logistic regression"

]
    # iterate over classifiers
```

[2]:
```
classifiers = [
    # KNeighborsClassifier(3),
    # SVC(kernel="linear", C=0.025, random_state=42),#linear
    # SVC(kernel="poly", C=0.025, random_state=42),#linear
    # SVC(gamma=2, C=1, random_state=42),
    # GaussianProcessClassifier(1.0 * RBF(1.0), random_state=42),
    # DecisionTreeClassifier(max_depth=5, random_state=42),
    # RandomForestClassifier(
    #     max_depth=5, n_estimators=10, max_features=1, random_state=42
    # ),
    # MLPClassifier(alpha=1, max_iter=1000, random_state=42),
```

```
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(2,4,␣
 ↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(4,8,␣
 ↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(8,16,␣
 ↪2),random_state=42),
    # MLPClassifier(alpha=1, max_iter=1000, hidden_layer_sizes=(16,32,␣
 ↪2),random_state=42),

#     AdaBoostClassifier(algorithm="SAMME", random_state=42),
#     GaussianNB(),
#     QuadraticDiscriminantAnalysis(),
LogisticRegression(random_state=42)
]
```

[6]:
```
X, y = make_classification(
    n_features=2, n_redundant=0, n_informative=2, random_state=1,␣
 ↪n_clusters_per_class=1
)
rng = np.random.RandomState(2)
X += 2 * rng.uniform(size=X.shape)
linearly_separable = (X, y)

datasets = [
    make_moons(noise=0.3, random_state=0),
    make_circles(noise=0.2, factor=0.5, random_state=1),
    linearly_separable,
]
figure = plt.figure(figsize=(9, 9))
i = 1
# iterate over datasets
for ds_cnt, ds in enumerate(datasets):
    # preprocess dataset, split into training and test part
    X, y = ds
    X_train, X_test, y_train, y_test = train_test_split(
        X, y, test_size=0.4, random_state=42
    )

    x_min, x_max = X[:, 0].min() - 0.5, X[:, 0].max() + 0.5
    y_min, y_max = X[:, 1].min() - 0.5, X[:, 1].max() + 0.5

    # just plot the dataset first
    cm = plt.cm.RdBu
    cm_bright = ListedColormap(["#FF0000", "#0000FF"])
    ax = plt.subplot(len(datasets), len(classifiers) + 1, i)
    if ds_cnt == 0:
        ax.set_title("Input data")
```

```
    # Plot the training points
    ax.scatter(X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k")
    # Plot the testing points
    ax.scatter(
        X_test[:, 0], X_test[:, 1], c=y_test, cmap=cm_bright, alpha=0.6,␣
↪edgecolors="k"
    )
    ax.set_xlim(x_min, x_max)
    ax.set_ylim(y_min, y_max)
    ax.set_xticks(())
    ax.set_yticks(())
    i += 1
    for name, clf in zip(names, classifiers):
        ax = plt.subplot(len(datasets), len(classifiers) + 1, i)

        clf = make_pipeline(StandardScaler(), clf)
        clf.fit(X_train, y_train)
        score = clf.score(X_test, y_test)
        DecisionBoundaryDisplay.from_estimator(
            clf, X, cmap=cm, alpha=0.8, ax=ax, eps=0.5
        )

        # Plot the training points
        ax.scatter(
            X_train[:, 0], X_train[:, 1], c=y_train, cmap=cm_bright,␣
↪edgecolors="k"
        )
        # Plot the testing points
        ax.scatter(
            X_test[:, 0],
            X_test[:, 1],
            c=y_test,
            cmap=cm_bright,
            edgecolors="k",
            alpha=0.6,
        )
        ax.set_xlim(x_min, x_max)
        ax.set_ylim(y_min, y_max)
        ax.set_xticks(())
        ax.set_yticks(())
        if ds_cnt == 0:
            ax.set_title(name)
        ax.text(
            x_max - 0.3,
            y_min + 0.3,
            ("%.2f" % score).lstrip("0"),
```

```
            size=15,
            horizontalalignment="right",
        )
        i += 1

plt.tight_layout()
plt.show()
```