```
import numpy as np
import matplotlib.pyplot as plt
from sklearn import tree
from sklearn.datasets import load_iris
from itertools import combinations
```

```
iris = load_iris()
X = iris.data
y = iris.target
feature_names = iris.feature_names
target_names = iris.target_names
```

```
print("Feature names:", feature_names)
print("Target names:", target_names)
print("\nFirst 5 samples:\n", X[:5])
print("\nFirst 5 labels:\n", y[:5])
```

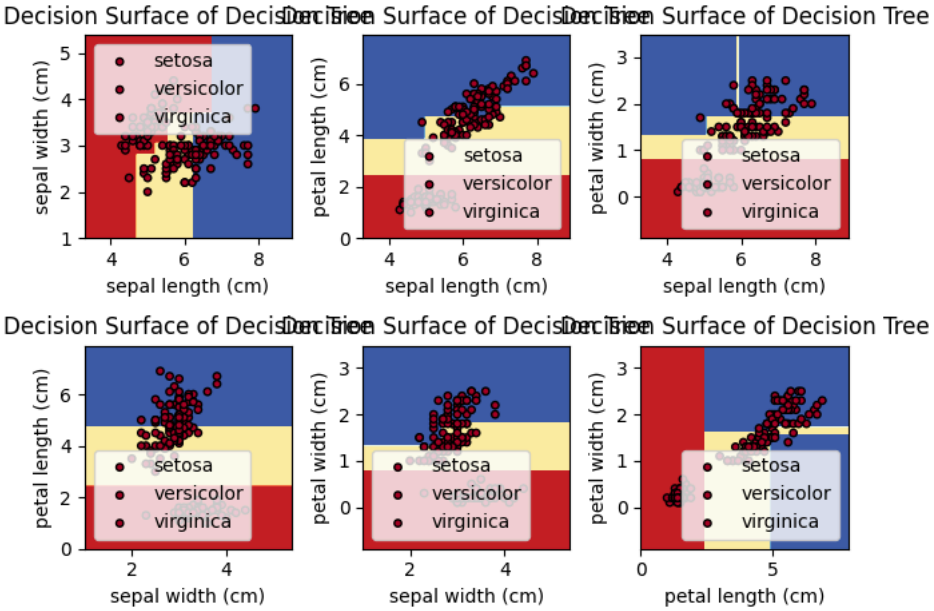
```
Feature names: ['sepal length (cm)', 'sepal width (cm)', 'petal length (cm)', 'petal width (cm)']
Target names: ['setosa' 'versicolor' 'virginica']

First 5 samples:
 [[5.1 3.5 1.4 0.2]
 [4.9 3.  1.4 0.2]
 [4.7 3.2 1.3 0.2]
 [4.6 3.1 1.5 0.2]
 [5.  3.6 1.4 0.2]]

First 5 labels:
 [0 0 0 0 0]
```

```
plot_colors = "ryb"
plot_step = 0.02
```

```
plt.figure(figsize=(12, 10))
pair_index = 1
```

```
<Figure size 1200x1000 with 0 Axes>
```

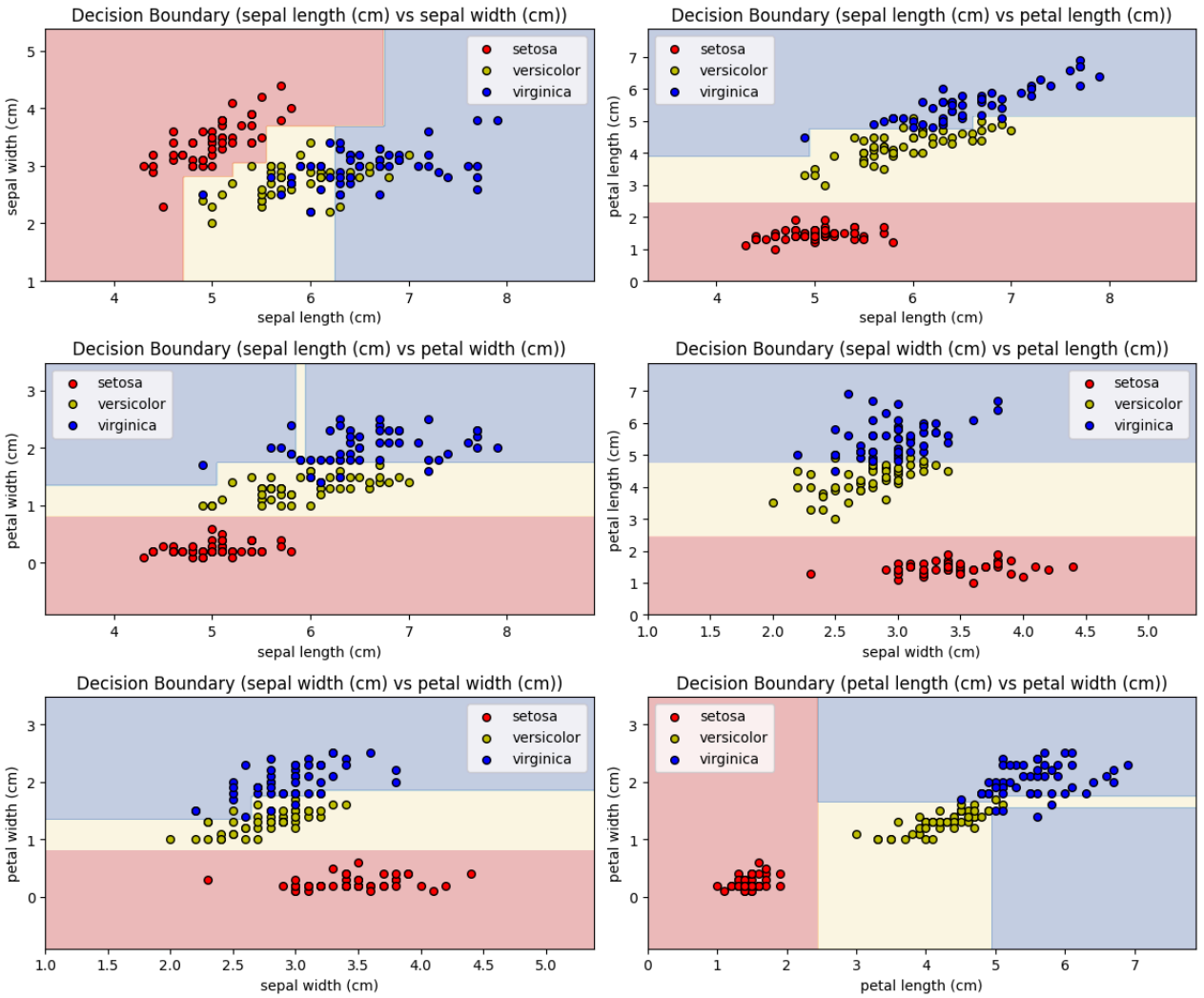
```
pair_index = 1
for pair in combinations(range(4), 2):
    X_pair = X[:, pair]
    clf = tree.DecisionTreeClassifier(criterion='entropy', max_depth=4, random_state=42)
    clf.fit(X_pair, y)

    x_min, x_max = X_pair[:, 0].min() - 1, X_pair[:, 0].max() + 1
    y_min, y_max = X_pair[:, 1].min() - 1, X_pair[:, 1].max() + 1
    xx, yy = np.meshgrid(np.arange(x_min, x_max, plot_step), np.arange(y_min, y_max, plot_step))

    plt.subplot(2, 3, pair_index)
    Z = clf.predict(np.c_[xx.ravel(), yy.ravel()])
    Z = Z.reshape(xx.shape)
    cs = plt.contourf(xx, yy, Z, cmap=plt.cm.RdYlBu)

    plt.xlabel(feature_names[pair[0]])
    plt.ylabel(feature_names[pair[1]])

    for i, color in zip(range(len(target_names)), plot_colors):
        idx = np.where(y == i)
        plt.scatter(X_pair[idx, 0], X_pair[idx, 1], c=y[idx], label=target_names[i], cmap=plt.cm.RdYlBu, edgecolor='black',

    plt.title('Decision Surface of Decision Tree')
    plt.legend()
    plt.tight_layout()
    pair_index += 1

plt.show()
```




```
 x_min, x_max = X_pair[:, 0].min() - 1, X_pair[:, 0].max() + 1
 y_min, y_max = X_pair[:, 1].min() - 1, X_pair[:, 1].max() + 1
 xx, yy = np.meshgrid(np.arange(x_min, x_max, plot_step),
          np.arange(y_min, y_max, plot_step))
```

```
 Z = clf.predict(np.c_[xx.ravel(), yy.ravel()])
Z = Z.reshape(xx.shape)
```

```
plt.figure(figsize=(12, 10))

for pair_index, pair in enumerate(combinations(range(4), 2), start=1):
    X_pair = X[:, pair]
    clf = tree.DecisionTreeClassifier(criterion='entropy', max_depth=4, random_state=42)
    clf.fit(X_pair, y)

    x_min, x_max = X_pair[:, 0].min() - 1, X_pair[:, 0].max() + 1
    y_min, y_max = X_pair[:, 1].min() - 1, X_pair[:, 1].max() + 1
    xx, yy = np.meshgrid(np.arange(x_min, x_max, 0.02),
                         np.arange(y_min, y_max, 0.02))
    Z = clf.predict(np.c_[xx.ravel(), yy.ravel()]).reshape(xx.shape)

    plt.subplot(3, 2, pair_index)
    plt.contourf(xx, yy, Z, alpha=0.3, cmap=plt.cm.RdYlBu)

    plot_colors = "ryb"
    for i, color in zip(range(3), plot_colors):
        plt.scatter(X_pair[y == i, 0], X_pair[y == i, 1],
                    c=color, label=target_names[i], edgecolor='k', s=30)

    plt.xlabel(feature_names[pair[0]])
    plt.ylabel(feature_names[pair[1]])
    plt.title(f"Decision Boundary ({feature_names[pair[0]]} vs {feature_names[pair[1]]})")
    plt.legend()

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


Decision Boundary (sepal length (cm) vs sepal width (cm))
sepal length (cm)
sepal width (cm)
Decision Boundary (sepal length (cm) vs petal length (cm))
sepal length (cm)
petal length (cm)
Decision Boundary (sepal length (cm) vs petal width (cm))
sepal length (cm)
petal width (cm)
Decision Boundary (sepal width (cm) vs petal length (cm))
sepal width (cm)
petal length (cm)
Decision Boundary (sepal width (cm) vs petal width (cm))
sepal width (cm)
petal width (cm)
Decision Boundary (petal length (cm) vs petal width (cm))
petal length (cm)
petal width (cm)
setosa
versicolor
virginica