Experimen PlayTennis

October 29, 2017

1 Eksperimen data playtennis

1.1 Dataset Playtennis (csv) Eksternal

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1.2 Fungsi *Plot Confusion Matrix*

Fungsi ini digunakan nanti, untuk memplot *confusion matrix* dalam bentuk grafik.

Diambil dari http://scikit-learn.org/stable/auto_examples/model_selection/plot_confusion_matrix.html

```
In [1]: %matplotlib inline
        import matplotlib.pyplot as plt
        import itertools
        import numpy as np
        def plot_confusion_matrix(cm, classes,
                                  normalize=False,
                                  title='Confusion matrix',
                                  cmap=plt.cm.Blues):
            """
            This function prints and plots the confusion matrix.
            Normalization can be applied by setting `normalize=True`.
            """
            if normalize:
                cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]
                print("Normalized confusion matrix")
            else:
                print('Confusion matrix, without normalization')

            print(cm)

            plt.imshow(cm, interpolation='nearest', cmap=cmap)
            plt.title(title)
            plt.colorbar()
            tick_marks = np.arange(len(classes))
            plt.xticks(tick_marks, classes, rotation=45)
            plt.yticks(tick_marks, classes)
```

```
    fmt = '.2f' if normalize else 'd'
    thresh = cm.max() / 2.
    for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
        plt.text(j, i, format(cm[i, j], fmt),
                 horizontalalignment="center",
                 color="white" if cm[i, j] > thresh else "black")

    plt.tight_layout()
    plt.ylabel('True label')
    plt.xlabel('Predicted label')
```

1.3 Mempersiapkan data dari csv

Data playtennis.csv harus ada di dalam folder yang sama dengan *script* ini dijalankan.

```
In [2]: from sklearn import datasets
        from sklearn.model_selection import cross_val_score
        import pandas

        playtennis_raw = pandas.read_csv("playtennis.csv")
        playtennis = pandas.DataFrame(playtennis_raw)
```

1.4 Preproses data playtennis

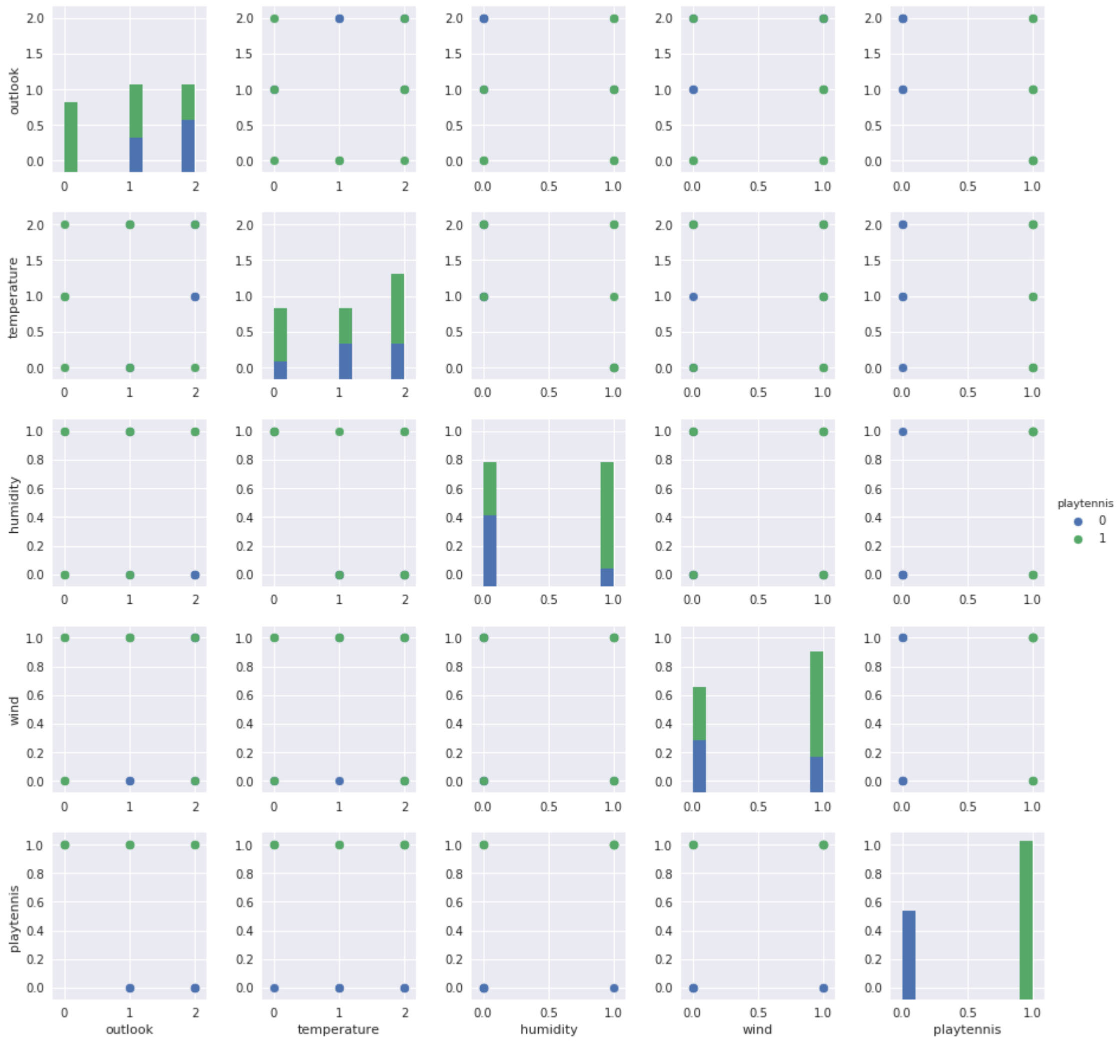
Karena nilai data playtennis semuanya dalam bentuk string, kalau langsung dimasukkan akan menyebabkan sklearn tree dan seaborn terbingung-bingung. Oleh karena itu, data playtennis mesti dipreproses dulu dengan meng-*encode* nya nilai datanya menjadi float.

```
In [3]: from sklearn import preprocessing
        encoder = preprocessing.LabelEncoder()
        playtennis_transformed = playtennis.apply(encoder.fit_transform)
        playtennis_train = playtennis_transformed.drop("playtennis", axis=1)
        playtennis_classes = playtennis_transformed.iloc[:,-1]
```

1.5 Visualisasi data playtennis

Data playtennis divisualisasikan dengan menggunakan *library* seaborn

```
In [4]: import seaborn
        seaborn.set(color_codes=True)
        g = seaborn.PairGrid(playtennis_transformed, hue="playtennis")
        g.map_diag(plt.hist)
        g.map_offdiag(plt.scatter)
        g.add_legend();
```

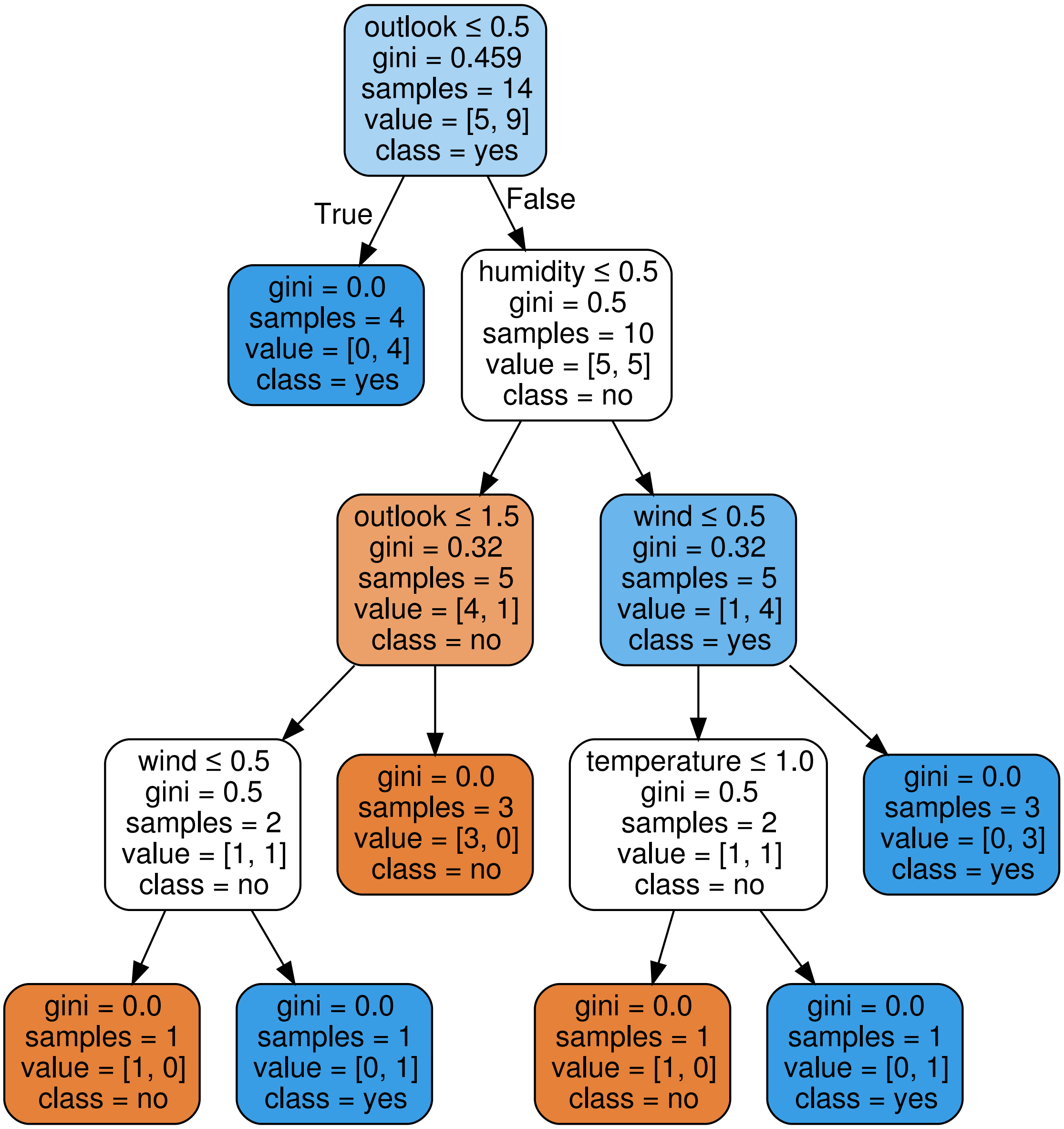


1.6 Membuat _Classifier Decision Tree dan ANN.

Skema *Full Training*.

```
In [5]: from sklearn import tree
        dtl = tree.DecisionTreeClassifier()
        dtl.fit(playtennis_train, playtennis_classes)

        import graphviz
        dot_data = tree.export_graphviz(dtl, out_file=None,
                                        feature_names=playtennis_train.columns.values,
                                        class_names=encoder.classes_,
                                        filled=True, rounded=True,
                                        special_characters=True)
        graph = graphviz.Source(dot_data)
        graph
```

Out[5]:



```
In [6]: from sklearn.neural_network import MLPClassifier
        ann = MLPClassifier(solver='lbfgs', alpha=1e-5, hidden_layer_sizes=(5, 2), random_state=
        ann.fit(playtennis_train, playtennis_classes)
```

```
Out[6]: MLPClassifier(activation='relu', alpha=1e-05, batch_size='auto', beta_1=0.9,
               beta_2=0.999, early_stopping=False, epsilon=1e-08,
               hidden_layer_sizes=(5, 2), learning_rate='constant',
               learning_rate_init=0.001, max_iter=200, momentum=0.9,
               nesterovs_momentum=True, power_t=0.5, random_state=1, shuffle=True,
              solver='lbfgs', tol=0.0001, validation_fraction=0.1, verbose=False,
              warm_start=False)
```

```
In [7]: ann.coefs_
```

```
Out[7]: [array([[-0.13550079,  0.00099321, -0.81629954, -0.3227855 , -0.49469775],
                [-0.53482092, -0.70828209, -0.2521951 , -0.31046607,  0.01149222],
                [-0.0065751 ,  0.60225994, -0.48262138,  0.33721485, -0.77176312],
                [ 0.40924777,  0.01155045,  0.09583888, -0.72912846, -0.55351094]]),
         array([[ 0.73066037, -0.8446235 ],
                [-0.85349395, -0.81169676],
                [ 0.70017505, -0.74370779],
                [-0.14607845,  0.66642695],
                [ 0.0614094 ,  0.19940107]]),
         array([[ 0.94645242],
                [-1.19663215]])]
```

```
In [8]: ann.intercepts_
```

```
Out[8]: [array([ 0.74737327,  0.86967696, -0.30467704,  0.03381831,  0.55843369]),
         array([-0.34159867, -0.22762354]),
         array([ 0.58779669])]
```

1.7 Membuat Skema Pembelajaran *Split-train*

Split train dengan test 10% dan train 90%

```
In [9]: from sklearn.model_selection import train_test_split
        X_train, X_test, y_train, y_test = train_test_split(playtennis_train, playtennis_classes
```

```
In [10]: from sklearn.metrics import accuracy_score
         split = tree.DecisionTreeClassifier()
         split = split.fit(X_train, y_train)
         y_predict = split.predict(X_test)
         accuracy = accuracy_score(y_test, y_predict)
         print('Akurasi: {} %'.format(accuracy * 100))
```

```
Akurasi: 50.0 %
```

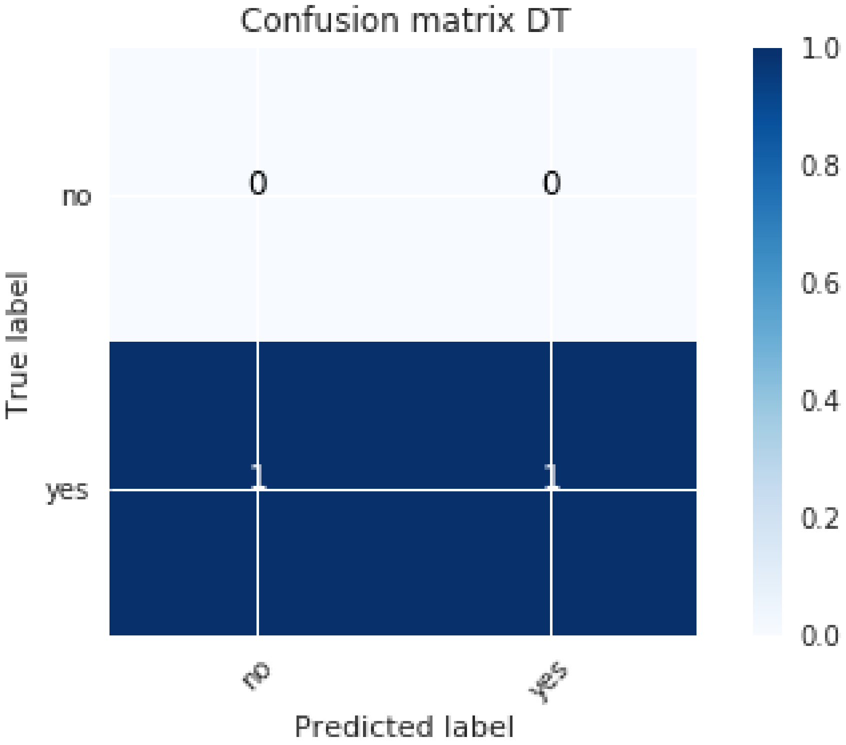
```
In [11]: from sklearn.metrics import classification_report
         print(classification_report(y_test, y_predict, target_names=encoder.classes_))
```

```
             precision    recall  f1-score   support

         no       0.00      0.00      0.00         0
        yes       1.00      0.50      0.67         2

avg / total       1.00      0.50      0.67         2
```

```
/usr/local/lib/python3.5/dist-packages/sklearn/metrics/classification.py:1137: UndefinedMetricWa
  'recall', 'true', average, warn_for)
```

```
In [12]: from sklearn.metrics import confusion_matrix
         cnf_matrix = confusion_matrix(y_test, y_predict)
         plt.figure()
         plot_confusion_matrix(cnf_matrix, classes=encoder.classes_,
                               title='Confusion matrix DT')
```

```
Confusion matrix, without normalization
[[0 0]
 [1 1]]
```



```
In [13]: ann_split = MLPClassifier(solver='lbfgs', alpha=1e-5, hidden_layer_sizes=(5, 2), random
         ann_split.fit(X_train, y_train)
         y_ann_predict = ann_split.predict(X_test)
         accuracy_ann = accuracy_score(y_test, y_ann_predict)
         print('Akurasi: {} %'.format(accuracy_ann * 100))
```

```
Akurasi: 50.0 %
```

```
In [14]: print(classification_report(y_test, y_ann_predict, target_names=encoder.classes_))

             precision    recall  f1-score   support

         no       0.00      0.00      0.00         0
        yes       1.00      0.50      0.67         2

avg / total       1.00      0.50      0.67         2
```

```
/usr/local/lib/python3.5/dist-packages/sklearn/metrics/classification.py:1137: UndefinedMetricWa
  'recall', 'true', average, warn_for)
```

```
In [15]: from sklearn.model_selection import cross_val_score
         scores = cross_val_score(dtl, playtennis_train, playtennis_classes, cv=3)
         print("Accuracy: %0.2f (+/- %0.2f)" % (scores.mean(), scores.std() * 2))

Accuracy: 0.78 (+/- 0.05)
```

```
In [16]: scores = cross_val_score(ann, playtennis_train, playtennis_classes, cv=3)
         print("Accuracy: %0.2f (+/- %0.2f)" % (scores.mean(), scores.std() * 2))

Accuracy: 0.72 (+/- 0.17)
```

1.8 *Save* dan *Load* Model

```
In [17]: from sklearn.externals import joblib
         joblib.dump(dtl, 'playtennis_dtl.pkl')
         joblib.dump(ann, 'playtennis_ann.pkl')

Out[17]: ['playtennis_ann.pkl']
```

```
In [18]: loaded_tree_model = joblib.load('playtennis_dtl.pkl')
         loaded_ann_model = joblib.load('playtennis_ann.pkl')
```

1.9 Klasifikasi *Unseen* Instance

Mengklasifikasikan instans baru dengan dtl skema full train dan ann skema full train.

```
In [19]: new_instance_data = {"outlook":[1],"temperature":[1],"humidity":[1],"wind":[1]}
         new_instance = pandas.DataFrame(data=new_instance_data, columns = playtennis_train.colu

         print(new_instance.dtypes)
```

```
outlook        int64
temperature    int64
humidity       int64
wind           int64
dtype: object
```

```
In [20]: loaded_tree_model.predict(new_instance)

Out[20]: array([1])

In [21]: loaded_ann_model.predict(new_instance)

Out[21]: array([1])
```

experiment_iris

October 29, 2017

1 Pembelajaran Mesin

1.1 Dataset Iris Internal Sklearn

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1.1.1 Persiapan

- Melakukan import yang diperlukan

```
In [1]: %matplotlib inline
        from sklearn.datasets import load_iris
        from sklearn import tree
        from sklearn.neural_network import MLPClassifier
        from sklearn.model_selection import cross_val_score, train_test_split
        from sklearn.metrics import accuracy_score, classification_report, confusion_matrix
        import matplotlib.pyplot as plt
        import itertools
        import numpy as np
        import seaborn as sns
        import pandas as pd
        import graphviz
```

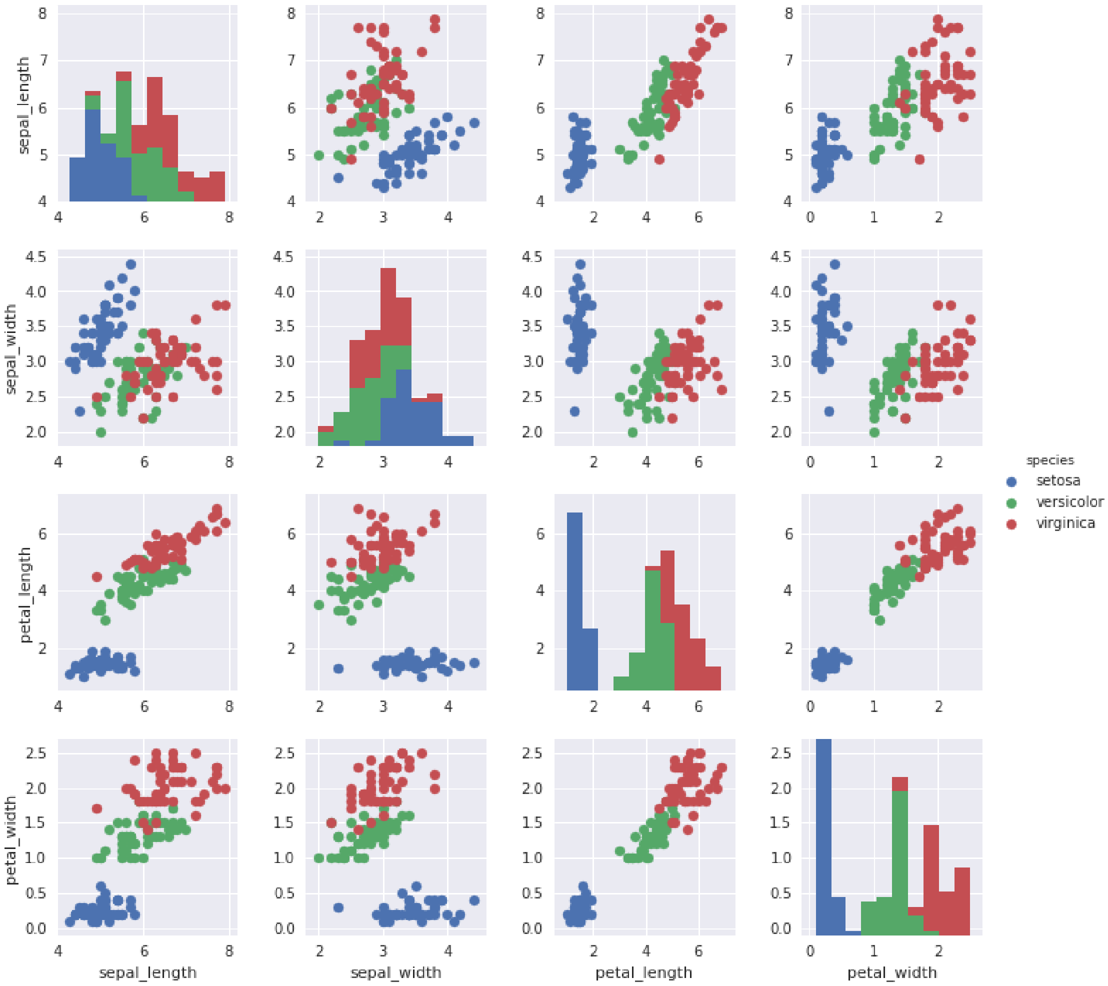
- Mengambil atau men-load data iris internal dari sklearn.datasets

```
In [2]: iris = load_iris()
```

- Visualisasi hubungan antar fitur

Agar mudah data yang digunakan yaitu pada seaborn sehingga struktur data sesuai dengan yang dibutuhkan untuk menggambar hubungan antar features.

```
In [3]: sns.set(color_codes=True)
        iris_features = sns.load_dataset("iris")
        g = sns.PairGrid(iris_features, hue="species")
        g.map_diag(plt.hist)
        g.map_offdiag(plt.scatter)
        g.add_legend();
```



1.1.2 Pembelajaran dengan Full Training

- Melakukan pembelajaran full training dengan DTL

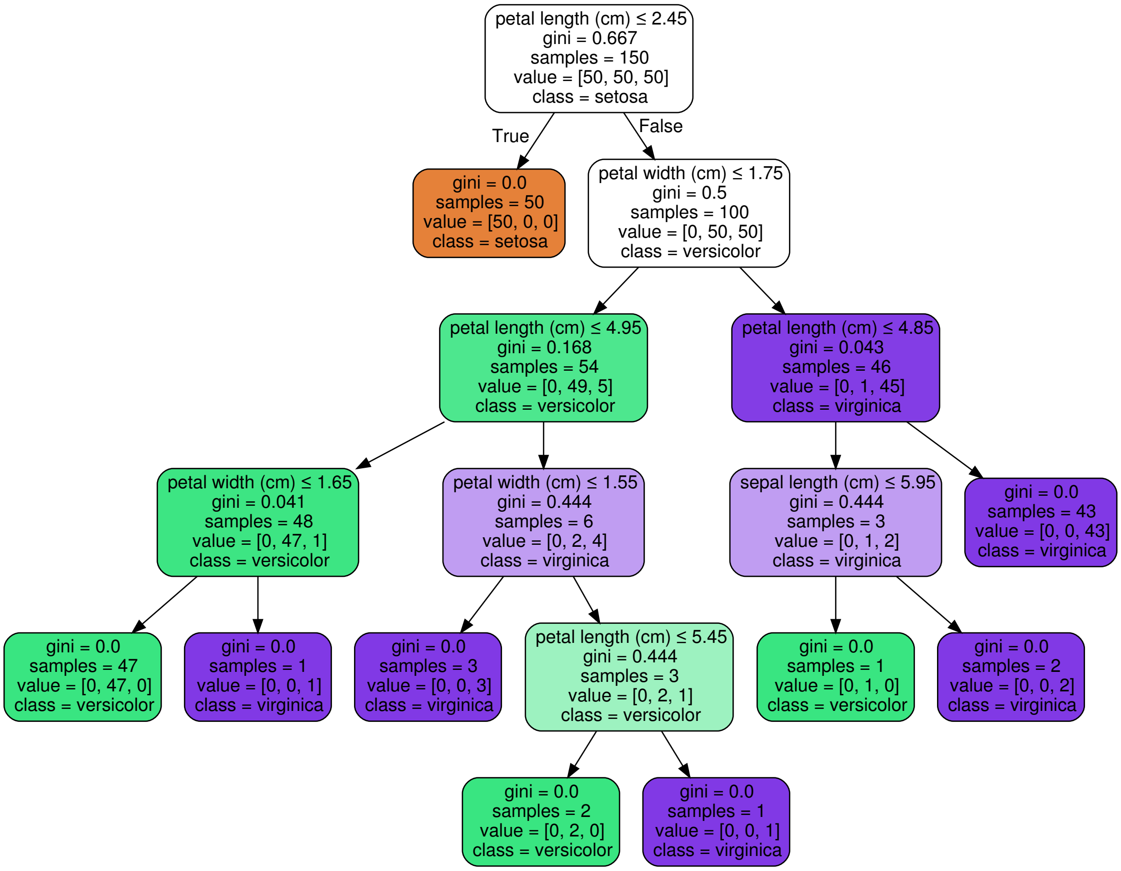
```
In [4]: clf = tree.DecisionTreeClassifier()
        clf = clf.fit(iris.data, iris.target)
        clf
```

```
Out[4]: DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                    max_features=None, max_leaf_nodes=None,
                    min_impurity_decrease=0.0, min_impurity_split=None,
                    min_samples_leaf=1, min_samples_split=2,
                    min_weight_fraction_leaf=0.0, presort=False, random_state=None,
                    splitter='best')
```

- Hasil Pohon

```
In [5]: dot_data = tree.export_graphviz(clf, out_file=None,
                                 feature_names=iris.feature_names,
                                 class_names=iris.target_names,
                                 filled=True, rounded=True,
                                 special_characters=True)
        graph = graphviz.Source(dot_data)
        graph
```

```
Out[5]:
```



- Full training dengan ANN (Multi Layer Perceptron)

```
In [6]: ann = MLPClassifier(solver='lbfgs', alpha=1e-5, hidden_layer_sizes=(5, 2), random_state=
        ann.fit(iris.data, iris.target)
```

```
Out[6]: MLPClassifier(activation='relu', alpha=1e-05, batch_size='auto', beta_1=0.9,
               beta_2=0.999, early_stopping=False, epsilon=1e-08,
               hidden_layer_sizes=(5, 2), learning_rate='constant',
               learning_rate_init=0.001, max_iter=200, momentum=0.9,
               nesterovs_momentum=True, power_t=0.5, random_state=1, shuffle=True,
               solver='lbfgs', tol=0.0001, validation_fraction=0.1, verbose=False,
               warm_start=False)
```

- Menampilkan weigth pada hidden layer

```
In [7]: ann.coefs_
```

```
Out[7]: [array([[-0.13550239,  0.3597881 , -0.81630916, -0.3227893 , -0.57684476],
                [-0.66570776, -0.51233452, -0.25219808, -0.16857787,  0.06338741],
                [-0.1319547 ,  0.30246194, -0.48262707,  0.6174627 , -0.77177221],
                [ 0.27837206, -0.13504058,  0.09584001, -0.5872452 , -0.49299781]]),
         array([[ 0.73066898, -0.76834821],
                [-0.85350401, -0.61135478],
                [ 0.7001833 , -0.74371656],
                [-0.14608018,  0.84784599],
                [ 0.06141013,  0.35528709]]),
         array([[ 0.73312753, -1.05537667,  0.5480383 ],
                [ 1.07104013,  0.54370328, -0.48102273]])]
```

- Vector bias

```
In [8]: ann.intercepts_
```

```
Out[8]: [array([ 0.49111382,  0.76466795, -0.30467704,  0.31406152,  0.61464091]),
         array([-0.34159867,  0.34533261]),
         array([-0.11660927, -0.11662606, -0.11643325])]
```

1.1.3 Pembelajaran dengan Split Training

- Membagi data

```
In [9]: X_train, X_test, y_train, y_test = train_test_split(iris.data, iris.target, test_size=0.
```

- Pembelajaran dengan DTL dan akurasinya

```
In [10]: split = tree.DecisionTreeClassifier()
         split = split.fit(X_train, y_train)
         y_predict = split.predict(X_test)
         accuracy = accuracy_score(y_test, y_predict)
         print('Akurasi: {} %'.format(accuracy * 100))
```

```
Akurasi: 100.0 %
```

- Fungsi untuk menggambarkan confusion matrix

```
In [11]: def plot_confusion_matrix(cm, classes,
                                   normalize=False,
                                   title='Confusion matrix',
                                   cmap=plt.cm.Blues):
             """
             This function prints and plots the confusion matrix.
             Normalization can be applied by setting `normalize=True`.
```

```
    """
    if normalize:
        cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]
        print("Normalized confusion matrix")
    else:
        print('Confusion matrix, without normalization')

    print(cm)

    plt.imshow(cm, interpolation='nearest', cmap=cmap)
    plt.title(title)
    plt.colorbar()
    tick_marks = np.arange(len(classes))
    plt.xticks(tick_marks, classes, rotation=45)
    plt.yticks(tick_marks, classes)

    fmt = '.2f' if normalize else 'd'
    thresh = cm.max() / 2.
    for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
        plt.text(j, i, format(cm[i, j], fmt),
                 horizontalalignment="center",
                 color="white" if cm[i, j] > thresh else "black")

    plt.tight_layout()
    plt.ylabel('True label')
    plt.xlabel('Predicted label')
```

- Hasil klasifikasi dengan DTL

```
In [12]: print(classification_report(y_test, y_predict, target_names=iris.target_names))
```

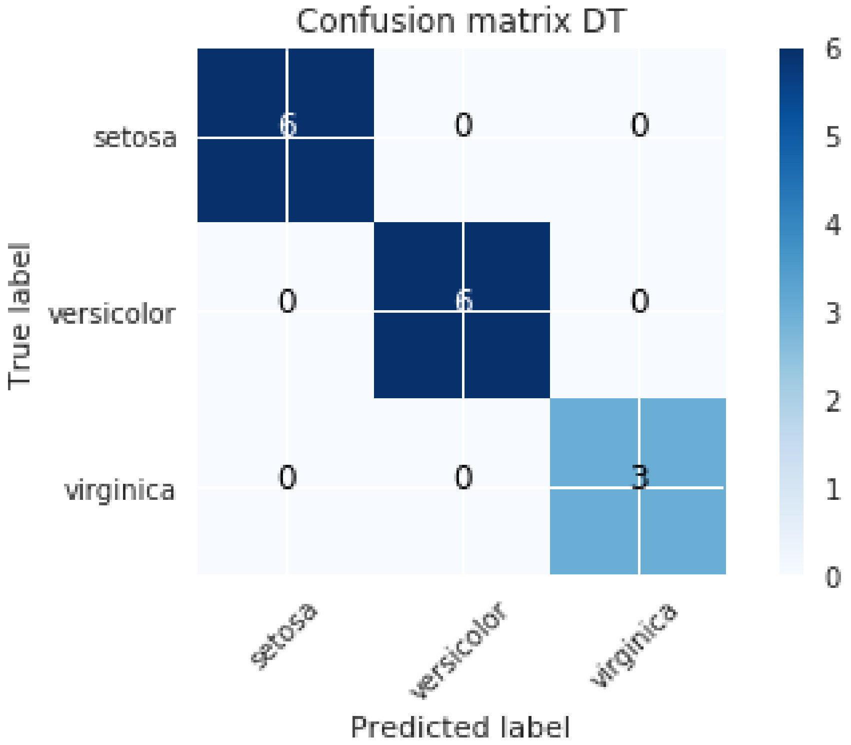
```
             precision    recall  f1-score   support

     setosa       1.00      1.00      1.00         6
 versicolor       1.00      1.00      1.00         6
  virginica       1.00      1.00      1.00         3

avg / total       1.00      1.00      1.00        15
```

- Confusion Matrix pada DTL

```
In [13]: cnf_matrix = confusion_matrix(y_test, y_predict)
         plt.figure()
         plot_confusion_matrix(cnf_matrix, classes=iris.target_names,
                               title='Confusion matrix DT')
```

```
Confusion matrix, without normalization
[[6 0 0]
```

```
 [0 6 0]
 [0 0 3]]
```



- Pembelajaran dengan ANN dan akurasinya

```
In [14]: ann_split = MLPClassifier(solver='lbfgs', alpha=1e-5, hidden_layer_sizes=(5, 2), random
         ann_split.fit(X_train, y_train)
         y_ann_predict = ann_split.predict(X_test)
         accuracy_ann = accuracy_score(y_test, y_ann_predict)
         print('Akurasi: {} %'.format(accuracy_ann * 100))
```

```
Akurasi: 20.0 %
```

- Hasil klasifikasi dengan ANN

```
In [15]: print(classification_report(y_test, y_ann_predict, target_names=iris.target_names))
```

```
             precision    recall  f1-score   support

     setosa       0.00      0.00      0.00         6
 versicolor       0.00      0.00      0.00         6
  virginica       0.20      1.00      0.33         3
```

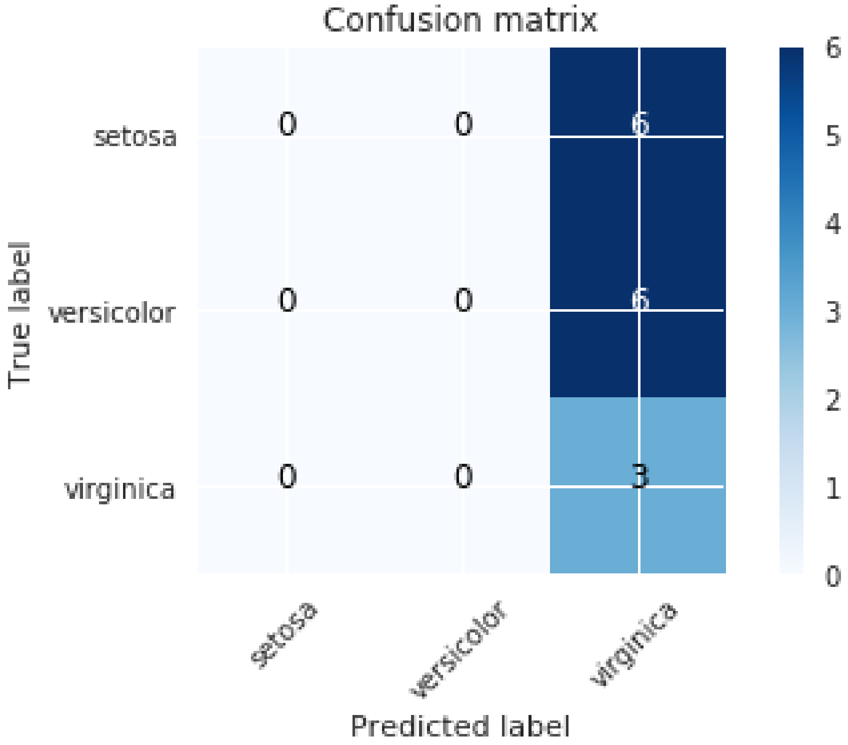
```
avg / total       0.04      0.20      0.07        15
```

```
/usr/local/lib/python3.5/dist-packages/sklearn/metrics/classification.py:1135: UndefinedMetricWa
  'precision', 'predicted', average, warn_for)
```

- Confusion Matrix pada ANN

```
In [16]: cnf_matrix_ann = confusion_matrix(y_test, y_ann_predict)
         plt.figure()
         plot_confusion_matrix(cnf_matrix_ann, classes=iris.target_names,
                               title='Confusion matrix')
```

```
Confusion matrix, without normalization
[[0 0 6]
 [0 0 6]
 [0 0 3]]
```



1.1.4 Pembelajaran dengan 10-fold cross validation

- Pembelajaran dengan DTL

```
In [17]: scores = cross_val_score(clf, iris.data, iris.target, cv=10)
         print("Accuracy: %0.2f (+/- %0.2f)" % (scores.mean(), scores.std() * 2))
```

```
Accuracy: 0.96 (+/- 0.09)
```

- Pembelajaran dengan ANN

```
In [18]: scores = cross_val_score(ann, iris.data, iris.target, cv=10)
         print("Accuracy: %0.2f (+/- %0.2f)" % (scores.mean(), scores.std() * 2))
```

```
Accuracy: 0.33 (+/- 0.00)
```

1.1.5 Melakukan Save Model

```
In [19]: from sklearn.externals import joblib
         joblib.dump(clf, 'full_train_dtl.pkl')
         joblib.dump(ann, 'full_train_ann.pkl')
```

```
Out[19]: ['full_train_ann.pkl']
```

1.1.6 Melakukan Load Model

```
In [20]: loaded_model_dtl = joblib.load('full_train_dtl.pkl')
         loaded_model_ann = joblib.load('full_train_ann.pkl')
```

1.1.7 Predict New Instance

- New Instance

```
In [21]: new_instance = []
         for iris_attr in iris.feature_names:
             value = input("Value for "+iris_attr+": ")
             new_instance.append(value)

         print(new_instance)
```

```
Value for sepal length (cm): 5.1
Value for sepal width (cm): 3.5
Value for petal length (cm): 1.4
Value for petal width (cm): 0.2
['5.1', '3.5', '1.4', '0.2']
```

- Predict with DTL

```
In [22]: instance = []
         instance.append(new_instance)
         loaded_model_dtl.predict(instance)
```

```
Out[22]: array([0])
```

- Predict with ANN

```
In [23]: instance_in_float = [float(i) for i in new_instance]
         instance_ann = []
         instance_ann.append(instance_in_float)
         loaded_model_ann.predict(instance_ann)
```

```
Out[23]: array([2])
```