```
# Latihan 1
# import library pandas
import pandas as pd

# Import library numpy
import numpy as np

# Import library matplotlib dan seaborn untuk visualisasi
import matplotlib.pyplot as plt
import seaborn as sns
plt.style.use('seaborn')

# me-non aktifkan peringatan pada python
import warnings
warnings.filterwarnings('ignore')
```

```
# Latihan 2
# Panggil file (load file bernama Iris_AfterClean.csv) dan simpan 
dalam dataframe Lalu tampilkan 5 baris awal dataset dengan function 
head()
df = pd.read_csv("Iris_AfterClean.csv")
df.head(5)
```

```
   SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm 
Species
0            4.6           3.1            1.5           0.2  Iris-
setosa
1            5.0           3.6            1.4           0.2  Iris-
setosa
2            5.4           3.9            1.7           0.4  Iris-
setosa
3            4.9           3.1            1.5           0.1  Iris-
setosa
4            5.4           3.7            1.5           0.2  Iris-
setosa
```

```
# Melihat Informasi lebih detail mengenai struktur DataFrame dapat 
dilihat menggunakan fungsi info()
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 140 entries, 0 to 139
Data columns (total 5 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   SepalLengthCm  140 non-null    float64
 1   SepalWidthCm   140 non-null    float64
 2   PetalLengthCm  140 non-null    float64
 3   PetalWidthCm   140 non-null    float64
 4   Species        140 non-null    object 
```

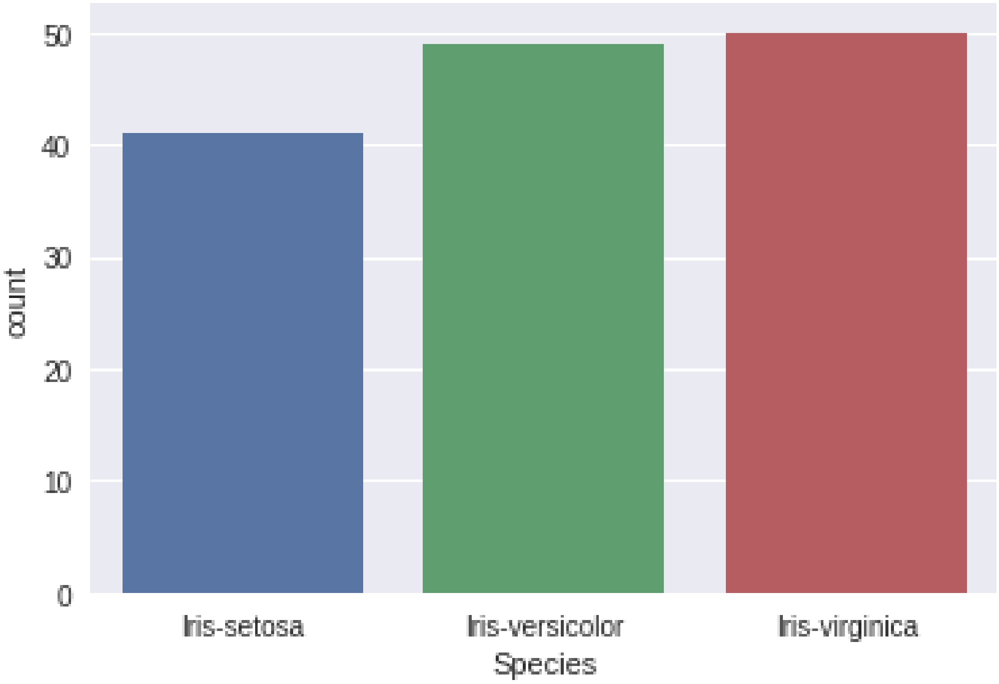
```
dtypes: float64(4), object(1)
memory usage: 5.6+ KB
```

```
# melihat statistik data untuk data numeric seperti count, mean,
standard deviation, maximum, mininum, dan quartile.
df.describe()
```

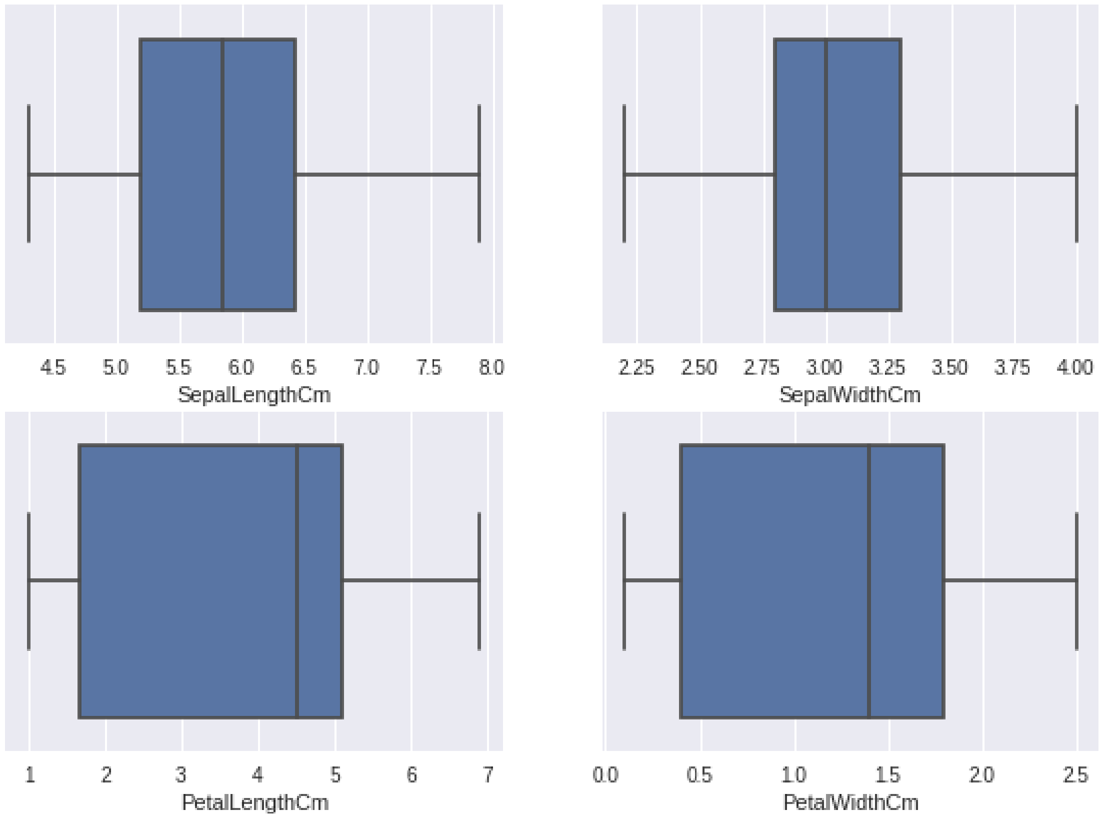
```
       SepalLengthCm  SepalWidthCm  PetalLengthCm  PetalWidthCm
count     140.000000    140.000000     140.000000    140.000000
mean        5.902857      3.028571       3.910714      1.262857
std         0.819365      0.398791       1.720369      0.746825
min         4.300000      2.200000       1.000000      0.100000
25%         5.200000      2.800000       1.675000      0.400000
50%         5.850000      3.000000       4.500000      1.400000
75%         6.425000      3.300000       5.100000      1.800000
max         7.900000      4.000000       6.900000      2.500000
```

```
# Latihan 3
# Melihat distribusi data dari target classes --> Species
sns.countplot(df['Species'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fbf17b442d0>
```

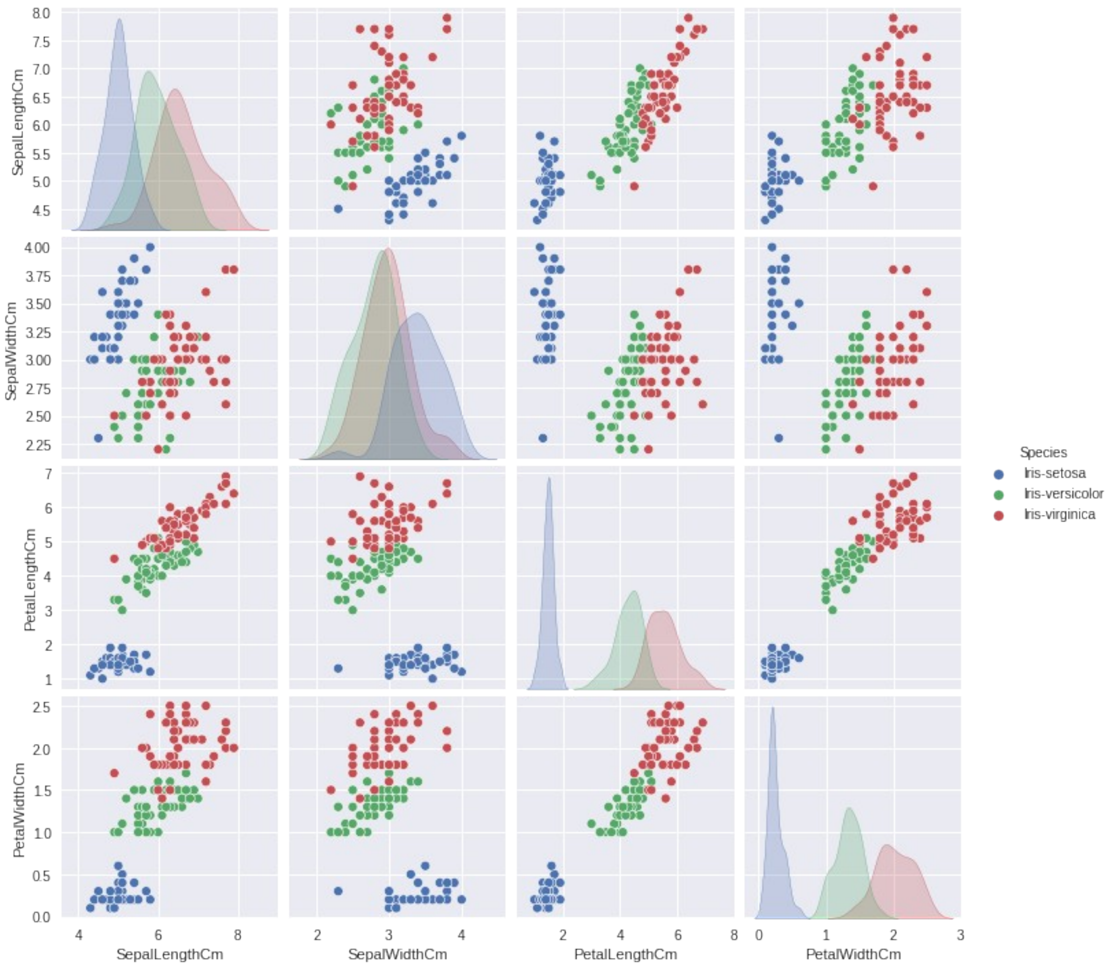


```
# Plotting boxplots untuk memeriksa distribusi kolom numerik
cols = df.columns[:-1].tolist()
fig,ax = plt.subplots(2,2,figsize=(10,7))
r = c = 0
for col in cols:
  sns.boxplot(x=col, data=df,ax=ax[r,c])
  if c == 1:
    r+=1
    c = 0
    continue
  c+=1
```



```
# visualisasikan kolom numerik yang dikelompokkan berdasarkan spesies
sns.pairplot(df,hue='Species')
```

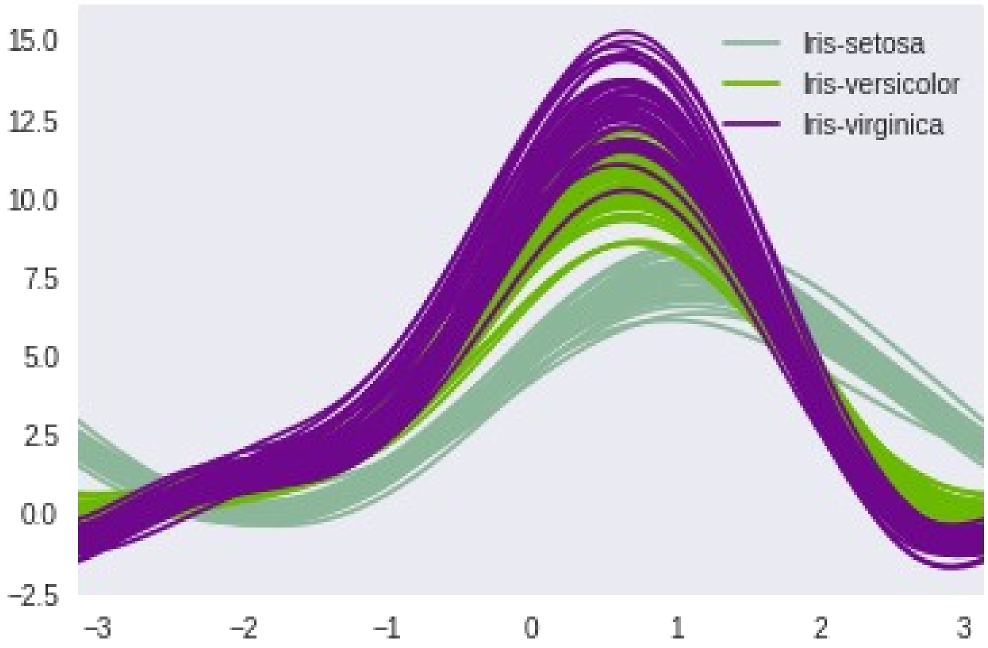
```
<seaborn.axisgrid.PairGrid at 0x7fbf17473b50>
```



```
'''
Satu teknik pandas yang lebih canggih dan keren telah tersedia disebut
Andrews Curves.
Kurva Andrews melibatkan penggunaan atribut sampel sebagai koefisien
untuk deret Fourier
dan kemudian mem plotting ini
'''
```

```
from pandas.plotting import andrews_curves
andrews_curves(df, "Species")
```

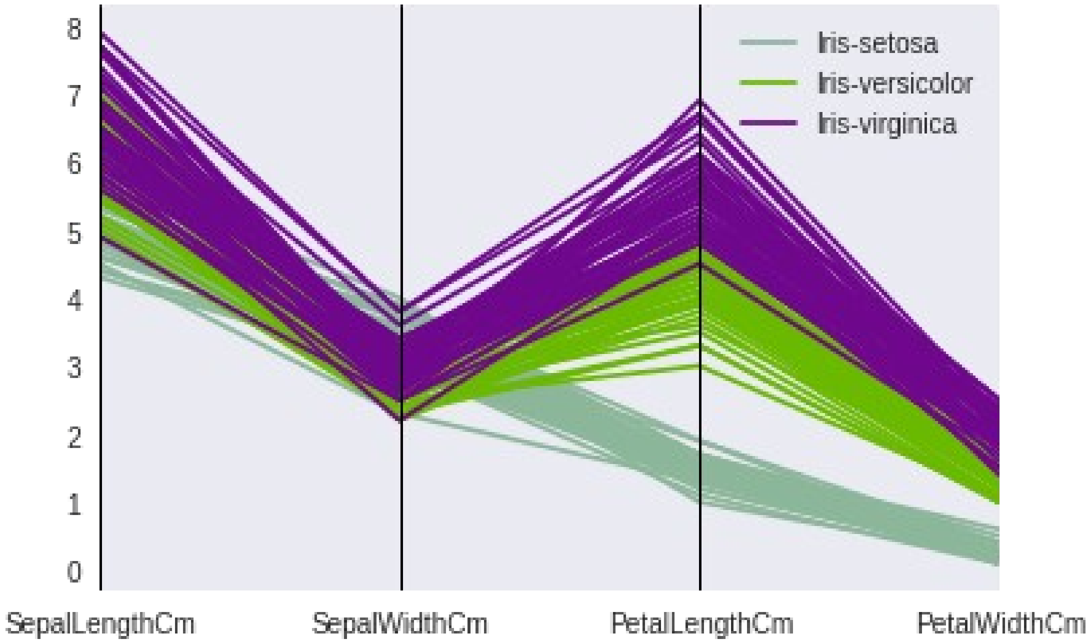
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fbf099b6c50>
```



```
'''
Teknik visualisasi multivariat lain yang dimiliki pandas adalah
parallel_coordinates.
Koordinat paralel memplot setiap fitur pada kolom terpisah & kemudian
menggambar garis
menghubungkan fitur untuk setiap sampel data
'''

from pandas.plotting import parallel_coordinates
parallel_coordinates(df, "Species")

<matplotlib.axes._subplots.AxesSubplot at 0x7fbf09767fd0>
```



```
# Latihan 4
# definisi variabel X / data feature dan y / data targer (species):
X = df.drop('Species',axis=1).values

# Karena ini adalah klasifikasi multikelas, label keluaran dikodekan
satu kali untuk melatih ANN
y = pd.get_dummies(df['Species']).values

# split data train dan test dengan function train_test_split() dengan
train_size=0.7, test_size=0.25 dan random_state=101

from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test  =
train_test_split(X,y,test_size=0.25,random_state=101)

# Latihan 5
# lakukan penskalaan min-maks
from sklearn.preprocessing import MinMaxScaler

scaler = MinMaxScaler()
X_train_scaled = scaler.fit_transform(X_train)
X_test_scaled = scaler.transform(X_test)

# Latihan 6
# Import library pada keras yang dibutuhkan
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.wrappers.scikit_learn import KerasClassifier
```

```
# input_shape
X_train_scaled.shape[1:]
```

```
(4,)
```

```
def build_model(n_hidden = 1, n_neurons=5, learning_rate=3e-3,
input_shape=X_train_scaled.shape[1:]):
  '''
  Membangun keras ANN untuk Klasifikasi Multiclass yaitu kelas
keluaran yang saling eksklusif
  '''

  model = Sequential()
  options = {"input_shape": input_shape}


  # Menambahkan input dan hidden layers
  for layer in range(n_hidden):
    model.add(Dense(n_neurons,activation="relu",**options))
    options = {}


  # Menambahkan output layer yang memiliki 3 neuron, 1 per kelas
  model.add(Dense(3,activation='softmax'))


  # Membuat instance adam optimizer
  opt = Adam(learning_rate=learning_rate)

model.compile(optimizer=opt,loss='categorical_crossentropy',metrics='a
ccuracy')
  return model
```

```
# Menerapkan KerasClassifier Wrapper ke neural network
keras_cls = KerasClassifier(build_model)
```

```
# Latihan 7
# import library EarlyStopping dan RandomizedSearchCV

from tensorflow.keras.callbacks import EarlyStopping
from sklearn.model_selection import RandomizedSearchCV

param_dict = {
    "n_hidden" : (2,3),
    "n_neurons" : tuple(range(2,7)),
    "learning_rate" : (3e-2,3e-3,3e-4)
}

model_cv = RandomizedSearchCV(keras_cls, param_dict, n_iter=10, cv=3)
```

```
%%time
model_cv.fit(
    X_train_scaled, y_train, epochs=150,
    validation_data = (X_test_scaled,y_test),
    callbacks = [EarlyStopping(monitor='val_loss', mode='min',
verbose=0, patience=10)],
    verbose=0
)
```

```
2/2 [==============================] - 0s 8ms/step - loss: 0.1602 -
accuracy: 0.9143
2/2 [==============================] - 0s 8ms/step - loss: 0.1368 -
accuracy: 0.9429
2/2 [==============================] - 0s 10ms/step - loss: 0.1983 -
accuracy: 0.9429
2/2 [==============================] - 0s 8ms/step - loss: 1.1027 -
accuracy: 0.3143
2/2 [==============================] - 0s 9ms/step - loss: 0.5652 -
accuracy: 0.5143
2/2 [==============================] - 0s 7ms/step - loss: 1.1007 -
accuracy: 0.3429
2/2 [==============================] - 0s 7ms/step - loss: 0.9886 -
accuracy: 0.5429
2/2 [==============================] - 0s 8ms/step - loss: 1.1148 -
accuracy: 0.1429
2/2 [==============================] - 0s 10ms/step - loss: 1.0987 -
accuracy: 0.3429
2/2 [==============================] - 0s 7ms/step - loss: 1.0993 -
accuracy: 0.3143
2/2 [==============================] - 0s 7ms/step - loss: 1.1147 -
accuracy: 0.1429
2/2 [==============================] - 0s 10ms/step - loss: 0.9520 -
accuracy: 0.6000
2/2 [==============================] - 0s 9ms/step - loss: 0.4001 -
accuracy: 0.7714
2/2 [==============================] - 0s 8ms/step - loss: 0.4175 -
accuracy: 0.8571
2/2 [==============================] - 0s 9ms/step - loss: 0.3162 -
accuracy: 0.9429
2/2 [==============================] - 0s 9ms/step - loss: 1.1300 -
accuracy: 0.3143
2/2 [==============================] - 0s 12ms/step - loss: 1.1456 -
accuracy: 0.1429
2/2 [==============================] - 0s 6ms/step - loss: 0.1378 -
accuracy: 0.9429
2/2 [==============================] - 0s 11ms/step - loss: 1.1693 -
accuracy: 0.3143
2/2 [==============================] - 0s 8ms/step - loss: 0.0587 -
accuracy: 0.9714
2/2 [==============================] - 0s 8ms/step - loss: 0.1482 -
```

```
accuracy: 0.9429
2/2 [==============================] - 0s 8ms/step - loss: 1.0530 -
accuracy: 0.5714
2/2 [==============================] - 0s 8ms/step - loss: 1.0789 -
accuracy: 0.4571
2/2 [==============================] - 0s 8ms/step - loss: 1.0405 -
accuracy: 0.6286
2/2 [==============================] - 0s 5ms/step - loss: 1.1063 -
accuracy: 0.3143
2/2 [==============================] - 0s 7ms/step - loss: 1.1473 -
accuracy: 0.1429
2/2 [==============================] - 0s 8ms/step - loss: 1.1010 -
accuracy: 0.3429
2/2 [==============================] - 0s 5ms/step - loss: 0.1483 -
accuracy: 0.9429
2/2 [==============================] - 0s 8ms/step - loss: 0.1565 -
accuracy: 0.9143
2/2 [==============================] - 0s 5ms/step - loss: 0.1247 -
accuracy: 0.9429
CPU times: user 1min 36s, sys: 3.38 s, total: 1min 39s
Wall time: 1min 42s
```

```
RandomizedSearchCV(cv=3,

estimator=<keras.wrappers.scikit_learn.KerasClassifier object at
0x7fbea066aa10>,
                   param_distributions={'learning_rate': (0.03, 0.003,
0.0003),
                                        'n_hidden': (2, 3),
                                        'n_neurons': (2, 3, 4, 5, 6)})
```

```
model_cv.best_params_
```

```
{'learning_rate': 0.03, 'n_hidden': 3, 'n_neurons': 6}
```

```
model_cv.best_score_
```

```
0.9333333373069763
```

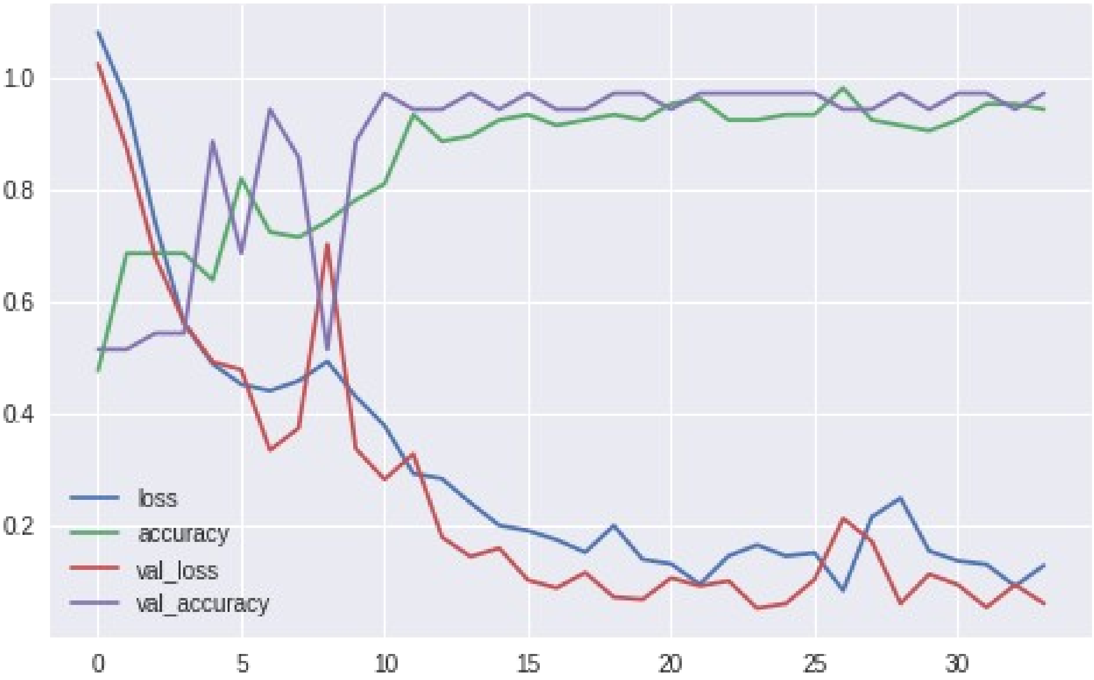
```
# Latihan 8
# building model based on best set of parameters obtained from
RandomSearchCV
best_set = model_cv.best_params_

model = build_model(learning_rate= best_set['learning_rate'],
                    n_hidden= best_set['n_hidden'], n_neurons=
best_set['n_neurons'])

model.fit(
    X_train_scaled, y_train, epochs=100,
    validation_data = (X_test_scaled,y_test),
    callbacks = [EarlyStopping(monitor='val_loss', mode='min',
patience=10)],
    verbose=0
)
```

```
<keras.callbacks.History at 0x7fbe932a5750>
```

```
# Latihan 9
pd.DataFrame(model.history.history).plot(figsize=(8, 5))
plt.grid(True)
plt.show()
```



```
# Latihan 10
from sklearn.metrics import classification_report,confusion_matrix

# Instead of probabilities it provides class labels
pred_classes = model_cv.predict(X_test_scaled)
y_test_classes = np.argmax(y_test,axis=1)
print(classification_report(y_test_classes,pred_classes),"\n\n")
print(confusion_matrix(y_test_classes,pred_classes))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00         9
           1       1.00      0.94      0.97        16
           2       0.91      1.00      0.95        10

    accuracy                           0.97        35
   macro avg       0.97      0.98      0.97        35
```

```
weighted avg       0.97      0.97      0.97        35


[[ 9  0  0]
 [ 0 15  1]
 [ 0  0 10]]
```