Package Imports

In [81]:

```
import sys
import pandas as pd
import numpy as np
import sklearn
import matplotlib
import keras
```

In [82]:

```
import matplotlib.pyplot as plt
from pandas.plotting import scatter_matrix
```

Loading the data from cloud

In [83]:

```
# azureml-core of version 1.0.72 or higher is required
# azureml-dataprep[pandas] of version 1.1.34 or higher is required
from azureml.core import Workspace, Dataset

subscription_id = 'd8c9631a-72a2-4c02-bd86-46a64cba0932'
resource_group = 'CIT'
workspace_name = 'MCC'

workspace = Workspace(subscription_id, resource_group, workspace_name)

dataset = Dataset.get_by_name(workspace, name='heart disease')
```

Pre-processing

In [84]:

```
df = dataset.to_pandas_dataframe()
```

In [85]:

```
print( 'Shape of DataFrame: {}'.format(df.shape))
print (df.loc[1])
```

```
Shape of DataFrame: (303, 14)
age          37.0
sex           1.0
cp            2.0
trestbps    130.0
chol        250.0
fbs           0.0
restecg       1.0
thalach     187.0
exang         0.0
oldpeak       3.5
slope         0.0
ca            0.0
thal          2.0
target        1.0
Name: 1, dtype: float64
```

In [86]:

```
data = df[~df.isin(['?'])]
```

Droping Null Values

In [87]:

```
data = data.dropna(axis=0)
```

Expolatory Data Analysis

In [88]:

```
print(data.shape)
print(data.dtypes)
```

```
(303, 14)
age           int64
sex           int64
cp            int64
trestbps      int64
chol          int64
fbs           int64
restecg       int64
thalach       int64
exang         int64
oldpeak     float64
slope         int64
ca            int64
thal          int64
target        int64
dtype: object
```

In [89]:

```
data = data.apply(pd.to_numeric)
data.dtypes
```

Out[89]:

```
age           int64
sex           int64
cp            int64
trestbps      int64
chol          int64
fbs           int64
restecg       int64
thalach       int64
exang         int64
oldpeak     float64
slope         int64
ca            int64
thal          int64
target        int64
dtype: object
```

In [90]:

```
data.describe()
```

Out[90]:

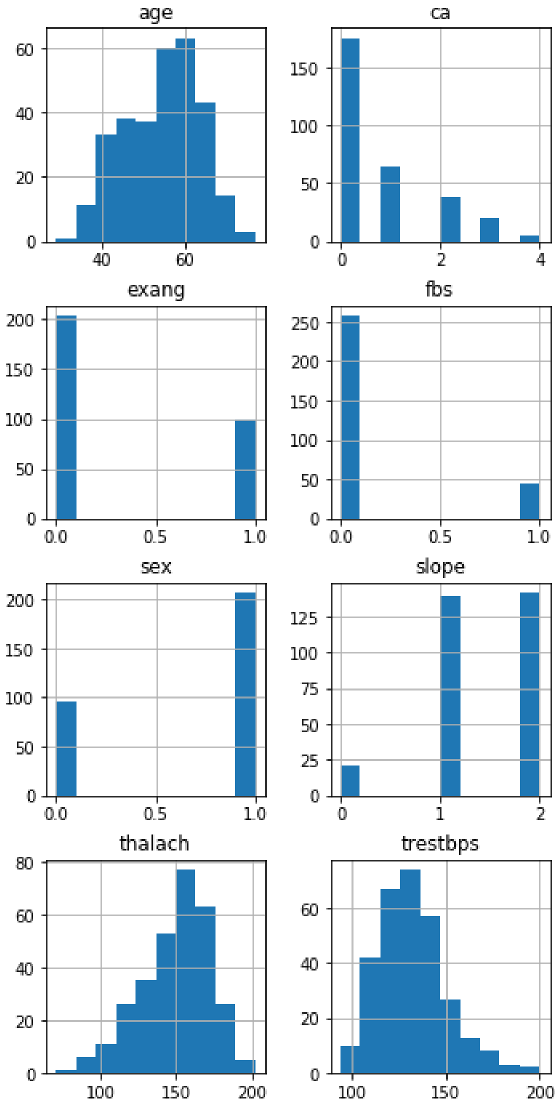
	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	
count	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.000000	303.00
mean	54.366337	0.683168	0.966997	131.623762	246.264026	0.148515	0.528053	149.646865	0.326733	1.039604	1.39
std	9.082101	0.466011	1.032052	17.538143	51.830751	0.356198	0.525860	22.905161	0.469794	1.161075	0.61
min	29.000000	0.000000	0.000000	94.000000	126.000000	0.000000	0.000000	71.000000	0.000000	0.000000	0.00

	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	
25%	47.500000	0.000000	0.000000	120.000000	211.000000	0.000000	0.000000	133.500000	0.000000	0.000000	1.0(
50%	55.000000	1.000000	1.000000	130.000000	240.000000	0.000000	1.000000	153.000000	0.000000	0.800000	1.0(
75%	61.000000	1.000000	2.000000	140.000000	274.500000	0.000000	1.000000	166.000000	1.000000	1.600000	2.0(
max	77.000000	1.000000	3.000000	200.000000	564.000000	1.000000	2.000000	202.000000	1.000000	6.200000	2.0(

Histogram

In [91]:

```
data.hist(figsize = (12, 12))
plt.show()
```



Train and Test split

In [92]:

```
from sklearn import model_selection

X = np.array(data.drop(['target'], 1))
y = np.array(data['target'])

X_train, X_test, y_train, y_test = model_selection.train_test_split(X, y, test_size = 0.2)
```

Model: Categorical Classification Model

Model: Categorical Classification Model

In [93]:

```
from keras.utils.np_utils import to_categorical

Y_train = to_categorical(y_train, num_classes=None)
Y_test = to_categorical(y_test, num_classes=None)
print (Y_train.shape)
print (Y_train[:10])
```

```
(242, 2)
[[1. 0.]
 [1. 0.]
 [1. 0.]
 [0. 1.]
 [0. 1.]
 [1. 0.]
 [0. 1.]
 [1. 0.]
 [0. 1.]
 [0. 1.]]
```

Importing the Model

In [94]:

```
from keras.models import Sequential
from keras.layers import Dense
from keras.optimizers import Adam
```

Model Creation

In [95]:

```
def create_model():
    # create model
    model = Sequential()
    model.add(Dense(16, input_dim=13, kernel_initializer='normal', activation='relu'))
    model.add(Dense(8, kernel_initializer='normal', activation='relu'))
    model.add(Dense(2, activation='softmax'))

    # compile model
    adam = Adam(lr=0.001)
    model.compile(loss='categorical_crossentropy', optimizer=adam, metrics=['accuracy'])
    return model

model = create_model()

print(model.summary())
```

```
Model: "sequential_5"
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
dense_13 (Dense)             (None, 16)                224       
_________________________________________________________________
dense_14 (Dense)             (None, 8)                 136       
_________________________________________________________________
dense_15 (Dense)             (None, 2)                 18        
=================================================================
Total params: 378
Trainable params: 378
Non-trainable params: 0
_________________________________________________________________
None
```

Model Training

In [96]:

```
history=model.fit(X_train, Y_train, validation_data=(X_test, Y_test),epochs=200, batch_size=10, ver
bose = 10)
```

```
Train on 242 samples, validate on 61 samples
Epoch 1/200
Epoch 2/200
Epoch 3/200
Epoch 4/200
Epoch 5/200
Epoch 6/200
Epoch 7/200
Epoch 8/200
Epoch 9/200
Epoch 10/200
Epoch 11/200
Epoch 12/200
Epoch 13/200
Epoch 14/200
Epoch 15/200
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Epoch 199/200
Epoch 200/200
```

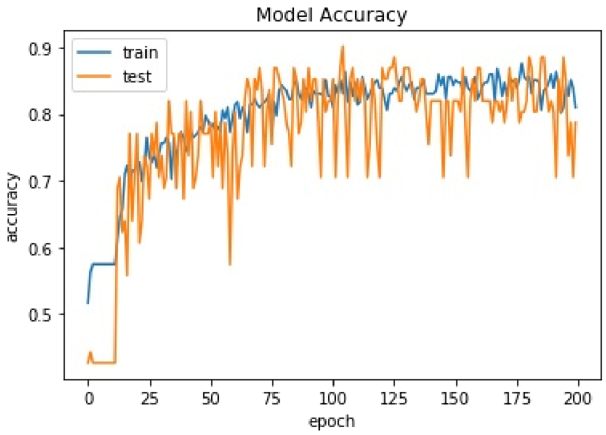
Model Accuracy rate

In [97]:

```
import matplotlib.pyplot as plt
%matplotlib inline
```

In [98]:

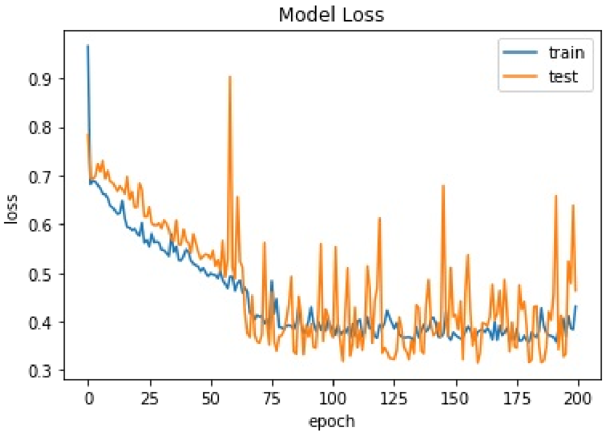
```
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.title('Model Accuracy')
plt.ylabel('accuracy')
plt.xlabel('epoch')
plt.legend(['train', 'test'])
plt.show()
```



Model Loss rate

In [99]:

```
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('Model Loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'test'])
plt.show()
```



Evaluation Metrics

In [100]:

```
from sklearn.metrics import classification_report, accuracy_score

categorical_pred = np.argmax(model.predict(X_test), axis=1)

print('Acuuracy Score for Categorical Model')
print(accuracy_score(y_test, categorical_pred)*100)
print(classification_report(y_test, categorical_pred))
```

```
Acuuracy Score for Categorical Model
78.68852459016394
              precision    recall  f1-score   support

           0       1.00      0.63      0.77        35
           1       0.67      1.00      0.80        26

   micro avg       0.79      0.79      0.79        61
   macro avg       0.83      0.81      0.79        61
weighted avg       0.86      0.79      0.78        61
```