In [71]:
```
# Import Python Libraries: NumPy and Pandas
import pandas as pd
import numpy as np
# Import Libraries & modules for data visualization
from pandas.plotting import scatter_matrix
from matplotlib import pyplot
```

In [72]:
```
# Import scikit-Learn module for the algorithm/modeL: Nearest Neighbors
from sklearn.neighbors import KNeighborsClassifier
# Import scikit-Learn module to split the dataset into train/ test sub-datasets
from sklearn.model_selection import train_test_split
```

In [73]:
```
# Import scikit-Learn module for K-fold cross-validation - algorithm/modeL evaluation & validation
from sklearn.model_selection import KFold
from sklearn.model_selection import cross_val_score
# Import scikit-Learn module classification report to later use for information about how the system try to clas
from sklearn.metrics import classification_report
```

Load the data

Data Set: pima_diabetes.csv

In [74]:
```
filename ='C:/Users/miriamgarcia/Downloads/pima_diabetes.csv'
df=pd.read_csv(filename)
```

Preprocess Dataset

In [75]:
```
# count the number of NaN values in each column
print (df.isnull().sum())
```

```
preg     0
plas     0
pres     0
skin     0
test     0
mass     0
pedi     0
age      0
class    0
dtype: int64
```

In [76]:
```
#mark zero values as missing or NaN - do not include class
df[[ 'preg' , 'plas' , 'pres' ,'skin', 'test', 'mass', 'pedi', 'age']] \
= df[['preg' , 'plas' , 'pres' ,'skin', 'test', 'mass', 'pedi', 'age' ]].replace(0,np.NaN)
df=df.fillna(df.mean())
# count the number of NaN values in each column
print (df.isnull().sum())
```

```
preg     0
plas     0
pres     0
skin     0
test     0
mass     0
pedi     0
age      0
class    0
dtype: int64
```

In [77]:
```
# count the number of NaN values in each column
print (df.isnull().sum())
```

```
preg     0
plas     0
pres     0
skin     0
test     0
mass     0
pedi     0
age      0
class    0
dtype: int64
```

In [ ]:
```

```

Exploratory data analysis (EDA) on the dataset

In [78]:
```
# get the dimensions or shape of the dataset
# i.e. number of records / rows X number of variables / columns
print(df.shape)
```

```
(768, 9)
```

In [79]:
```
#return the first five records / rows of the data set
print(df.head(5))
```

```
       preg   plas  pres      skin        test  mass   pedi  age  class
0  6.000000  148.0  72.0  35.00000  155.548223  33.6  0.627   50      1
1  1.000000   85.0  66.0  29.00000  155.548223  26.6  0.351   31      0
2  8.000000  183.0  64.0  29.15342  155.548223  23.3  0.672   32      1
3  1.000000   89.0  66.0  23.00000   94.000000  28.1  0.167   21      0
4  4.494673  137.0  40.0  35.00000  168.000000  43.1  2.288   33      1
```

In [80]:
```
#get the data types of all the variables / attributes in the data set
print(df.dtypes)
```

```
preg     float64
plas     float64
pres     float64
skin     float64
test     float64
mass     float64
pedi     float64
age        int64
class      int64
dtype: object
```

In [81]:
```
#return the summary statistics of the numeric variables / attributes in the data set
print(df.describe())
```

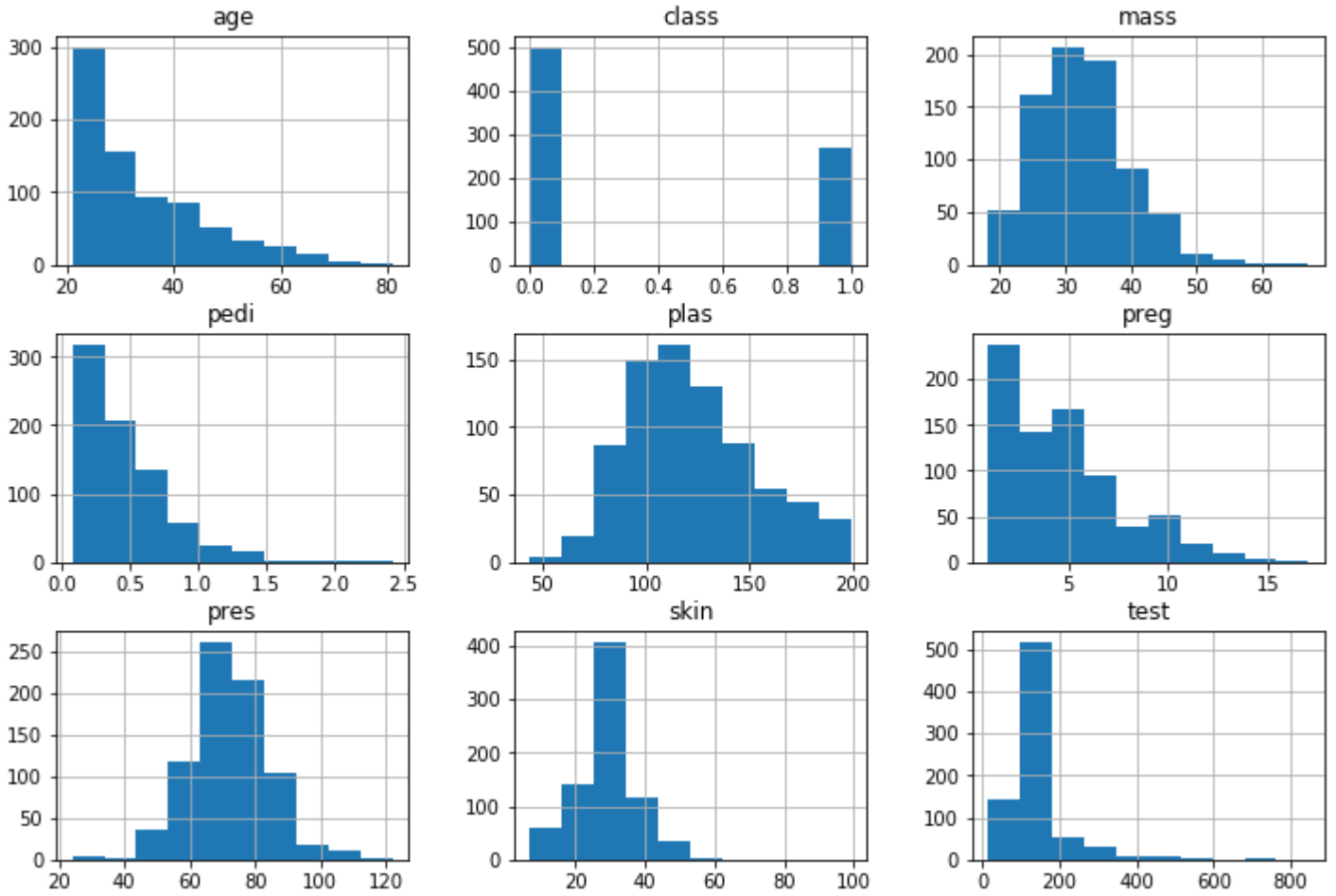
```
             preg        plas        pres        skin        test        mass  \
count  768.000000  768.000000  768.000000  768.000000  768.000000  768.000000
mean     4.494673  121.686763   72.405184   29.153420  155.548223   32.457464
std      2.975395   30.435949   12.096346    8.790942   85.021108    6.875151
min      1.000000   44.000000   24.000000    7.000000   14.000000   18.200000
25%      2.000000   99.750000   64.000000   25.000000  121.500000   27.500000
50%      4.494673  117.000000   72.202592   29.153420  155.548223   32.400000
75%      6.000000  140.250000   80.000000   32.000000  155.548223   36.600000
max     17.000000  199.000000  122.000000   99.000000  846.000000   67.100000

             pedi         age       class
count  768.000000  768.000000  768.000000
mean     0.471876   33.240885    0.348958
std      0.331329   11.760232    0.476951
min      0.078000   21.000000    0.000000
25%      0.243750   24.000000    0.000000
50%      0.372500   29.000000    0.000000
75%      0.626250   41.000000    1.000000
max      2.420000   81.000000    1.000000
```

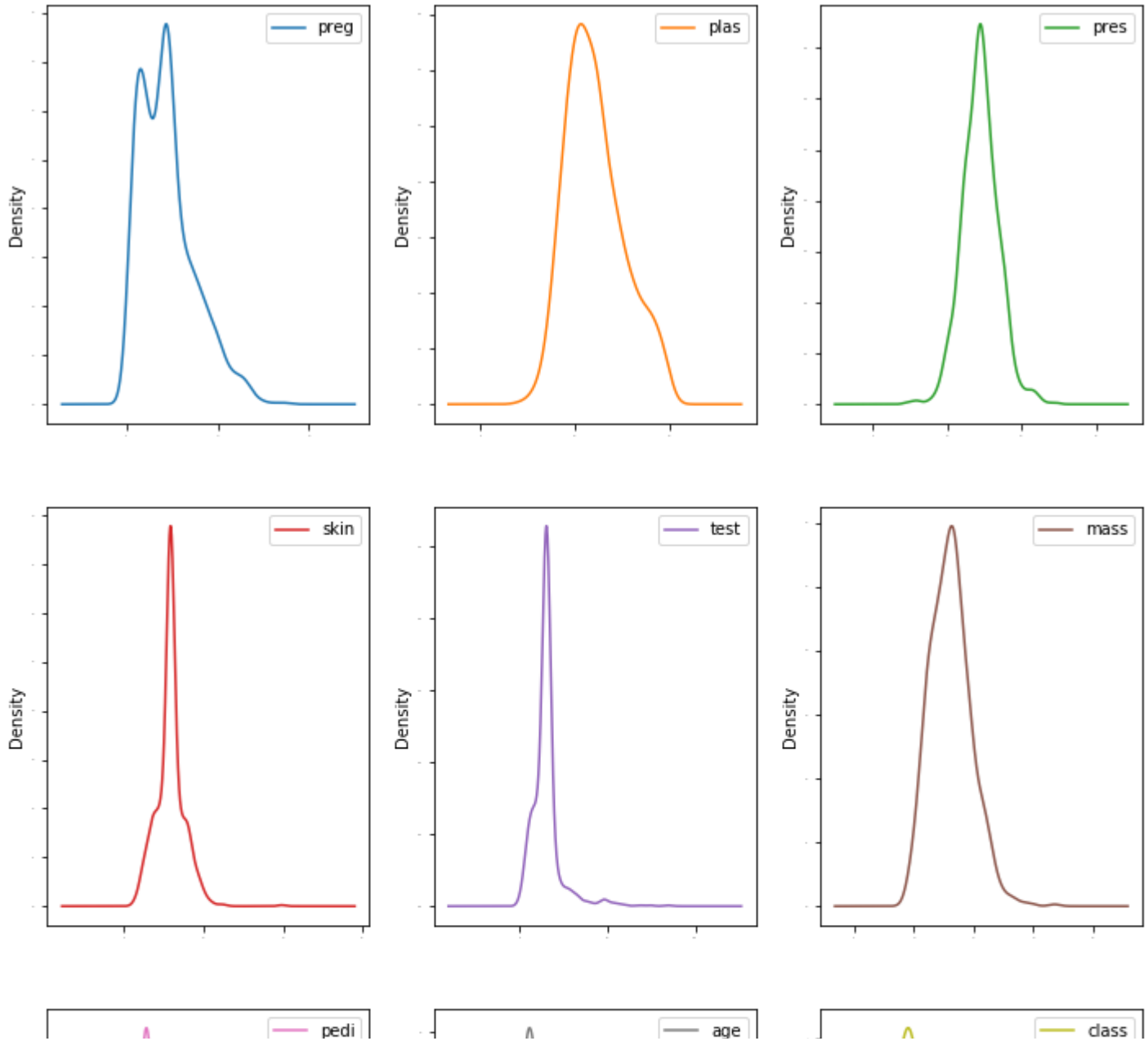
In [82]:
```
#class distribution i.e. how many records are in each class
print(df.groupby('class').size())
```

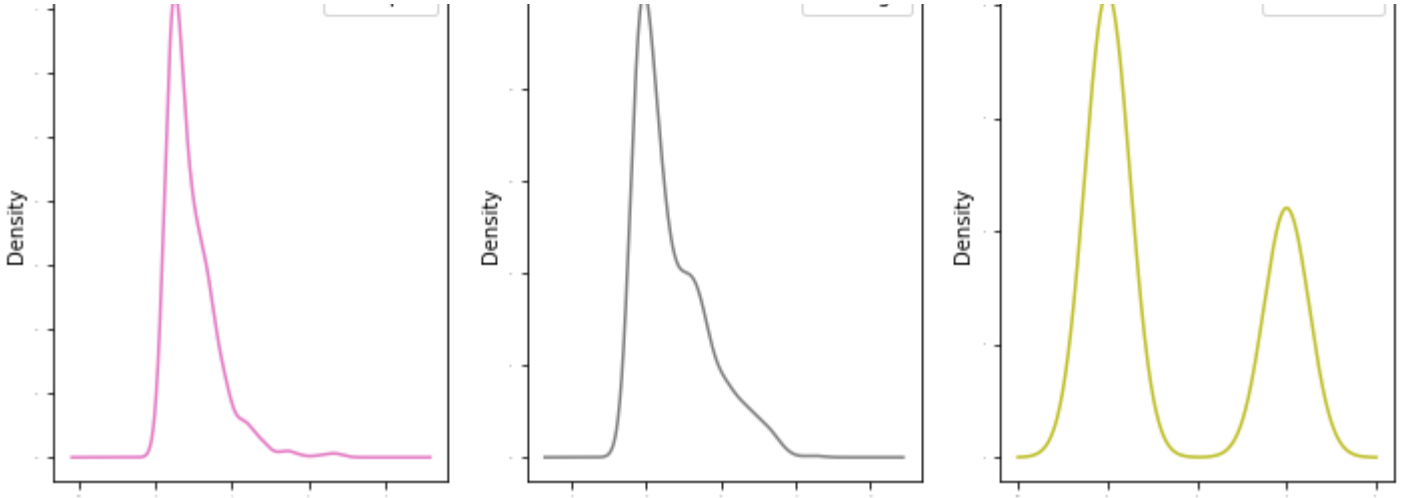
```
class
0    500
1    268
dtype: int64
```

In [83]:
```
#plot histogram of each numeric variable / attribute in the data set
df.hist(figsize=(12, 8))
pyplot.show()
```

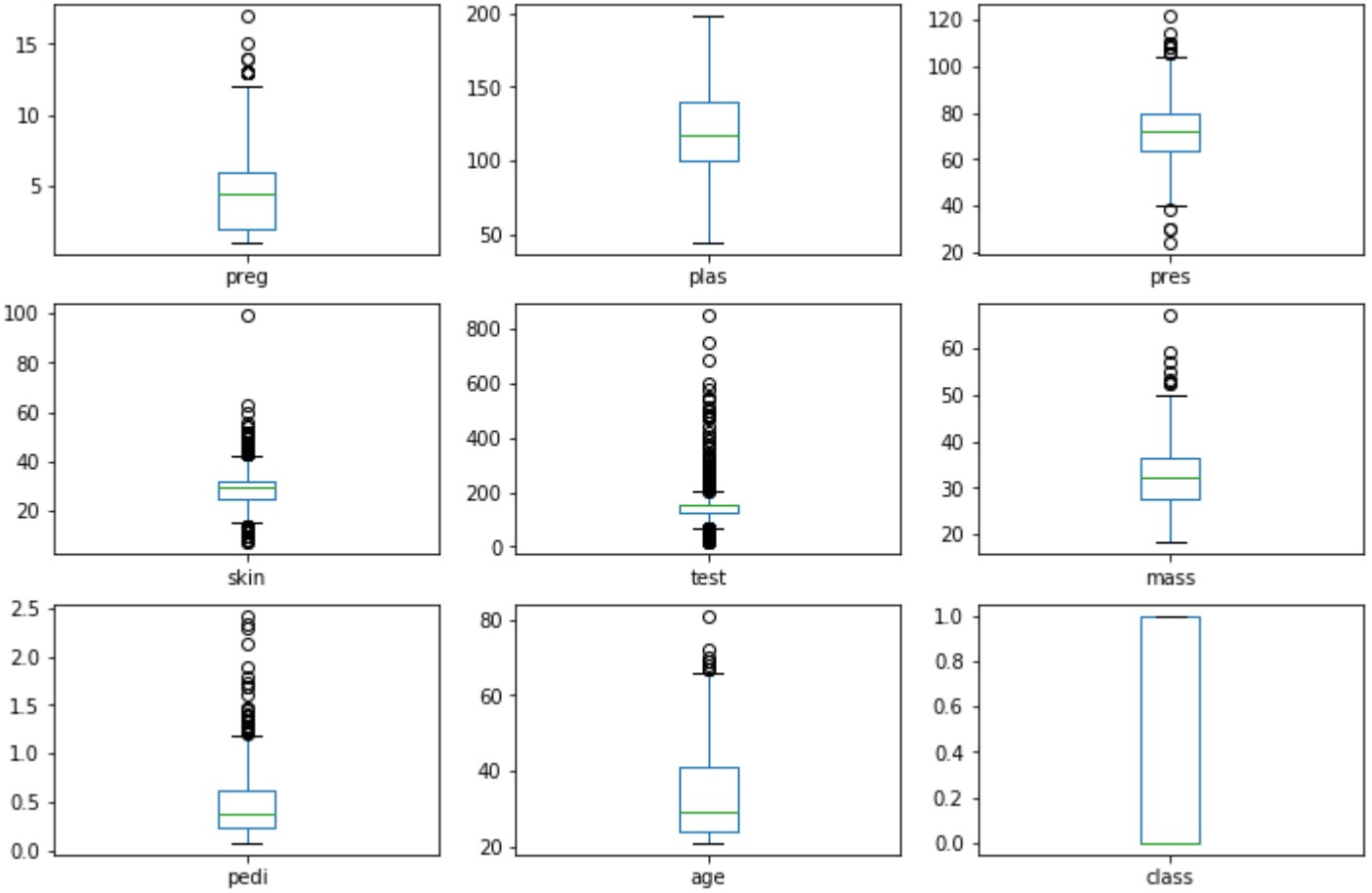


In [84]:
```
# generate density plots of each numeric variable / attribute in the data set
df.plot(kind='density', subplots=True, layout=(3, 3), sharex=False, legend=True, fontsize=1,
figsize=(12, 16))
pyplot.show()
```

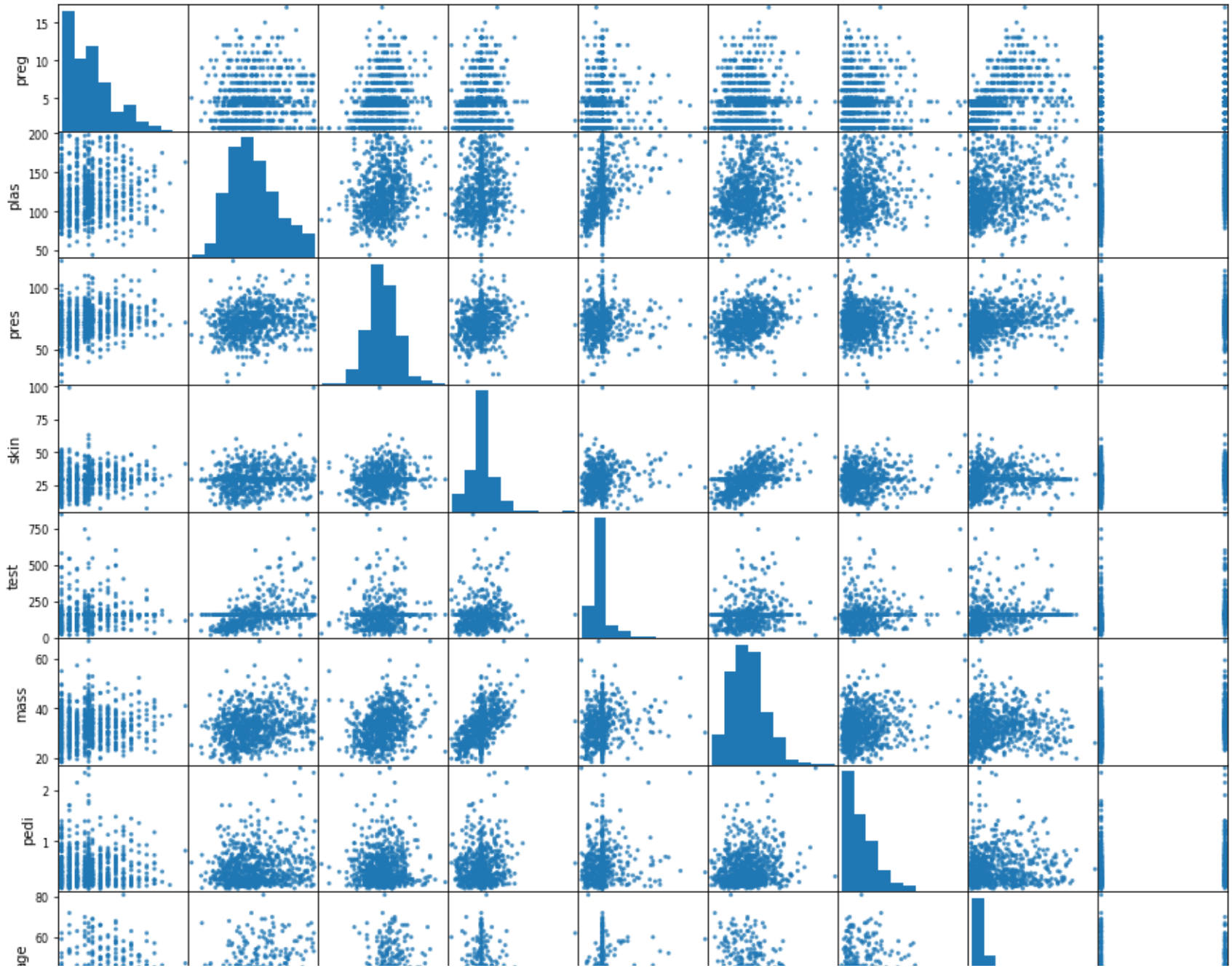


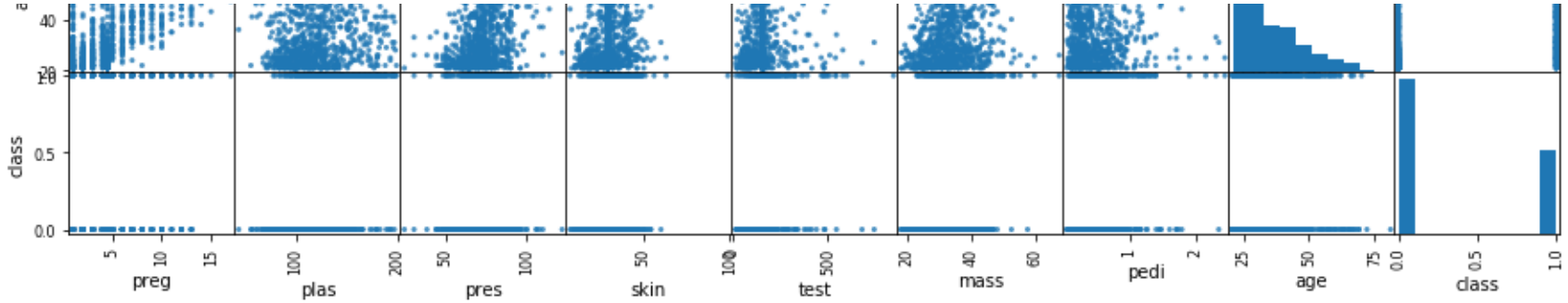

Density
Density
Density

In [85]:
```
# generate box plots of each numeric variable / attribute in the data set
df.plot(kind='box', subplots=True, layout=(3,3), sharex=False, figsize=(12,8))
pyplot.show()
```



In [86]:
```
# generate scatter plot matrix of each numeric variable / attribute in the data set
scatter_matrix(df, alpha=0.8, figsize=(15, 15))
pyplot.show()
```





##Separate Dataset into Input & Output NumPy arrays

In [87]:
```
# store dataframe values into a numpy array
array = df.values
# separate array into input and output by slicing
# for X(input) [:, 0:8] --> all the rows, columns from 0 - 8
# these are the independent variables or predictors
X = array[:,0:8]
# for Y(input) [:, 8] --> all the rows, column 8
# this is the value we are trying to predict
Y = array[:,8]
```

In [88]:
```
test_size =0.33
seed=4
```

In [89]:
```
X_train,X_test,Y_train,Y_test =train_test_split(X,Y,test_size=test_size, random_state=seed)
```

Build and Train the Model

In [90]:
```
# build the model
model = KNeighborsClassifier()
# train the model using the training sub-dataset
model.fit(X_train, Y_train)
#print the classification report
predicted = model.predict(X_test)
report = classification_report(Y_test, predicted)
print(report)
```

```
              precision    recall  f1-score   support

         0.0       0.82      0.79      0.80       171
         1.0       0.60      0.64      0.62        83

    accuracy                           0.74       254
   macro avg       0.71      0.71      0.71       254
weighted avg       0.75      0.74      0.74       254
```

Score the accuracy of the model

In [91]:
```
#score the accuracy leve
result = model.score(X_test, Y_test)
#print out the results
print(("Accuracy: %.3f%%") % (result*100.0))
```

```
Accuracy: 74.016%
```

Classify/Predict Model 1

Use the trained model to predict / classify using the following predictors

In [92]:
```
model.predict([[6.0, 110, 68, 15,85,18,0.5,38]])
```

Out[92]:
```
array([0.])
```

Evaluate the model using the 10-fold cross-validation technique

In [93]:
```
# evaluate the algorythm
# specify the number of time of repeated splitting, in this case 10 folds
n_splits = 10
# fix the random seed
# must use the same seed value so that the same subsets can be obtained
# for each time the process is repeated
seed = 4
```

In [94]:
```
kfold = KFold(n_splits, random_state=seed)
scoring = 'accuracy'
```

In [95]:
```
# train the model and run K-fold cross validation to validate / evaluate the model
results = cross_val_score(model, X, Y, cv=kfold, scoring=scoring)
# print the evaluationm results
# result: the average of all the results obtained from the K-fold cross validation
print("Accuracy: %.3f (%.3f)" % (results.mean(), results.std()))
```

```
Accuracy: 0.712 (0.067)
```

using the 10-fold cross-validation to evaluate the model / algorithm, the accuracy of this logistic regression model is 71%

Predict Model 2

In [96]:
```
model.predict([[5, 130, 59, 18,70,16,0.3,31]])
```

Out[96]:
```
array([0.])
```

Evaluate the model using the 10-fold cross-validation technique

In [97]:
```
# evaluate the algorythm
# specify the number of time of repeated splitting, in this case 10 folds
n_splits = 10
# fix the random seed
# must use the same seed value so that the same subsets can be obtained
# for each time the process is repeated
seed = 4
```

In [98]:
```
kfold = KFold(n_splits, random_state=seed)
scoring = 'accuracy'
```

In [99]:
```
# train the model and run K-fold cross validation to validate / evaluate the model
results = cross_val_score(model, X, Y, cv=kfold, scoring=scoring)
print("Accuracy: %.3f (%.3f)" % (results.mean(), results.std()))
```

```
Accuracy: 0.712 (0.067)
```

In [ ]:

In [ ]: