Importing the libraries

```
In [95]: import numpy as np
         import pandas as pd
         from sklearn.datasets import make_classification
         from sklearn.model_selection import train_test_split
         import math as m
         from sklearn import linear_model
         import warnings
         warnings.filterwarnings("ignore")
```

Splitting data into train and test

```
In [106]: X, y = make_classification(n_samples=50000, n_features=15, n_informative=10, n_redundant=5,
                                     n_classes=2, weights=[0.7], class_sep=0.7, random_state=15)
```

```
In [107]: X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25, random_state=15)
```

```
In [108]: X_train.shape, y_train.shape, X_test.shape, y_test.shape

Out[108]: ((37500, 15), (37500,), (12500, 15), (12500,))
```

Intializing initial parameters

```
In [109]: w = np.zeros_like(X_train[0])# initial weight vector
          b = 0      # initial intercept value
          eta0  = 0.0001  # learning rate
```

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```
alpha = 0.0001 # lambda value
N = len(X_train)
```

In [110]:

```
def sigmoid(w,x,b):
    return 1/(1+np.exp(-(np.dot(x,w.T)+b))) #return 1/1+e(-x)
```

In [111]:

```
def logloss(w,x,y,b,reg=0):
    val=sigmoid(w,x,b)
    return -np.mean(y*np.log10(val)+(1-y)*np.log10(1-val))+reg  # cost
 function of logistic regression
```

In [112]:

```
print("INITIAL LOG LOSS:")
logloss(w,X_train,y_train,b)
```

```
INITIAL LOG LOSS:
```

Out[112]:

```
0.3010299956639812
```

SGD Alorithm

In [113]:

```
def sgd_algo(x_train,y_train,x_test,y_test,eta0,alpha,w,b,epoch):
    train_loss=[]
    test_loss=[]
    epoc=[]
    for i in  range(0,epoch):
        epoc.append(i)
        for j in range(0,N):
            reg=alpha/2*np.dot(w.T,w) #regulrization term
            w = ((1-eta0*(alpha/N))*w)+((eta0*x_train[j])*(y_train[j]-s
igmoid(w,x_train[j],b))) # updating weight vector
            b = b+(eta0*(y_train[j]-sigmoid(w,x_train[j],b)))       # u
pdatind intercept
        train=logloss(w,x_train,y_train,b,reg)
        train_loss.append(train)    # calculating train and test loss f
or updated w,b on each epoch
        test=logloss(w,x_test,y_test,b,reg)
        test_loss.append(test)
```

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```
        """
       if i==0 :
            continue                                              # blo
ck to check covergence
        else:                                                     # but
 checking not getting optimium value as sklearn implementation
            if abs(train_loss[i]-train_loss[i-1])>.001:
                continue
            else:
                break"""
    return w,b ,train_loss,test_loss,epoc
```

In [114]:

```
epoch=6
w,b,tr,te,epoc=sgd_algo(X_train,y_train,X_test,y_test,eta0, alpha,w,b,e
poch)
```

In [115]:

```
print("optimal weight vector:")
print("\n")
print(w)
```

```
optimal weight vector:


[-0.40819512  0.18608803 -0.13873193  0.33720386 -0.19058573  0.5532163
1
 -0.44625706 -0.09550674  0.20929646  0.16027648  0.18715532  0.0082206
4
 -0.0701101   0.33795986  0.0206259 ]
```

In [116]:

```
print("optimal intercept value:")
print("\n")
print(b)
```

```
optimal intercept value:


-0.7613483856830058
```

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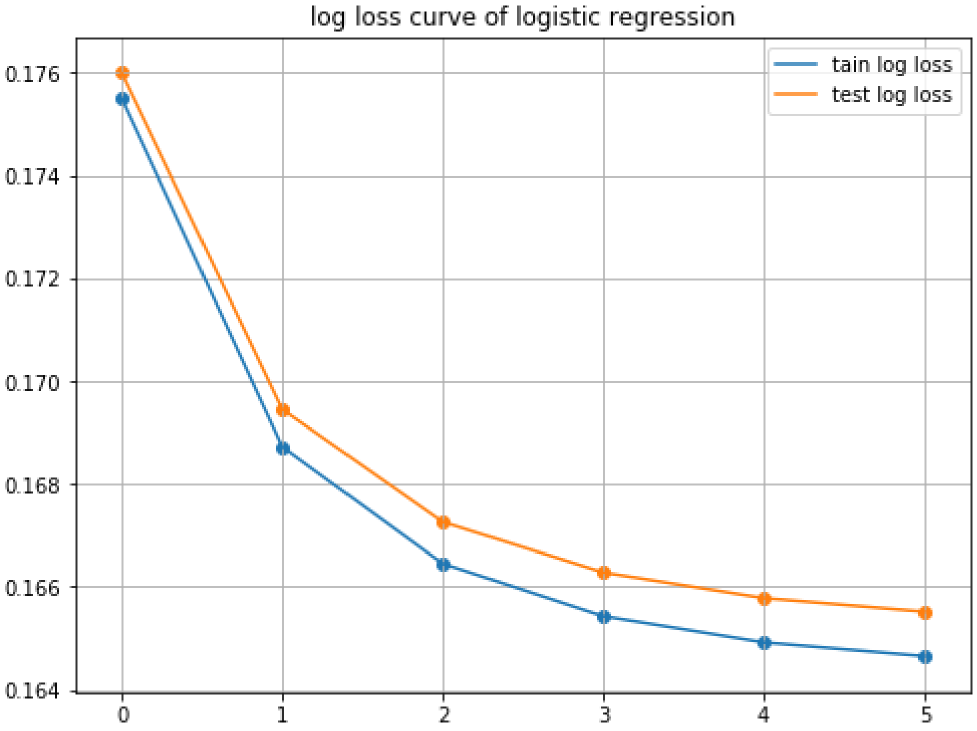
In [120]:

```
%matplotlib inline
import matplotlib.pyplot as plt
plt.figure(figsize=(8,6))
plt.grid()
plt.plot(epoc,tr, label='tain log loss')
plt.plot(epoc,te, label='test log loss')
plt.scatter(epoc,tr)
plt.scatter(epoc,te)
plt.title('log loss curve of logistic regression')
plt.legend()
```

Out[120]:

```
<matplotlib.legend.Legend at 0x22f1df62f60>
```



sklearn implementation

In [97]:

```
clf = linear_model.SGDClassifier(eta0=0.0001, alpha=0.0001, loss='log',
```

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```
 random_state=15, penalty='l2', tol=.001, verbose=2, learning_rate='con
stant')
clf.fit(X=X_train, y=y_train)
```

```
-- Epoch 1
Norm: 0.76, NNZs: 15, Bias: -0.314605, T: 37500, Avg. loss: 0.455801
Total training time: 0.02 seconds.
-- Epoch 2
Norm: 0.92, NNZs: 15, Bias: -0.469578, T: 75000, Avg. loss: 0.394737
Total training time: 0.04 seconds.
-- Epoch 3
Norm: 0.98, NNZs: 15, Bias: -0.580452, T: 112500, Avg. loss: 0.385561
Total training time: 0.06 seconds.
-- Epoch 4
Norm: 1.02, NNZs: 15, Bias: -0.660824, T: 150000, Avg. loss: 0.382161
Total training time: 0.08 seconds.
-- Epoch 5
Norm: 1.04, NNZs: 15, Bias: -0.717218, T: 187500, Avg. loss: 0.380474
Total training time: 0.11 seconds.
-- Epoch 6
Norm: 1.06, NNZs: 15, Bias: -0.761816, T: 225000, Avg. loss: 0.379481
Total training time: 0.13 seconds.
Convergence after 6 epochs took 0.13 seconds
```

```
Out[97]: SGDClassifier(alpha=0.0001, average=False, class_weight=None, epsilon=
0.1,
       eta0=0.0001, fit_intercept=True, l1_ratio=0.15,
       learning_rate='constant', loss='log', max_iter=None, n_iter=Non
e,
       n_jobs=1, penalty='l2', power_t=0.5, random_state=15, shuffle=Tr
ue,
       tol=0.001, verbose=2, warm_start=False)
```

```
In [100]: clf.coef_
```

```
Out[100]: array([[-0.41177431,  0.18416782, -0.13895073,  0.33572511, -0.1842323
7,
         0.5494352 , -0.45213692, -0.08857465,  0.21536661,  0.1735175
7,
```

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```
         0.18480827,  0.00443463, -0.07033001,  0.33683181,  0.0200412
9]])
```

In [99]:
```python
clf.coef_-w
```

Out[99]:
```
array([[-0.0035792 , -0.00192022, -0.0002188 , -0.00147875,  0.0063533
6,
        -0.0037811 , -0.00587986,  0.00693208,  0.00607015,  0.0132411
,
        -0.00234705, -0.00378601, -0.00021991, -0.00112805, -0.0005846
2]])
```

- differnce between sklearn and custom implementation is almost in terms of 10^-3

In [123]:
```python
def pred(w,b, X):
    N = len(X)
    predict = []
    for i in range(N):
        if sigmoid(w, X[i], b) >= 0.5:
            predict.append(1)
        else:
            predict.append(0)
    return np.array(predict)
print("train accuracy :")
print(1-np.sum(y_train - pred(w,b,X_train))/len(X_train))
print("test accuracy :")
print(1-np.sum(y_test  - pred(w,b,X_test))/len(X_test))
```

```
train accuracy :
0.9617866666666667
test accuracy :
0.95952
```

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