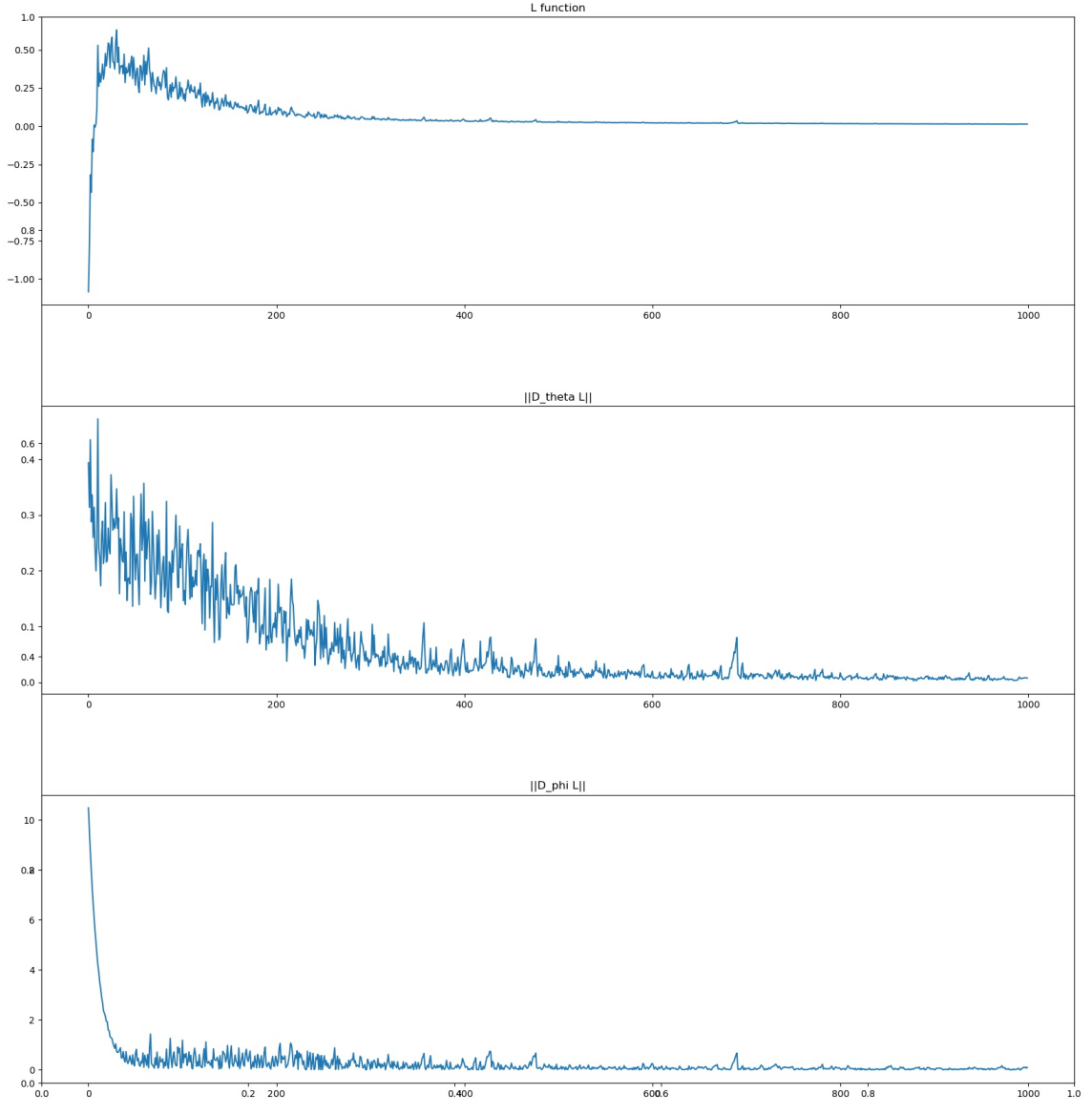
```
import numpy as np
from matplotlib import pyplot as plt

N, p = 30, 20
np.random.seed(0)
X = np.random.randn(N,p)
Y = 2*np.random.randint(2, size = N) - 1
lamda = 30

theta = 0.1 * np.random.randn(p)
phi = 0.1 * np.random.randn(p)
alpha = 3e-1
beta = 1e-4

epoch = 1000
L_val = []
d_phi_val = []
d_theta_val = []

for _ in range(epoch):
    for __ in range(N):
        i = np.random.randint(0,30)    # SGD

        d_phi_i = Y[i]/(1+np.exp(Y[i]*(X[i,:]-phi)@theta))*theta - lamda*phi
        d_theta_i = -Y[i]*(X[i,:]-phi) / (1+np.exp(Y[i]*(X[i,:]-phi)@theta))

        phi += beta * d_phi_i
        theta -= alpha * d_theta_i

          L_i = np.average(np.log(1 + np.exp(-Y * ((X - phi.reshape(1,-1)) @ theta)))) - lamda/2 *
np.linalg.norm(phi, axis=0, ord=2) **2
    d_phi = np.average(Y / (1 + np.exp(Y * ((X-phi.reshape(1,-1)) @ theta)))) * theta - lamda * phi
              d_theta = np.average(( -Y / (1 + np.exp(Y * ((X-phi.reshape(1,-1)) @ theta)))
).reshape(-1,1)*(X-phi.reshape(1,-1)), axis=0)

    L_val.append(L_i)
    d_phi_val.append(d_phi)
    d_theta_val.append(d_theta)

fig, ax = plt.subplots(figsize=(20, 20))
plt.subplots_adjust(left=0.125,
                    bottom=0.1,
                    right=0.9,
                    top=0.9,
                    wspace=0.2,
                    hspace=0.35)
plt.subplot(3, 1, 1)
plt.title("L function")
plt.plot(L_val)
plt.subplot(3, 1, 2)
plt.title("||D_theta L||")
plt.plot(np.linalg.norm(d_theta_val, axis=1, ord=2))
plt.subplot(3, 1, 3)
```


L function
1.0
0.50
0.25
0.00
−0.25
−0.50
0.8
−0.75
−1.00
0
200
400
600
800
1000
||D_theta L||
0.6
0.4
0.3
0.2
0.1
0.4
0.0
0
200
400
600
800
1000
||D_phi L||
10
6
4
2
0
0.0
0
0.2
200
0.4
400
600
0.6
800
0.8
1000
1.0

```
plt.title("||D_phi L||")
plt.plot(np.linalg.norm(d_phi_val, axis=1, ord=2))
plt.savefig('plot.png')
plt.show()
```