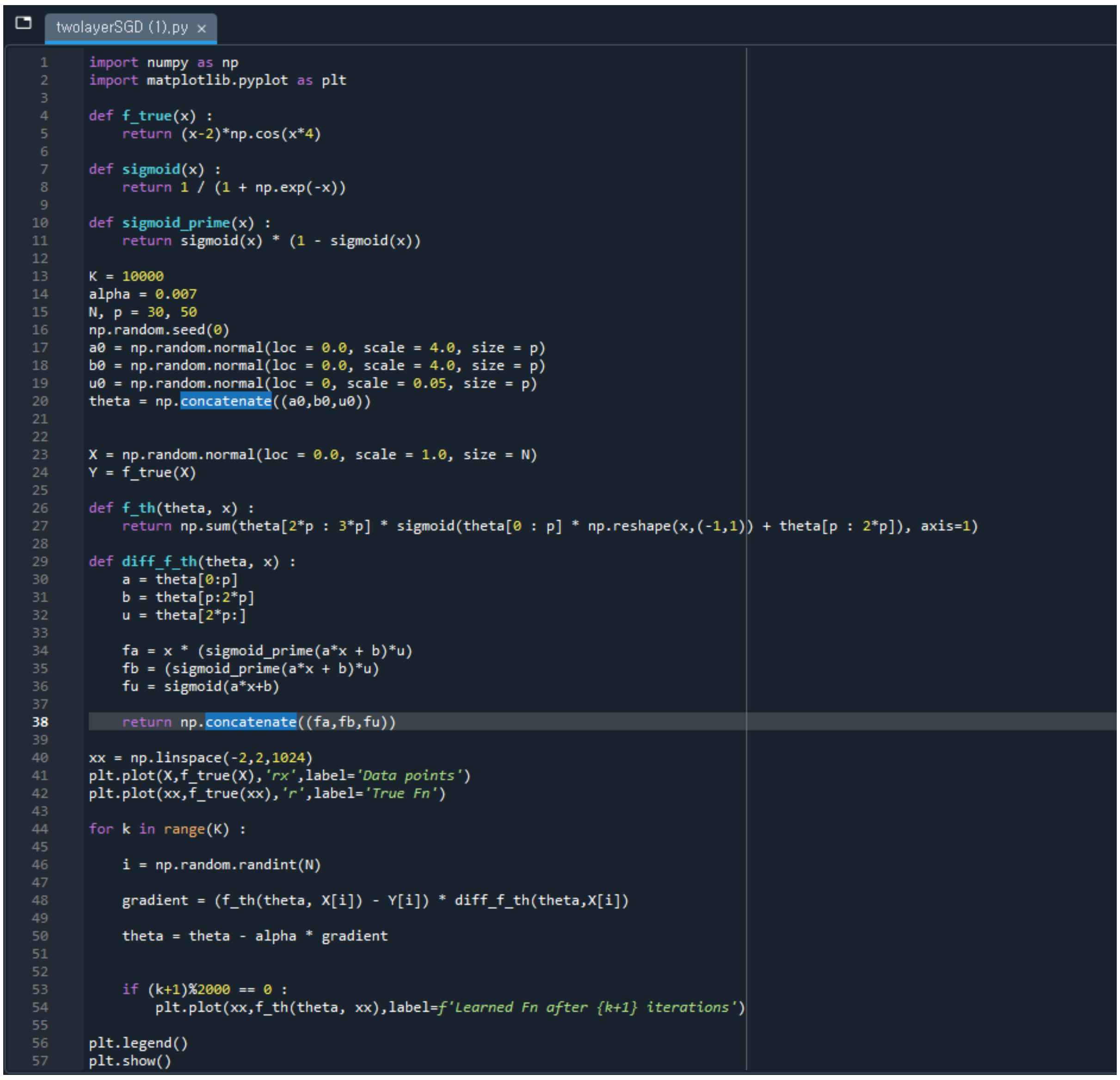
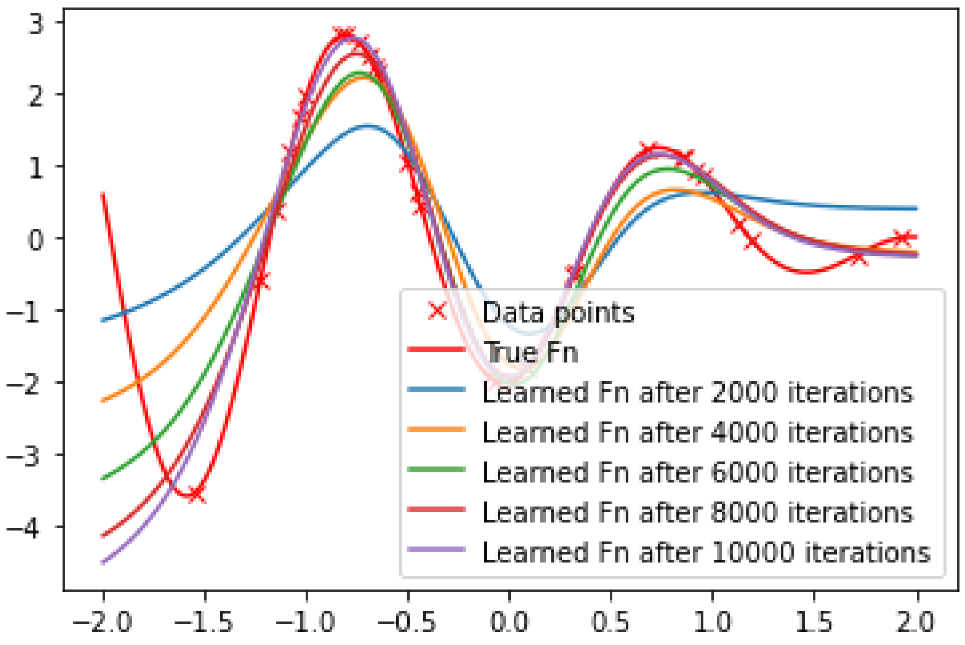
Problem 7



```python
import numpy as np
import matplotlib.pyplot as plt

def f_true(x) :
    return (x-2)*np.cos(x*4)

def sigmoid(x) :
    return 1 / (1 + np.exp(-x))

def sigmoid_prime(x) :
    return sigmoid(x) * (1 - sigmoid(x))

K = 10000
alpha = 0.007
N, p = 30, 50
np.random.seed(0)
a0 = np.random.normal(loc = 0.0, scale = 4.0, size = p)
b0 = np.random.normal(loc = 0.0, scale = 4.0, size = p)
u0 = np.random.normal(loc = 0, scale = 0.05, size = p)
theta = np.concatenate((a0,b0,u0))


X = np.random.normal(loc = 0.0, scale = 1.0, size = N)
Y = f_true(X)

def f_th(theta, x) :
    return np.sum(theta[2*p : 3*p] * sigmoid(theta[0 : p] * np.reshape(x,(-1,1)) + theta[p : 2*p]), axis=1)

def diff_f_th(theta, x) :
    a = theta[0:p]
    b = theta[p:2*p]
    u = theta[2*p:]

    fa = x * (sigmoid_prime(a*x + b)*u)
    fb = (sigmoid_prime(a*x + b)*u)
    fu = sigmoid(a*x+b)

    return np.concatenate((fa,fb,fu))

xx = np.linspace(-2,2,1024)
plt.plot(X,f_true(X),'rx',label='Data points')
plt.plot(xx,f_true(xx),'r',label='True Fn')

for k in range(K) :

    i = np.random.randint(N)

    gradient = (f_th(theta, X[i]) - Y[i]) * diff_f_th(theta,X[i])

    theta = theta - alpha * gradient


    if (k+1)%2000 == 0 :
        plt.plot(xx,f_th(theta, xx),label=f'Learned Fn after {k+1} iterations')

plt.legend()
plt.show()
```



위와 같은 결과를 얻을 수 있다.