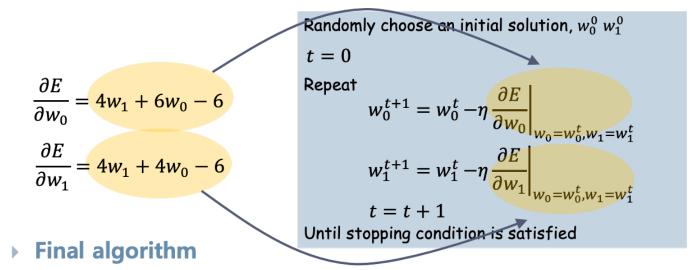
# Homework #3

# 1. Make a Python program of the final alg.



Make a Python program of the final algorithm and find the solution

#### ▶ Step 2-3: Plug the derivatives into the algorithm



Randomly choose an initial solution, 
$$w_0^0$$
  $w_1^0$   $t=0$  Repeat 
$$w_0^{t+1}=w_0^t-\eta(4w_1^t+6w_0^t-6)$$
 
$$w_1^{t+1}=w_1^t-\eta(4w_1^t+4w_0^t-6)$$
  $t=t+1$  Until stopping condition is satisfied

## 2. Make Python programs



You have four samples as follows: D =  $\{(x, t) | (-1, 1), (0, 1), (1, 1), (1, 0) \}$ 

- a) Your model is  $f(x) = w_1x + w_0$ . You have to find  $w_1$  and  $w_0$  so that f(x) best fits the samples. Make a quadratic function to optimize. Find the solution by GDM.
- b) Your model is  $f(x) = w_1 \cos \pi x + w_0$ . You have to find  $w_1$  and  $w_0$  so that f(x) best fits the samples. Make a quadratic function to optimize. Find the solution by GDM.

### 3. Gradient



You have four samples as follows:  $D = \{(x, t) | (-1, 1), (0, 1), (1, 1), (1, 0) \}$ . The error function is defined as follows:

$$E = \sum_{(\mathbf{x},t)\in Data} (t - f(\mathbf{x}))^{2}$$

a) Your model is  $f(x) = w_2 x + \cos w_1 x + w_0$ . What is the gradient of E at  $w_0 = 1$ ,  $w_1 = 1$ ,  $w_2 = 1$ . Use the following equation.

$$\left. \frac{\partial E}{\partial w_1} \right|_{w_0 = w_0^k, w_1 = w_1^k} = \sum_{(\mathbf{x}_i, t_i) \in Data} \left. \frac{\partial E_i}{\partial w_j} \right|_{w_0 = w_0^k, w_1 = w_1^k}$$

b) Your model is  $f(x) = w_2 x + \cos w_1 x + w_0$ . What is the gradient of E at  $w_0 = 2 w_1 = 2$ ,  $w_2 = 2$ . Use the following equation.

$$\left. \frac{\partial E}{\partial w_1} \right|_{w_0 = w_0^k, w_1 = w_1^k} = \sum_{(\mathbf{x}_i, t_i) \in Data} \frac{\partial E_i}{\partial w_j} \right|_{w_0 = w_0^k, w_1 = w_1^k}$$

# 4. Python program for new algorithm



You have four samples as follows:  $D = \{(x, t) | (-1, 1), (0, 1), (1, 1), (1, 0) \}$ . The error function is defined as follows:

$$E = \sum_{(\mathbf{x}, t) \in Data} (t - f(\mathbf{x}))^{2}$$

a) Your model is  $f(x) = w_2 x + \cos w_1 x + w_0$ . Find the best-fit f(x). Use the new algorithm.

Randomly choose an initial solution, 
$$w_0^0$$
  $w_1^0$   $t=0$ 
Repeat 
$$g_0^t=0;\ g_1^t=0 \\ \text{for all } (\mathbf{x}_i,t_i)\in Data \\ g_0^t=g_0^t+\frac{\partial E_i}{\partial w_0}\Big|_{w_0=w_0^t,w_1=w_1^t} \\ g_1^t=g_1^t+\frac{\partial E_i}{\partial w_0}\Big|_{w_0=w_0^t,w_1=w_1^t} \\ w_0^{t+1}=w_0^t-\eta g_0^t \\ w_1^{t+1}=w_1^t-\eta g_1^t \\ t=t+1$$

Until stopping condition is satisfied