$$\nabla E = \frac{dE}{dW} = \frac{dE}{d[W_0\ W_1\ W_2\ W_3]} = \left[\frac{\partial E}{\partial W_0}\ \frac{\partial E}{\partial W_1}\ \frac{\partial E}{\partial W_2}\ \frac{\partial E}{\partial W_3}\right]^T.$$

$$= \left[-\sum_{i=1}^{m}(y^{(i)}-\hat{y}^{(i)}) \quad -\sum_{i=1}^{m}(y^{(i)}-\hat{y}^{(i)})x_1 \quad -\sum_{i=1}^{m}(y^{(i)}-\hat{y}^{(i)})x_2\right]$$

For a sing training example, i.e. when $m=1$, the above becomes,

$$\nabla E = \left[-(y-\hat{y}) \quad -(y-\hat{y})x_1 \quad -(y-\hat{y}^{(i)})x_2 \quad -(y-\hat{y})x_3\right]$$

PROBLEM 3 : Example

Let f be a function of two variables x_1, x_2 defined as,

$$f(x_1, x_2) = x_1^2 + 2\sin x_2$$

then

$$\nabla f = \frac{d f(x_1,x_2)}{d[x_1\ x_2]} = \left[\frac{\partial}{\partial x_1}[x_1^2+2\sin x_2] \quad \frac{\partial}{\partial x_2}[x_1^2+2\sin x_2]\right]^T$$

$$= \left[[2x_1+0] \quad [0+2\cos x_2]\right]^T$$

$$= \left[2x_1 \quad 2\cos x_2\right]^T$$

To calculate ∇f at $(x_1, x_2) = (5, 25)$, we simply put values in the above expression.

$$\nabla f = \left[2\times 5 \quad 2\cos 25\right]^T$$