Ömer YILMAZ
2017721048

MECA 533 - HOMEWORK 1

④ Direct differentiation:

$$o^{(i)} = x^{(i)} w, \quad J(w) = \frac{1}{2} \sum_i (y^{(i)} - o^{(i)})^2 = \frac{1}{2} \sum_i (y^{(i)} - x^{(i)} w)^2$$

$$\Rightarrow \frac{\partial J(w)}{\partial w} = \frac{1}{2} \cdot 2 \sum_i (y^{(i)} - x^{(i)} w) \cdot \frac{\partial (y^{(i)} - x^{(i)} w)}{\partial w} = -\sum_i (y^{(i)} - x^{(i)} w) w$$

$D = [-1, 1, 2, 3.2, 3.5, 5, 6]$ and

$X = [-0.5, -0.2, -0.1, 0.3, 0.4, 0.5, 0.7]$

$$\Rightarrow J'(2) = -2 \cdot \sum_i (D(i) - 2X(i)) = -6.58 \quad \text{(average is } -0.94)$$

LMS approximation:

$$O = XW, \quad J(W) = \frac{1}{2} (Y-O)^T (Y-O)$$

$$J(W) = \frac{1}{2} (Y-XW)^T (Y-XW) = \frac{1}{2} [Y^T Y - 2X^T W Y + W^T X^T X W]$$

$$\frac{\partial J(W)}{\partial W} = -X^T Y + X^T X W,$$

Y is given as D^T and X is given as X^T above.

$$\Rightarrow J'(2) = -X D^T + 2 X X^T = -6.58 \quad \text{(average is } -0.94)$$

At MATLAB:

```
X = [-0.5; -0.2; -0.1; 0.3; 0.4; 0.5; 0.7];
D = [-1; 1; 2; 3.2; 3.5; 5; 6];
J_grad = @(W) -X' * D + X' * X * W;
J_grad(2)
(X * 2 - D)' * X
```