

Lecture 4

Multi-variable linear regression

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Recap

- Hypothesis
- Cost function
- Gradient descent algorithm

Recap

- Hypothesis

$$H(x) = Wx + b$$

- Cost function

$$cost(W, b) = \frac{1}{m} \sum_{i=1}^m (H(x^{(i)}) - y^{(i)})^2$$

- Gradient descent algorithm

Predicting exam score: regression using one input (x)

one-variable
one-feature

x (hours)	y (score)
10	90
9	80
3	50
2	60
11	40

Predicting exam score: regression using two inputs (x_1 , x_2)

multi-variable/feature

x_1 (hours)	x_2 (attendance)	y (score)
10	5	90
9	5	80
3	2	50
2	4	60
11	1	40

Hypothesis

$$H(x) = Wx + b$$

Hypothesis

$$H(x) = Wx + b$$

$$H(x_1, x_2) = w_1x_1 + w_2x_2 + b$$

Cost function

$$H(x_1, x_2) = w_1x_1 + w_2x_2 + b$$

$$cost(W, b) = \frac{1}{m} \sum_{i=1}^m (H(x^{(i)}) - y^{(i)})^2$$

Multi-variable

$$H(x_1, x_2) = w_1x_1 + w_2x_2 + b$$

$$H(x_1, x_2, x_3, \dots, x_n) = w_1x_1 + w_2x_2 + w_3x_3 + \dots + w_nx_n + b$$

Matrix

$$w_1x_1 + w_2x_2 + w_3x_3 + \dots + w_nx_n$$

Matrix

$$w_1x_1 + w_2x_2 + w_3x_3 + \dots + w_nx_n$$

$$\begin{bmatrix} w_1 & w_2 & w_3 \end{bmatrix} \times \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} w_1 \times x_1 + w_2 \times x_2 + w_3 \times x_3 \end{bmatrix}$$

Matrix multiplication

"Dot Product"

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \times \begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix} = \begin{bmatrix} 58 & \end{bmatrix}$$

<https://www.mathsisfun.com/algebra/matrix-multiplying.html>

Hypothesis

$$\begin{bmatrix} w1 & w2 & w3 \end{bmatrix} \times \begin{bmatrix} x1 \\ x2 \\ x3 \end{bmatrix} = \begin{bmatrix} w1 \times x1 + w2 \times x2 + w3 \times x3 \end{bmatrix} :$$

$$H(X) = WX + b$$

Hypothesis without b

$$\begin{bmatrix} b & w_1 & w_2 & w_3 \end{bmatrix} \times \begin{bmatrix} 1 \\ x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} b \times 1 + w_1 \times x_1 + w_2 \times x_2 + w_3 \times x_3 \end{bmatrix}$$

$$H(X) = WX$$

W vs X

$$\begin{bmatrix} b & w1 & w2 & w3 \end{bmatrix} \times \begin{bmatrix} 1 \\ x1 \\ x2 \\ x3 \end{bmatrix} = \begin{bmatrix} b \times 1 + w1 \times x1 + w2 \times x2 + w3 \times x3 \end{bmatrix}$$

$$H(X) = WX$$

Transpose

$$\begin{bmatrix} 6 & 4 & 24 \\ 1 & -9 & 8 \end{bmatrix}^T = \begin{bmatrix} 6 & 1 \\ 4 & -9 \\ 24 & 8 \end{bmatrix}$$

<http://www.mathsisfun.com/algebra/matrix-introduction.html>

Hypothesis using Transpose

$$\begin{bmatrix} b & w1 & w2 & w3 \end{bmatrix} \times \begin{bmatrix} 1 \\ x1 \\ x2 \\ x3 \end{bmatrix} = \begin{bmatrix} b \times 1 + w1 \times x1 + w2 \times x2 + w3 \times x3 \end{bmatrix}$$

$$H(X) = W^T X$$

Next
Logistic Regression
(Classification)

