solve eq^n

$$J = (Y^T - (X\theta)^T)(Y - X\theta)$$

$$= (Y^T - X^T\theta^T)(Y - X\theta)$$

$$= Y^TY - Y^TX\theta - X^T\theta^TY + XX^T\theta^T\theta$$

take derivative wrt θ

$$\frac{dJ}{d\theta} = 0 - (Y^TX)^T - (X^TY) + 2(X^TX)\theta \quad (\theta^T \approx \theta)$$

$$-X^TY^T - X^TY + 2X^TX\theta$$

$$0 = -2X^TY^T + 2X^TX\theta$$

$$2X^TX\theta = 2X^TY^T$$

$$\theta$$

$$\boxed{\theta = (X^TX)^{-1}X^TY}$$?

This is called closed-form solution since we know X & Y & close on the Sol^n

Summary of Closed-form Linear Regression:

Given:

- Training data matrix X of size N×D
- Training Target values Y of size N×1

Add a Col^n of ones to beginning x

$$x \rightarrow [1\ x]$$

Compute weights $\theta = (X^TX)^{-1}X^TY$