Normal Equation

Multi-variate regression $\boxed{y_p = w^T x}$ (1)

MEAN SQUARED ERROR : $\|e\|^2 = (y_p - y)^2$ (2)

(1) and (2) $\rightarrow (w^T x - y)^T (w^T x - y)$ $\quad \|\bar{e}\|^2 = \bar{e}\cdot\bar{e}^T = \bar{e}^T\bar{e}$

$\rightarrow \left((w^T x)^T - y^T\right)\left(w^T x - y\right)$

$= (w^T x)^T (w^T x) - y^T (w^T x) - y (w^T x)^T + y^T y$

↳ drop as no function of w

$= x^T \underbrace{w w^T}_{\|w\|^2} x - \underbrace{y^T (w^T x) - (w^T x)^T y}_{-2(w^T x)^T y}$

m samples
d Features.

$\rightarrow \nabla_w C = 2x^T x w - 2x^T y$

SET

$\nabla_w C = 0$

$\rightarrow 2x^T x w - 2x^T y^T = 0$

$\rightarrow x^T x w = x^T y$

$\rightarrow \boxed{w = (x^T x)^{-1} x^T y}$

pseudo-inverse of x

→ sometimes $(x^T x)^{-1}$ is not defined

ex. $(x^T x)$ is SINGULAR (features are related)