Feature Normalization

$$x_i \leftarrow \frac{x_i - \mu_i}{\sigma_i} \quad \mu_i \to \text{mean}_i, \quad \sigma_i \to \text{std}_i$$

$$\mu = [\mu_1 \ \mu_2 \ \mu_3]_{1\times 3}$$

$$X = \begin{bmatrix} x_1^{(1)} & x_2^{(01)} & x_3^{(1)} \\ x_1^{(2)} & x_2^{(2)} & x_3^{(2)} \\ \vdots & \vdots & \vdots \\ x_1^{(m)} & x_2^{(m)} & x_3^{(m)} \end{bmatrix}_{m\times 3}$$

$$X - \mu = \begin{bmatrix} x_1^{(1)} - \mu_1 & x_2^{(1)} - \mu_2 & x_3^{(1)} - \mu_3 \\ & \vdots & \\ x_1^{(m)} - \mu_1 & x_2^{(m)} - \mu_2 & x_3^{(m)} - \mu_3 \end{bmatrix}$$

$$\sigma = [\sigma_1 \ \sigma_2 \ \sigma_3]$$

$$(X - \mu).\!/\sigma = \begin{bmatrix} \frac{x_1^{(1)} - \mu_1}{\sigma_1} & \frac{x_2^{(1)} - \mu_2}{\sigma_2} & \frac{x_3^{(1)} - \mu_3}{\sigma_3} \\ & \vdots & \\ \frac{x_1^{(m)} - \mu_1}{\sigma_1} & \frac{x_2^{(m)} - \mu_2}{\sigma_2} & \frac{x_3^{(m)} - \mu_3}{\sigma_3} \end{bmatrix}$$