

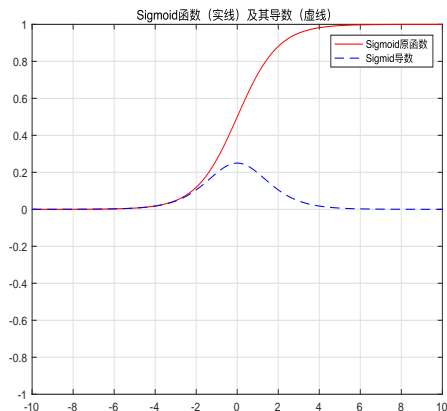
Deep Learning Technology and Application

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关于激活函数

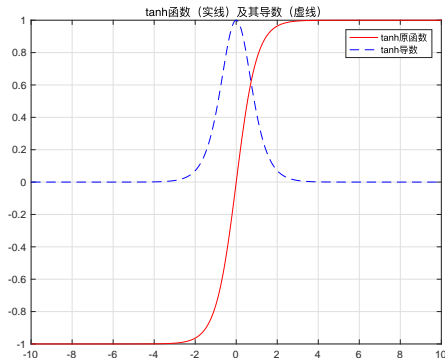
Sigmoid



$$\delta(z) = \frac{1}{1 + \exp(-z)} \in (0, 1)$$

$$\begin{aligned} \delta'(z) &= \frac{-\exp(-z)}{(1 + \exp(-z))^2} \\ &= \delta(z)(1 - \delta(z)) \end{aligned}$$

Tanh

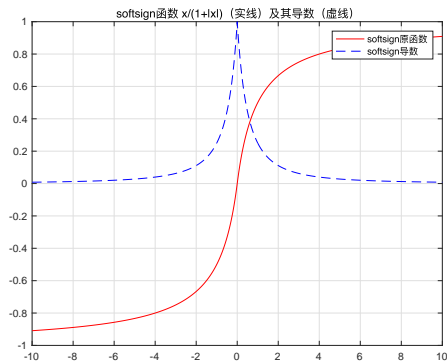


$$\begin{aligned} \tanh(z) &= \frac{\exp(z) - \exp(-z)}{\exp(z) + \exp(-z)} \\ &= 2\delta(2z) - 1 \end{aligned}$$

$$\tanh(z) \in (-1, 1)$$

$$\begin{aligned} \tanh'(z) &= 1 - \left(\frac{\exp(z) - \exp(-z)}{\exp(z) + \exp(-z)} \right)^2 \\ &= 1 - \tanh^2(z) \end{aligned}$$

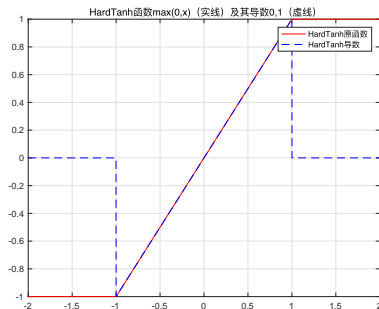
Softsign



$$\text{softsign}(z) = \frac{z}{1 + |z|}$$

$$\text{softsign}'(z) = \frac{\text{sgn}(z)}{(1 + |z|)^2}$$

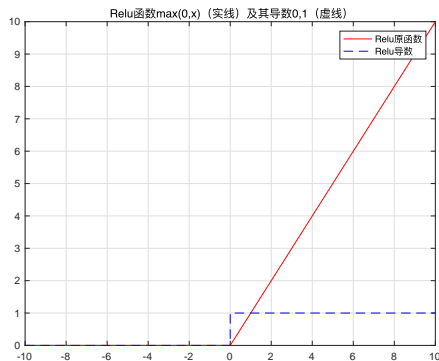
Hard Tanh



$$\text{hardtanh}(z) = \begin{cases} -1 & : z < -1 \\ z & : \text{otherwise} \\ 1 & : z > 1 \end{cases}$$

$$\text{hardtanh}'(z) = \begin{cases} 1 & : -1 \leq z \leq 1 \\ 0 & : \text{otherwise} \end{cases}$$

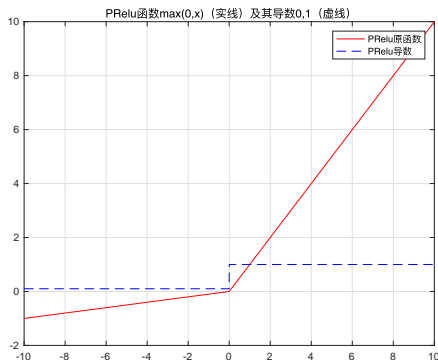
ReLU - Rectified Linear Unit



$$relu(z) = \begin{cases} 0 & : z < 0 \\ z & : z \geq 0 \end{cases}$$

$$relu'(z) = \begin{cases} 1 & : z > 0 \\ 0 & : otherwise \end{cases}$$

PReLU - Parametric ReLU

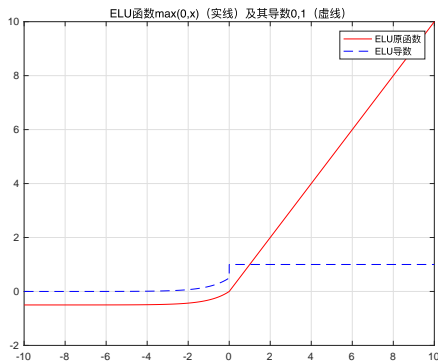


$$prelu(z) = \begin{cases} \alpha z & : z < 0 \\ z & : z \geq 0 \end{cases}$$

where $0 < \alpha < 1$

$$prelu'(z) = \begin{cases} 1 & : z > 0 \\ \alpha & : otherwise \end{cases}$$

ELU - Exponential Linear Unit

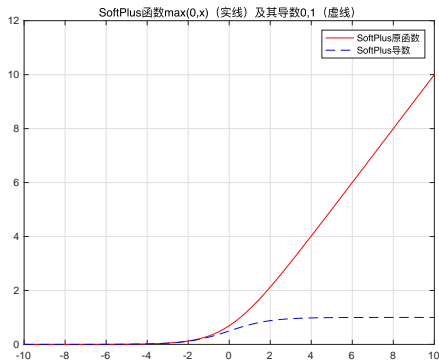


$$elu(z) = \begin{cases} \alpha(e^z - 1) & : z < 0 \\ z & : z \geq 0 \end{cases}$$

where $0 < \alpha < 1$

$$elu'(z) = \begin{cases} elu(z) + \alpha & : z < 0 \\ 1 & : z \geq 0 \end{cases}$$

SoftPlus



$$\text{softplus}(z) = \log_e(1 + e^z)$$

$$\text{softplus}'(z) = \frac{1}{1 + e^{(-z)}}$$

Thanks.