AI Coffe Club (09/01/2020)
Activation Functions

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Name	Function	Derivative	Range
Sigmoid	$\sigma(x) = \frac{1}{1+e^{-x}}$	$\sigma'(x) = \sigma(x)(1-\sigma(x))$	$(0,1)$
Hyperbolic Tangent	$\sigma(x) = \frac{e^{2x}-1}{e^{2x}+1}$	$\sigma'(x) = 1 - \sigma(x)^2$	$(-1,1)$
ReLU	$\sigma(x) = \begin{cases} 0 & x \leq 0 \\ x & x > 0 \end{cases}$	$\sigma(x) = \begin{cases} 0 & x \leq 0 \\ x & x > 0 \end{cases}$	$[0,\infty)$
Leaky ReLU	$\sigma(x) = \begin{cases} 0.01x & x \leq 0 \\ x & x > 0 \end{cases}$	$\sigma(x) = \begin{cases} 0.01 & x \leq 0 \\ x & x > 0 \end{cases}$	$(-\infty,\infty)$
Parametric ReLU	$\sigma(x) = \begin{cases} \alpha x & x \leq 0 \\ x & x > 0 \end{cases}$	$\sigma(x) = \begin{cases} \alpha & x \leq 0 \\ x & x > 0 \end{cases}$	$(-\infty,\infty)$
ELU	$\sigma(x) = \begin{cases} \alpha(e^x - 1) & x \leq 0 \\ x & x > 0 \end{cases}$	$\sigma(x) = \begin{cases} \alpha + \sigma(x) & x \leq 0 \\ x & x > 0 \end{cases}$	$(-\alpha,\infty)$
Softplus	$\sigma(x) = \ln(1 + e^x)$	$\sigma'(x) = \frac{1}{1+e^{-x}}$	$(0,\infty)$
Swish	$\sigma(x) = \frac{x}{1+e^{-\beta x}}$	$\sigma'(x) = \beta\sigma(x) + \frac{1}{1+e^{-\beta x}}(1 - \beta\sigma(x))$	

1 Sigmoid

$$\sigma(x) = \frac{1}{1 + e^{-x}} \tag{1}$$

$$\sigma'(x) = \sigma(x)(1 - \sigma(x)) \tag{2}$$

2 Hyperbolic Tangent

$$\sigma(x) = tanh(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}} = \frac{e^{2x} - 1}{e^{2x} + 1} \tag{3}$$

$$\sigma'(x) = 1 - \sigma(x)^2 \tag{4}$$

3 Rectified Linear Unit

$$\sigma(x) = \begin{cases} 0 & x \leq 0 \\ x & x > 0 \end{cases} \tag{5}$$

$$\sigma'(x) = \begin{cases} 0 & x \leq 0 \\ 1 & x > 0 \end{cases} \tag{6}$$

4 Leaky Rectified Linear Unit

$$\sigma(x) = \begin{cases} 0.01x & x \leq 0 \\ x & x > 0 \end{cases} \tag{7}$$

$$\sigma'(x) = \begin{cases} 0.01 & x \leq 0 \\ 1 & x > 0 \end{cases} \tag{8}$$

5 Parametric Rectified Linear Unit

$$\sigma(x) = \begin{cases} \alpha x & x \leq 0 \\ x & x > 0 \end{cases} \tag{9}$$

$$\sigma'(x) = \begin{cases} \alpha & x \leq 0 \\ 1 & x > 0 \end{cases} \tag{10}$$

6 Exponential Linear Unit

$$\sigma(x) = \begin{cases} \alpha(e^x - 1) & x \le 0 \\ x & x > 0 \end{cases} \tag{11}$$

$$\sigma'(x) = \begin{cases} \alpha + \sigma(x) & x \le 0 \\ 1 & x > 0 \end{cases} \tag{12}$$

7 Softplus

$$\sigma(x) = \ln(1 + e^x) \tag{13}$$

$$\sigma'(x) = \frac{1}{1 + e^{-x}} \tag{14}$$

8 Swish

$$\sigma(x) = \frac{x}{1 + e^{-x}} \tag{15}$$

$$\sigma'(x) = x\sigma(x) \tag{16}$$