## Funciones de Activación para Neuronas en Redes Computacionales

Nombre	Ecuación	Derivada (con respecto a x)	Rango	Orden de Continuidad	Monotónic
TanH	$f(x)=tanh(x)=rac{2}{1+e^2x}-1$	$f^{\prime}(x)=1-f(x)^2$	(-1,1)	$C^{\infty}$	Yes
SoftSign	$f(x)=rac{x}{1+ x }$	$f^{\prime}(x)=1-f(x)^2$	(-1,1)	$C^1$	Yes
SoftPlus	$f(x) = \ln(1+e^x)$	$f'(x) = \frac{1}{1+e^{-x}}$	$(0,\infty)$	$C^{\infty}$	Yes
SoftExponential	$f(lpha,x) = \left\{ egin{array}{l} -rac{\ln(1-lpha(x+lpha))}{lpha}  ext{ for } lpha < 0 \ & x  ext{ for } lpha = 0 \ & rac{e^{lpha x}-1}{lpha} + lpha  ext{ for } lpha > 0 \end{array}  ight.$	$f'(lpha,x) = \left\{ egin{array}{l} rac{1}{1-lpha(lpha+x)}  ext{ for } lpha < 0 \ e^{lpha x}  ext{ for } lpha \geq 0 \end{array}  ight.$	$(-\infty,\infty)$	$C^{\infty}$	Yes
Sinusoid	$f(x) = \sin(x)$	$f'(x)=\cos(x)$	[-1, 1]	$C^{\infty}$	No
Sinc	$f(x) = \left\{ egin{array}{l} 1  ext{ for } x = 0 \ rac{\sin(x)}{x}  ext{ for } x  eq 0 \end{array}  ight.$	$f'(x) = \cos(x)$ $f'(x) = \left\{ egin{array}{l} 0  ext{ for } x = 0 \ & rac{\sin(x)}{x} - rac{\sin(x)}{x^2}  ext{ for } x  eq 0 \end{array}  ight.$	[pprox217234, 1]	$C^{\infty}$	No
Scaled exponential linear unit (SELU)	$f(lpha,x)=\lambda\left\{egin{array}{l} lpha(e^x-1)\ { m for}\ x<0\ &x\ { m for}\ x\geq0\ &\lambda=1.0507\ { m y}\ lpha=1.67326 \end{array} ight.$	$f'(lpha,x) = \lambda \left\{ egin{aligned} f(lpha,x) + lpha  ext{ for } x < 0 \ & 1  ext{ for } x \geq 0 \end{aligned}  ight.$	$(-\lambda lpha, \infty)$	$C^0$	Yes
Rectified linear unit (ReLU)	$f(x) = \left\{egin{array}{l} 0  ext{ for } x < 0 \ x  ext{ for } x \geq 0 \end{array} ight.$	$f'(x) = \left\{ egin{array}{ll} 0 &  ext{for} & x < 0 \ 1 &  ext{for} & x \geq 0 \end{array}  ight.$	$[0,\infty)$	$C^0$	Yes
Randomized leaky rectified linear unit (RReLU)	$f(lpha,x) = \left\{egin{array}{l} lpha x  ext{ for } x < 0 \ x  ext{ for } x \geq 0 \end{array} ight.$	$f'(lpha,x) = \left\{ egin{array}{l} lpha  ext{ for } x < 0 \ 1  ext{ for } x \geq 0 \end{array}  ight.$	$(-\infty,\infty)$	$C^0$	Yes
Parametric rectified linear unit (PReLU)	$f(lpha,x) = \left\{egin{array}{l} lpha x  ext{ for } x < 0 \ x  ext{ for } x \geq 0 \end{array} ight.$	$f'(lpha,x) = \left\{ egin{array}{l} lpha \  ext{for} \ x < 0 \ 1 \  ext{for} \ x \geq 0 \end{array}  ight.$	$(-\infty,\infty)$	$C^0$	Yes iff $lpha \geq 0$
Logistic (a.k.a soft step)	$f(x)=rac{1}{1+e^{-x}}$	$f^{\prime}(x)=f(x)(1-f(x))$	(0,1)	$C^{\infty}$	Yes
Leaky rectified linear unit (Leaky ReLU)	$f(x) = \left\{ egin{aligned} 0.01x  ext{ for } x < 0 \ x  ext{ for } x \geq 0 \end{aligned}  ight.$	$f'(x) = \left\{egin{array}{l} 0.01  ext{ for } x < 0 \ 1  ext{ for } x \geq 0 \end{array} ight.$	$(-\infty,\infty)$	$C^0$	Yes
Identity	f(x) = x	f''(x)=1	$(-\infty,\infty)$	$C^{\infty}$	Yes
Gaussian	$f(x)=e^-x^2$	$f^{\prime}(x)=-2xe^{-}x^{2}$	(0, 1]	$C^{\infty}$	No
Exponential linear unit (ELU)	$f(lpha,x) = \left\{ egin{aligned} lpha(e^x-1)  ext{ for } x < 0 \ & x  ext{ for } x \geq 0 \end{aligned}  ight.$	$f'(lpha,x) = \left\{ egin{aligned} f(lpha,x) + lpha  ext{ for } x < 0 \ & 1  ext{ for } x \geq 0 \end{aligned}  ight.$	$(-lpha,\infty)$	$C^1$ when $lpha=1,$ otherwise $C^0$	Yes iff $lpha \geq 0$
Binary step	$f(x) = \left\{egin{array}{l} 0  ext{ for } x < 0 \ 1  ext{ for } x \geq 0 \end{array} ight.$	$f'(x) = \left\{ egin{aligned} 0 &  ext{for } x  eq 0 \ ? &  ext{for } x = 0 \end{aligned}  ight.$	{0,1}	$C^{-1}$	Yes
Bent Identity	$f(x)=rac{\sqrt{x^2+1}-1}{2}+x$	$f'(x)=rac{x}{2\sqrt{x^2+1}}+1$	$(-\infty,\infty)$	$C^{\infty}$	Yes
ArcTan	$f(x) =  an^{-1}(x)$	$f'(x)=rac{1}{x^2+1}$	$\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$	$C^{\infty}$	Yes
Adaptive piecewise linear (APL)	$f(x) = \max(0,x) + \sum_{s=1}^S a_i^s \max(0,-x+b_i^s)$	$f'(x) = H(x) - \sum_{s=1}^S a_i^s H(-x+b_i^s)$	$(-\infty,\infty)$	$C^0$	No