Perceptron Simple y Multicapa

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Volcovinsky, Bruno

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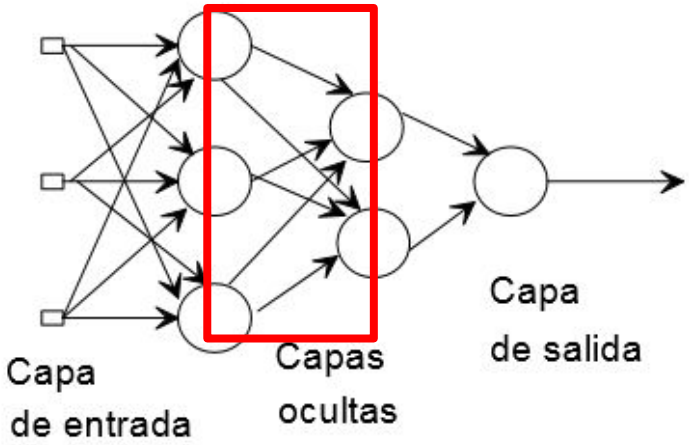
Modelo

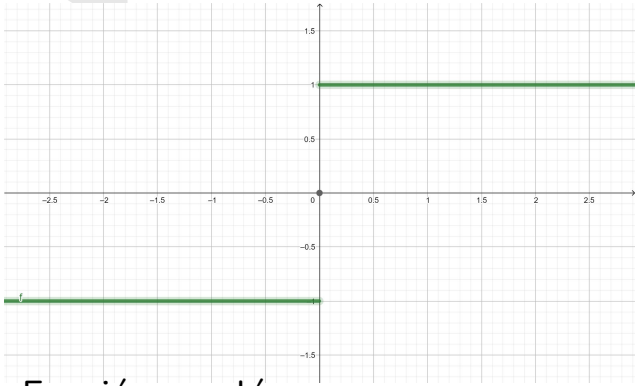
Modelo



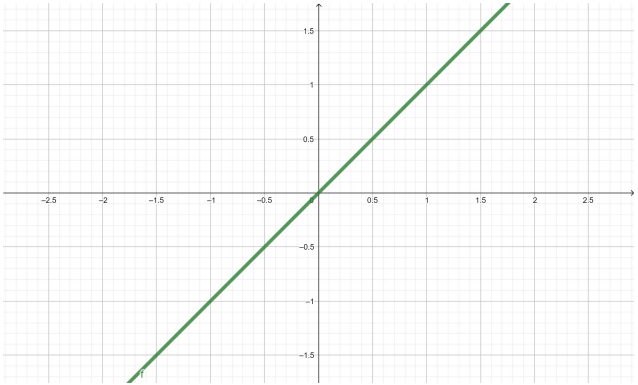
Cada capa es representada como una matriz de pesos, uniendo los perceptrones de la capa anterior con la siguiente.

$$\begin{pmatrix} W_{11} & W_{12} & W_{13} \\ W_{21} & W_{22} & W_{23} \end{pmatrix}$$

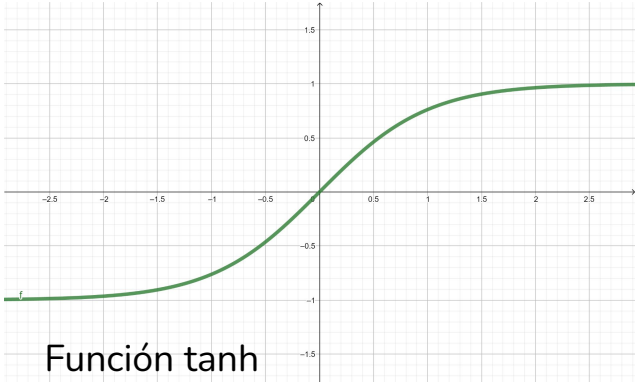
Funciones de activación



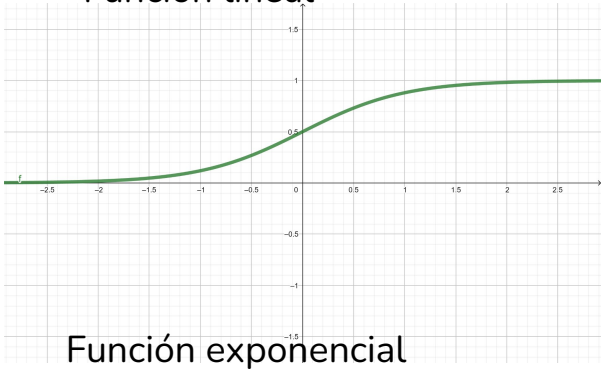
Función escalón



Función lineal



Función tanh



Función exponencial

Funciones de activación

Se buscó generalizar los distintos modelos en una misma implementación.
Para ello, se observó que la actualización de pesos en la función escalón tomaba como derivada la función constante y = 1

Con función de activación no lineal:

$$\Delta w = \eta(\zeta^{\mu} - O^{\mu})g'(h^{\mu})\xi_i^{\mu}$$

Con función de activación escalón:

$$\Delta w = \eta(\zeta^{\mu} - O^{\mu})\xi_i^{\mu}$$

Ejercicio 1

Datos para el entrenamiento

AND:

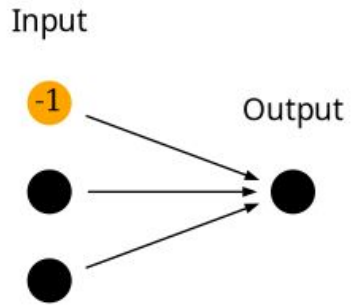
$$x = \{\{-1, 1\}, \{1, -1\}, \{-1, -1\}, \{1, 1\}\}$$

$$y = \{-1, -1, -1, 1\}$$

XOR:

$$x = \{\{-1, 1\}, \{1, -1\}, \{-1, -1\}, \{1, 1\}\}$$

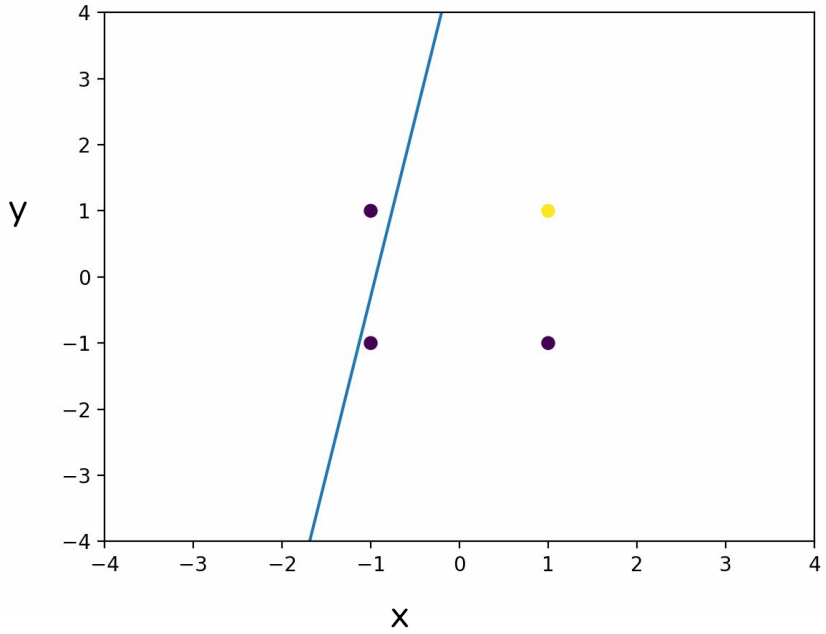
$$y = \{1, 1, -1, -1\}$$



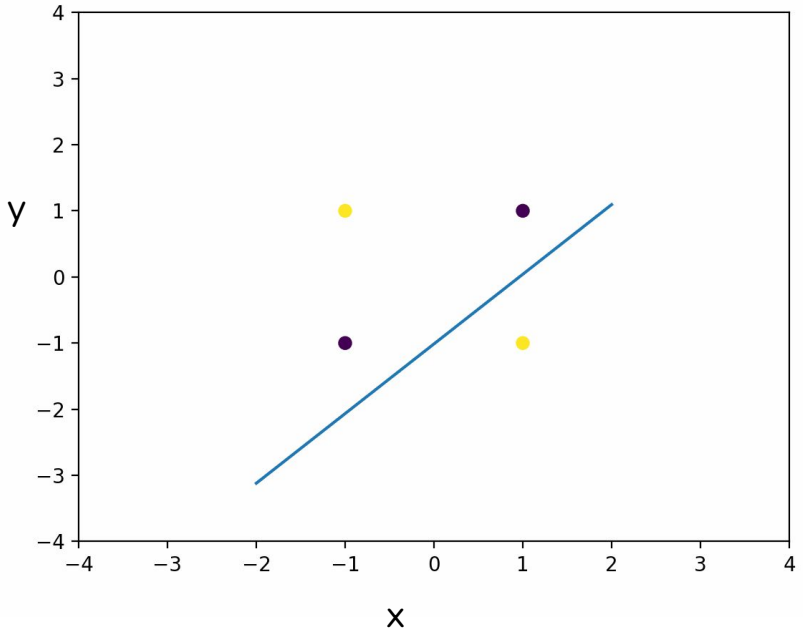
capas: 2, 1

Solución

Operación AND

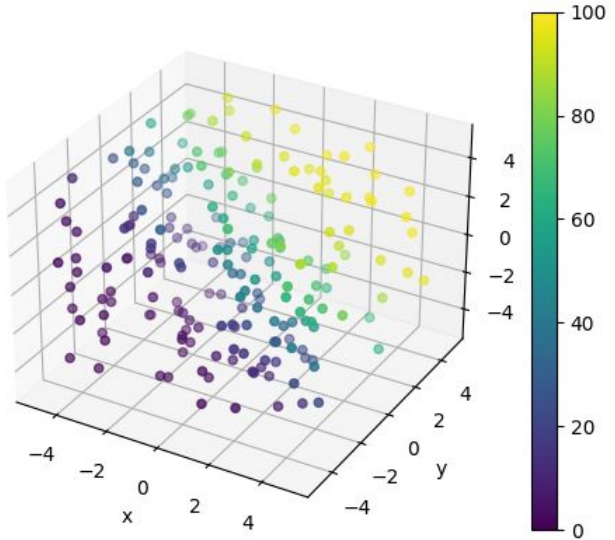


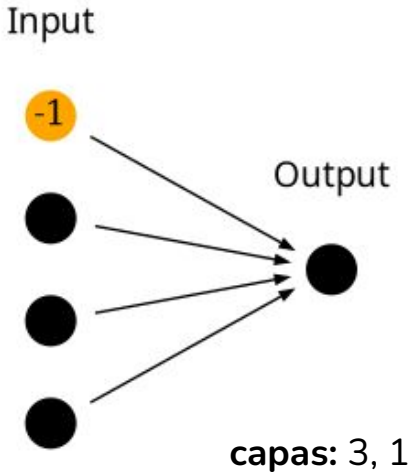
Operación XOR



Ejercicio 2

Datos de entrenamiento

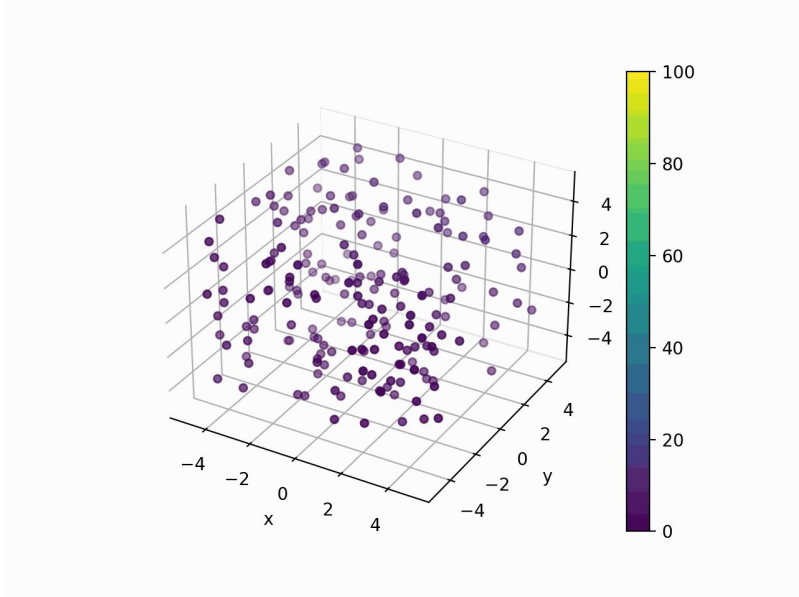




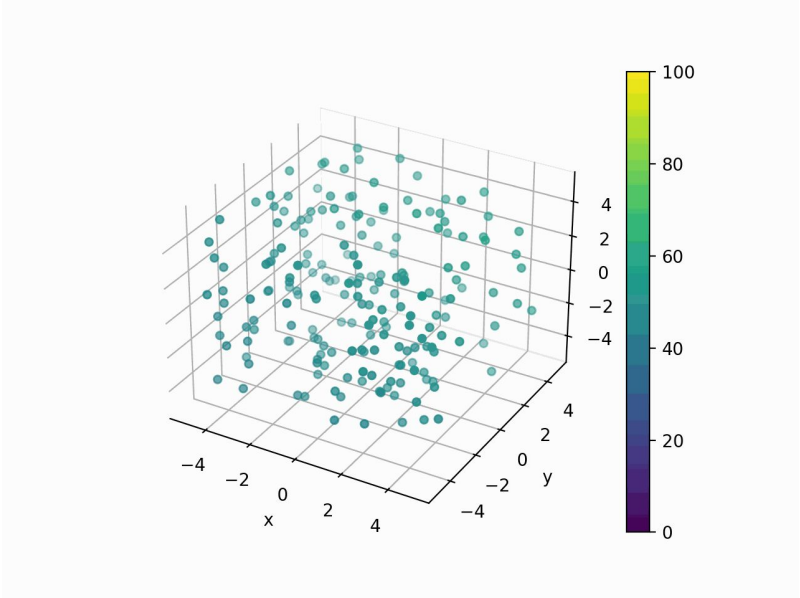
capas: 3, 1

Solución

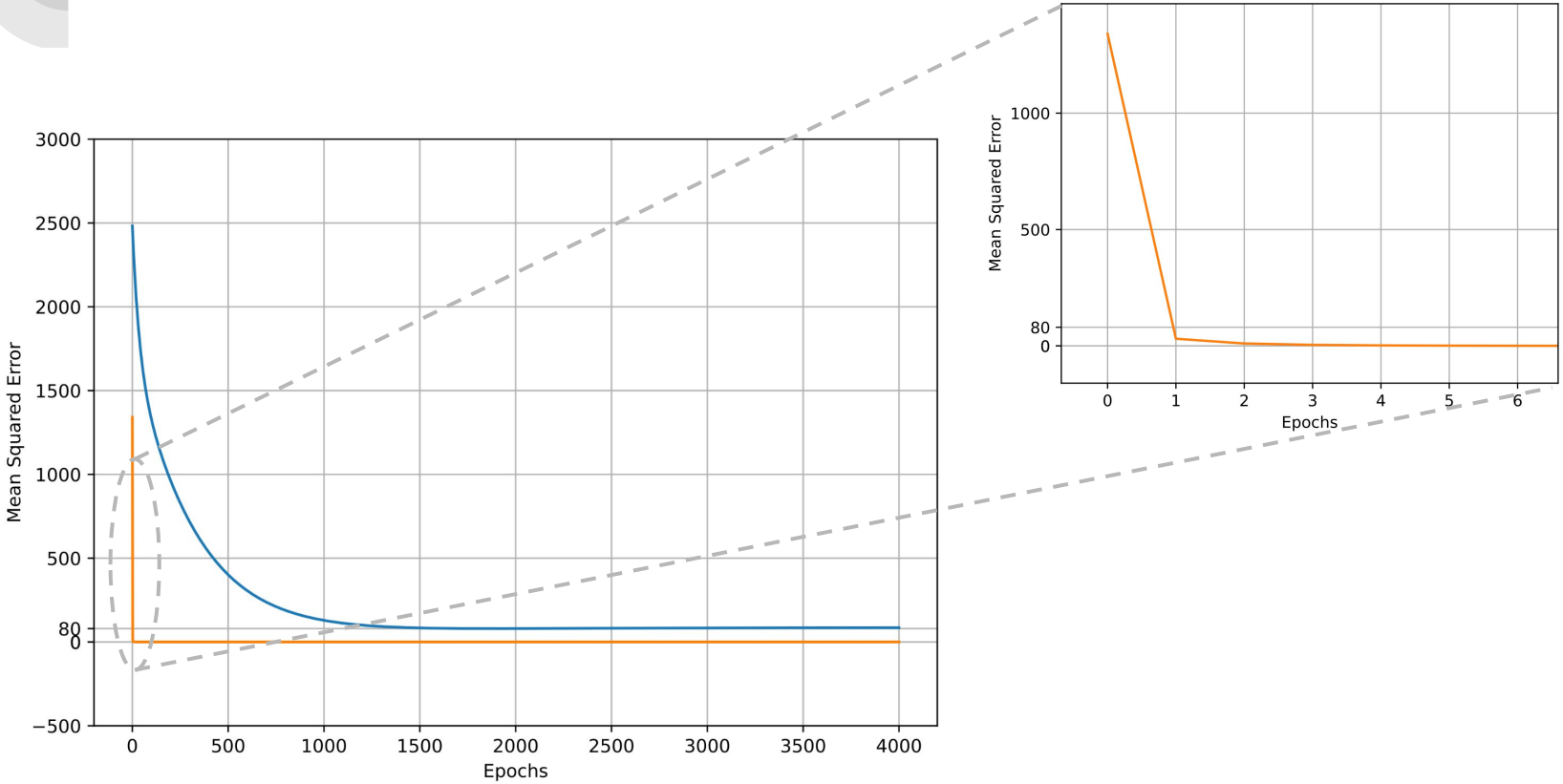
Con activación lineal:



Con activación exponencial (b=0.3):

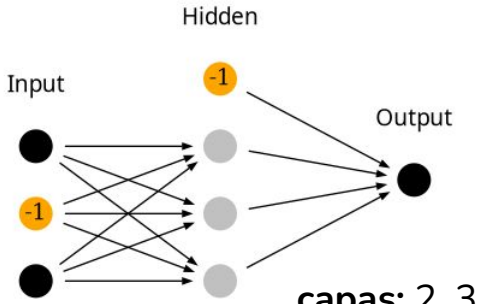


Error


Mean Squared Error
3000
2500
2000
1500
1000
500
80
0
−500
0
500
1000
1500
2000
2500
3000
3500
4000
Epochs
Mean Squared Error
1000
500
80
0
0
1
2
3
4
5
6
Epochs

Ejercicio 3

Función lógica ‘O exclusivo’

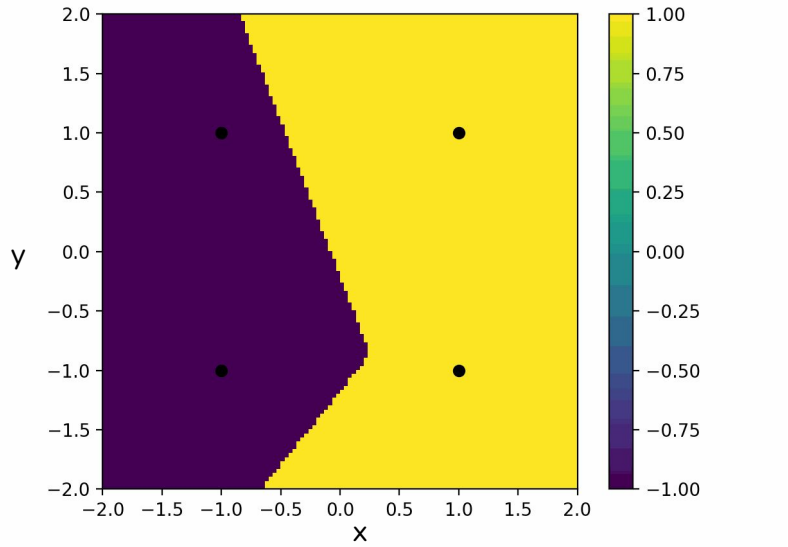


capas: 2, 3, 1

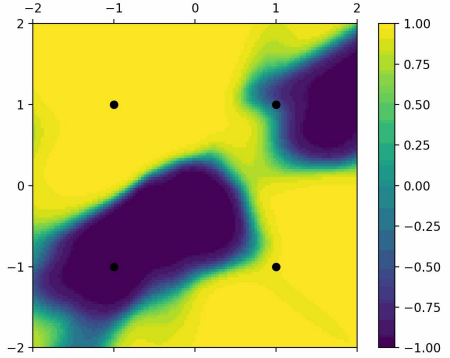
XOR:

$$x = \{\{-1, 1\}, \{1, -1\}, \{-1, -1\}, \{1, 1\}\}$$
$$y = \{1, 1, -1, -1\}$$

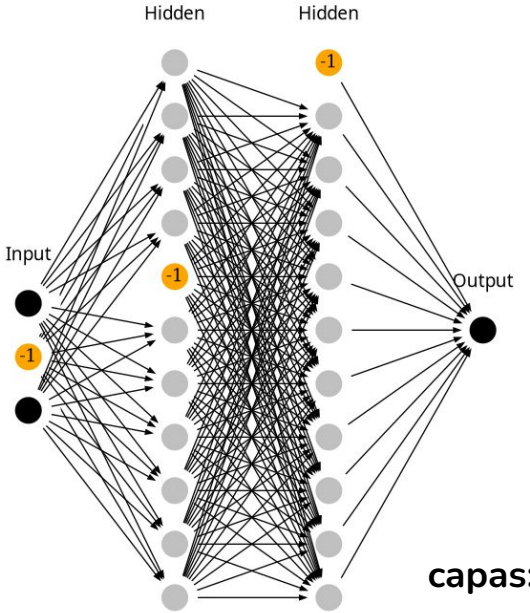
Utilizando un perceptrón multicapa es posible separar los puntos que se indican en la entrada del problema.



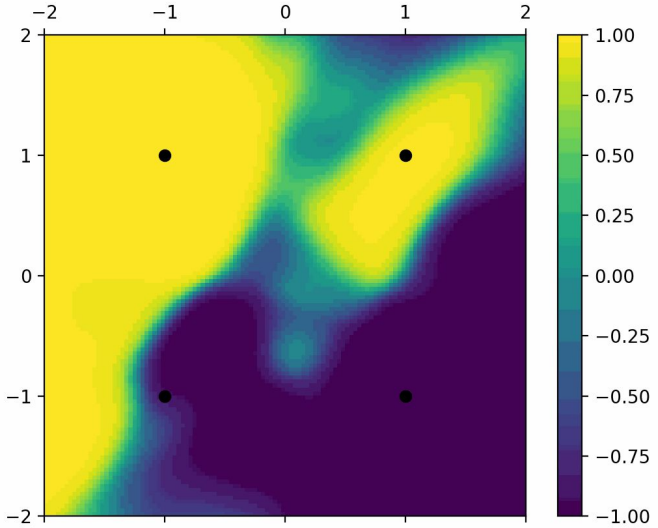
Función lógica `O exclusivo



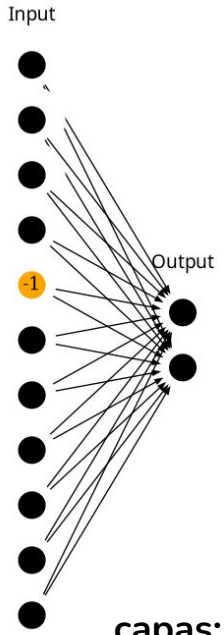
Con función de activación **tanh**



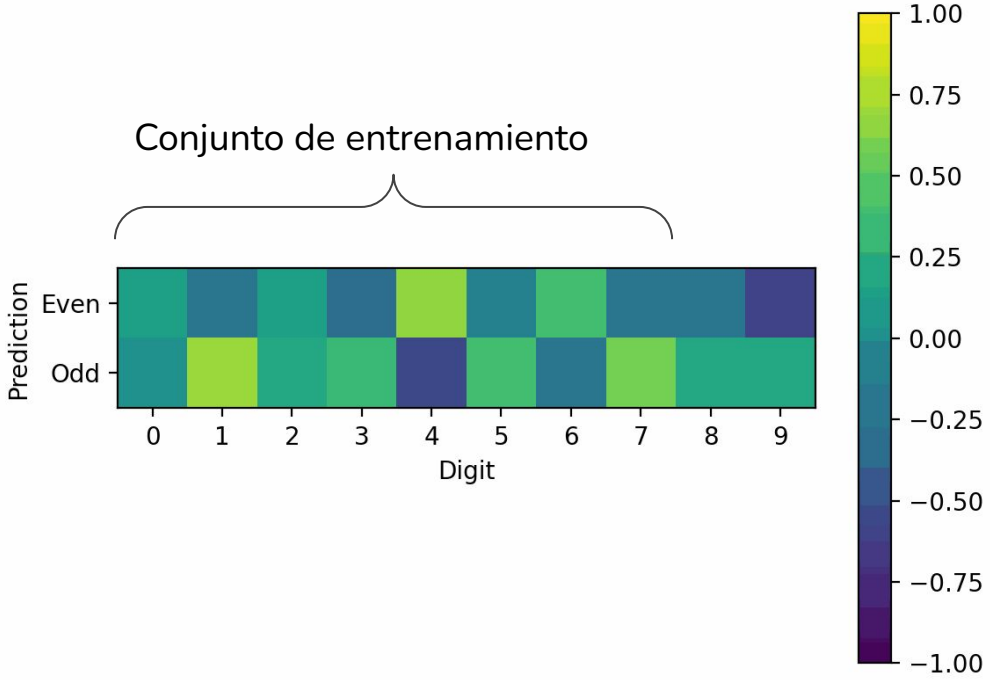
capas: 2, 100, 100, 1



Datos de entrada



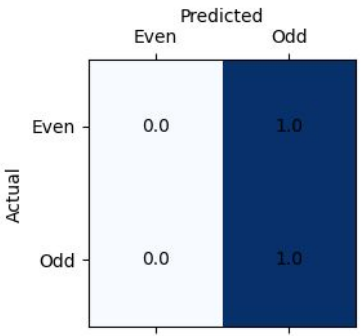
capas: 5x7, 2



Validación Cruzada

0 1 2 3 4 5 6 7 8 9

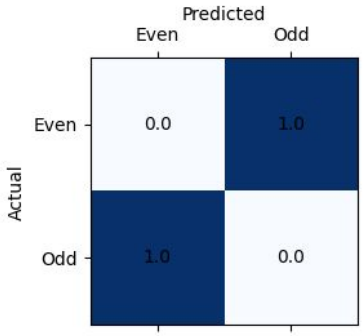
entrenamiento



Accuracy: 0.5

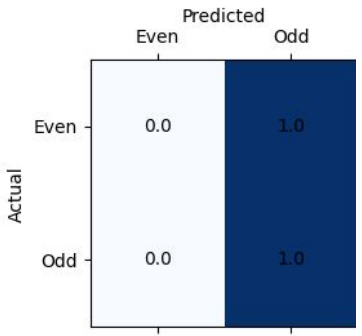
0 1 2 3 4 5 6 7 8 9

entrenamiento



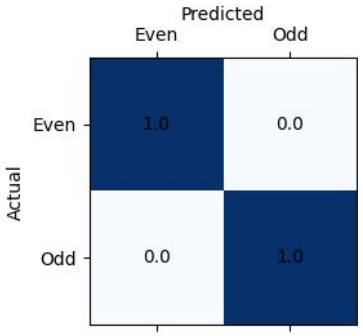
Accuracy: 0

0 1 2 3 4 5 6 7 8 9



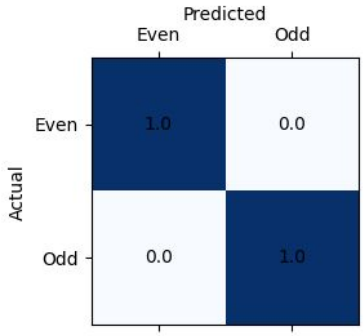
Accuracy: 0.5

0 1 2 3 4 5 6 7 8 9



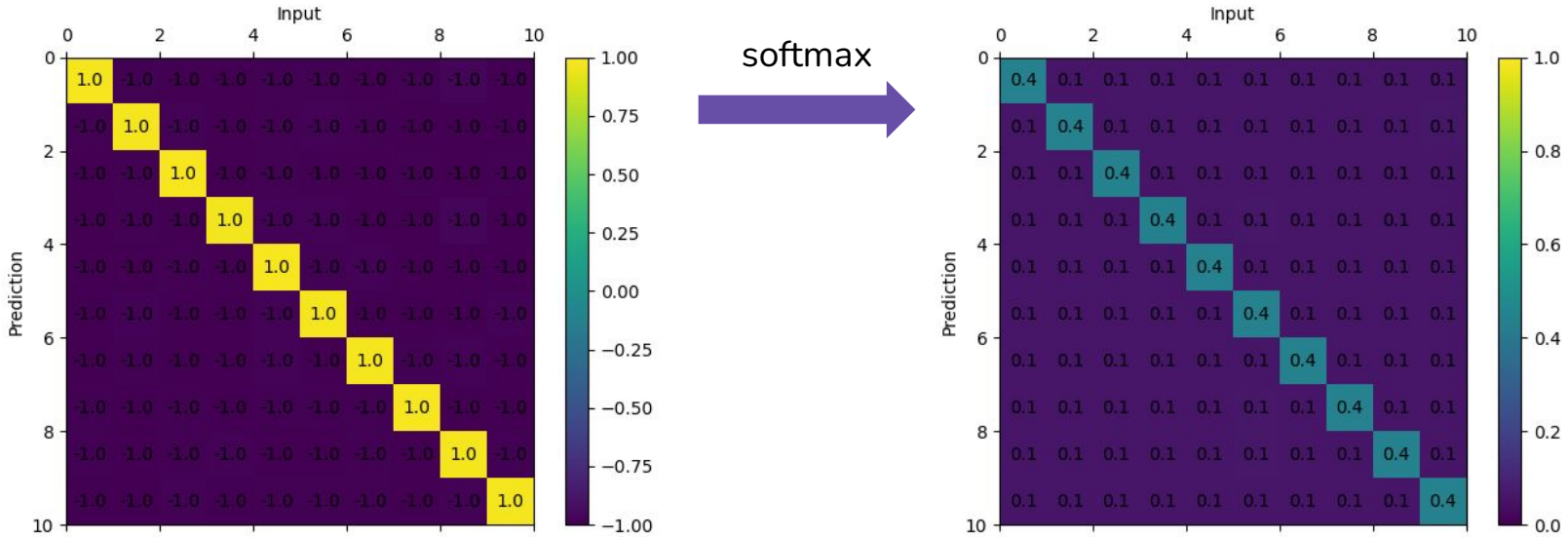
Accuracy: 1

0 1 2 3 4 5 6 7 8 9

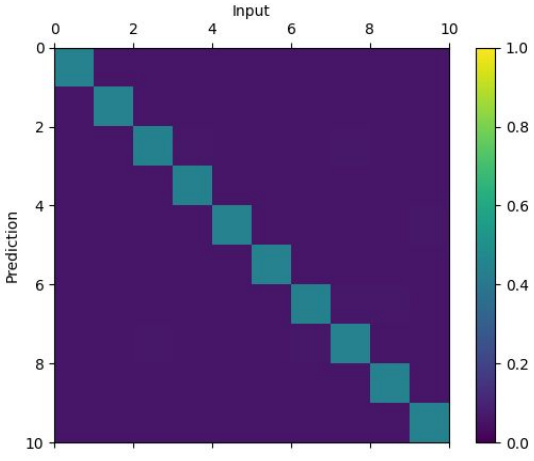


Accuracy: 1

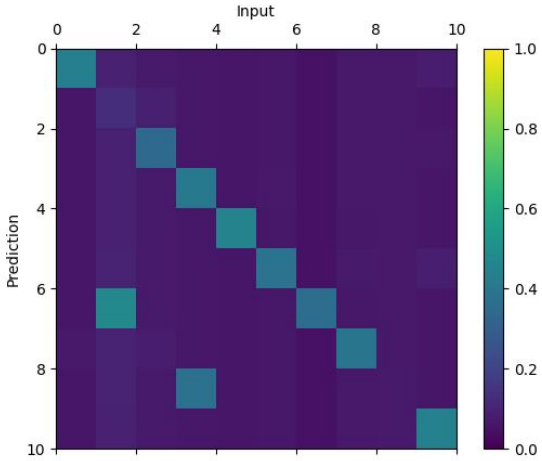
Utilizando softmax



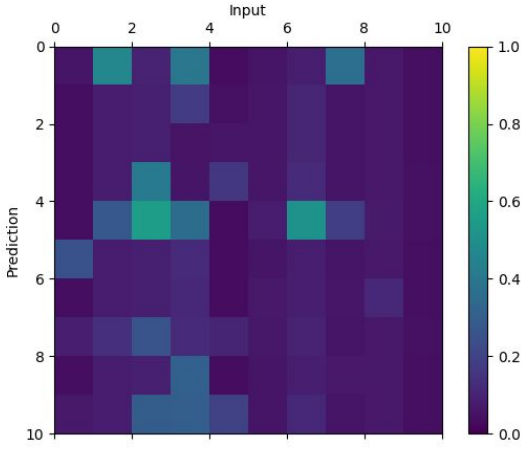
Píxeles afectados por ruido



Probabilidad de error = 0.002



Probabilidad de error = 0.2



Probabilidad de error = 0.5

Conclusiones