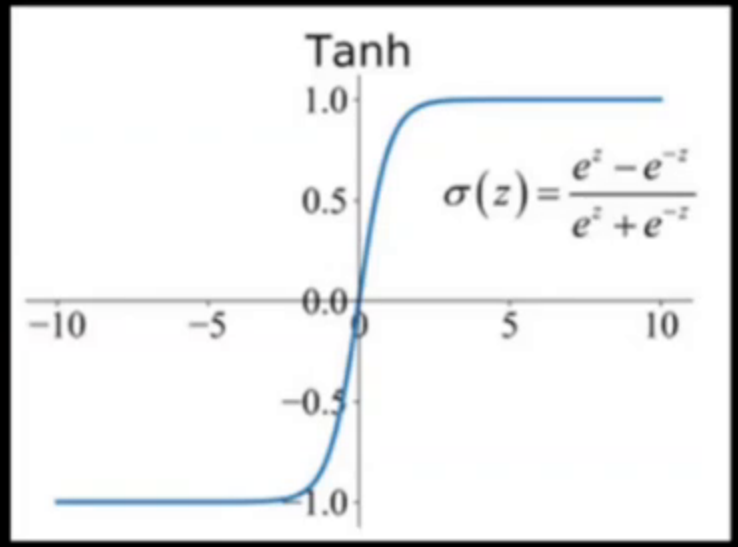
ACTIVATION FUNCTIONS



TANH ACTIVATION

Tanh Activation

ML For Nerds

Tanh Activation

ML For Nerds

Drawbacks of Sigmoid

- Vanishing Gradient
- Not zero-centered
- Only for Binary Classification problems

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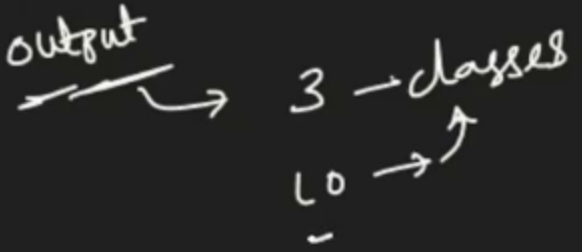

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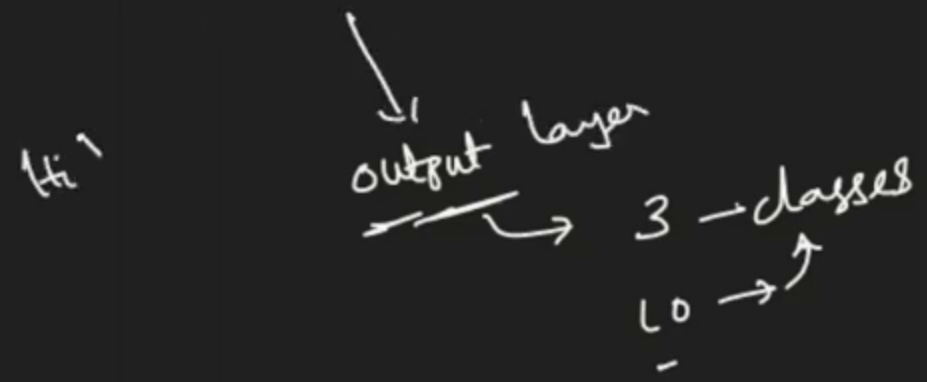
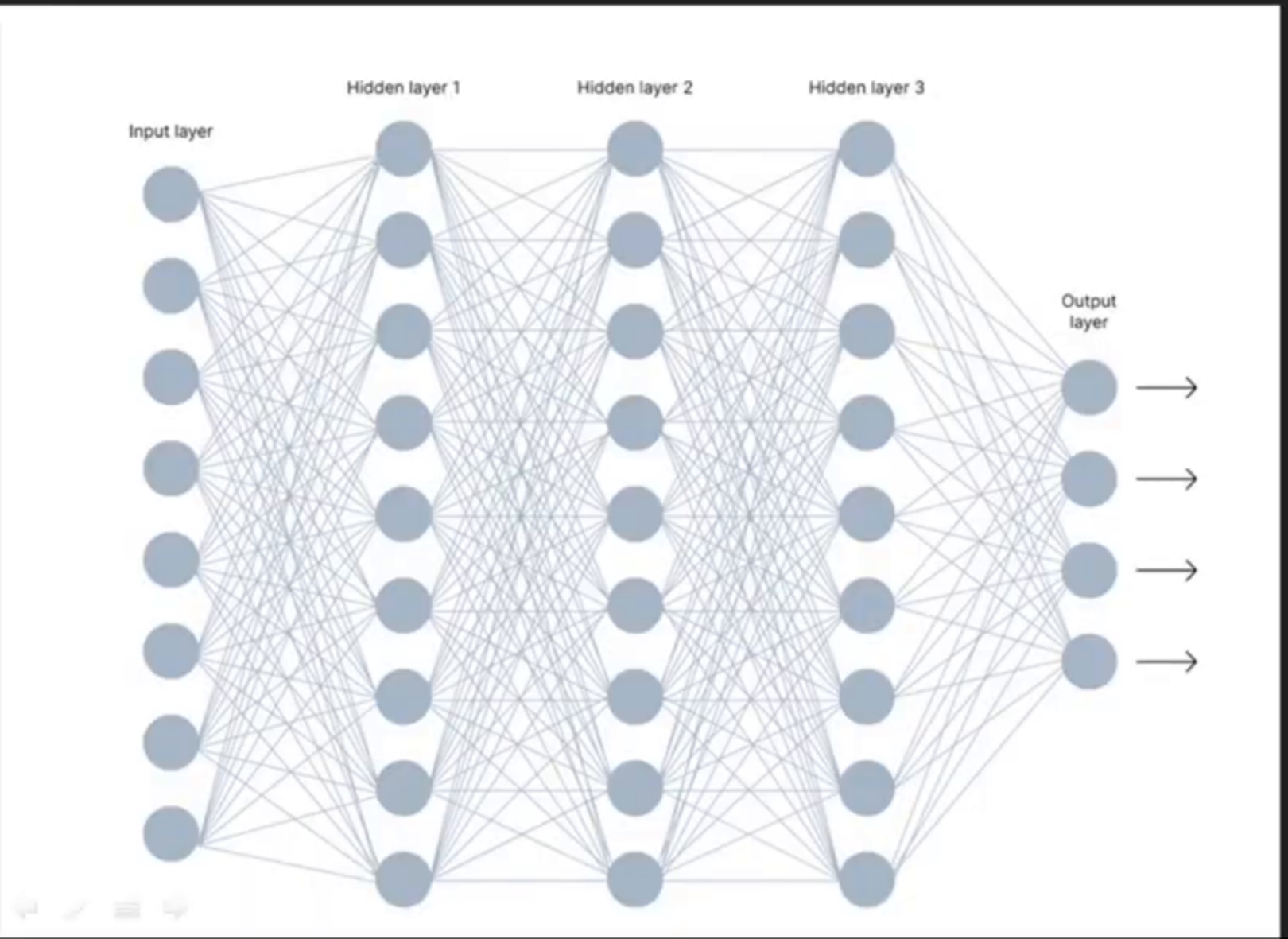


Multi-class problem



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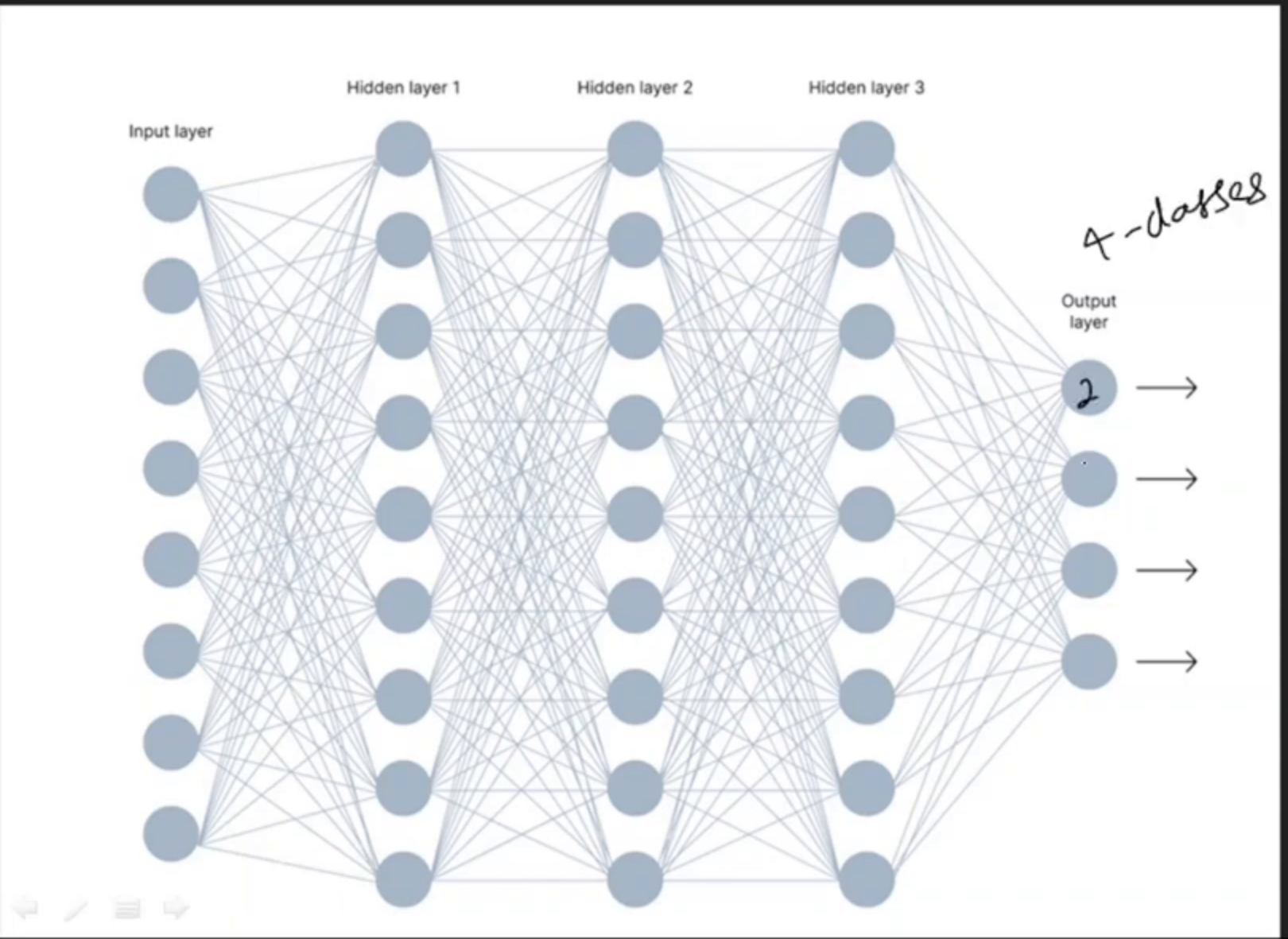

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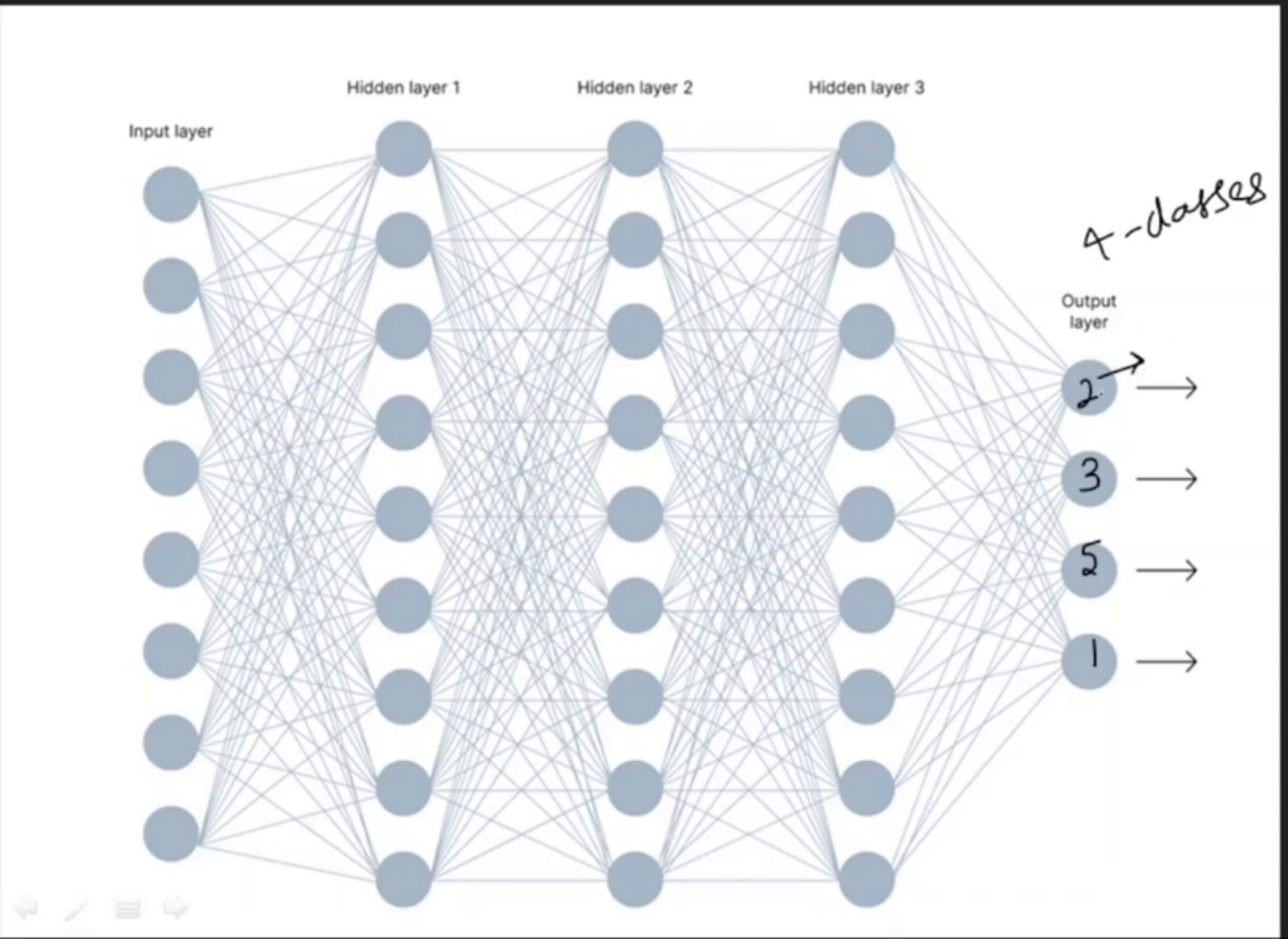

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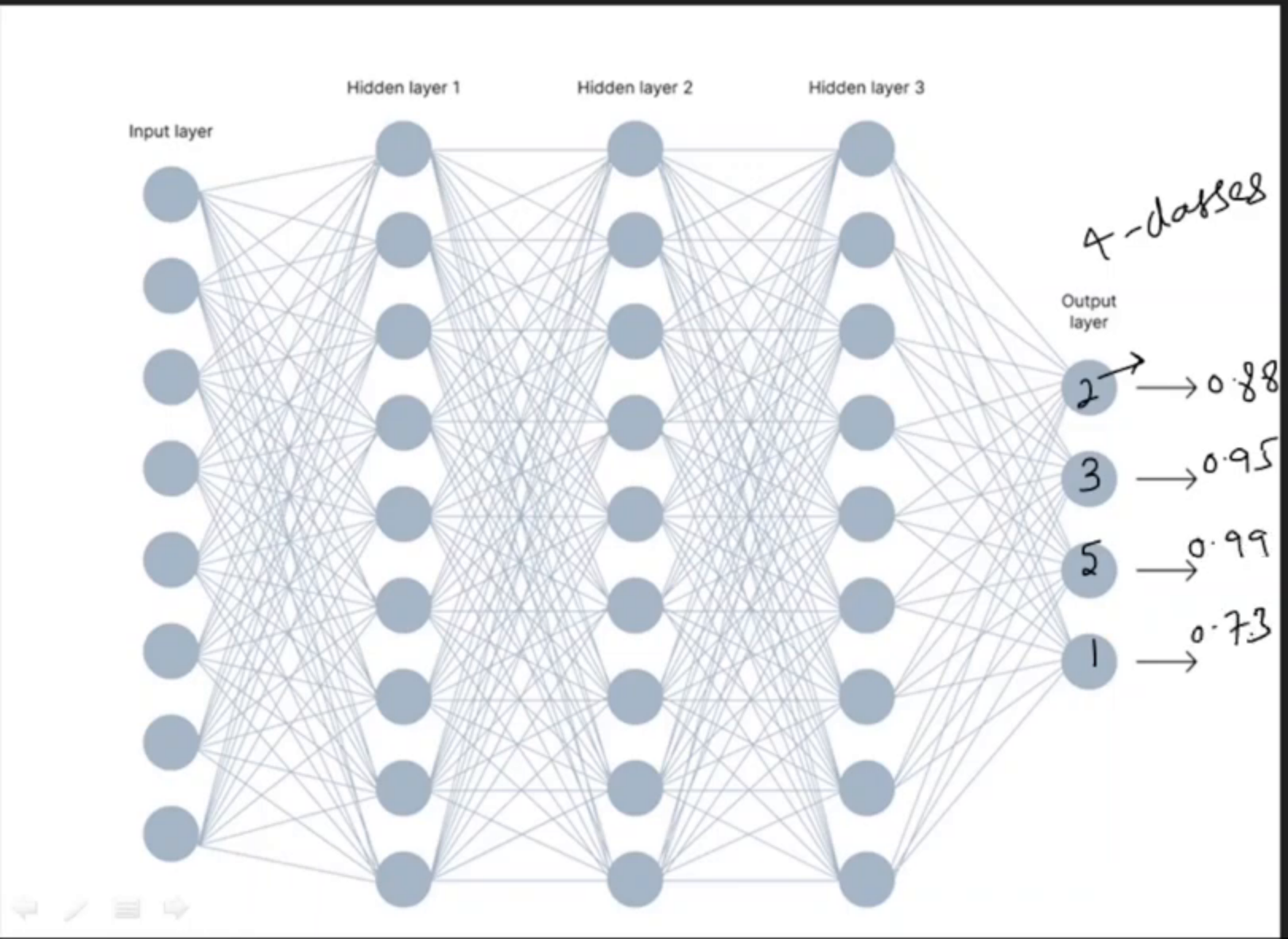

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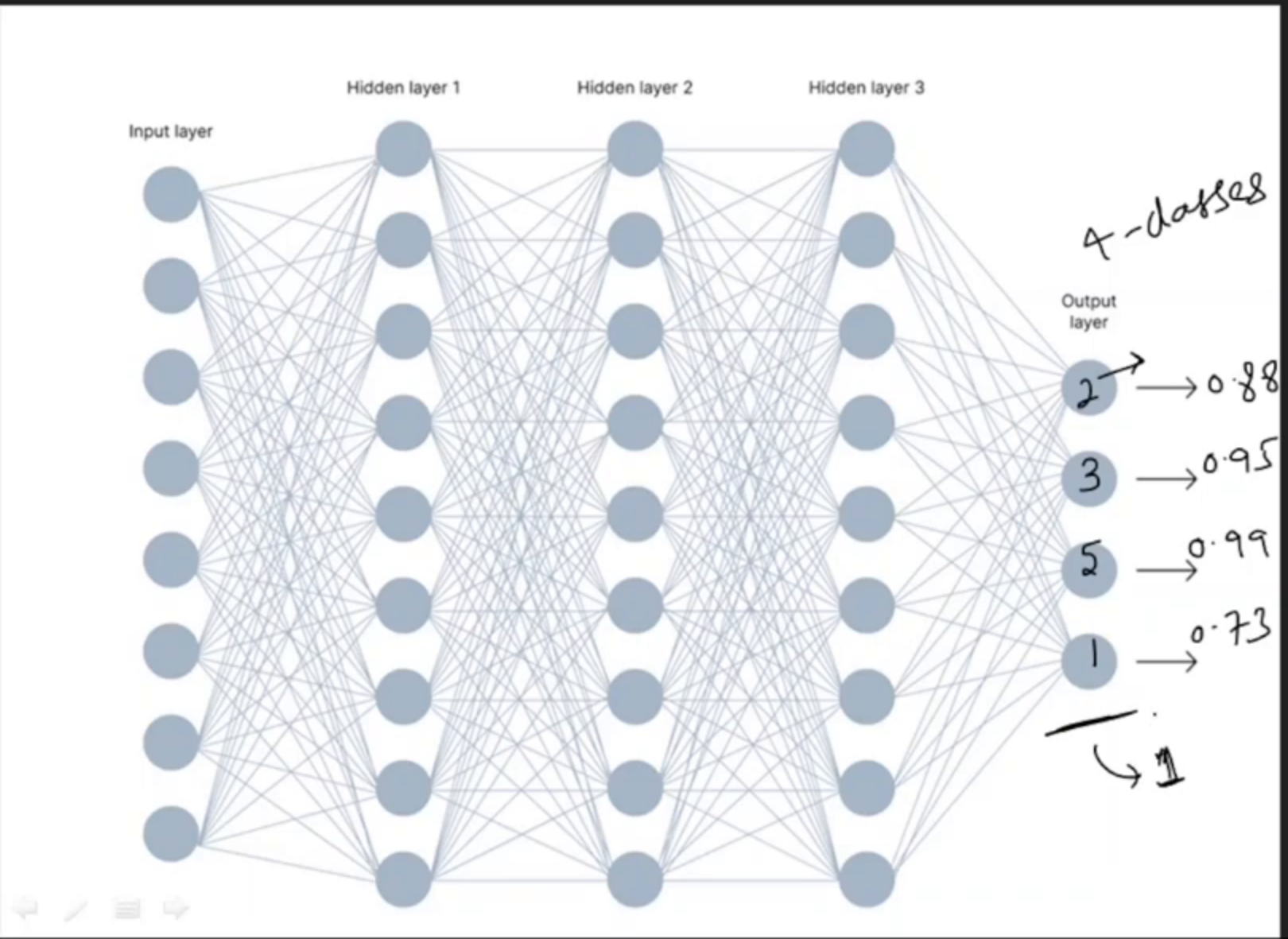

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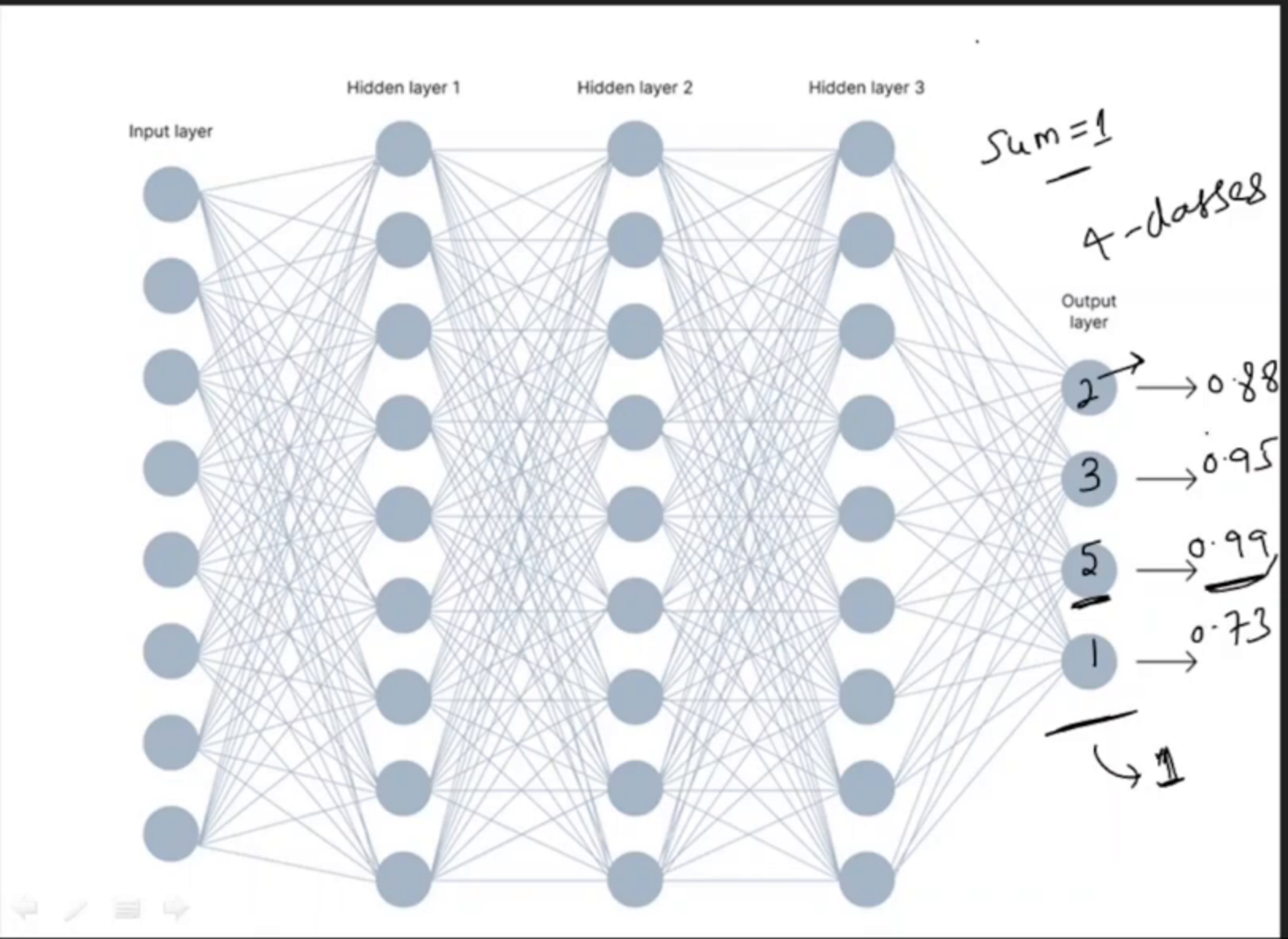

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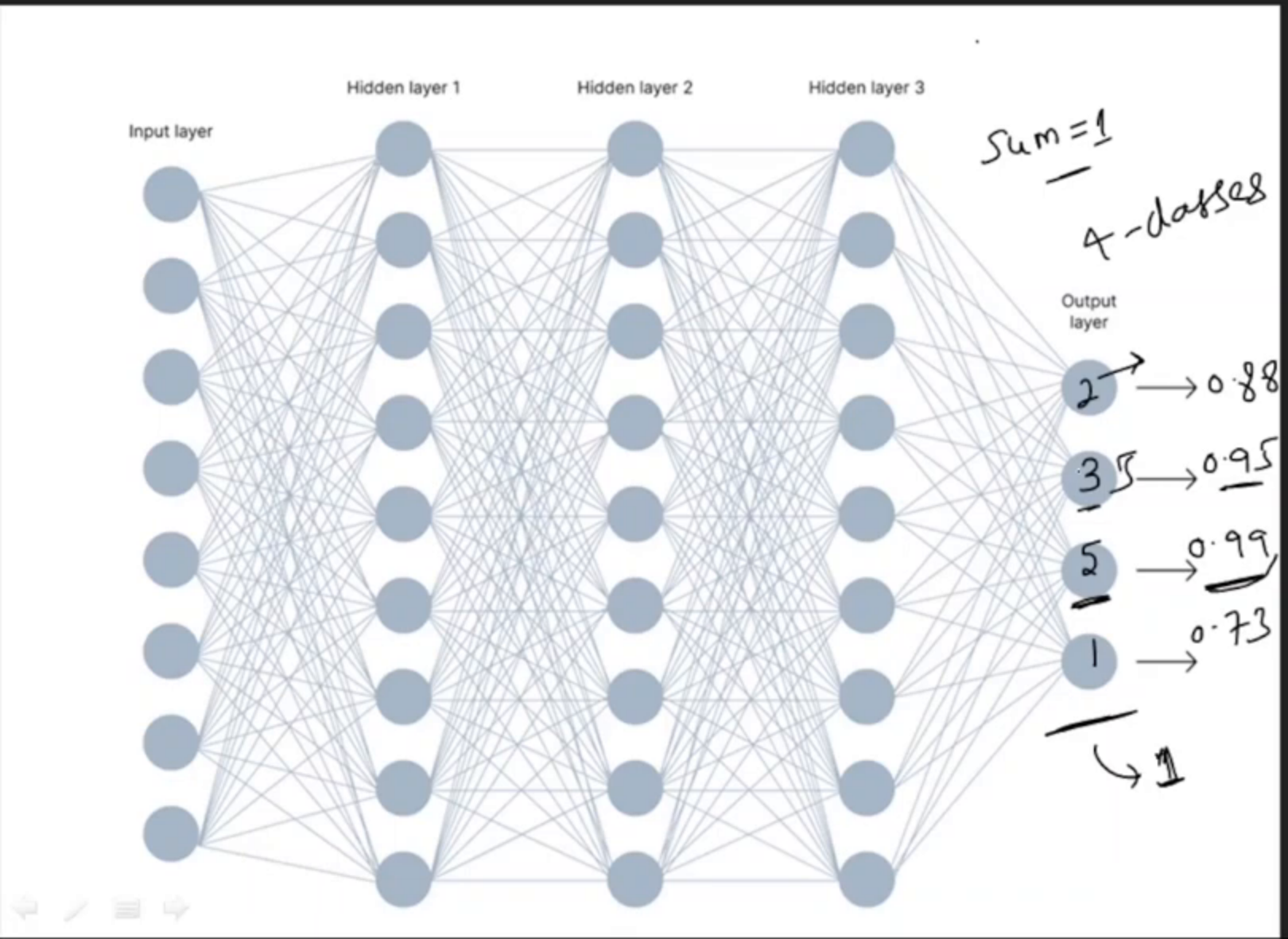

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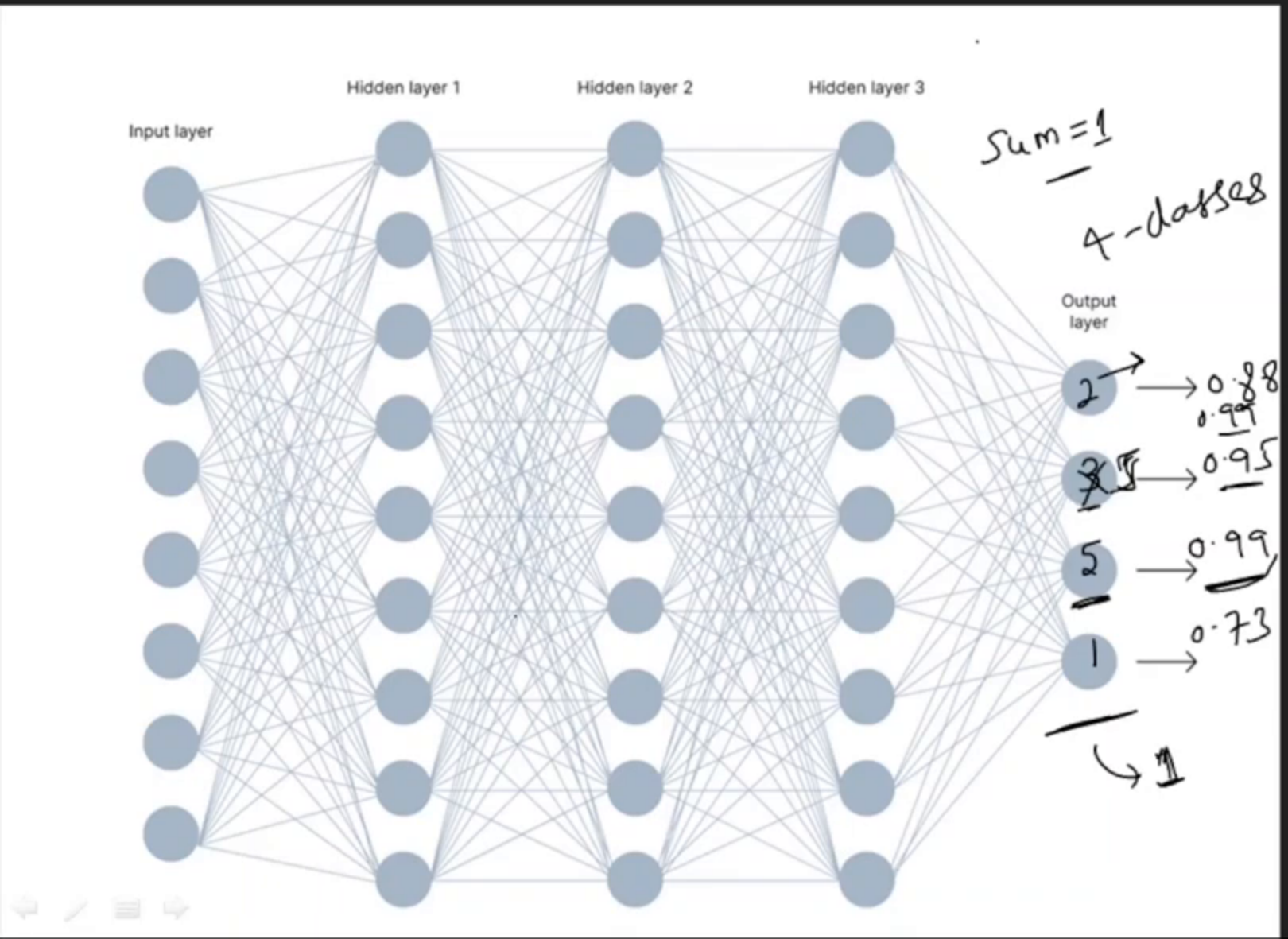

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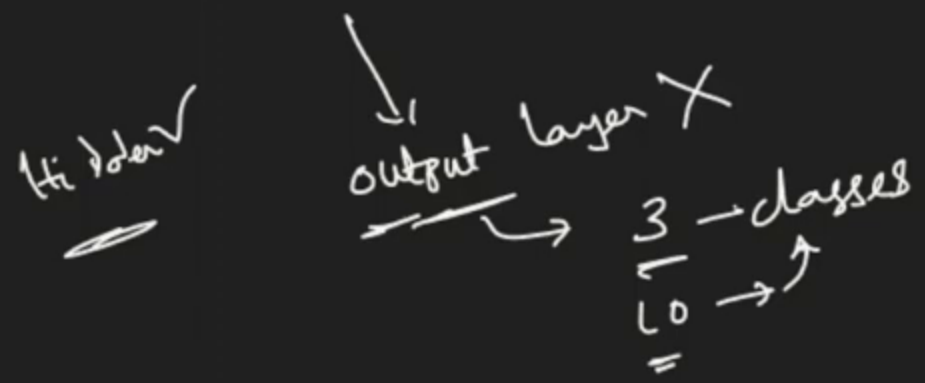
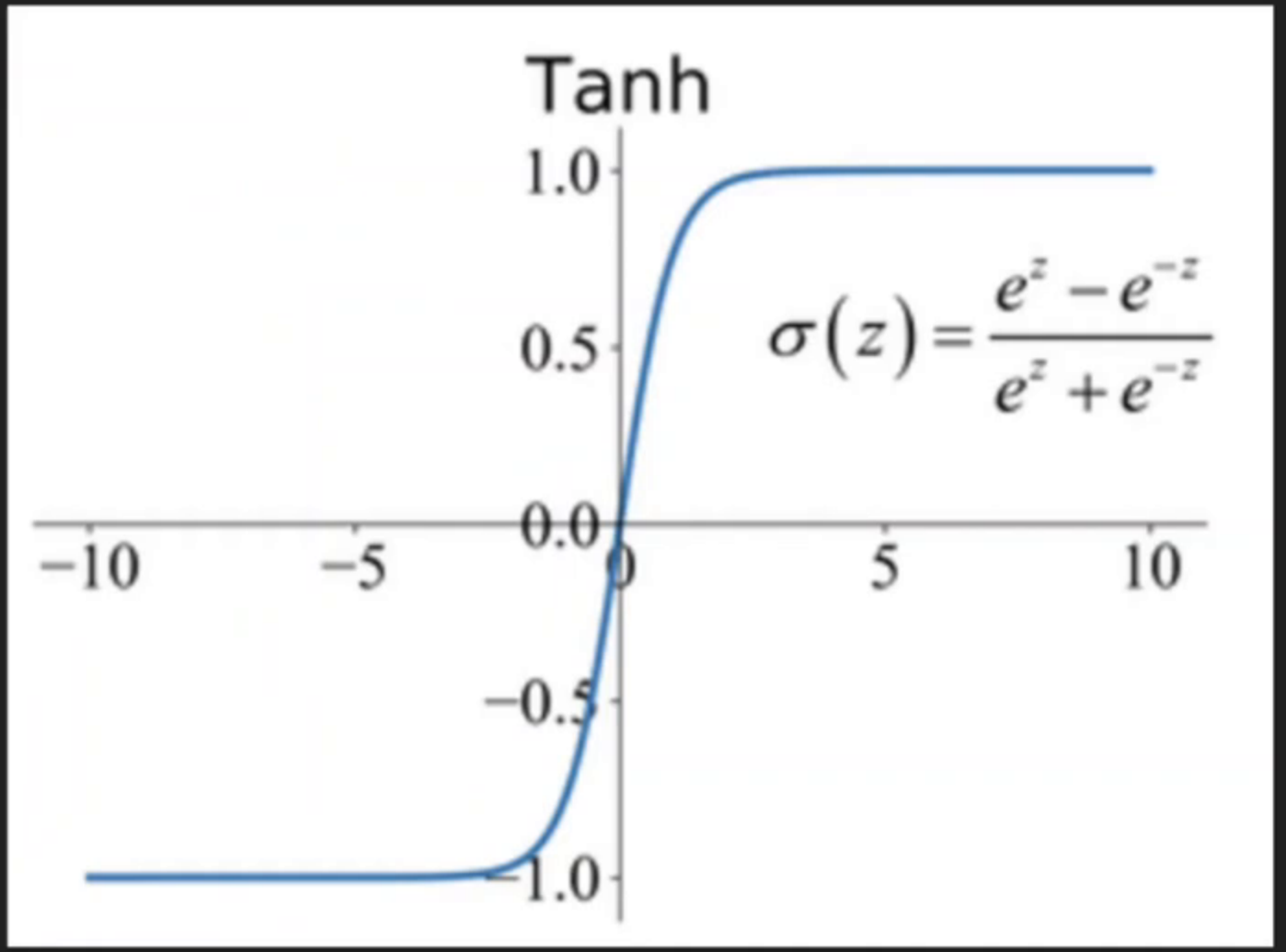


Definition

Tanh Function

$$a = \frac{e^{z} - e^{-z}}{e^{z} + e^{-z}}$$



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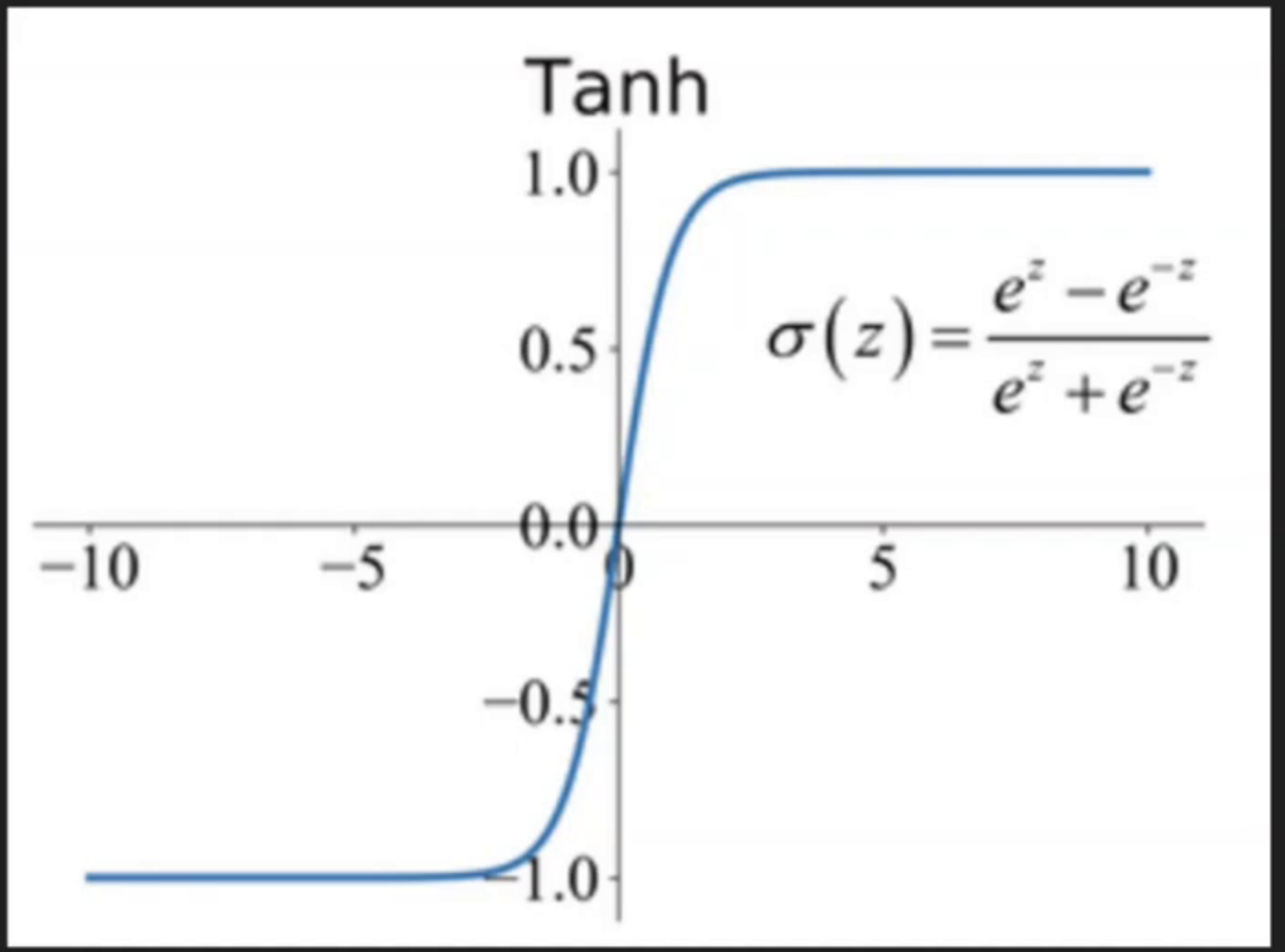
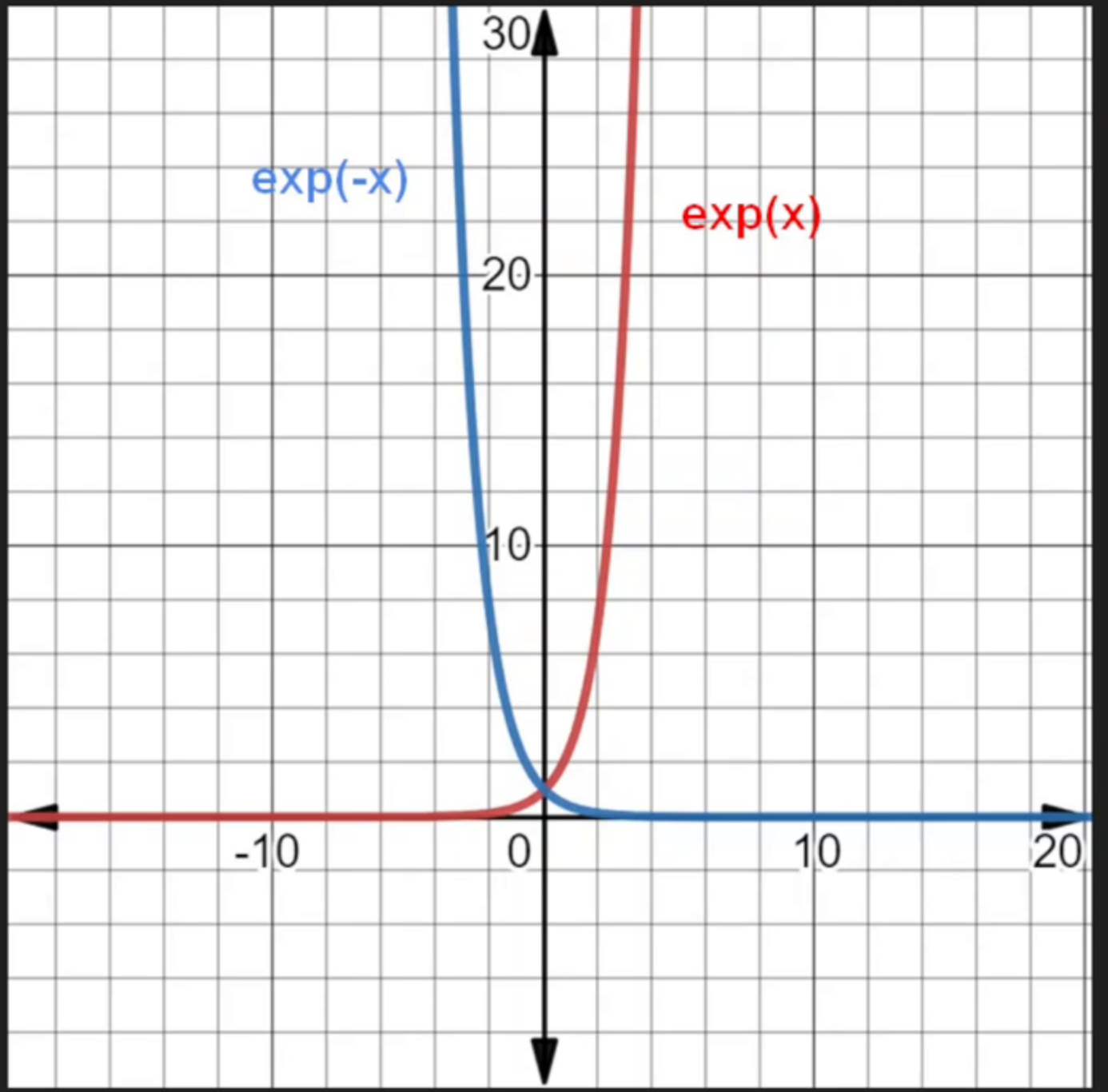


Range → -1 ↔ +1

x	-inf	0	inf
exp(x)	0	1	inf
exp(-x)	inf	1	0



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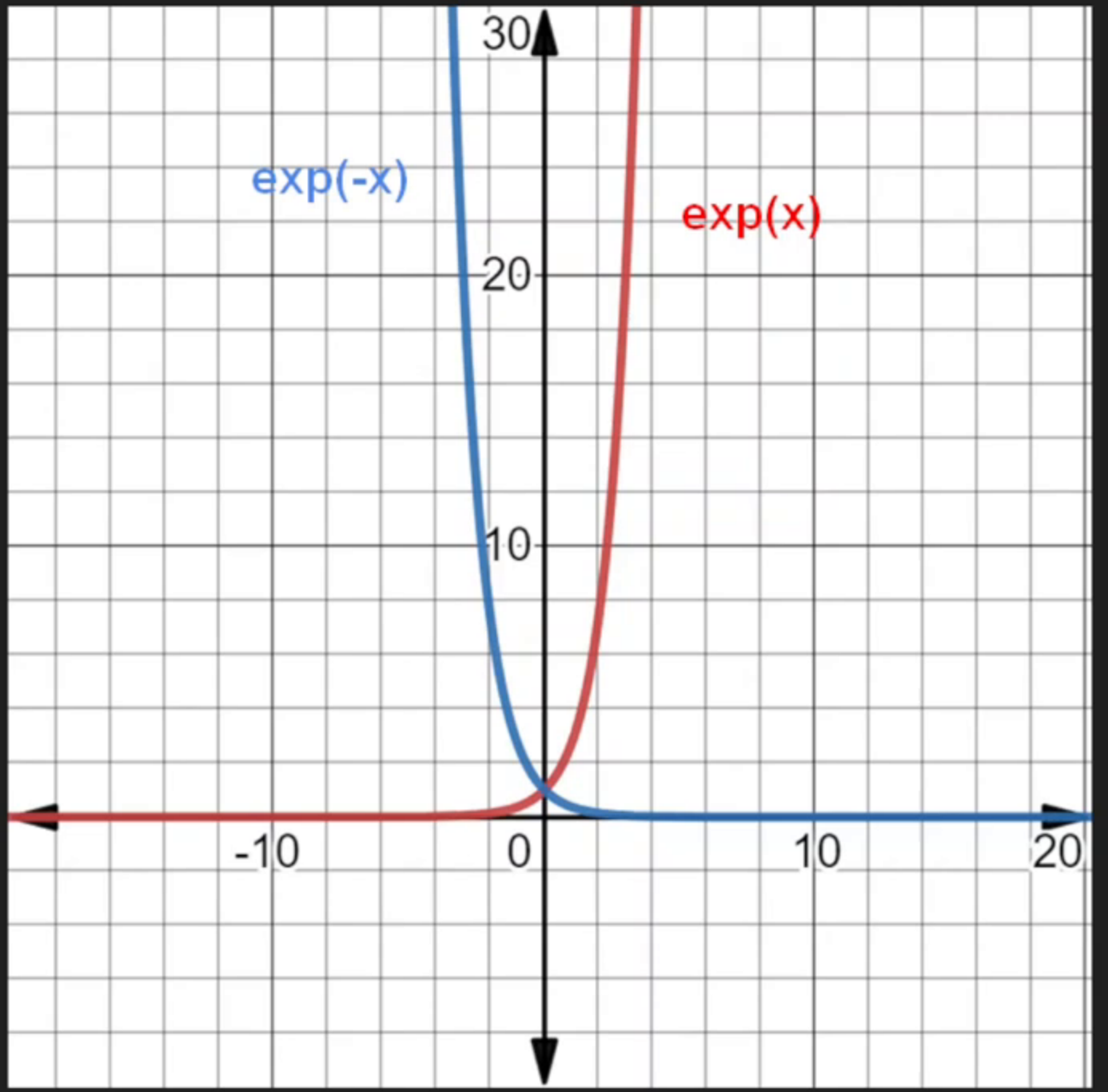

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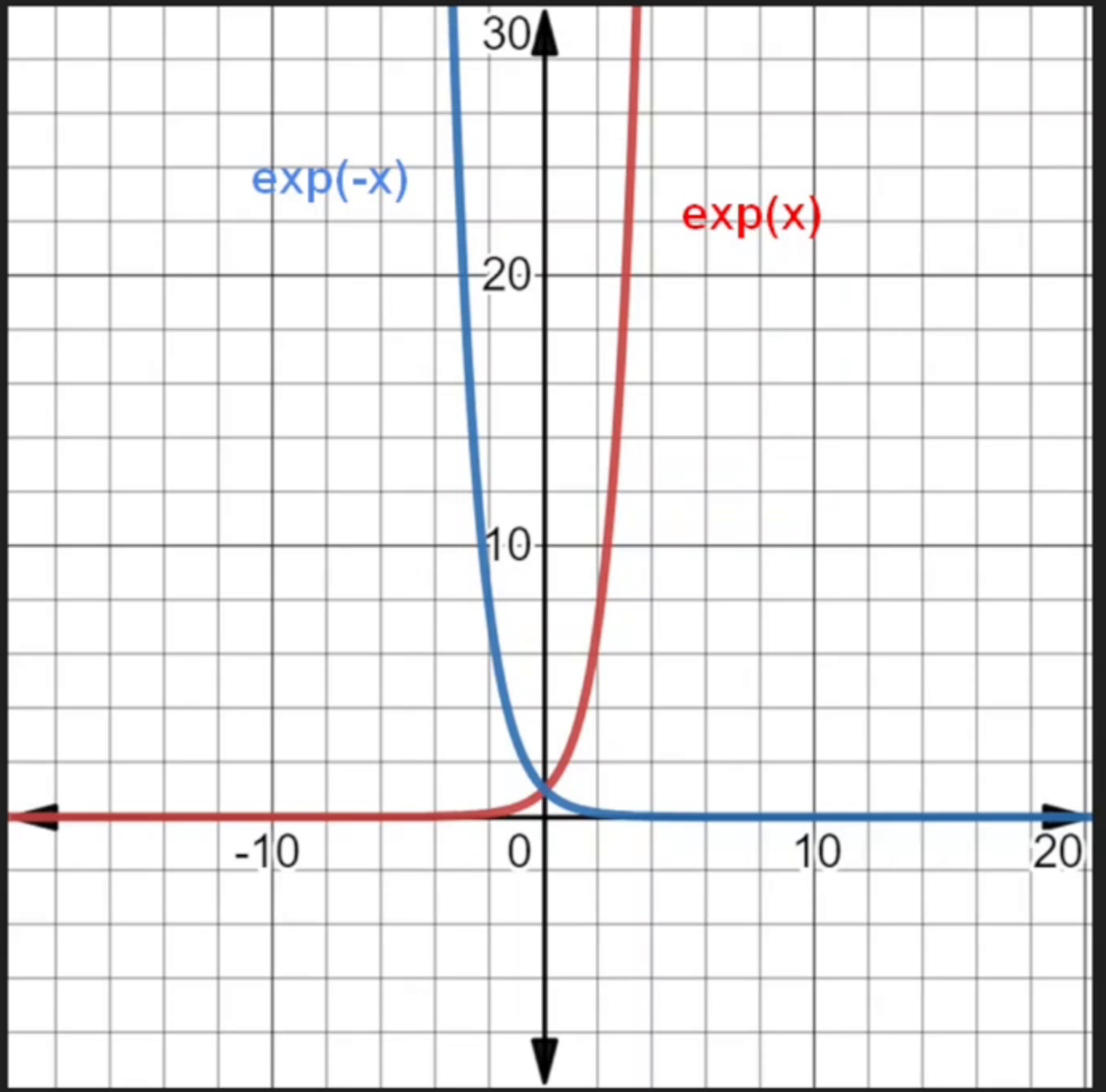
$x = -\infty \rightarrow 0 =$



Range → $-1 \leftrightarrow +1$ e^{∞}

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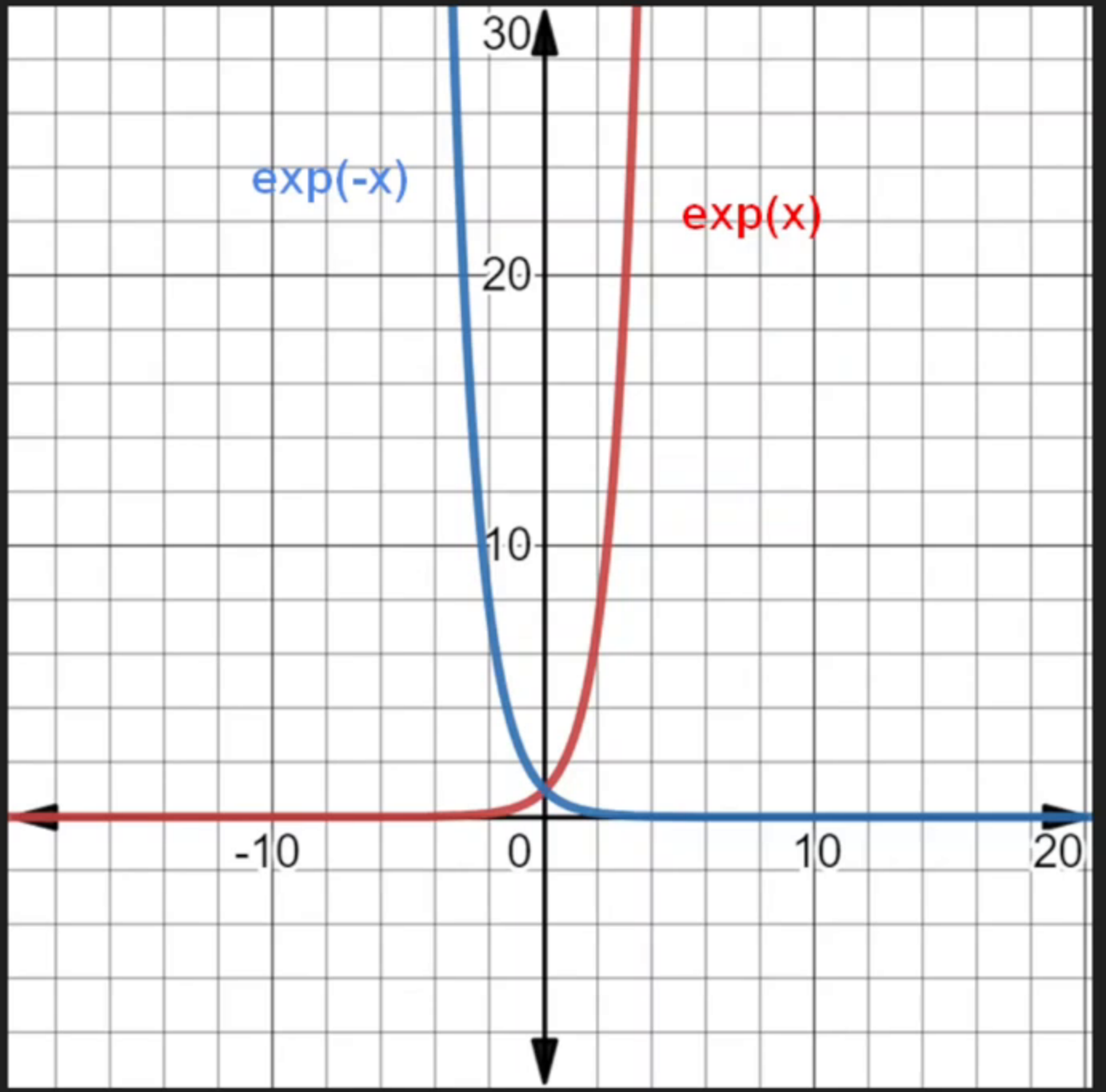
$x = -\infty \rightarrow \frac{0 - \infty}{0 + \infty} = -1$



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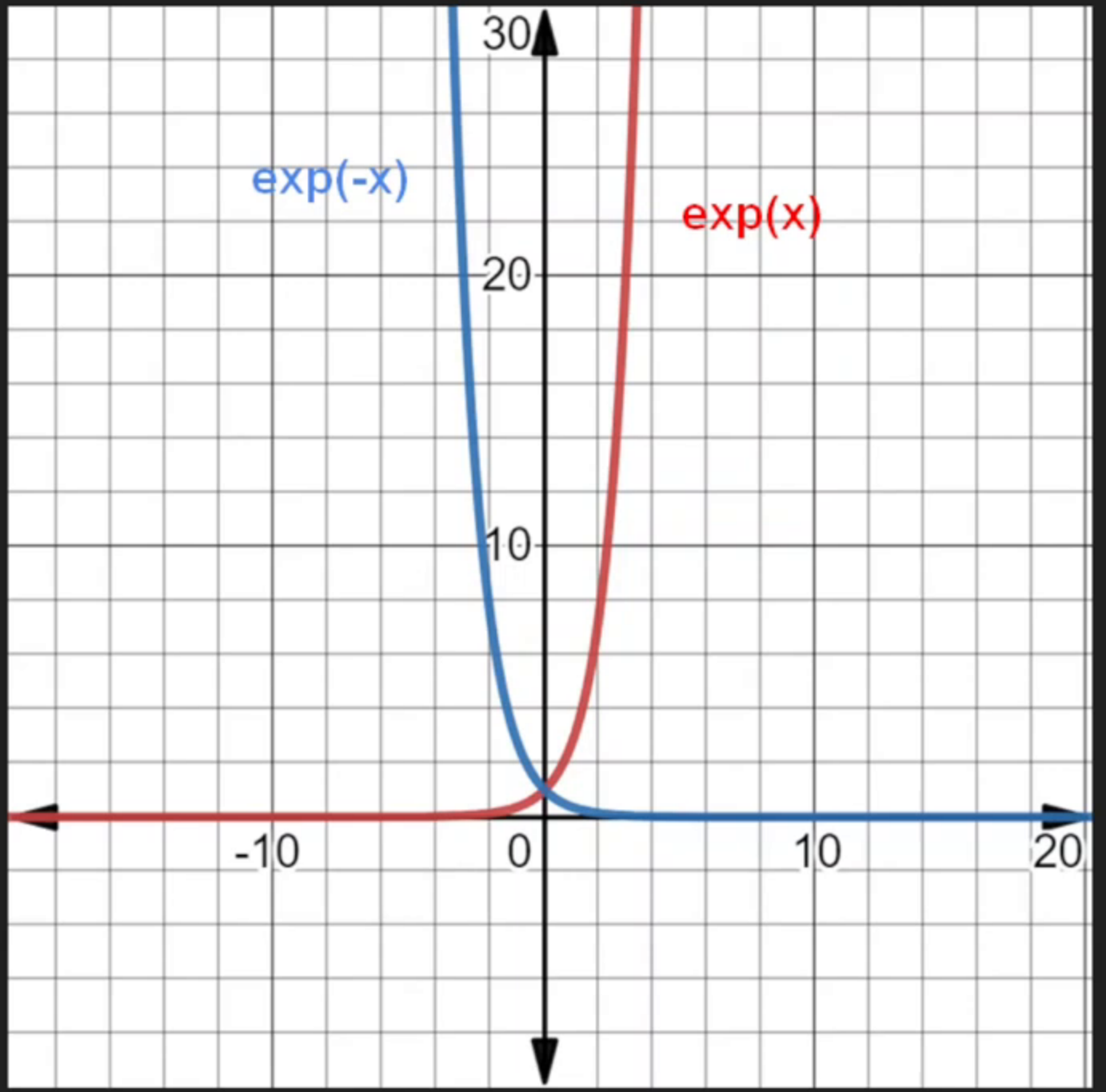

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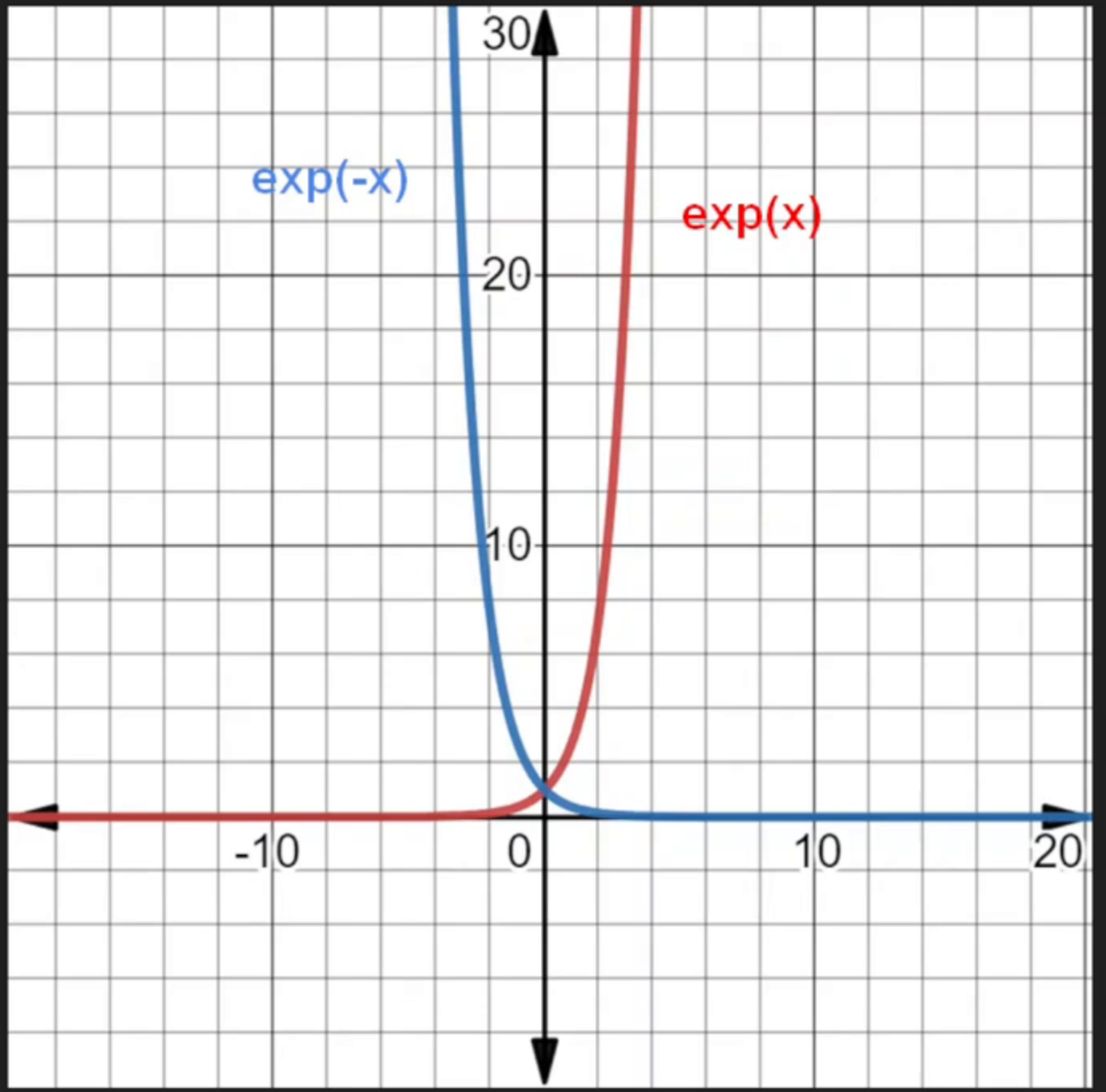

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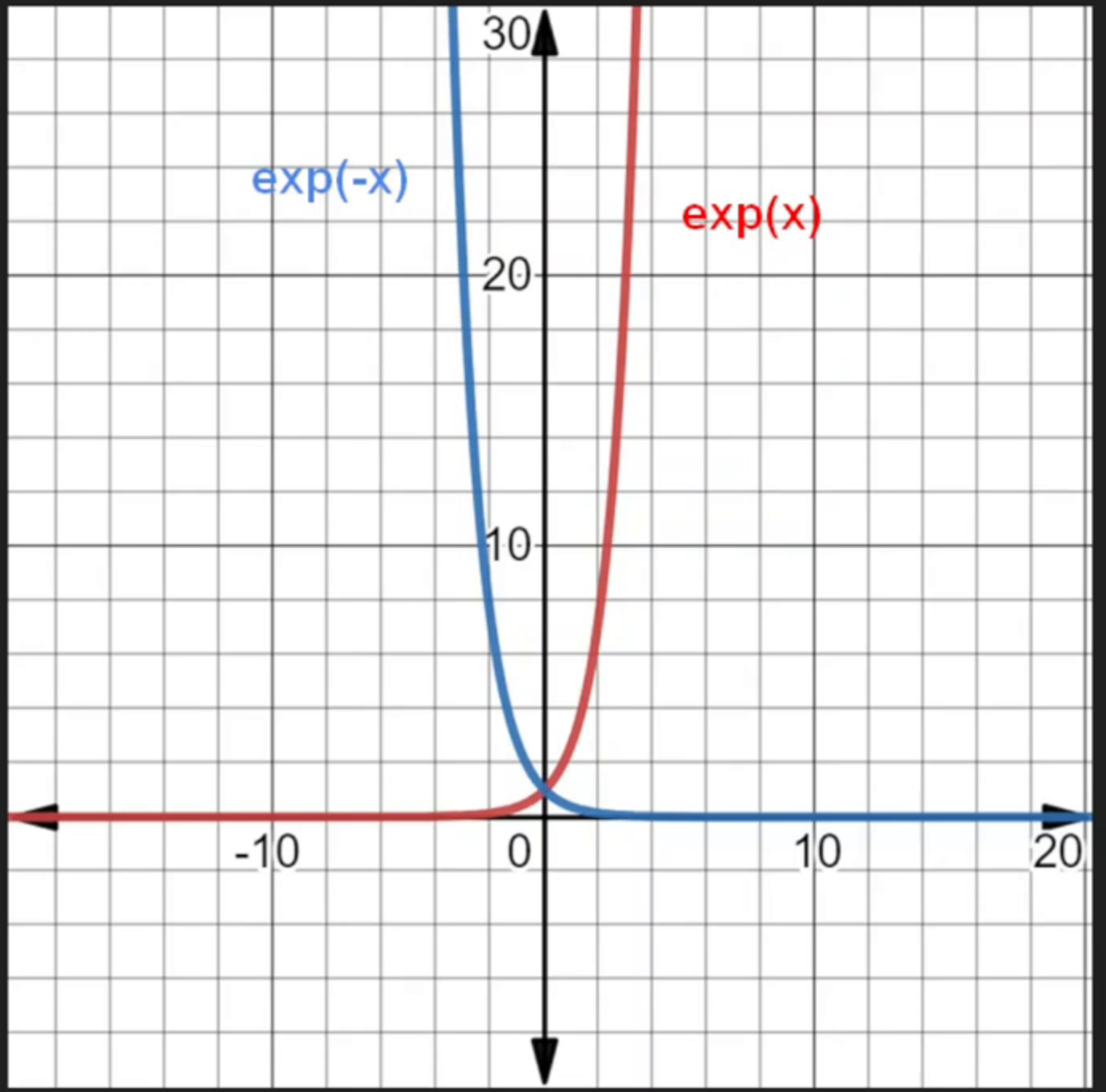

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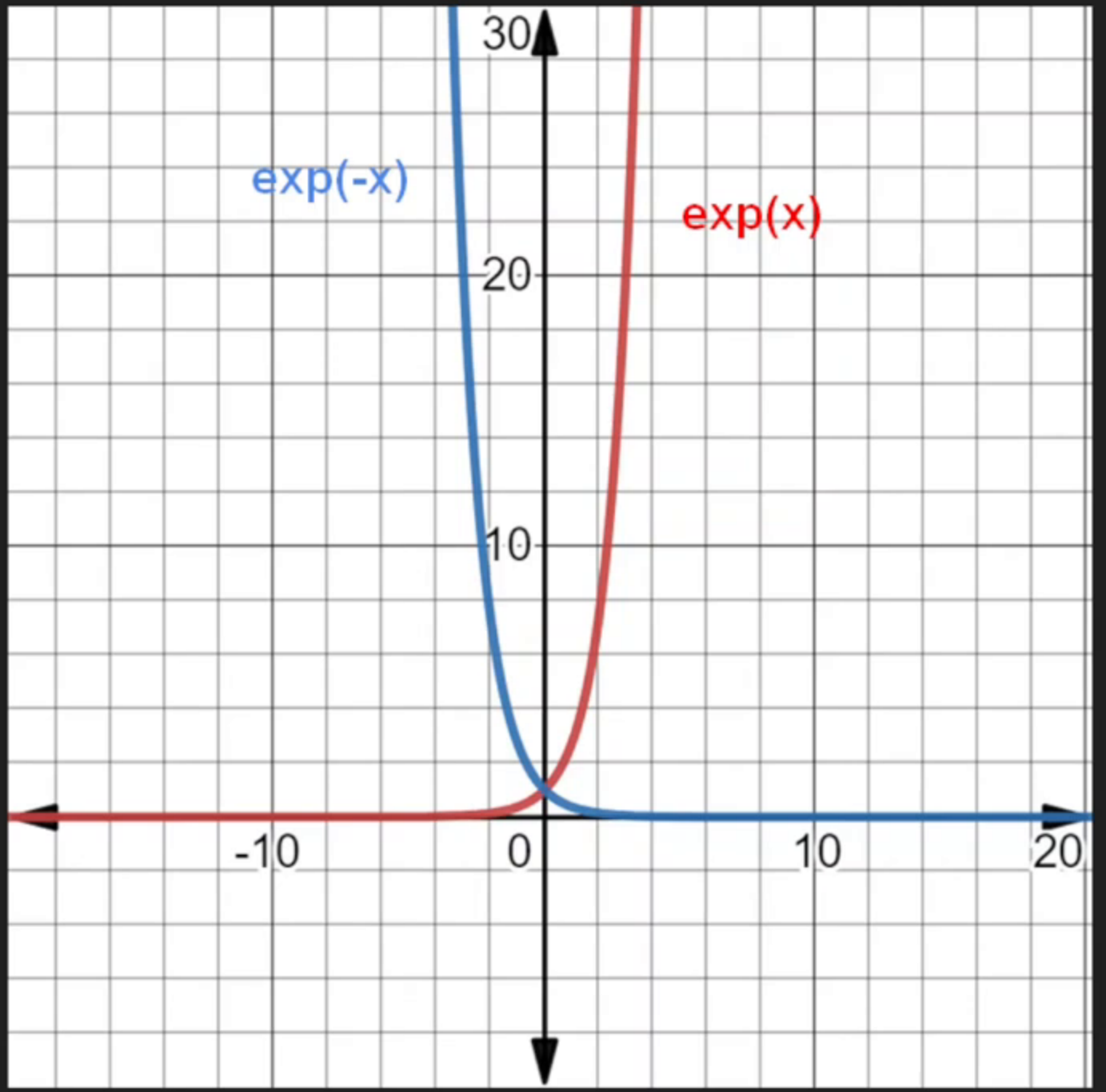
$x \rightarrow -\infty \quad 0 \quad \infty$

$\tanh \rightarrow -1 \cdot$



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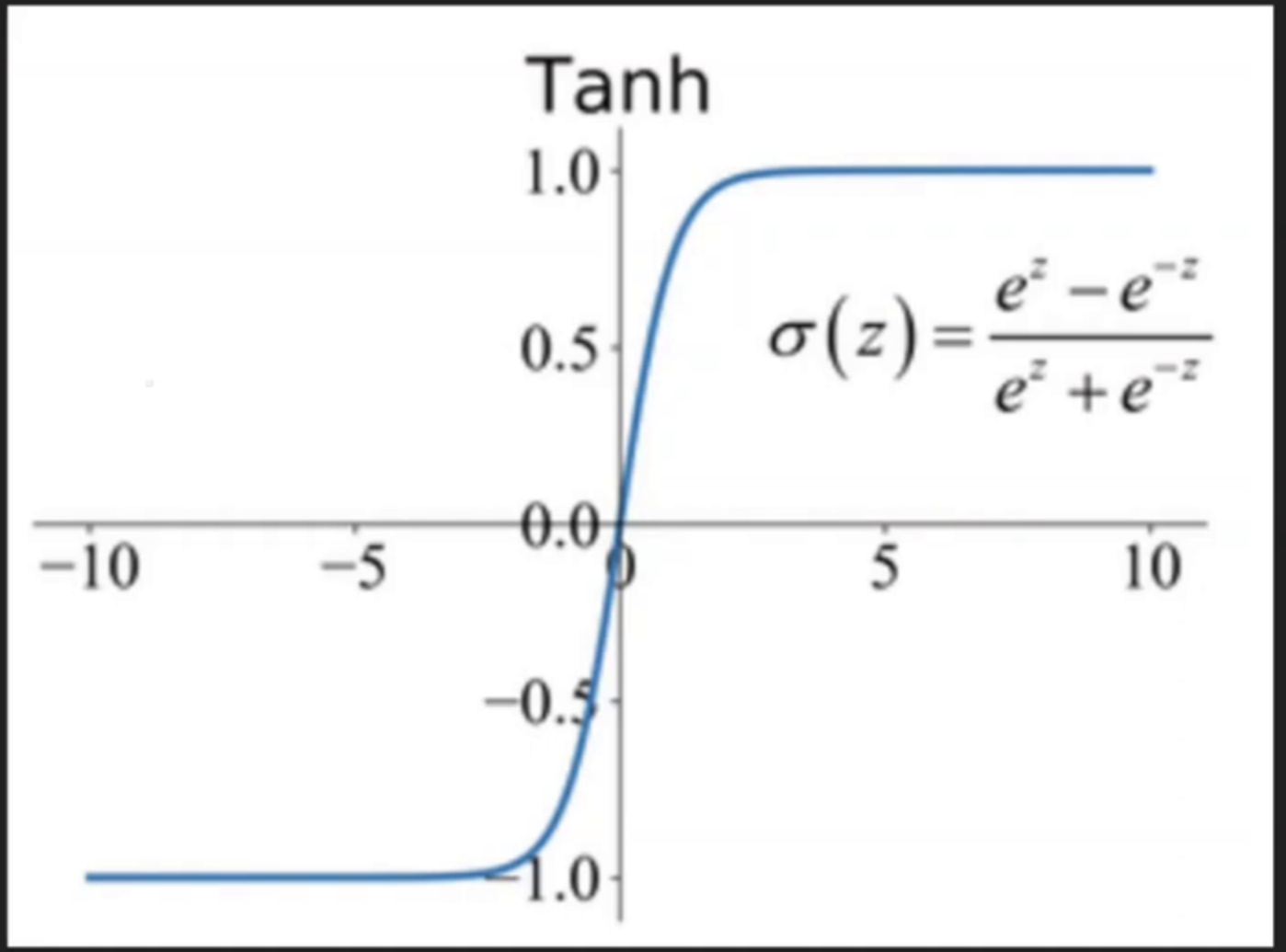
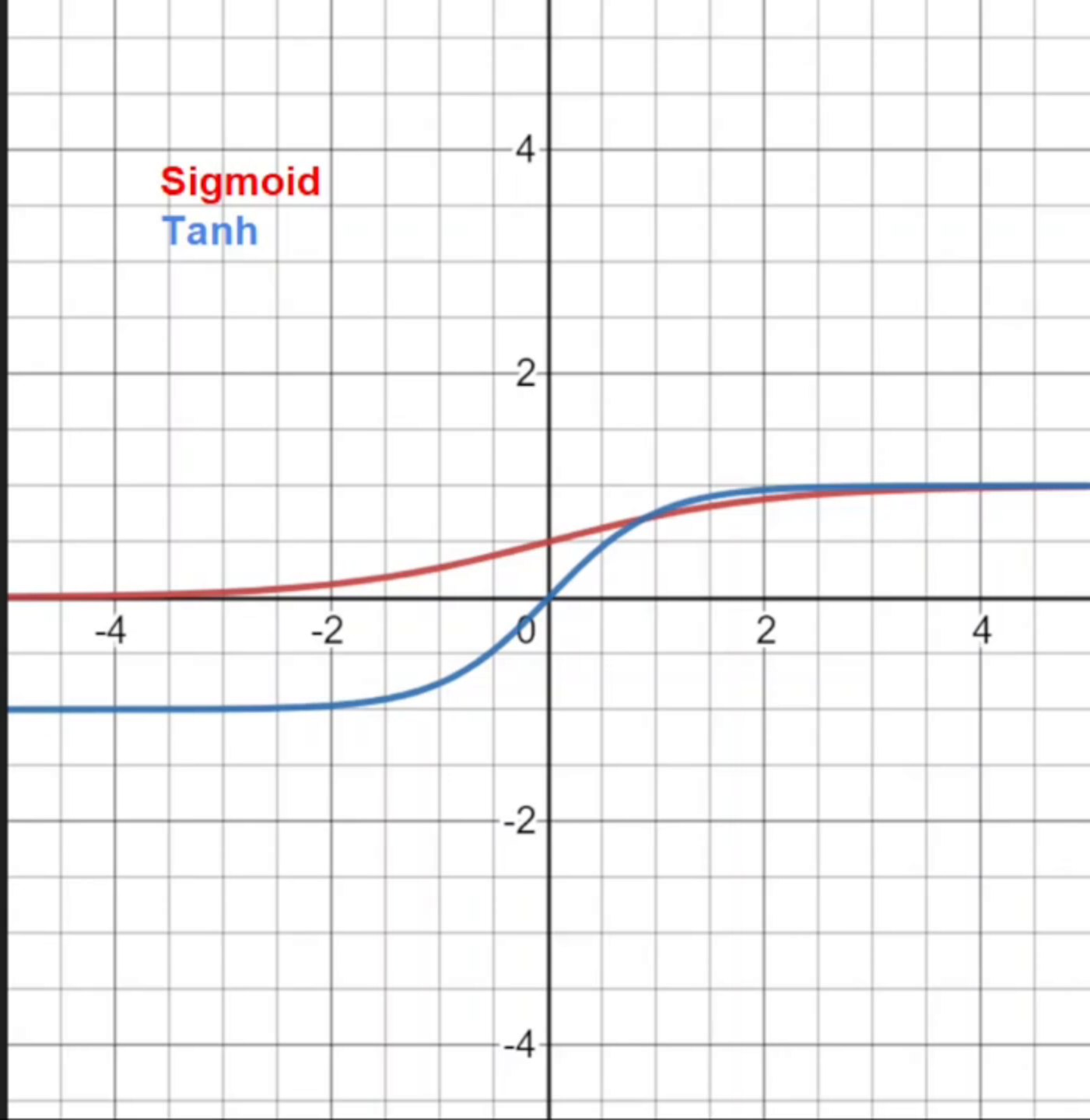
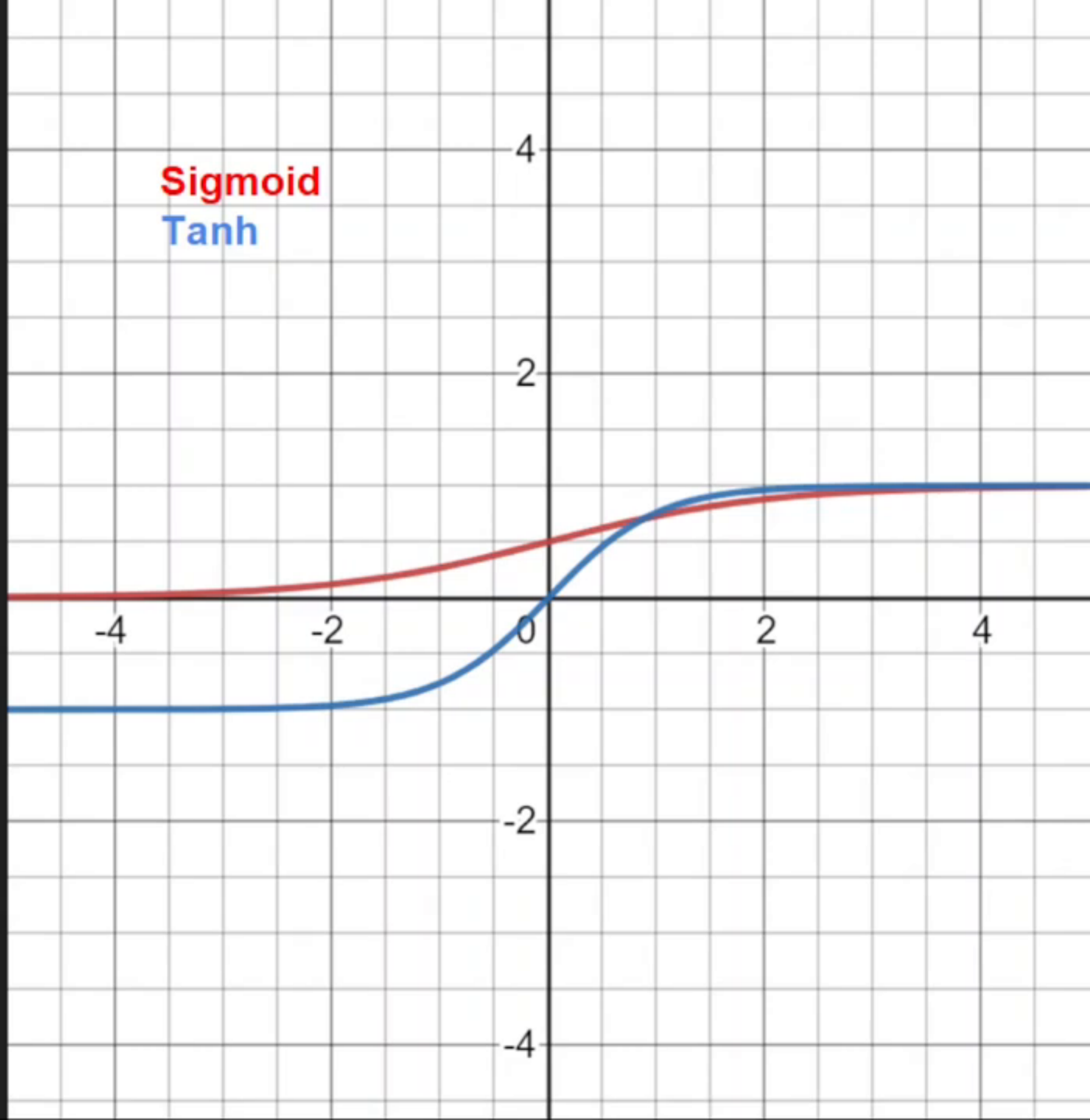


1)

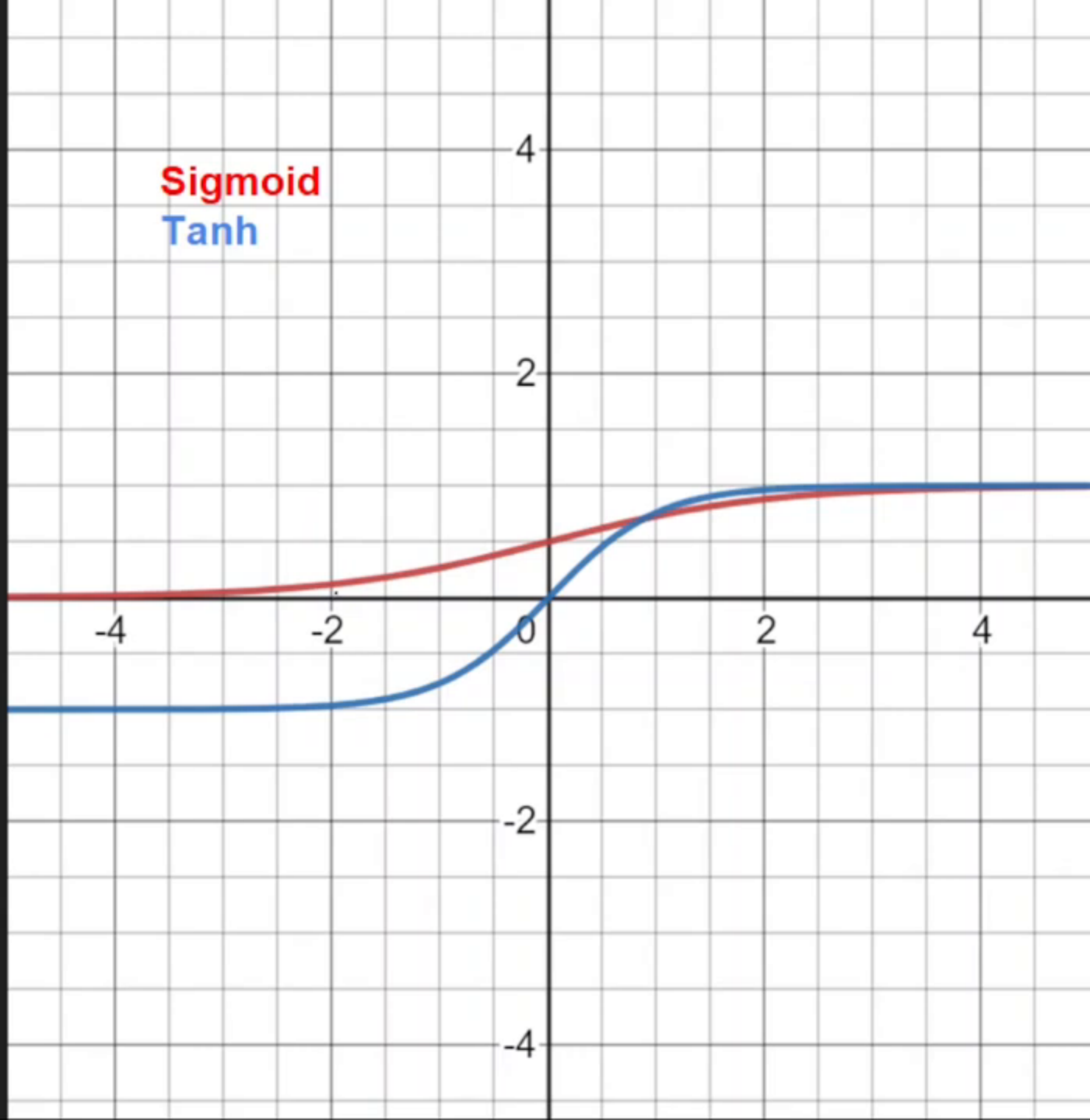


1) 0 – 1, -1 to +1



1) 0 – 1, −1 to +1

2) tanh is steeper



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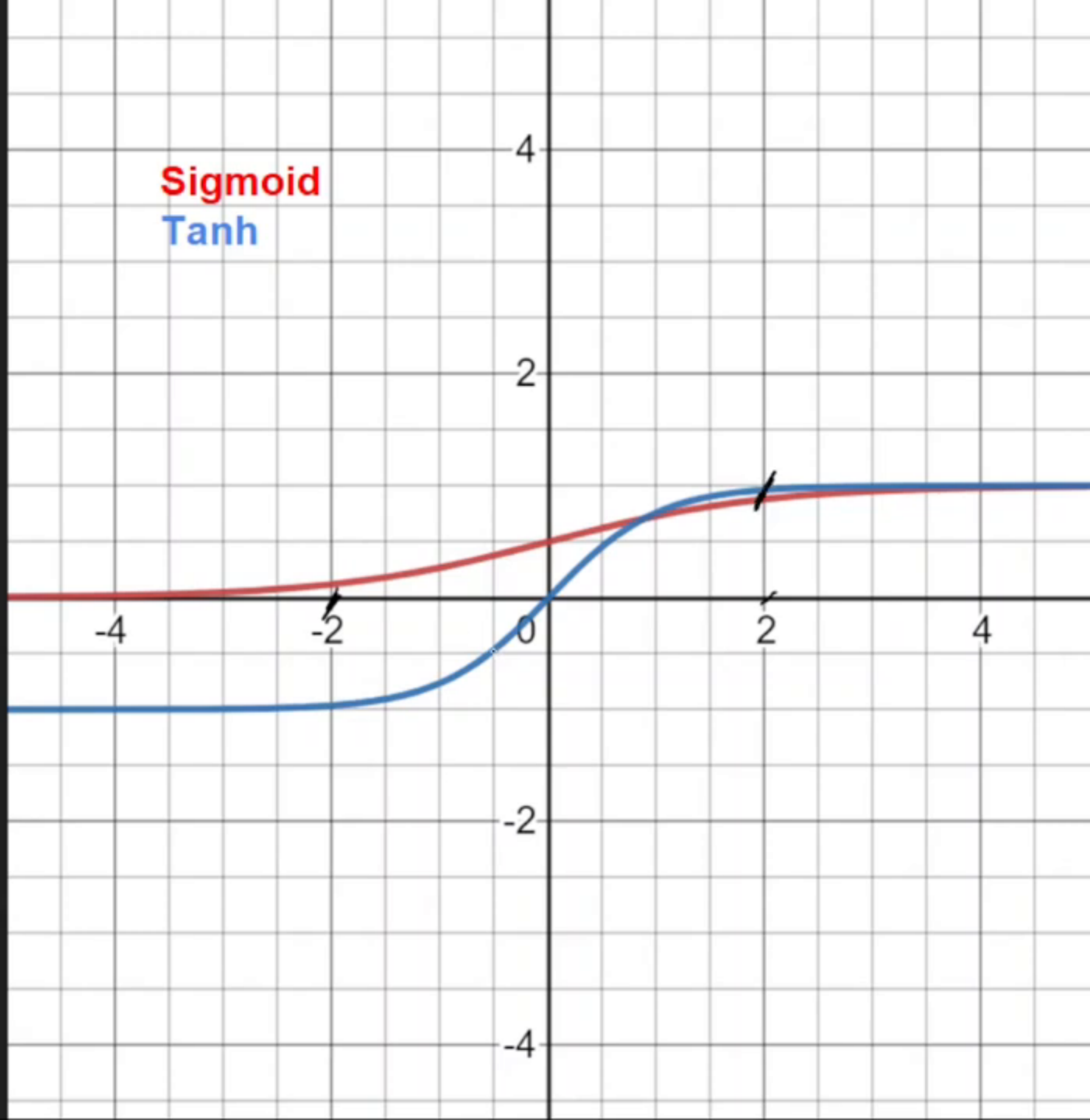

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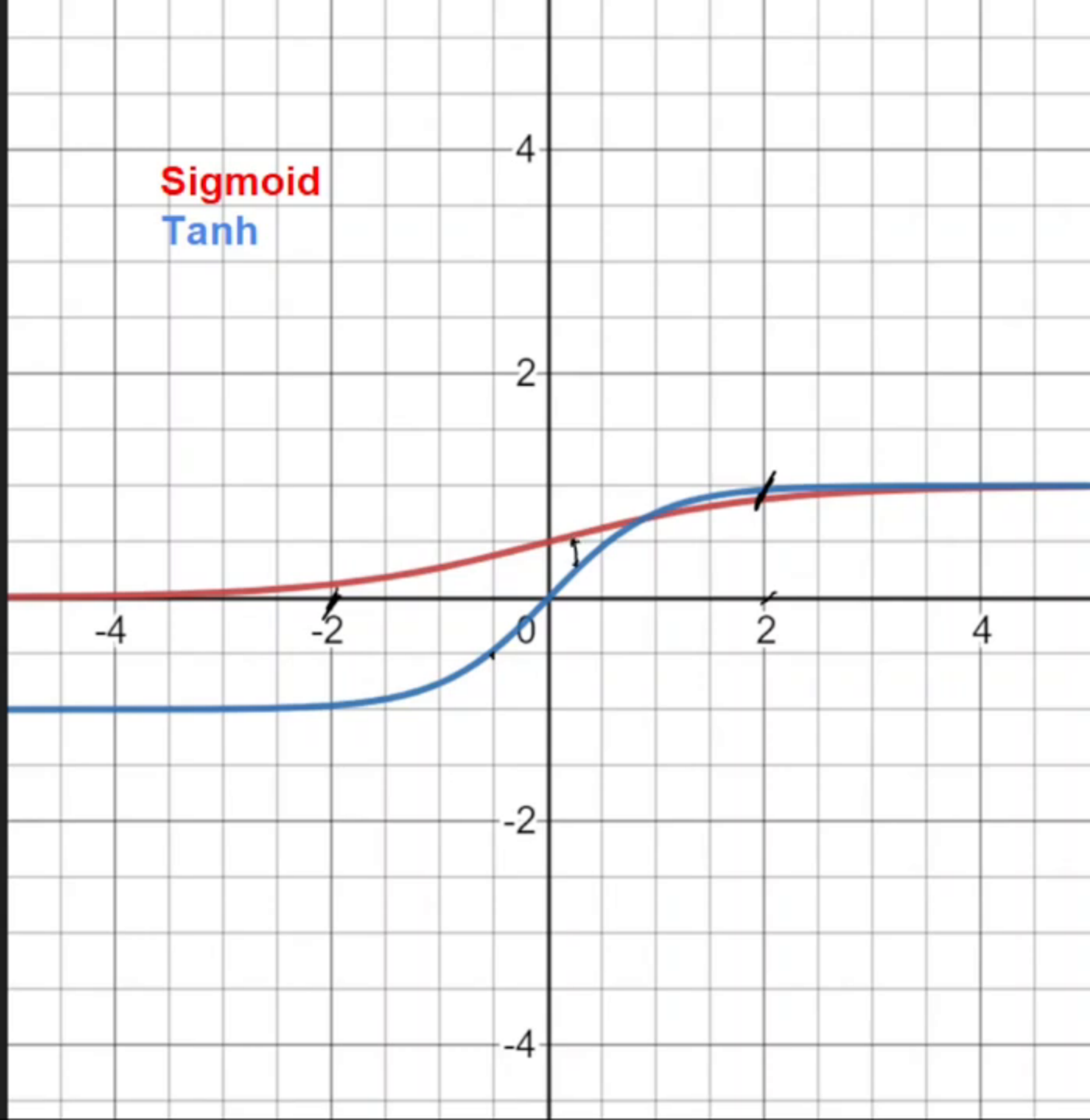
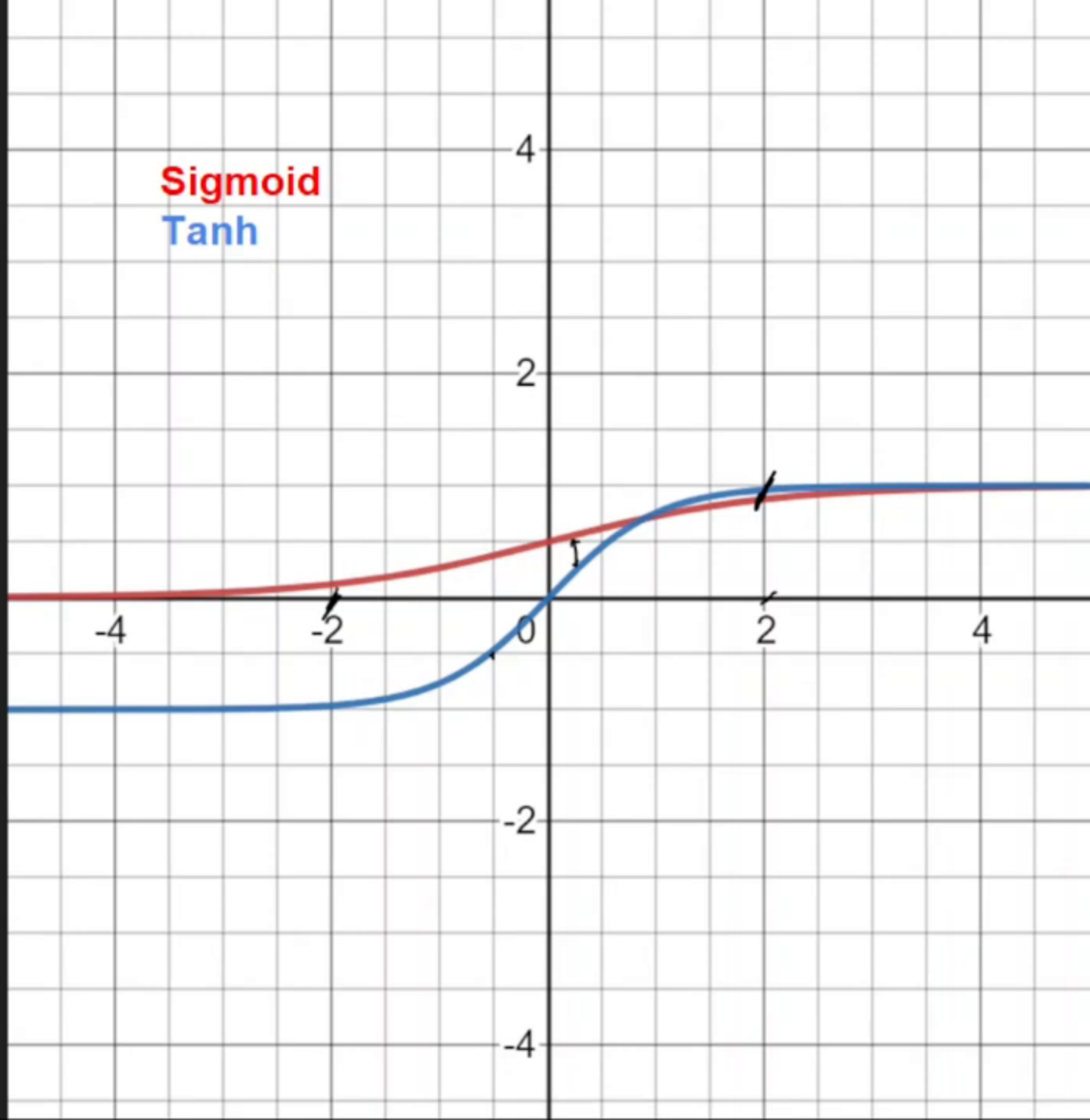


1) 0 – 1, −1 to +1

2) tanh is steeper

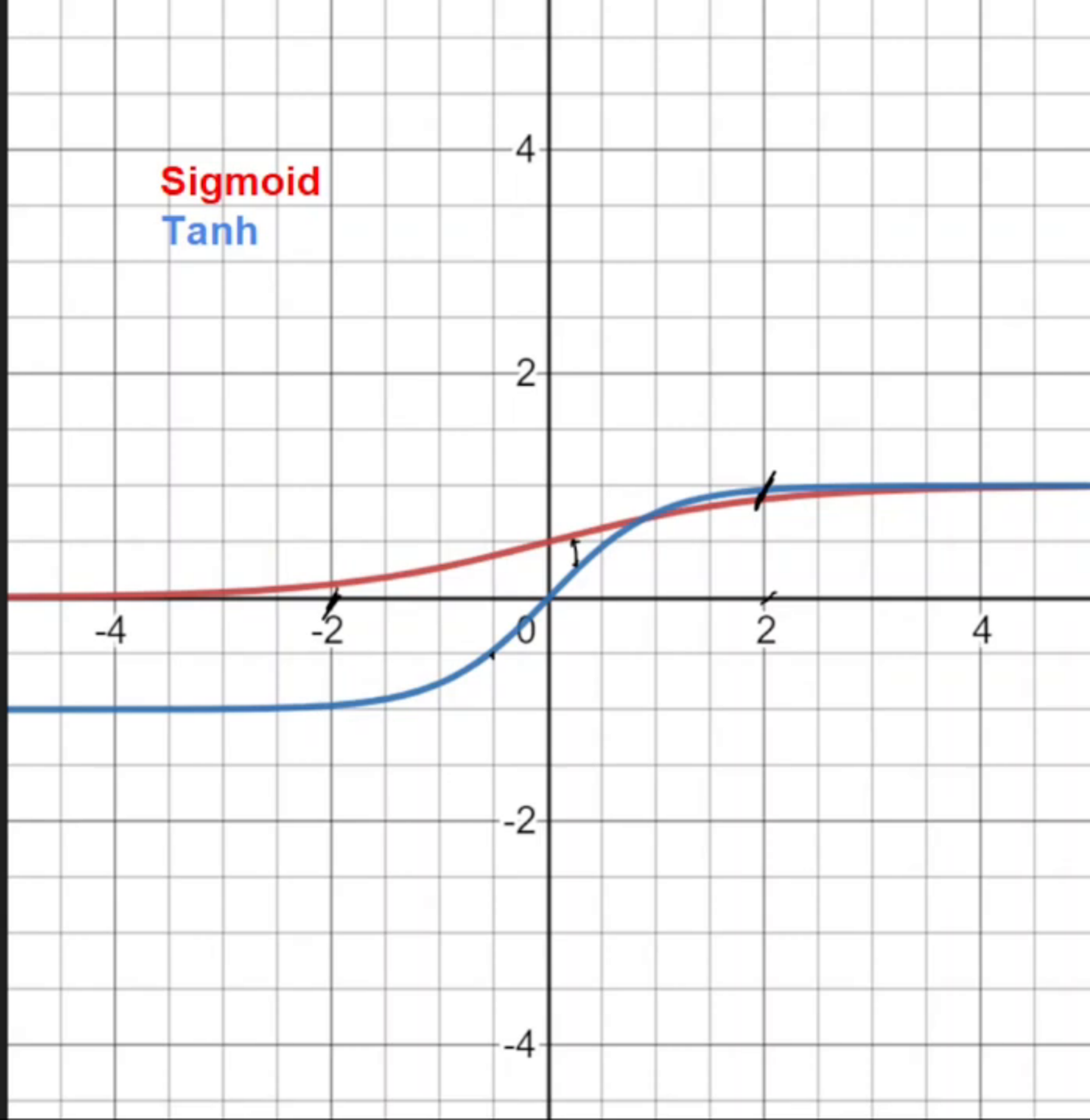
↓

large gradients



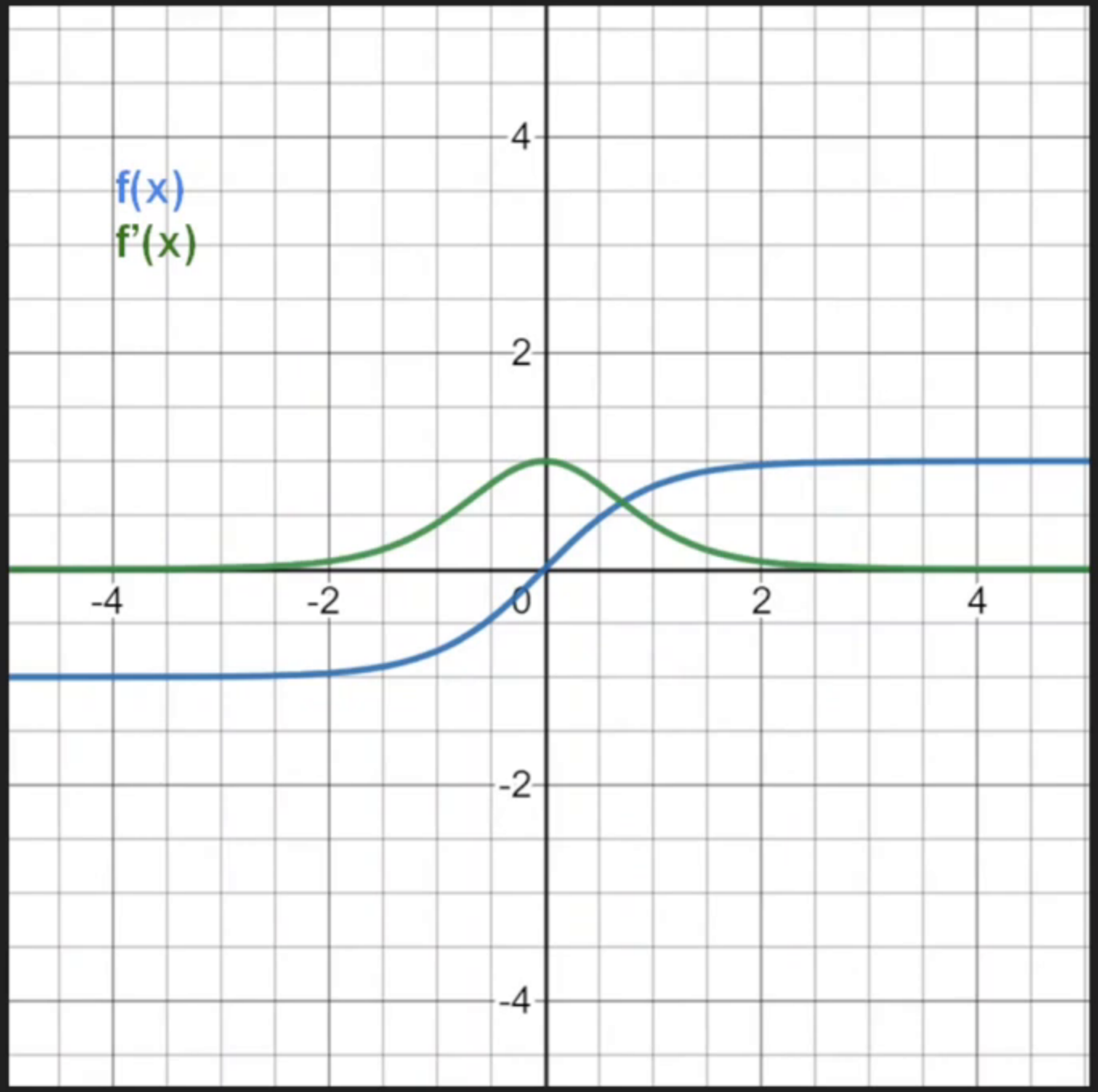
1) 0 – 1, −1 to +1

2) tanh is steeper
↓
large gradients
↓
-ve gradients
↓
faster



Derivative

$$1 - (\tanh(x))^2$$



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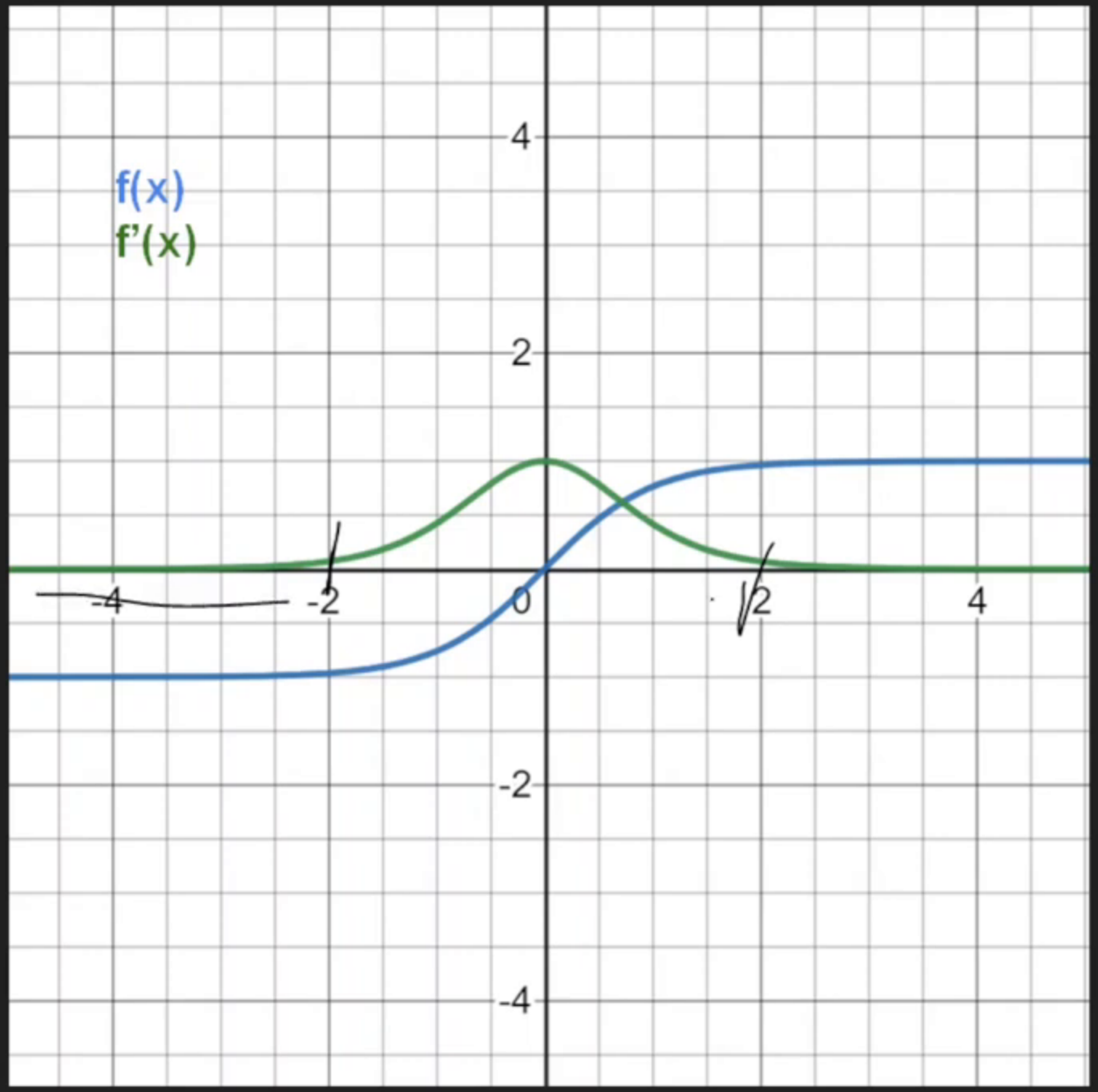

Derivative

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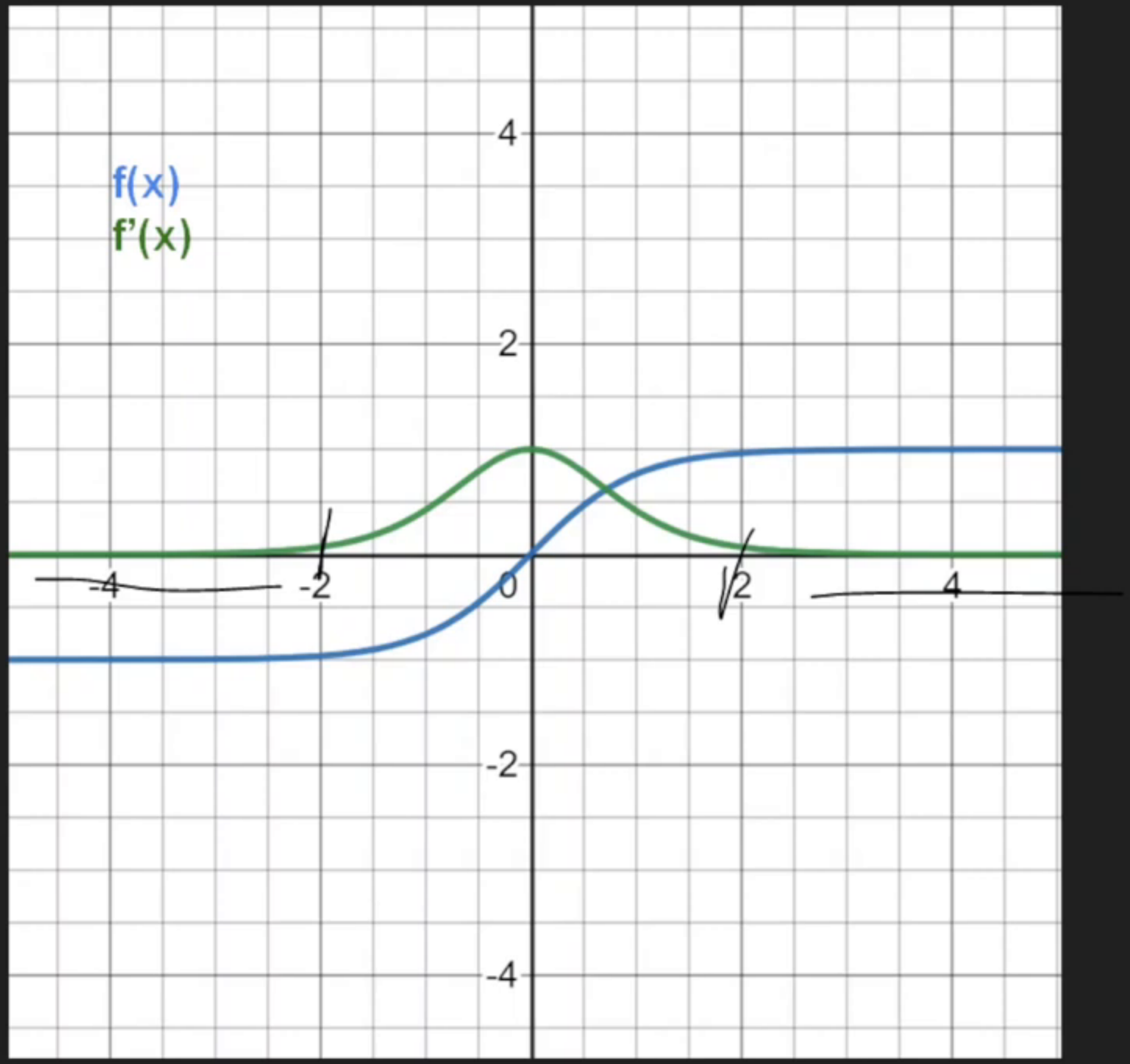
Vanishing Gradient



Derivative

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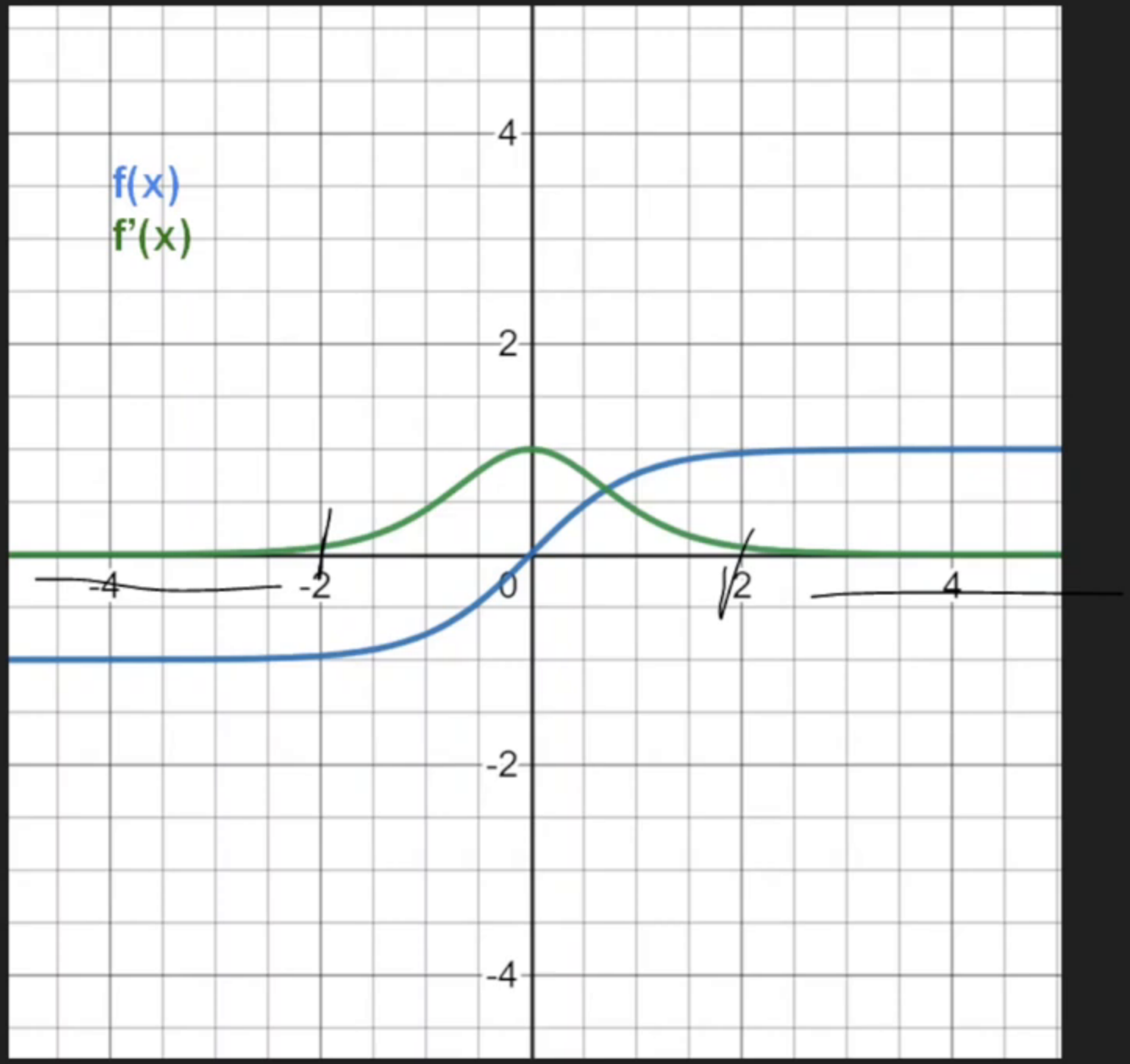
vanishing gradient

-1



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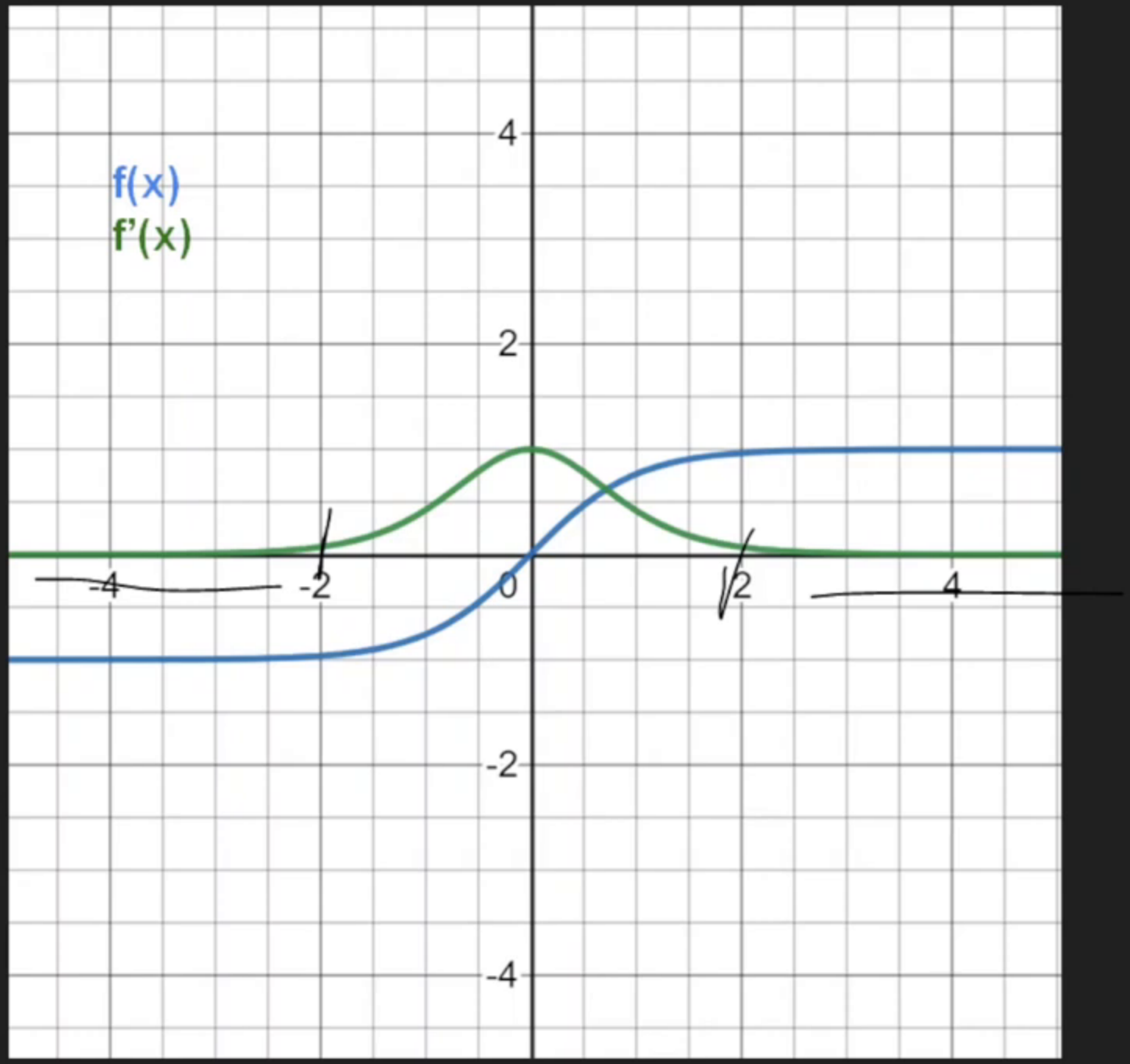
Vanishing Gradient

-1 to +1



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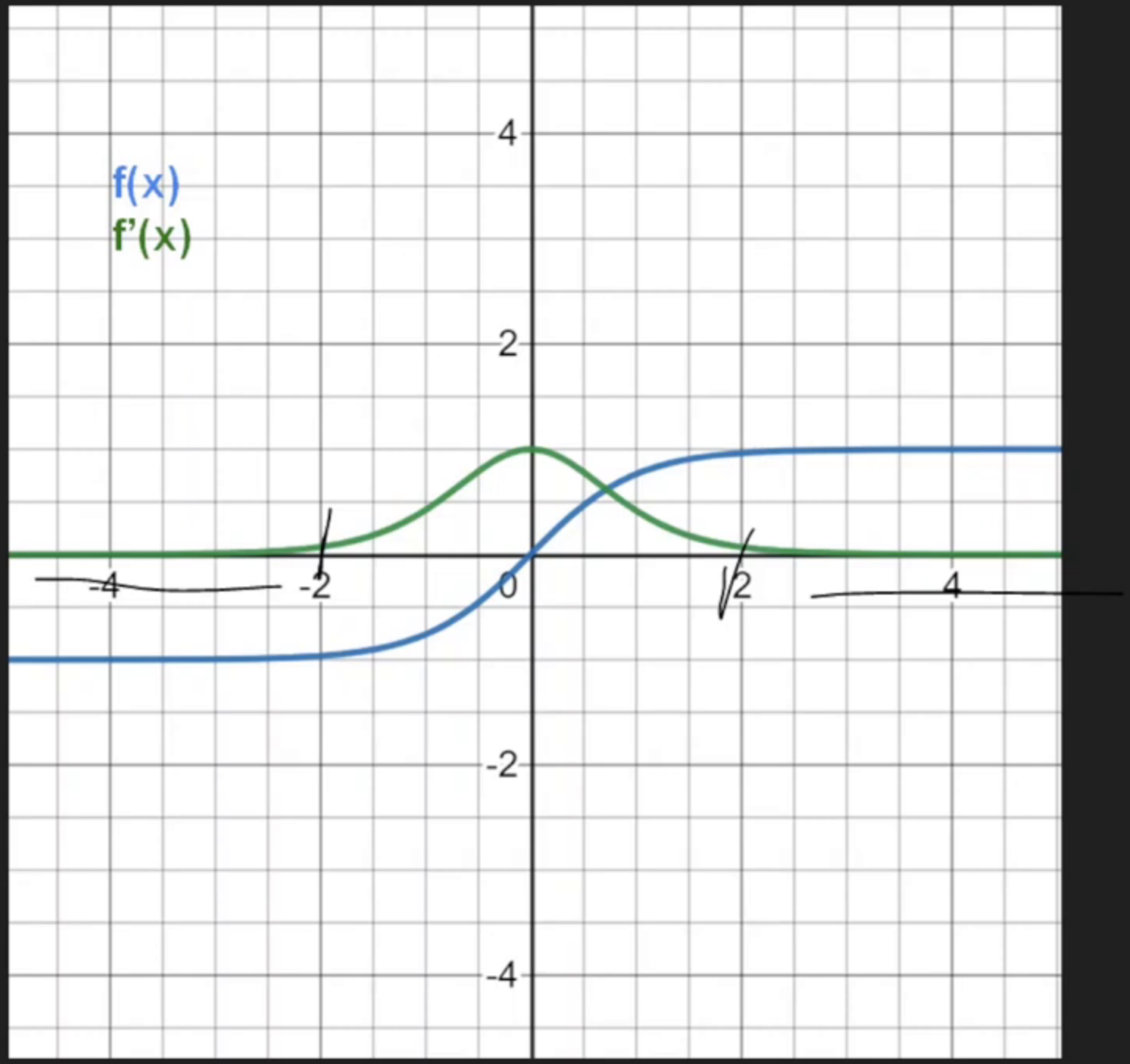
Vanishing Gradient

-1 to +1

→



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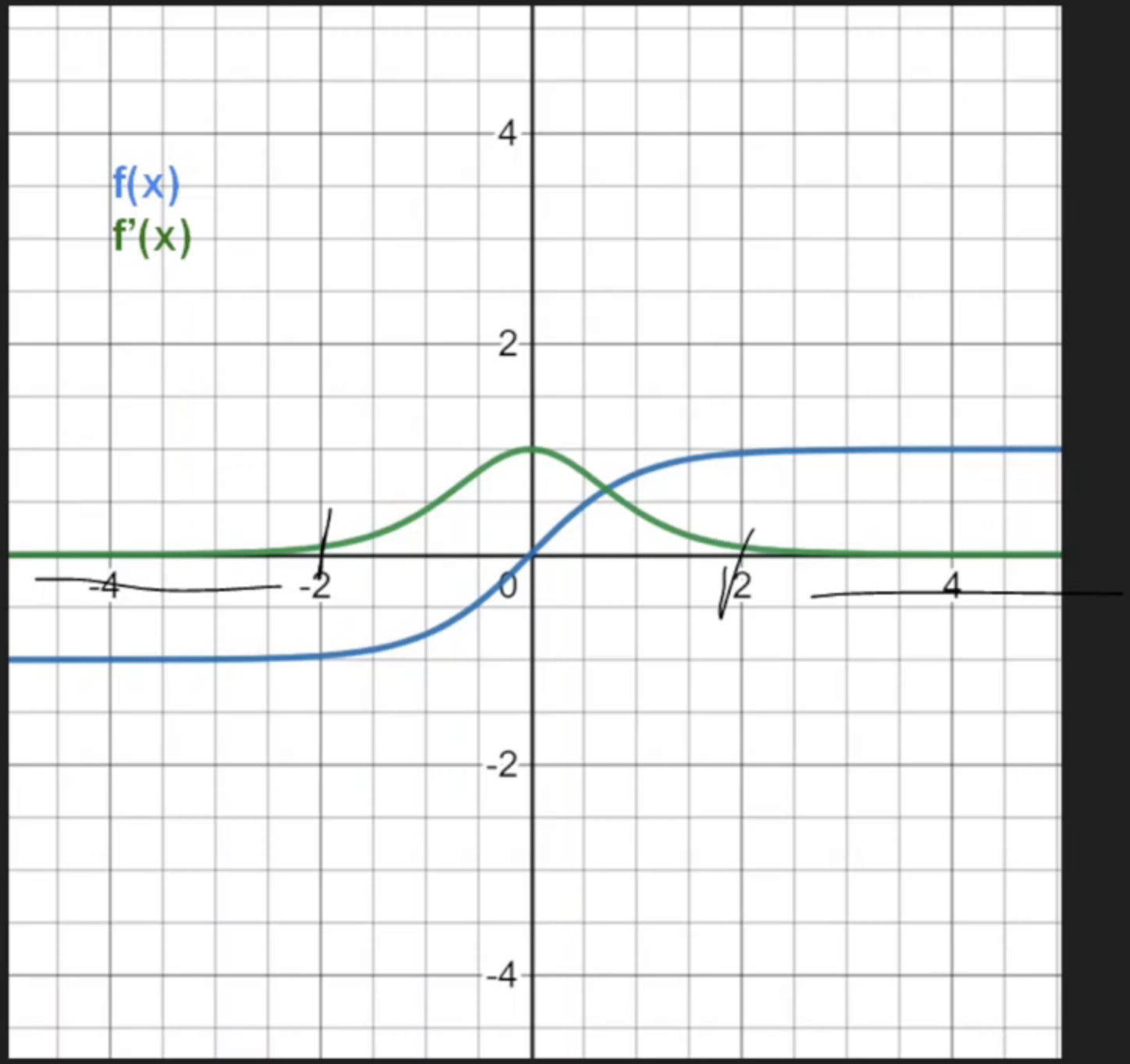
Vanishing Gradient

-1 to +1

→ only hidden layers
→ vanishing Gradient
→ Computationally expensive



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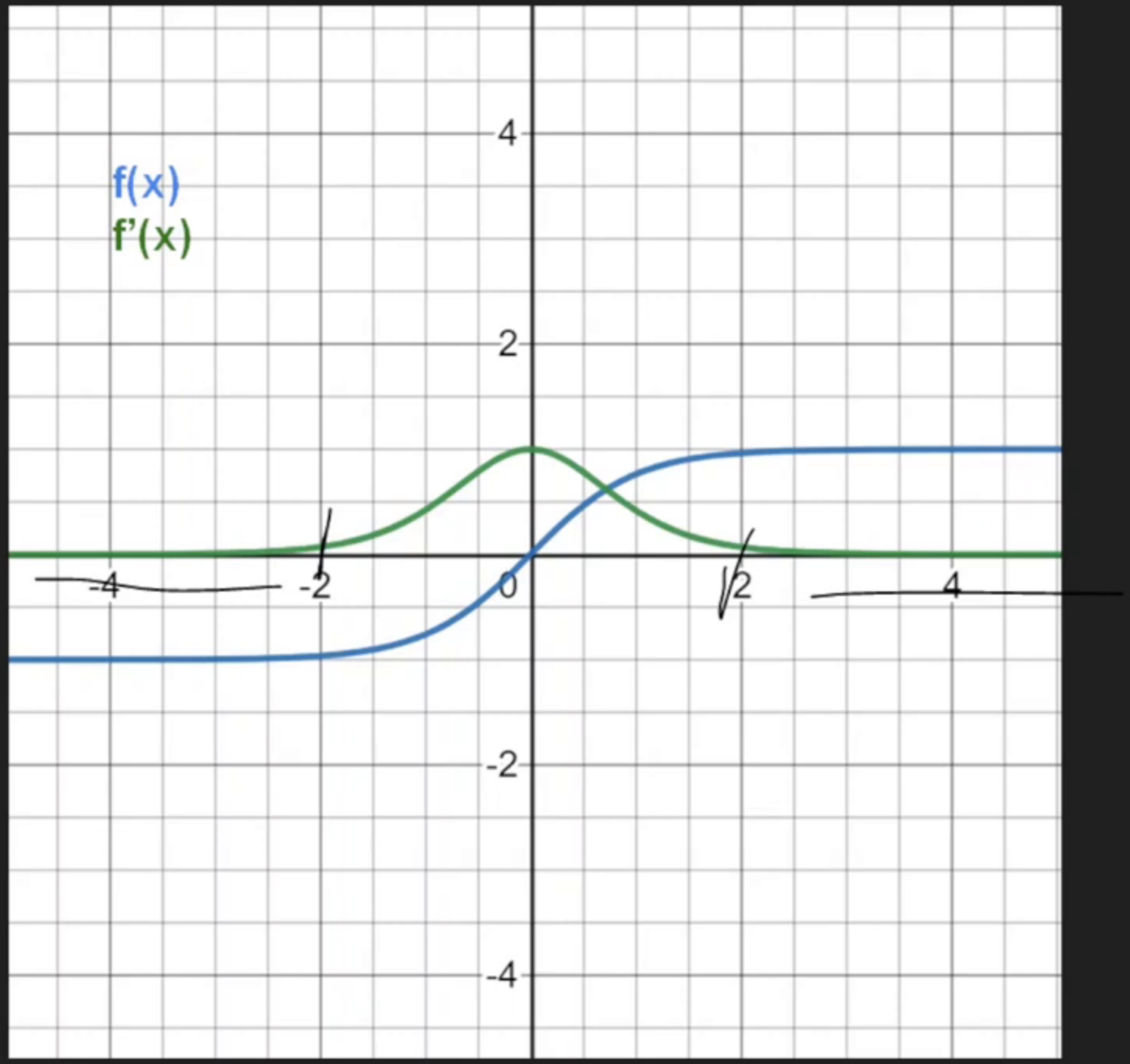

Python Implementation

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$$a = \frac{e^{z} - e^{-z}}{e^{z} + e^{-z}}$$

.

```
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Neuron.ipynb

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Tanh Activation

```
import matplotlib.pyplot as plt
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    t=(np.exp(x)-np.exp(-x))/(np.exp(x)+np.exp(-x))
    # t = np.tanh(x)
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```

```
[ ] z=np.arange(-4,4,0.01)

    fig, ax = plt.subplots(figsize=(9, 5))
    ax.spines['left'].set_position('center')
    ax.spines['bottom'].set_position('center')
    ax.spines['right'].set_color('none')
    ax.spines['top'].set_color('none')
    ax.xaxis.set_ticks_position('bottom')
    ax.yaxis.set_ticks_position('left')
    ax.plot(z,tanh(z)[0], color="#307EC7", linewidth=3, label="tanh")
    ax.plot(z,tanh(z)[1], color="#9621E2", linewidth=3, label="derivative")
    ax.legend(loc="upper left", frameon=False)
    fig.show()
```

```
[ ]
```

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Neuron.ipynb

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[ ]
```

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Tanh Activation

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```

[ ]

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Tanh Activation

[1]
```
import matplotlib.pyplot as plt
import numpy as np
def tanh(x):
    t=(np.exp(x)-np.exp(-x))/(np.exp(x)+np.exp(-x))
    # t = np.tanh(x)
    dt=1-t**2
    return t,dt
```

```
z=np.arange(-4,4,0.01)

fig, ax = plt.subplots(figsize=(9, 5))
ax.spines['left'].set_position('center')
ax.spines['bottom'].set_position('center')
ax.spines['right'].set_color('none')
ax.spines['top'].set_color('none')
ax.xaxis.set_ticks_position('bottom')
ax.yaxis.set_ticks_position('left')
ax.plot(z,tanh(z)[0], color="#307EC7", linewidth=3, label="tanh")
ax.plot(z,tanh(z)[1], color="#9621E2", linewidth=3, label="derivative")
ax.legend(loc="upper left", frameon=False)
fig.show()
```

[ ]

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Neuron.ipynb

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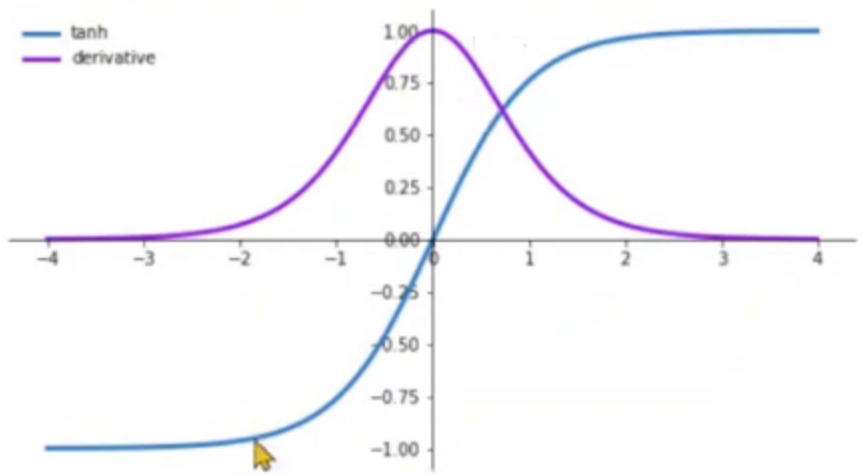

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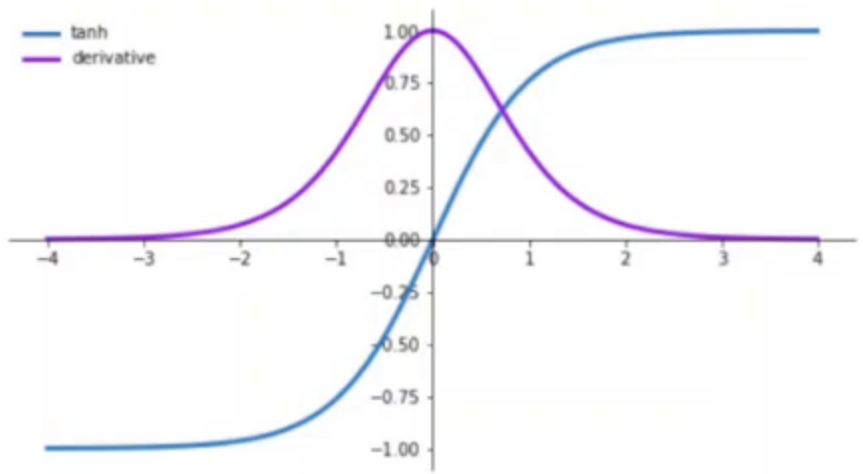

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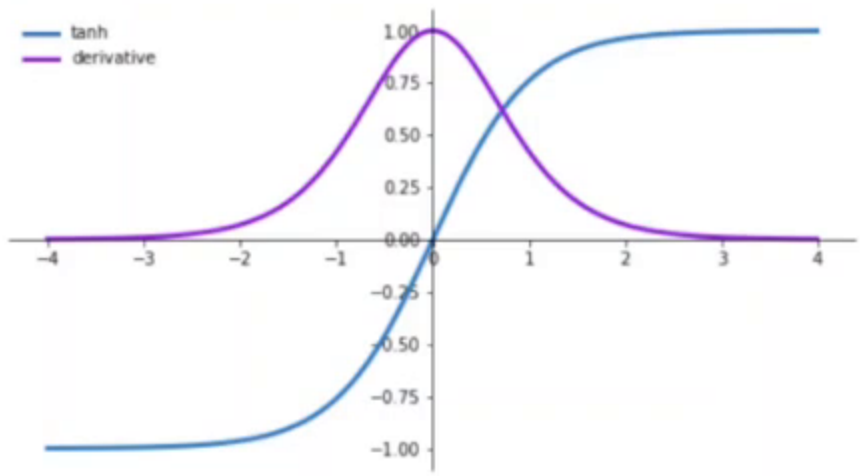

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