

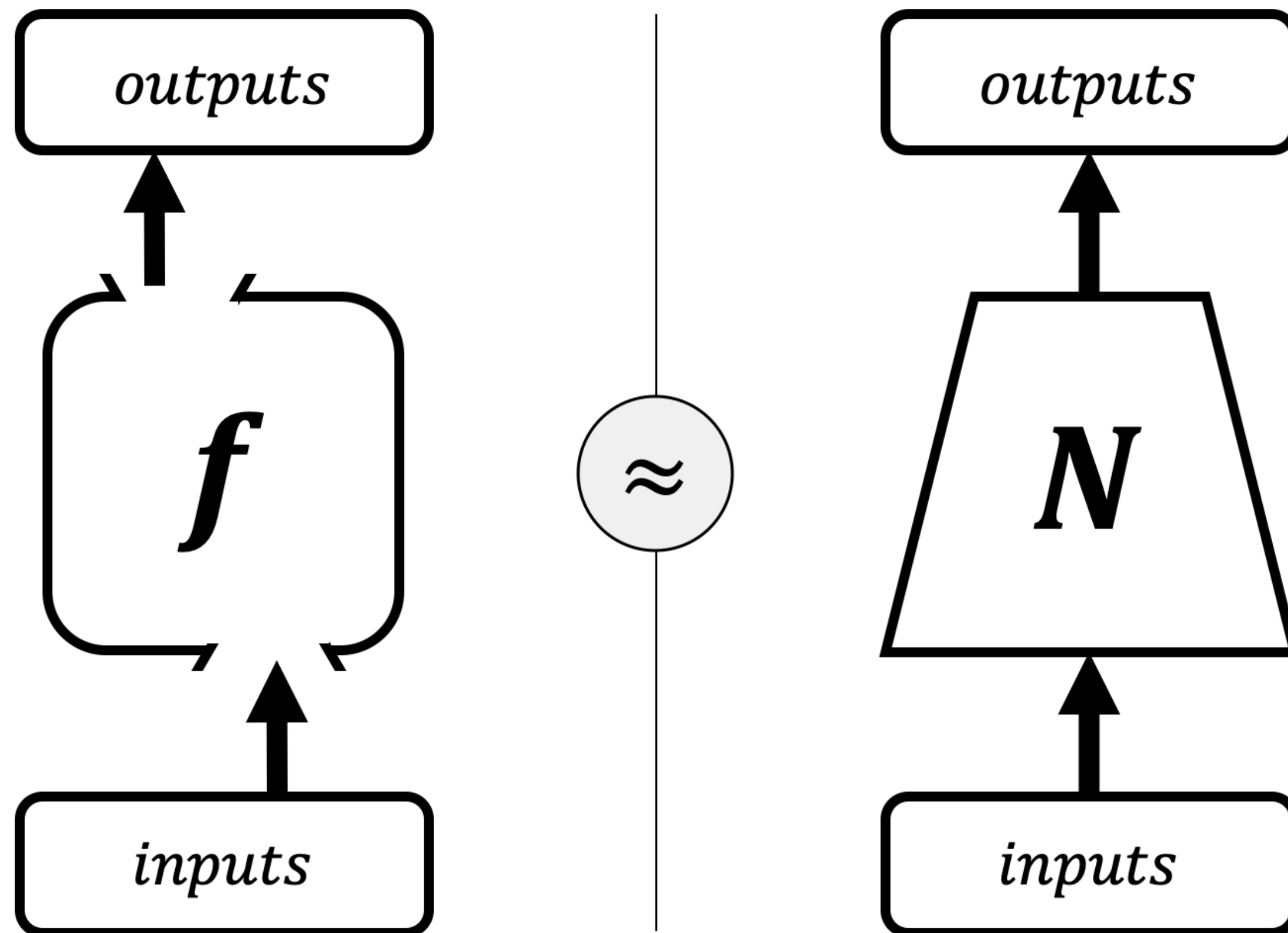
BASIC OF NEURAL NETWORKS

NEURAL NETWORKS & TENSORS

NEURAL NETWORKS

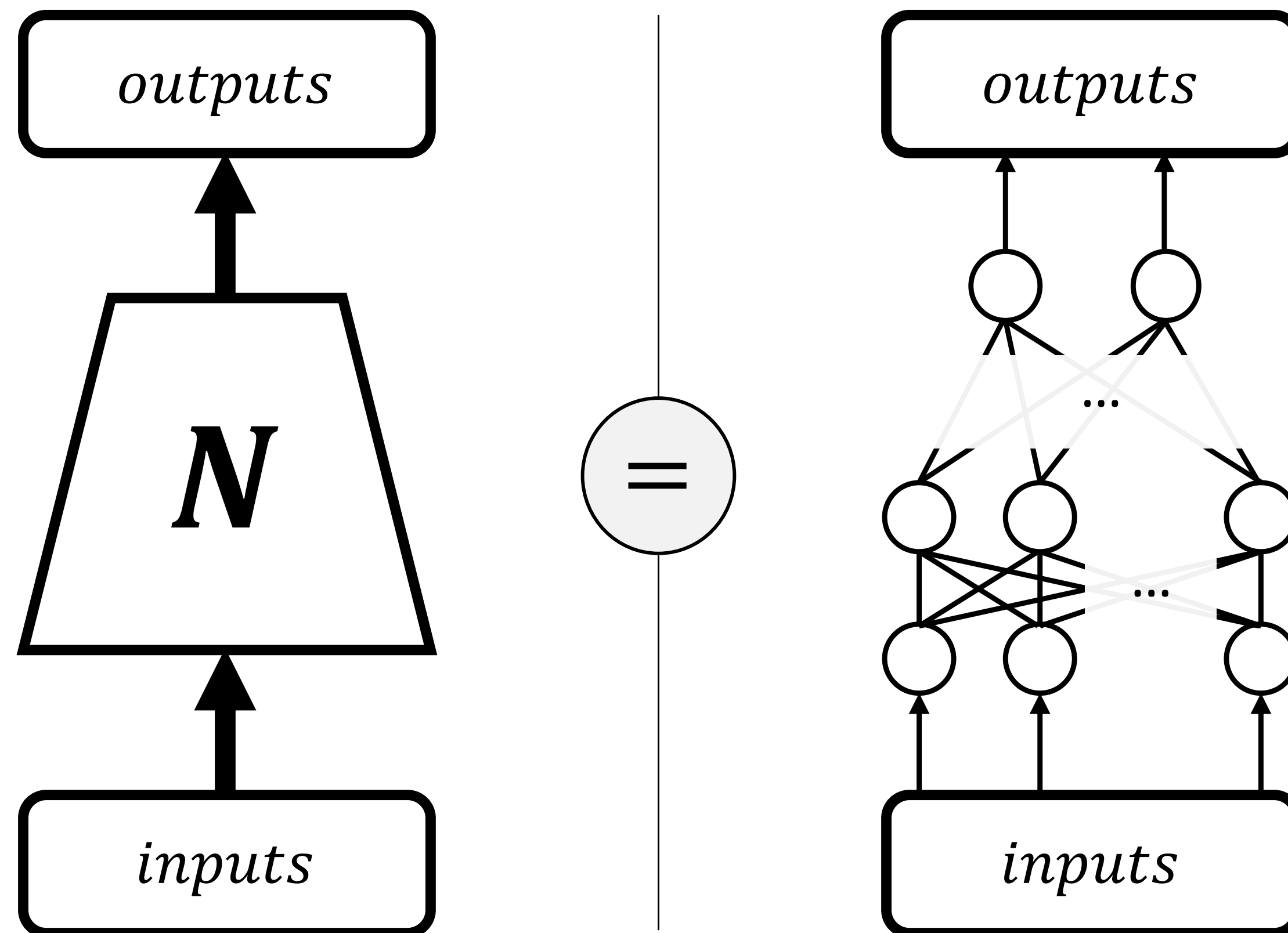
WHAT IS NEURAL NETWORK

▶ 함수의 근사

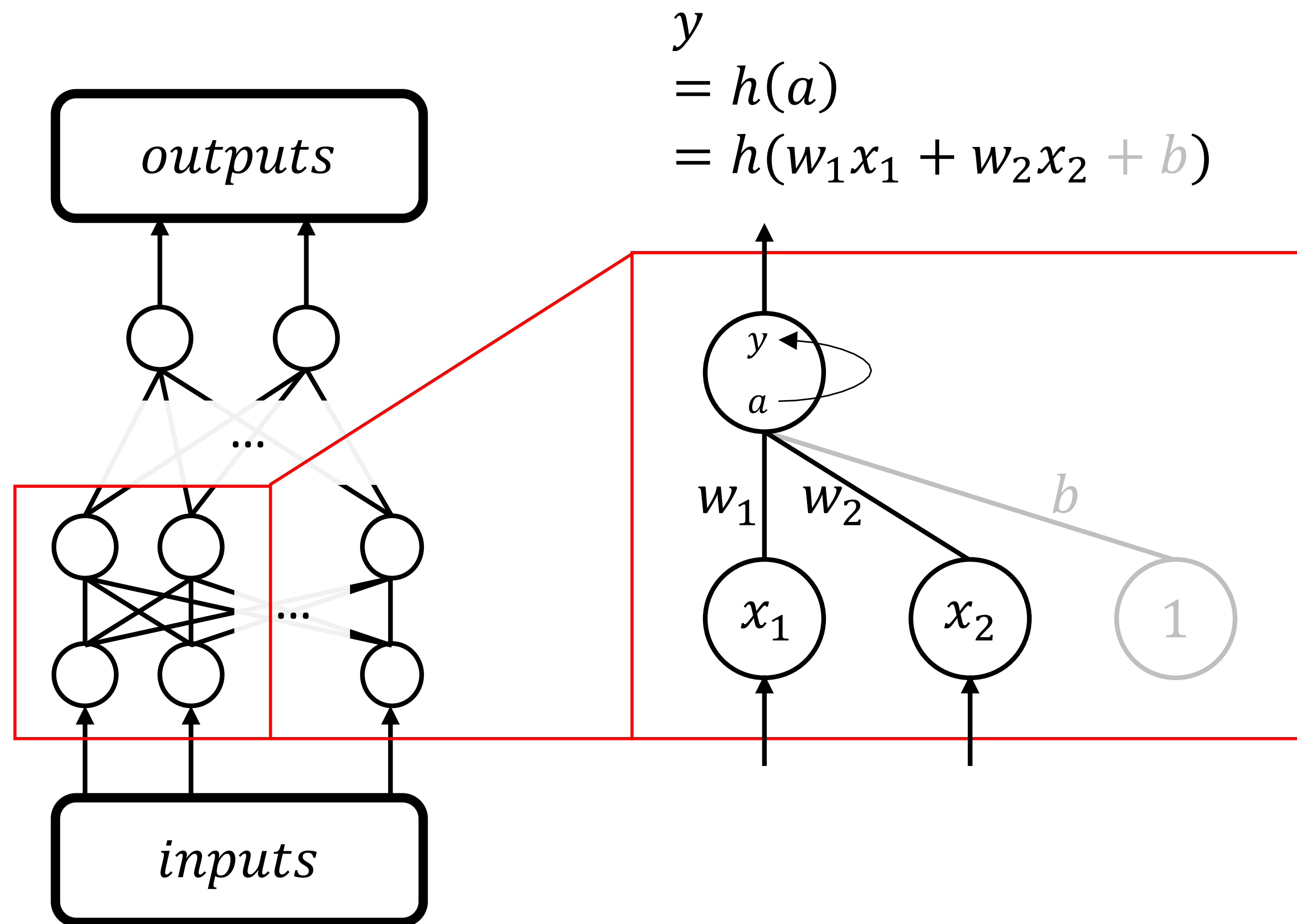


WHAT IS NEURAL NETWORK

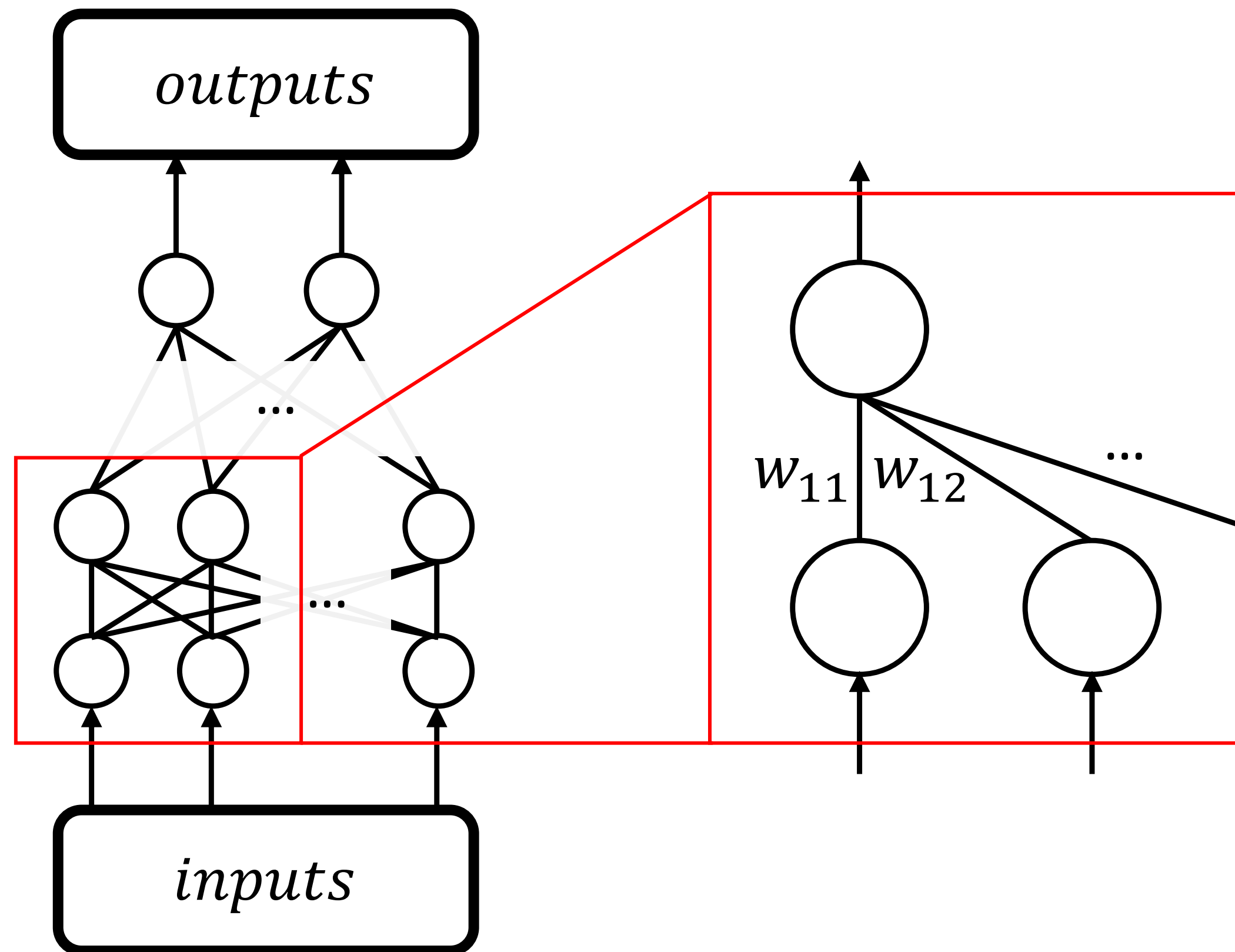
- ▶ Inputs \rightarrow "BlackBox" \rightarrow Outputs



WHAT IS NEURAL NETWORK



WHAT IS NEURAL NETWORK

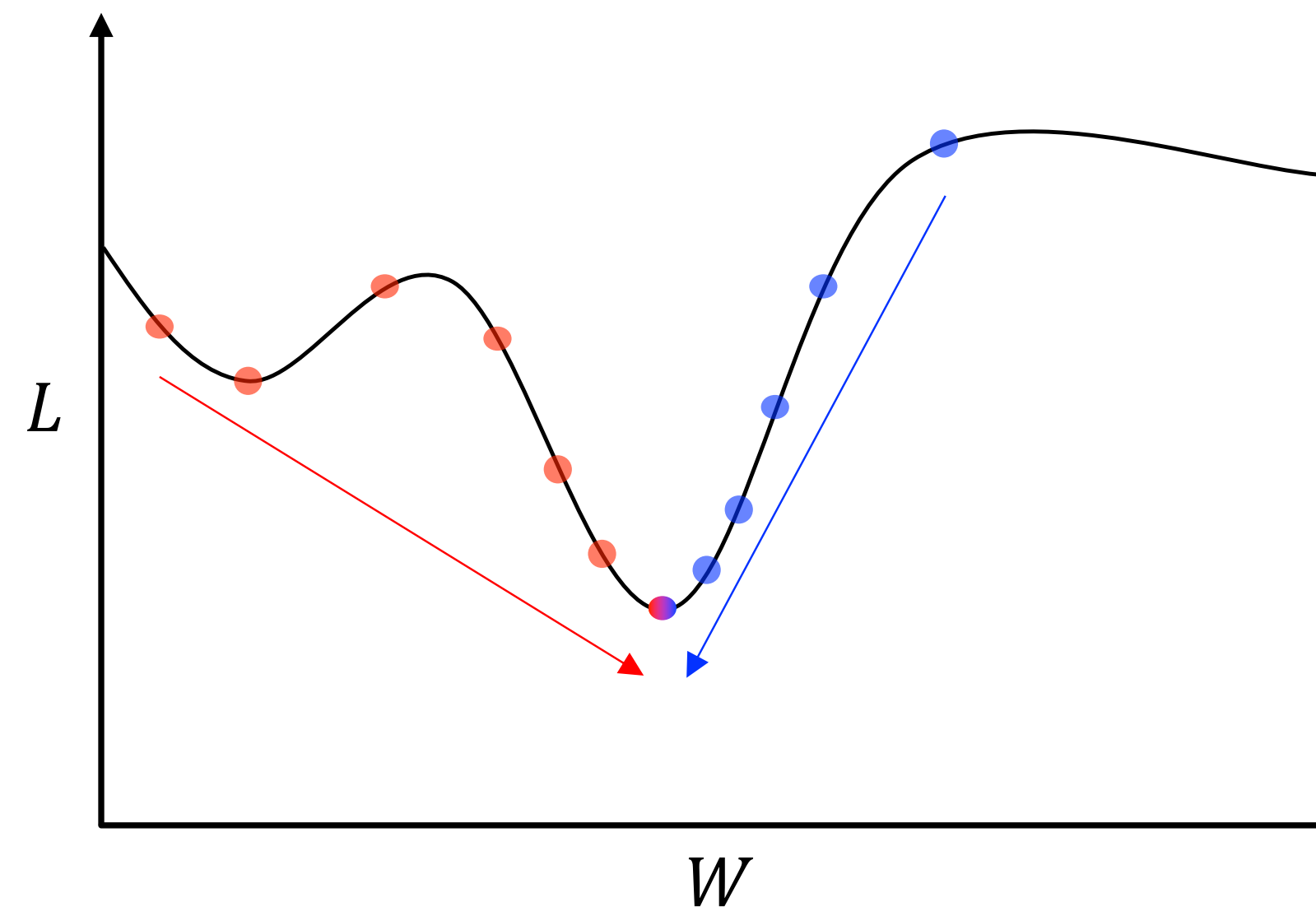
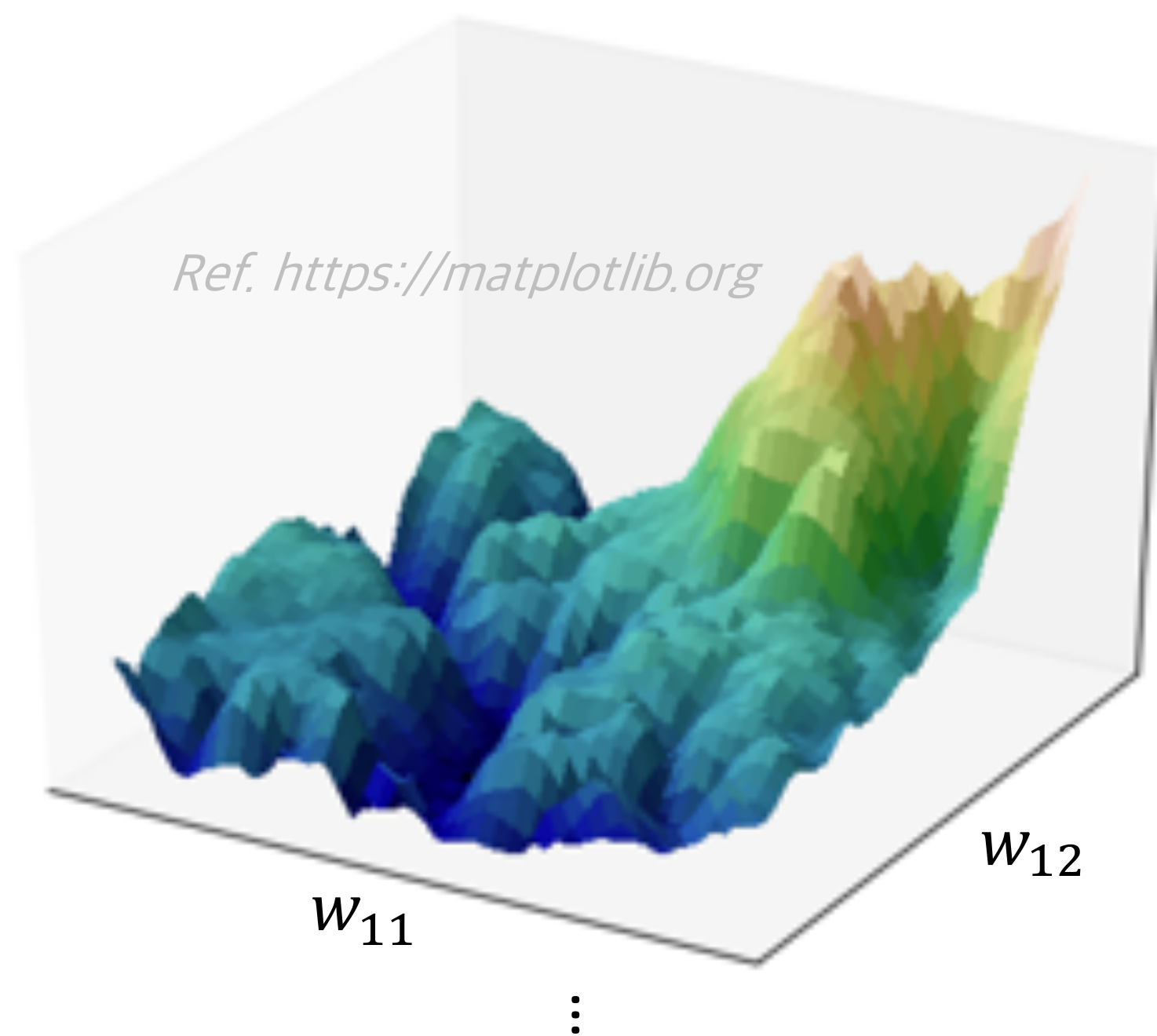


$$W = \begin{bmatrix} w_{11} & \cdots & w_{1n} \\ \vdots & \ddots & \vdots \\ w_{m1} & \cdots & w_{mn} \end{bmatrix}$$

► and Biases

WHAT IS NEURAL NETWORK

- ▶ Gradient Descent
- ▶ Not 'accuracy' but 'loss'



TENSORS

WHAT IS TENSOR

- ▶ Everything is tensor

 $[s]$

Scalar
(*rank 0*)

 $\begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{bmatrix}$

vector
(*rank 1*)

 $\begin{bmatrix} m_{11} & m_{12} & \dots & m_{1n} \\ m_{21} & m_{22} & \dots & m_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ m_{k1} & m_{k2} & \dots & m_{kn} \end{bmatrix}$

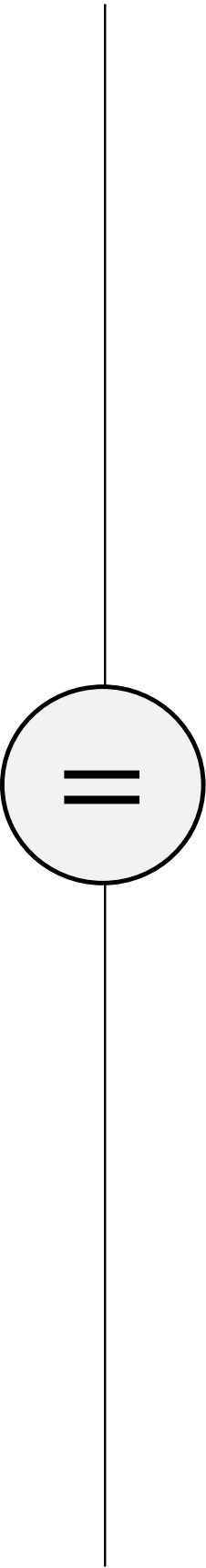
matrix
(*rank 2*)

WHAT IS TENSOR

- ▶ Everything is tensor
- ▶ Rank 4, and so on ...

$$\begin{bmatrix} \begin{bmatrix} t_{111} & t_{112} & \dots & t_{11n} \\ t_{121} & t_{122} & \dots & t_{12n} \\ \vdots & \vdots & \ddots & \vdots \\ t_{1k1} & t_{1k2} & \dots & t_{1kn} \end{bmatrix} & \begin{bmatrix} t_{211} & t_{212} & \dots & t_{21n} \\ t_{221} & t_{222} & \dots & t_{22n} \\ \vdots & \vdots & \ddots & \vdots \\ t_{2k1} & t_{2k2} & \dots & t_{2kn} \end{bmatrix} & \dots & \begin{bmatrix} t_{l11} & t_{l12} & \dots & t_{l1n} \\ t_{l21} & t_{l22} & \dots & t_{l2n} \\ \vdots & \vdots & \ddots & \vdots \\ t_{lk1} & t_{lk2} & \dots & t_{lkn} \end{bmatrix} \\ \vdots & \vdots & \ddots & \vdots \\ \begin{bmatrix} t_{i11} & t_{i12} & \dots & t_{i1n} \\ t_{i21} & t_{i22} & \dots & t_{i2n} \\ \vdots & \vdots & \ddots & \vdots \\ t_{ik1} & t_{ik2} & \dots & t_{ikn} \end{bmatrix} & \begin{bmatrix} t_{i+111} & t_{i+112} & \dots & t_{i+11n} \\ t_{i+121} & t_{i+122} & \dots & t_{i+12n} \\ \vdots & \vdots & \ddots & \vdots \\ t_{i+1k1} & t_{i+1k2} & \dots & t_{i+1kn} \end{bmatrix} & \dots & \begin{bmatrix} t_{ln1} & t_{ln2} & \dots & t_{lnn} \\ t_{ln2} & t_{ln2} & \dots & t_{lnn} \\ \vdots & \vdots & \ddots & \vdots \\ t_{lnk1} & t_{lnk2} & \dots & t_{lnkn} \end{bmatrix} \end{bmatrix}$$

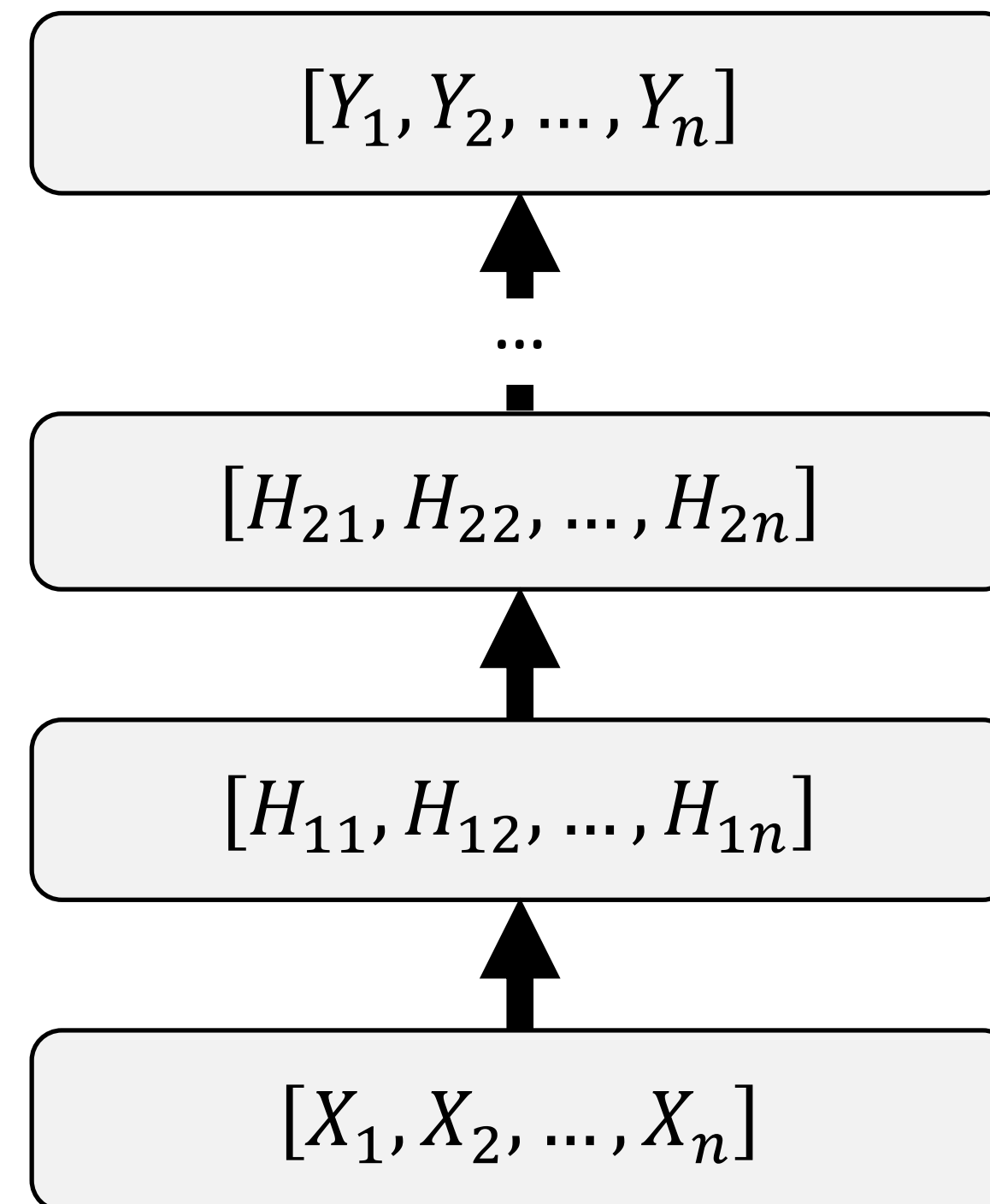
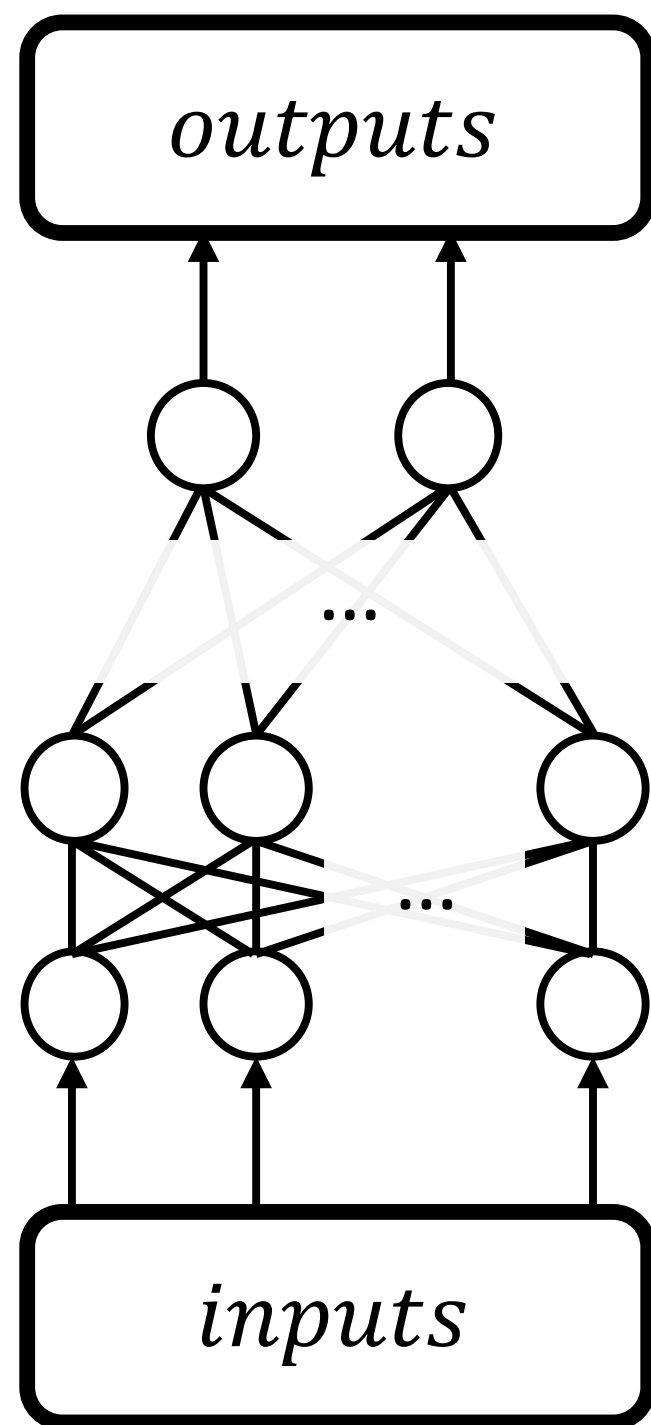
Rank-3 Tensor
(rank 3)



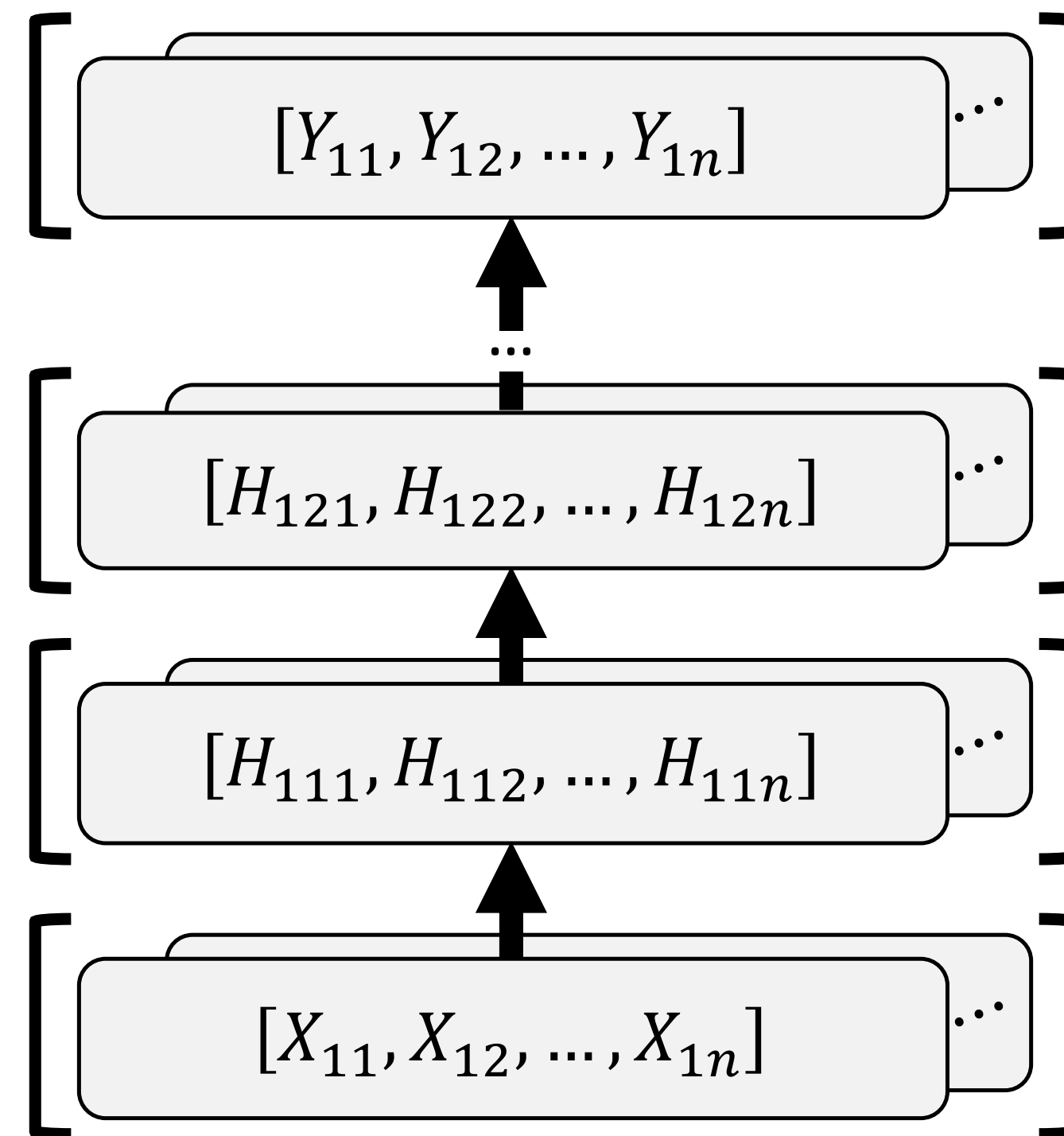
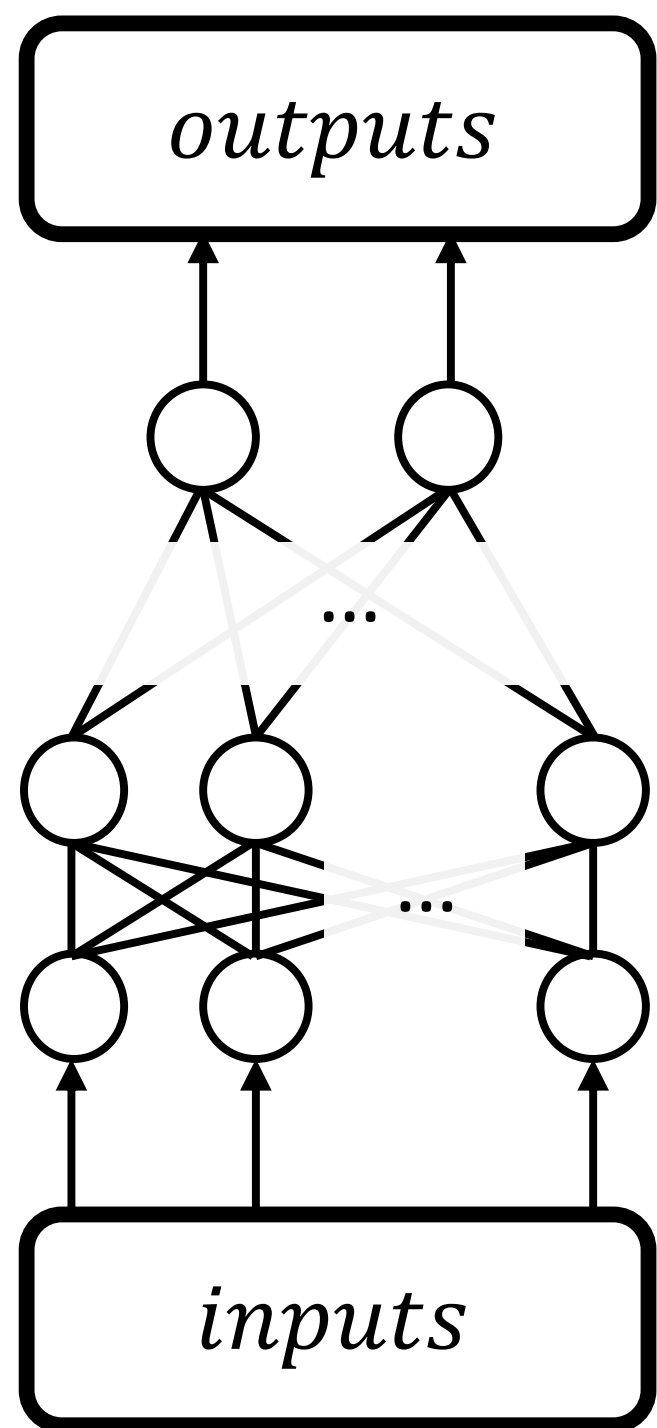
$$\begin{bmatrix} \begin{bmatrix} t_{111} & t_{112} & \dots & t_{11n} \\ t_{121} & t_{122} & \dots & t_{12n} \\ \vdots & \vdots & \ddots & \vdots \\ t_{1k1} & t_{1k2} & \dots & t_{1kn} \end{bmatrix} \\ \begin{bmatrix} t_{211} & t_{212} & \dots & t_{21n} \\ t_{221} & t_{222} & \dots & t_{22n} \\ \vdots & \vdots & \ddots & \vdots \\ t_{2k1} & t_{2k2} & \dots & t_{2kn} \end{bmatrix} \\ \vdots \\ \begin{bmatrix} t_{l11} & t_{l12} & \dots & t_{l1n} \\ t_{l21} & t_{l22} & \dots & t_{l2n} \\ \vdots & \vdots & \ddots & \vdots \\ t_{lk1} & t_{lk2} & \dots & t_{lkn} \end{bmatrix} \end{bmatrix}$$

Rank-3 Tensor
(rank 3)

TENSORS IN NEURAL NETWORK



TENSORS IN NEURAL NETWORK



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