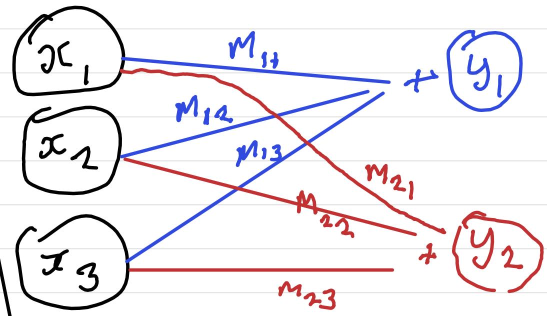
Consider
The Following Model :



3 inputs
2 outputs
No biases
or act. fn

Inputs as Col. Vectors

$$\begin{array}{c}\#\text{rows}\\=\\\#\text{outputs}\end{array}\left\{\underbrace{\begin{bmatrix} M_{11} & M_{12} & M_{13}\\ M_{21} & M_{22} & M_{23}\end{bmatrix}}_{\#\text{cols} = \#\text{inputs}}\right. \cdot \begin{bmatrix}x_1\\x_2\\x_3\end{bmatrix} = \begin{bmatrix}x_1M_{11}+x_2M_{12}+x_3M_{13}\\ x_1M_{21}+x_2M_{22}+x_3M_{23}\end{bmatrix} \to \begin{bmatrix}y_1\\ y_2\end{bmatrix}$$

Outputs as col vectors

Inputs As Row Vectors

$$\begin{bmatrix}x_1 & x_2 & x_3\end{bmatrix}\left.\overbrace{\begin{bmatrix} M_{11} & M_{21}\\ M_{12} & M_{22}\\ M_{13} & M_{23}\end{bmatrix}}^{\#\text{cols} = \#\text{outputs}}\right\}\begin{array}{c}\#\text{rows}\\=\#\text{inputs}\end{array} = \begin{bmatrix}x_1M_{11}+x_2M_{12}+x_3M_{13} & x_1M_{21}+x_2M_{22}+x_3M_{23}\end{bmatrix}$$

$$= \begin{bmatrix}y_1 & y_2\end{bmatrix}$$

Outputs as row vectors

This generalizes to Tensors, as you see in the lectures