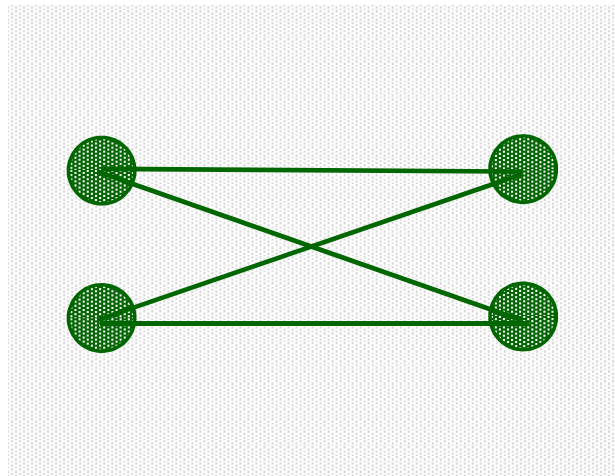
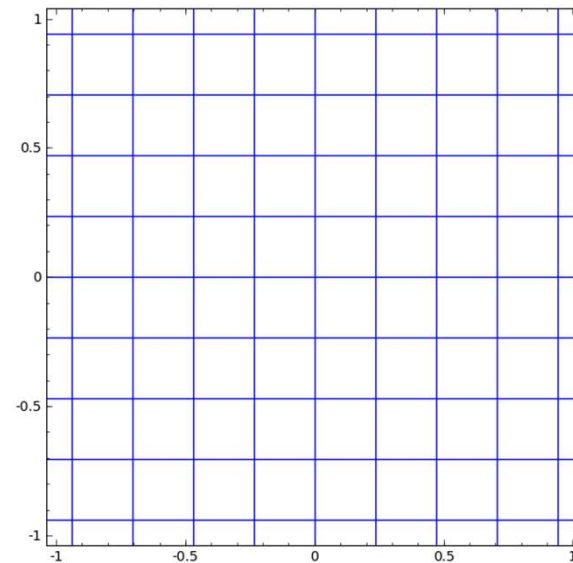


# Linear Transformation in Neural Networks

- Fully-connected layers (linear layer)



$$\mathbf{x} \xrightarrow{T_1} \mathbf{y}$$

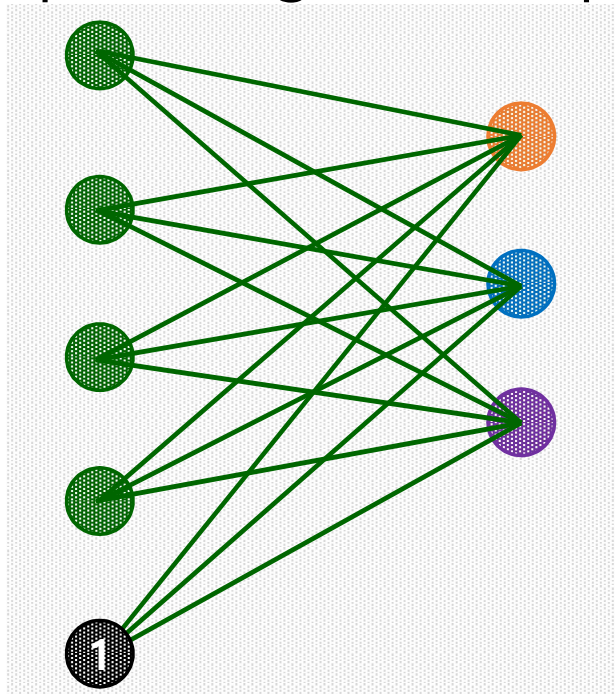


<https://colah.github.io/posts/2014-03-NN-Manifolds-Topology/>

# Affine Layer in Neural Networks

- Fully-connected layers usually involve a bias term. That is why we call it an affine layer, but not a linear layer.
- Example: Image with 4 pixels and 3 classes (cat/dog/ship)

56	231
24	2



0.2	-0.5	0.1	2	56	+	1.1	=	-96.8
1.5	1.3	2.1	1	231		3.2		439.9
-0.2	0.3	0.7	-1.3	24		-1.2		71.1
				2				

$$= 56 \begin{bmatrix} 0.2 \\ 1.5 \\ -0.2 \end{bmatrix} + 231 \begin{bmatrix} -0.5 \\ 1.3 \\ 0.3 \end{bmatrix} + 24 \begin{bmatrix} 0.1 \\ 2.1 \\ 0.7 \end{bmatrix} + 2 \begin{bmatrix} 2 \\ 1 \\ -1.3 \end{bmatrix} + 1 \begin{bmatrix} 1.1 \\ 3.2 \\ -1.2 \end{bmatrix}$$

$$= \begin{bmatrix} 0.2 & -0.5 & 0.1 & 2 & 1.1 \\ 1.5 & 1.3 & 2.1 & 1 & 3.2 \\ -0.2 & 0.3 & 0.7 & -1.3 & -1.2 \end{bmatrix} \begin{bmatrix} 56 \\ 231 \\ 24 \\ 2 \\ 1 \end{bmatrix}$$