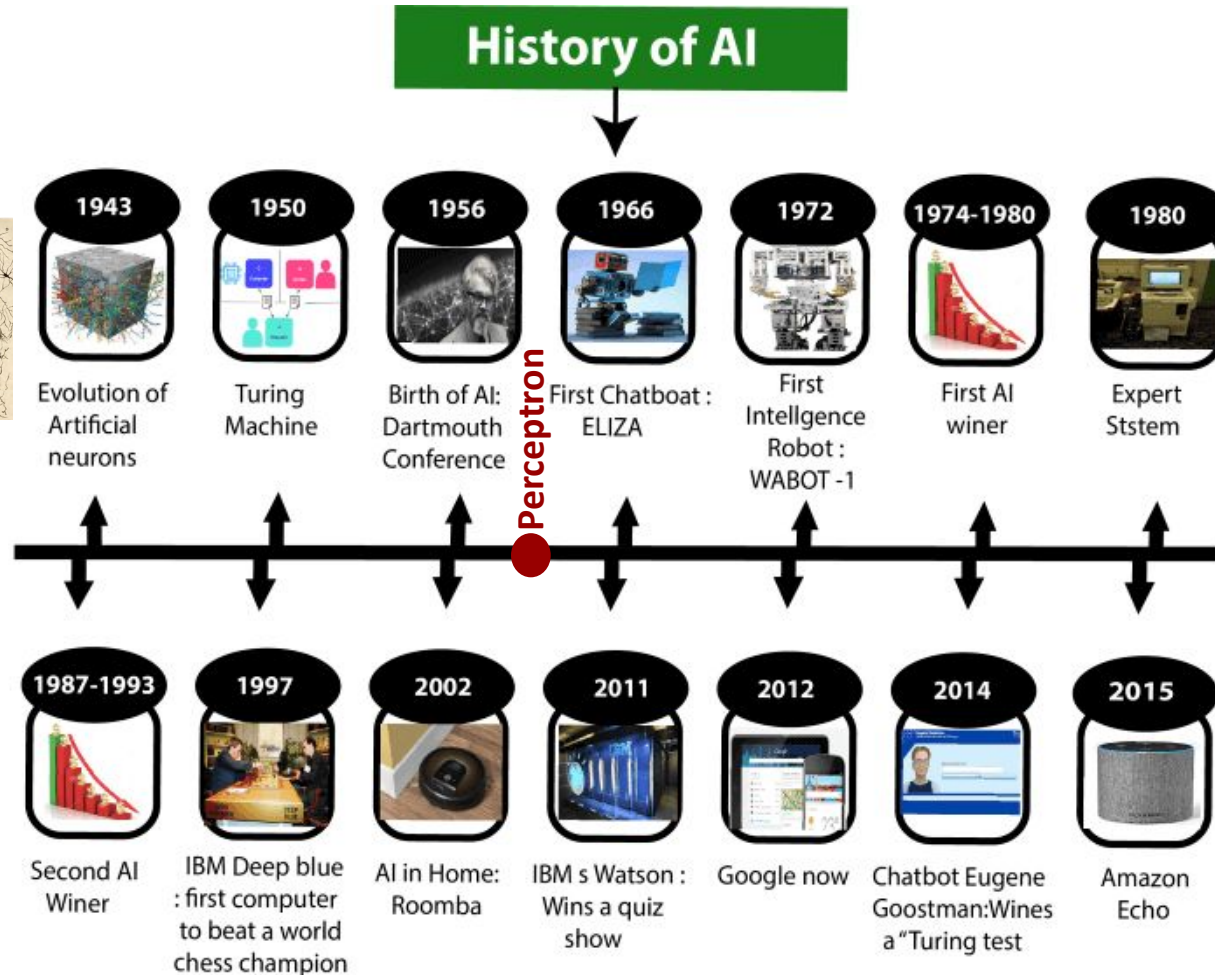# Introduction to Machine Learning

Module 1B: Multi Layer Perceptrons
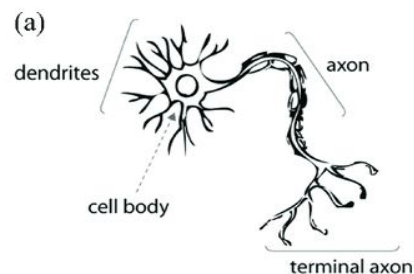
Instructor: Tugce Gurbuz

July 14th 2022

Artificial Intelligence (AI) is not new
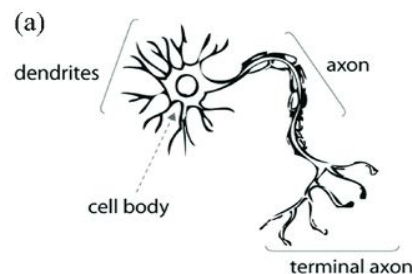

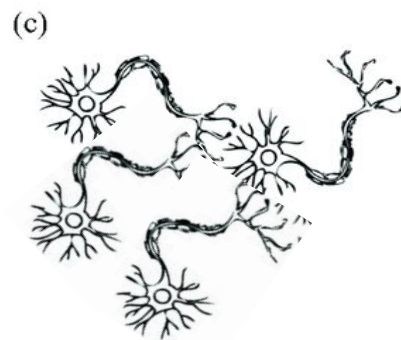
History of AI

Perceptron

1: fire
0: not fire

Source:
http://ttsuchi.github.io/2015/08/26/perceptron.html
https://www.researchgate.net/profile/Zhenzhu-Meng/publication/339446790/figure/fig2/AS:862019817320450@1582532948784/A-biological-neuron-in-comparison-to-an-artificial-neural-network-a-human-neuron-b.png
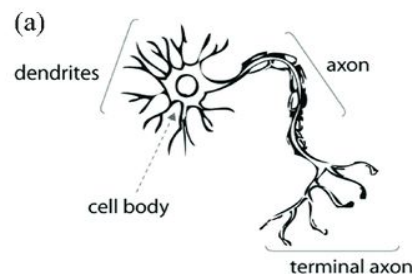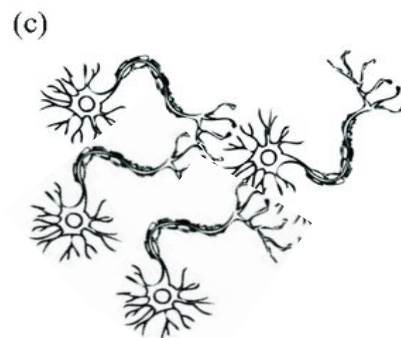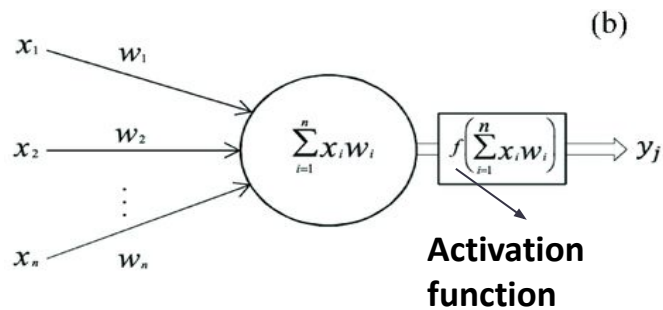
Perceptron

1: fire
0: not fire

**Excitatory
and
inhibitory
connections**

Perceptron

1: fire
0: not fire

Excitatory and inhibitory connections

Activation function

How does perceptron distinguish between 2 images?
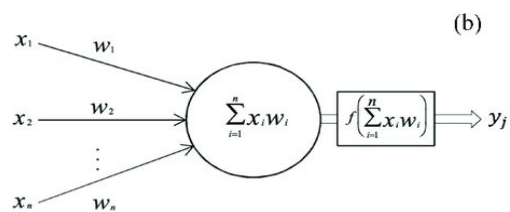
How does perceptron distinguish between 2 images?

How does perceptron distinguish between 2 images?
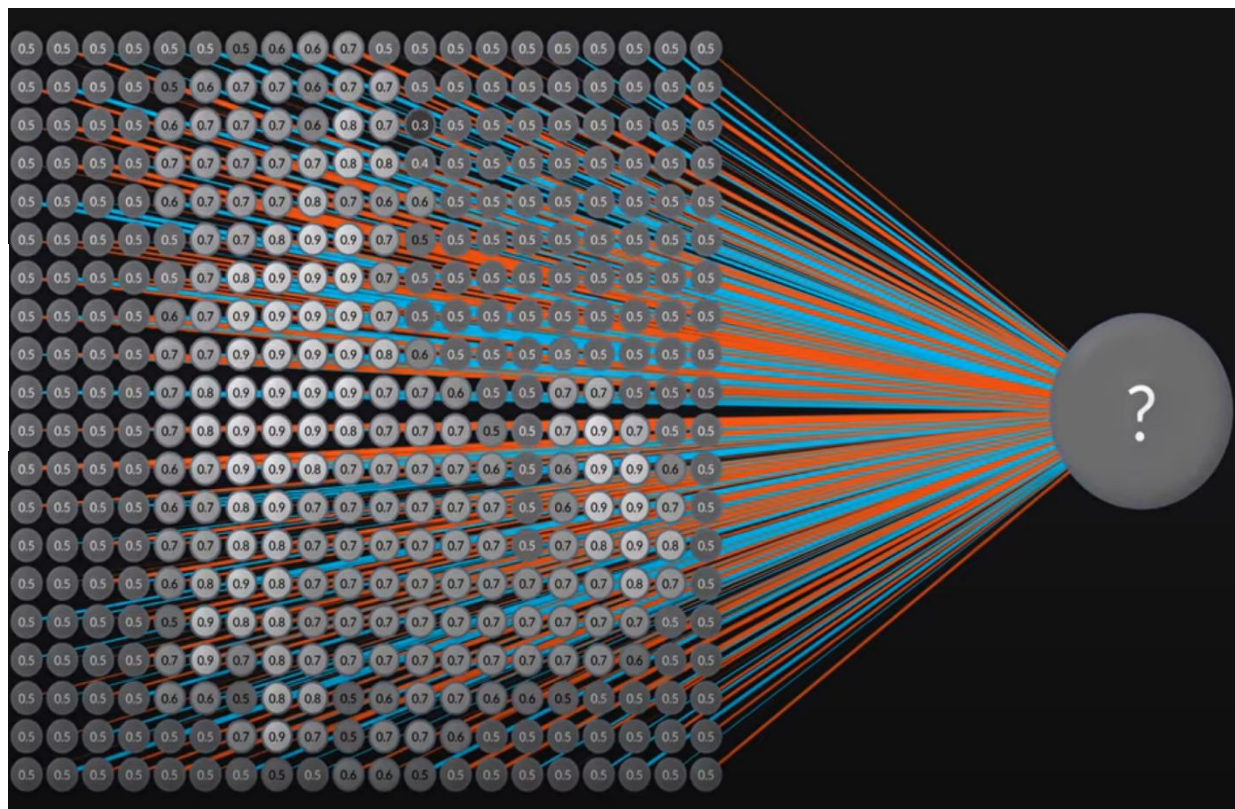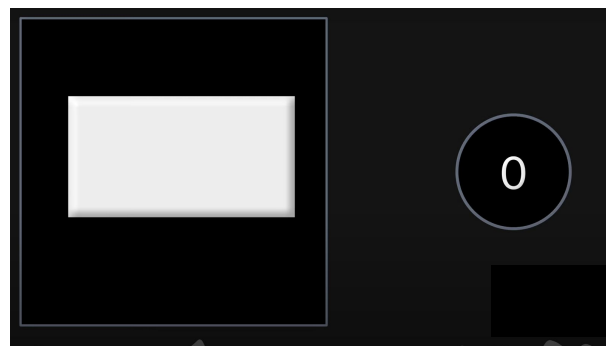
But, how does it know when to fire? -> **Training!**

How does perceptron distinguish between 2 images?
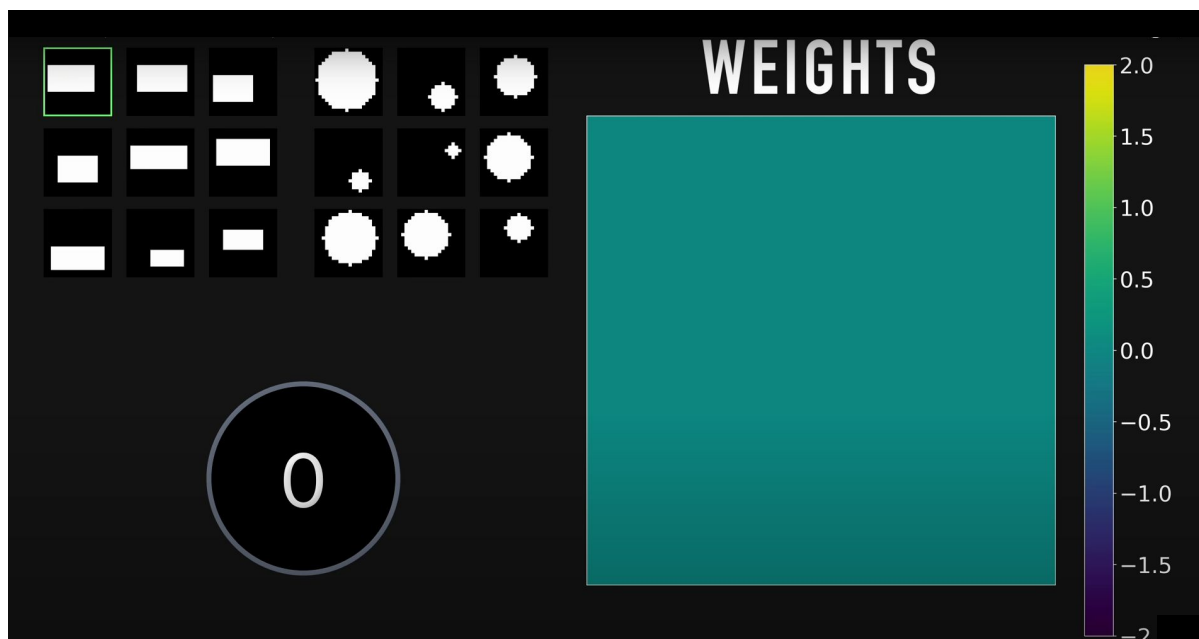
How does perceptron distinguish between 2 images?
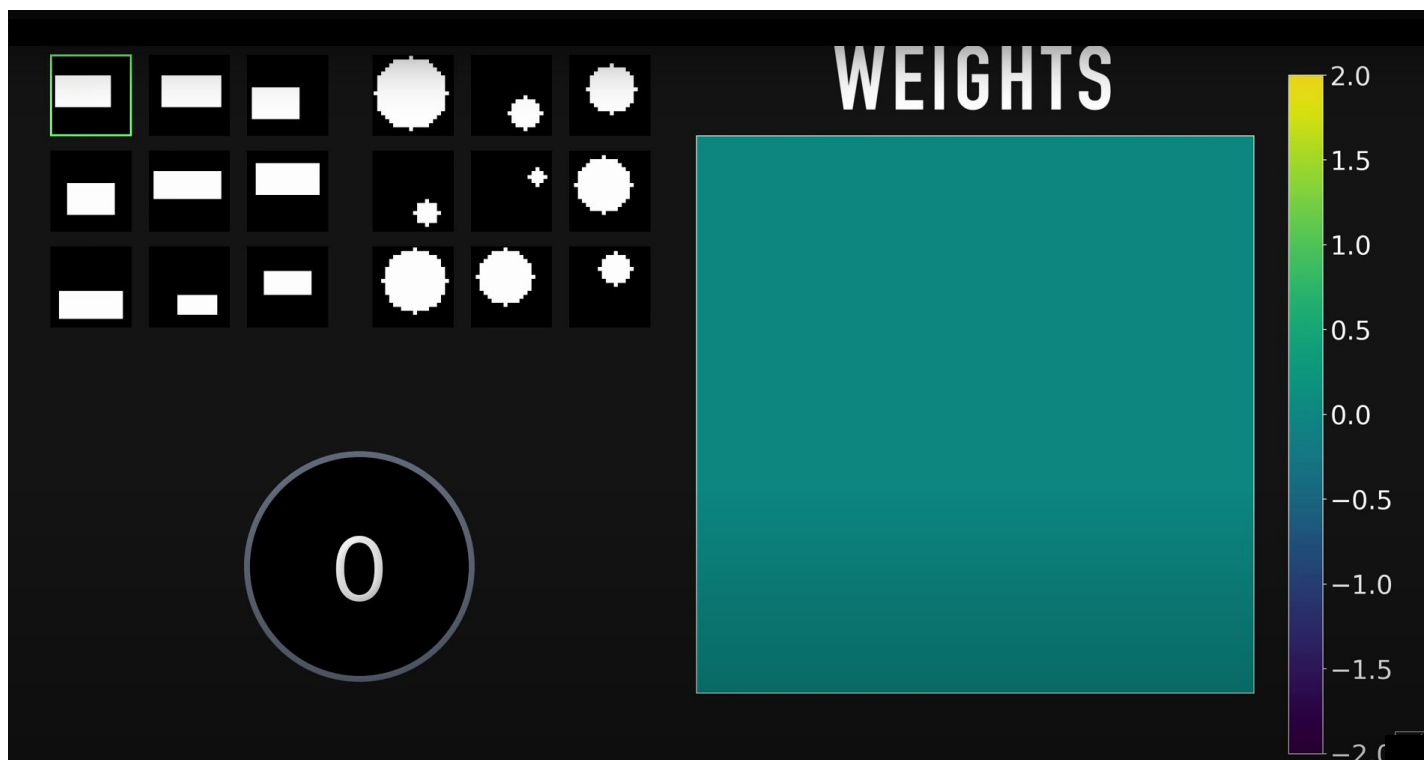
How does perceptron distinguish between 2 images?

How do we update the weights? -> **Backpropagation!**

How does perceptron distinguish between 2 images?
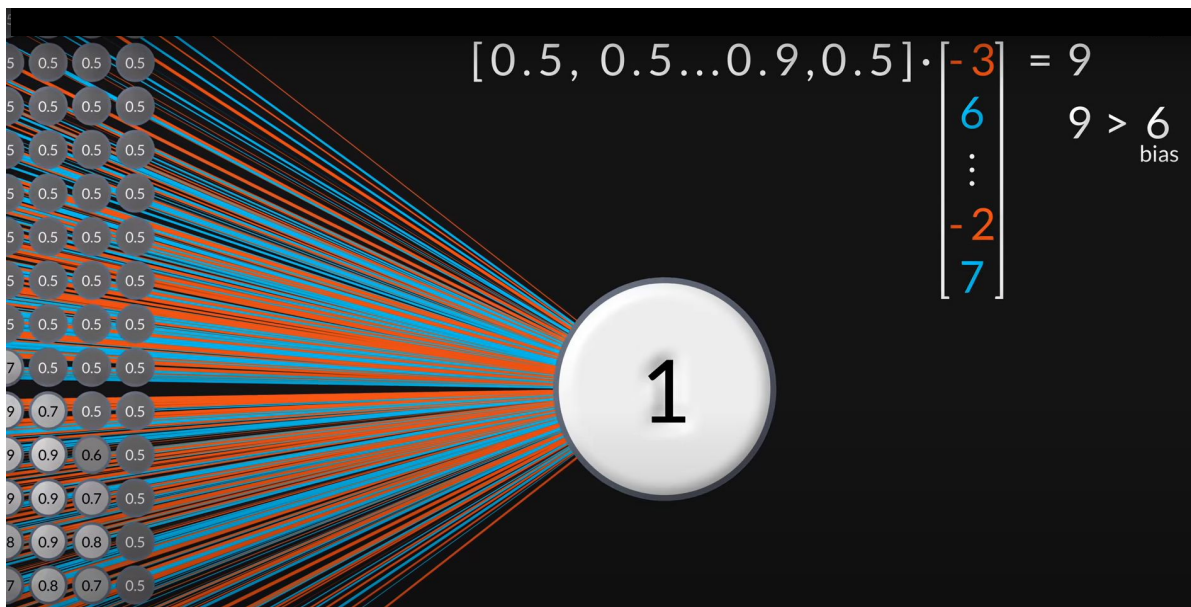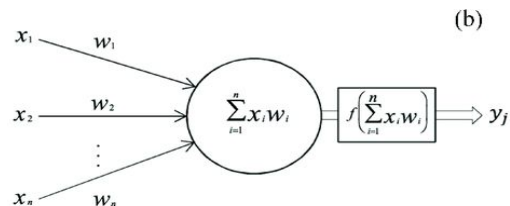
How do we update the weights? -> **Backpropagation!**

Recipe of backprop: (more details -> next section)
- Loss

How does perceptron distinguish between 2 images?

How do we update the weights? -> **Backpropagation!**

Recipe of backprop: (more details -> next section)
- Loss
- Optimizer

How does perceptron distinguish between 2 images?

How do we update the weights? -> **Backpropagation!**

Recipe of backprop: (more details -> next section)
- Loss
- Optimizer
- Backward pass

How does perceptron distinguish between 2 images?

How do we update the weights? -> **Backpropagation!**

Recipe of backprop: (more details -> next section)
- Loss -> Cross-entropy
- Optimizer
- Backward pass

For more information about cross-entropy:
https://www.youtube.com/watch?v=6ArSys5qHAU

How does perceptron distinguish between 2 images?

How do we update the weights? -> **Backpropagation!**

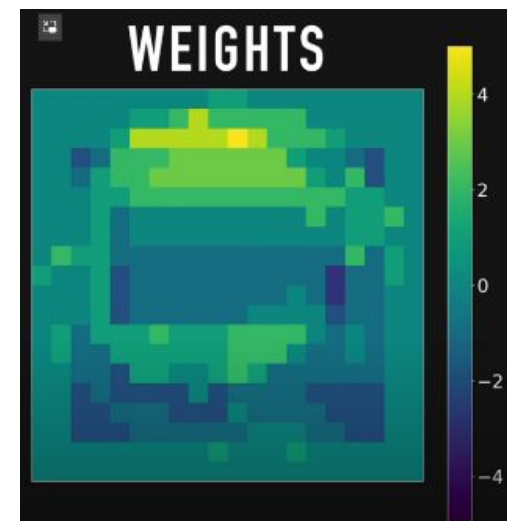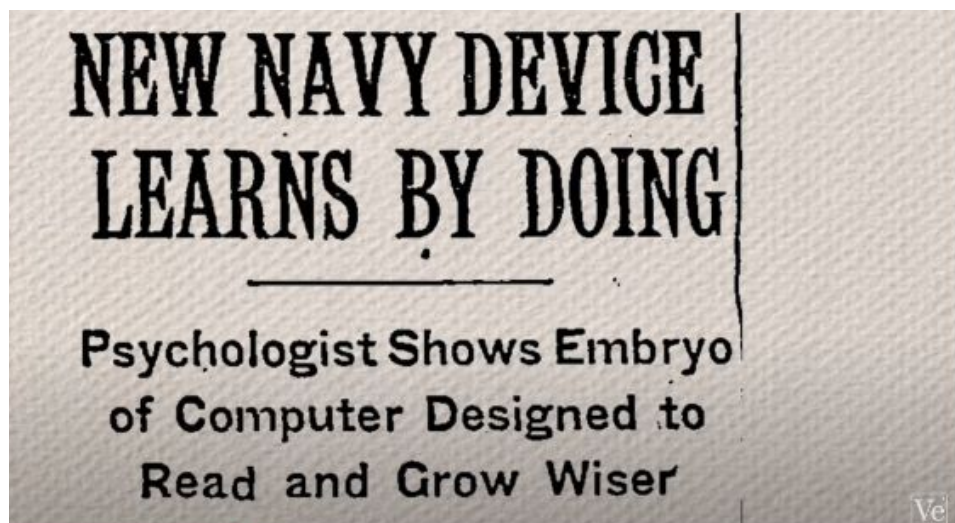**Recipe of backprop:** (more details -> next section)
- Loss -> Cross-entropy
- Optimizer -> Adaptive moment estimation (Adam)
- Backward pass

For more information about Adam:
https://youtu.be/JXQT_vxqwIs

From perceptron to multi layer perceptron (MLP)

NEW NAVY DEVICE
LEARNS BY DOING

Psychologist Shows Embryo
of Computer Designed to
Read and Grow Wiser

WASHINGTON, July 7 (UPI) —The Navy revealed the embryo of an electronic computer today that it expects will be able to walk, talk, see, write, reproduce itself and be conscious of its existence.
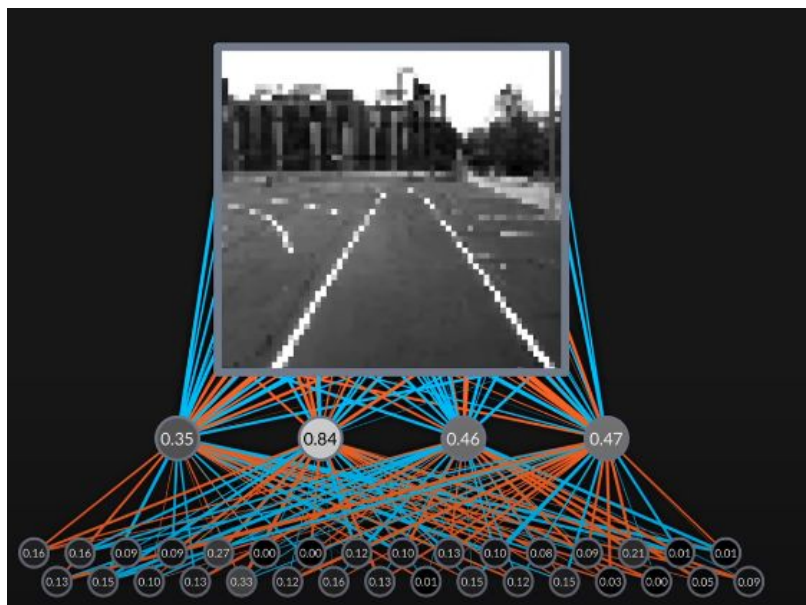
From perceptron to multi layer perceptron (MLP)
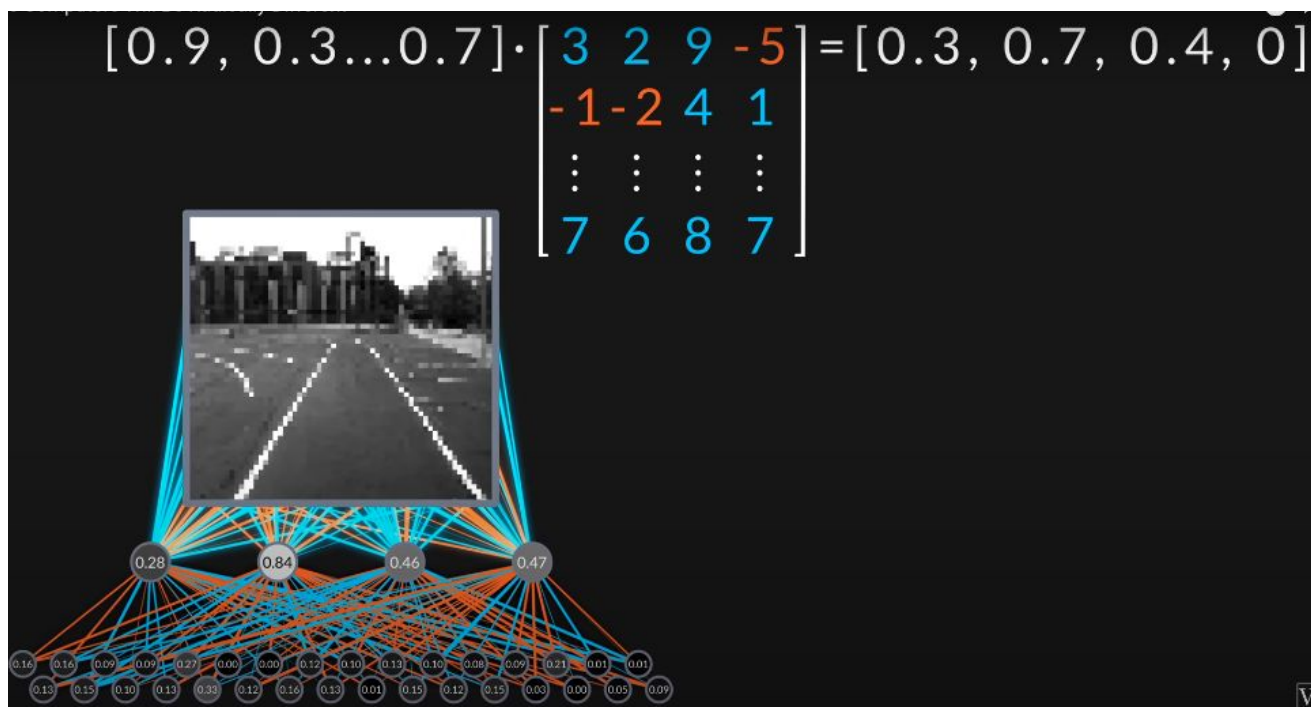
1980s: Attempt for self-driving car, ALVINN

From perceptron to multi layer perceptron (MLP)

1980s: Attempt for self-driving car, ALVINN

From perceptron to multi layer perceptron (MLP)

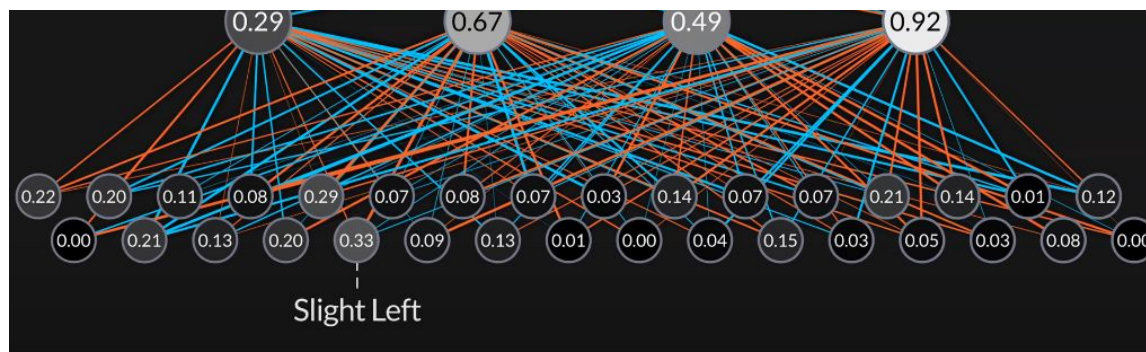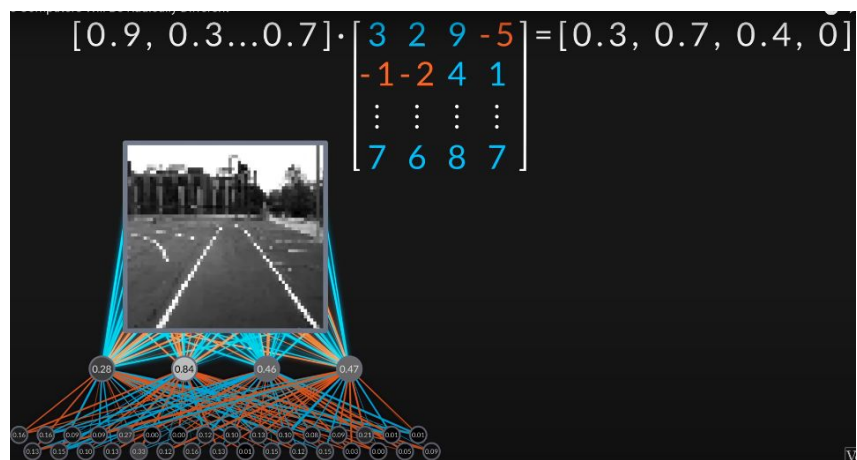**1980s: Attempt for self-driving car, ALVINN**

$$[0.9, 0.3 \ldots 0.7] \cdot \begin{bmatrix} 3 & 2 & 9 & -5 \\ -1 & -2 & 4 & 1 \\ \vdots & \vdots & \vdots & \vdots \\ 7 & 6 & 8 & 7 \end{bmatrix} = [0.3, 0.7, 0.4, 0]$$

Source:https://youtu.be/GVsUOuSjvcg

From perceptron to multi layer perceptron (MLP)

1980s: Attempt for self-driving car, ALVINN

$$[0.9, 0.3...0.7] \cdot \begin{bmatrix} 3 & 2 & 9 & -5 \\ -1 & -2 & 4 & 1 \\ \vdots & \vdots & \vdots & \vdots \\ 7 & 6 & 8 & 7 \end{bmatrix} = [0.3, 0.7, 0.4, 0]$$

Slight Left

Source:https://youtu.be/GVsUOuSjvcg

From perceptron to multi layer perceptron (MLP)

1980s: Attempt for self-driving car, ALVINN