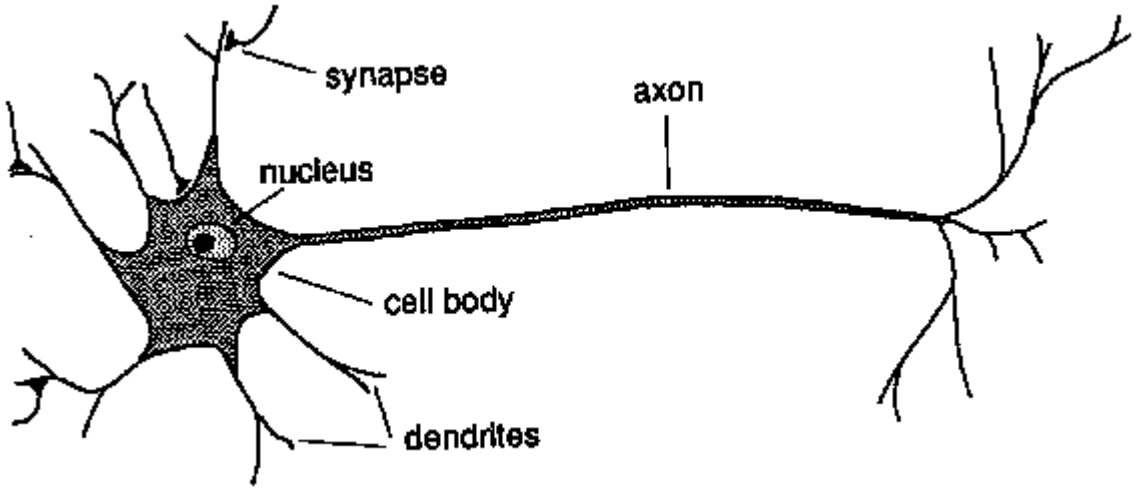
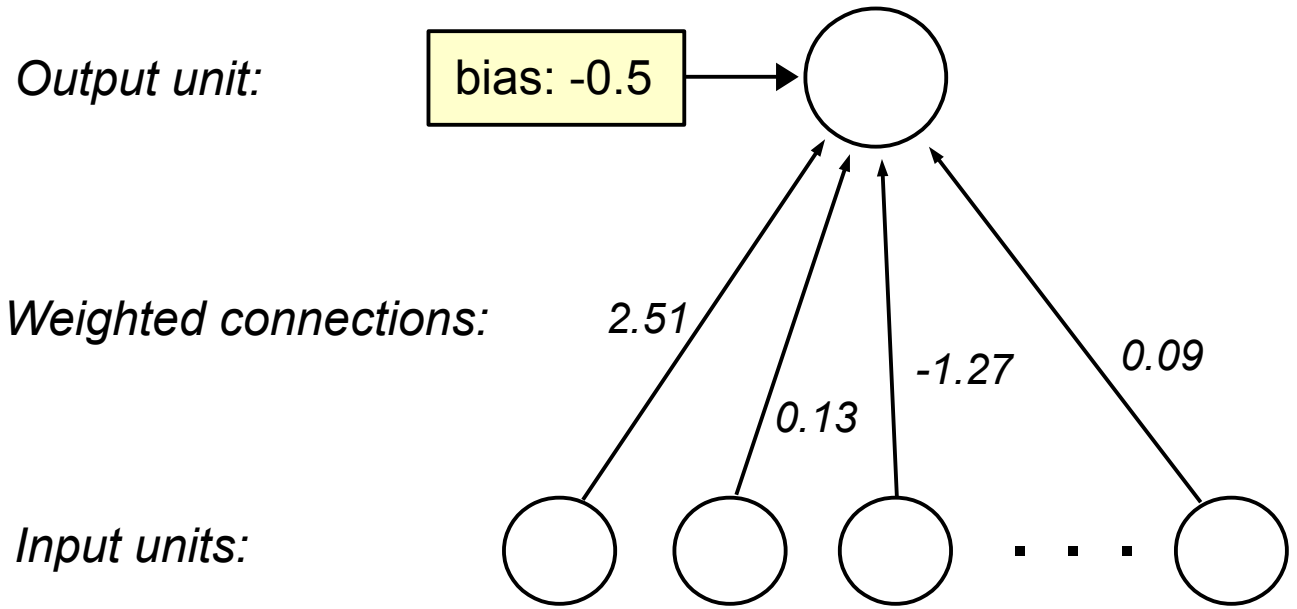
Overview of Artificial Neural Networks

Neurons and Brains



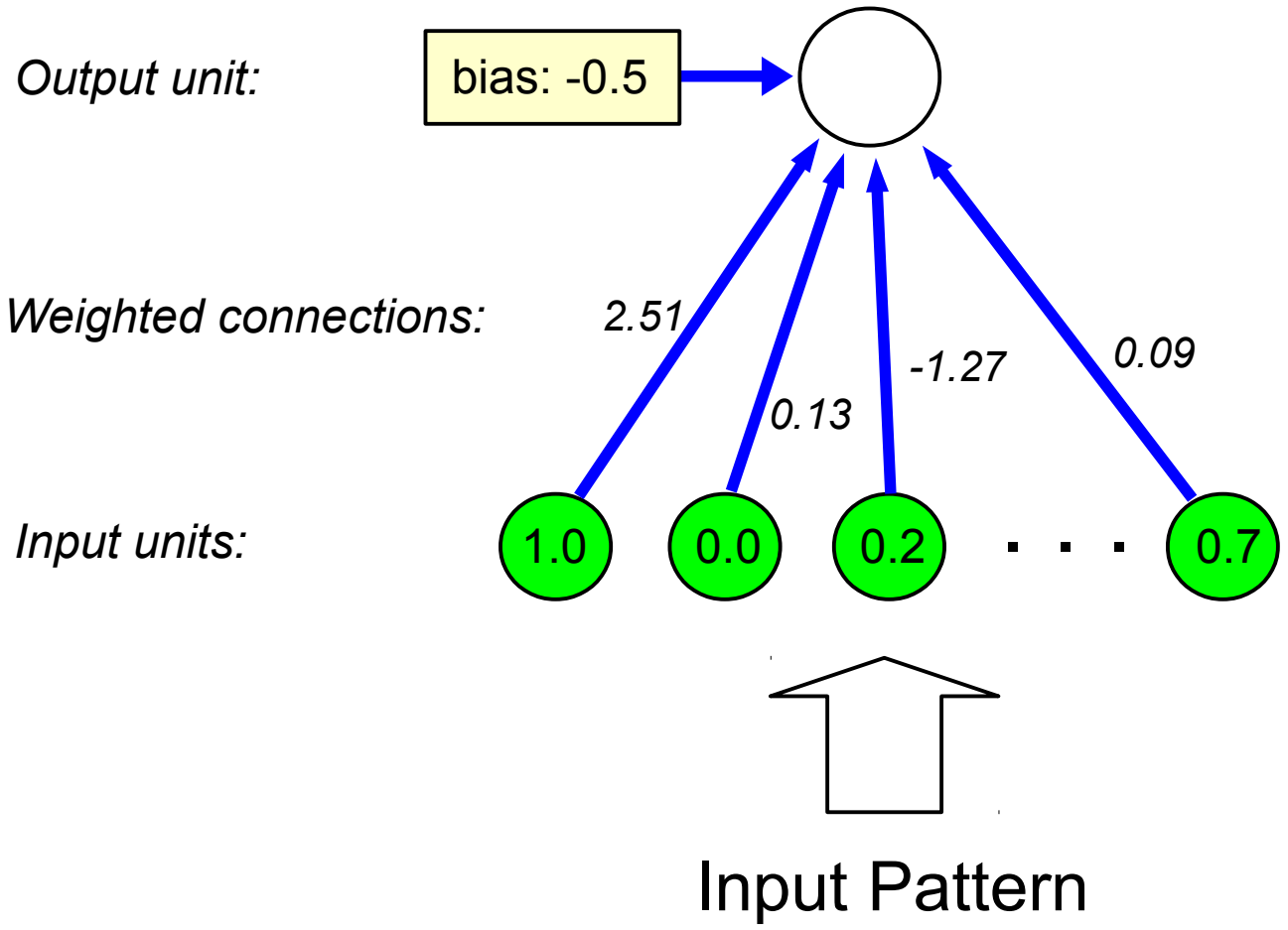
- Your brain has ~ 100 billion neurons
- Each neuron has ~ 10,000 synaptic connections to other neurons
- Hundreds of trillions of connections
- Learning induces changes in the connection strengths between neurons

An Artificial Neuron



An Artificial Neuron

1.0 × 2.51 + **0.0** × 0.13 + **0.2** × -1.27 + . . . + **0.7** × 0.09 **+ -0.5** = 1.82



An Artificial Neuron

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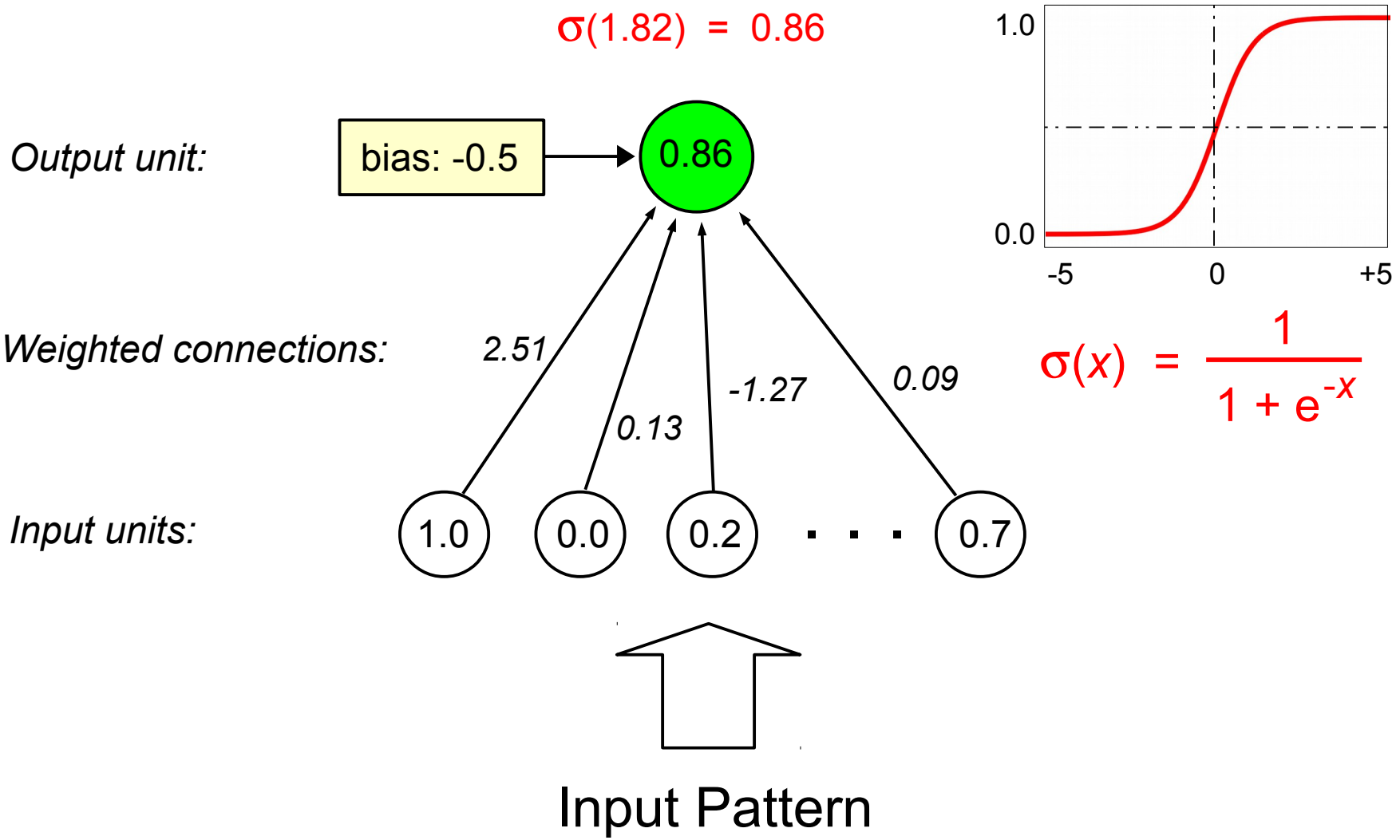
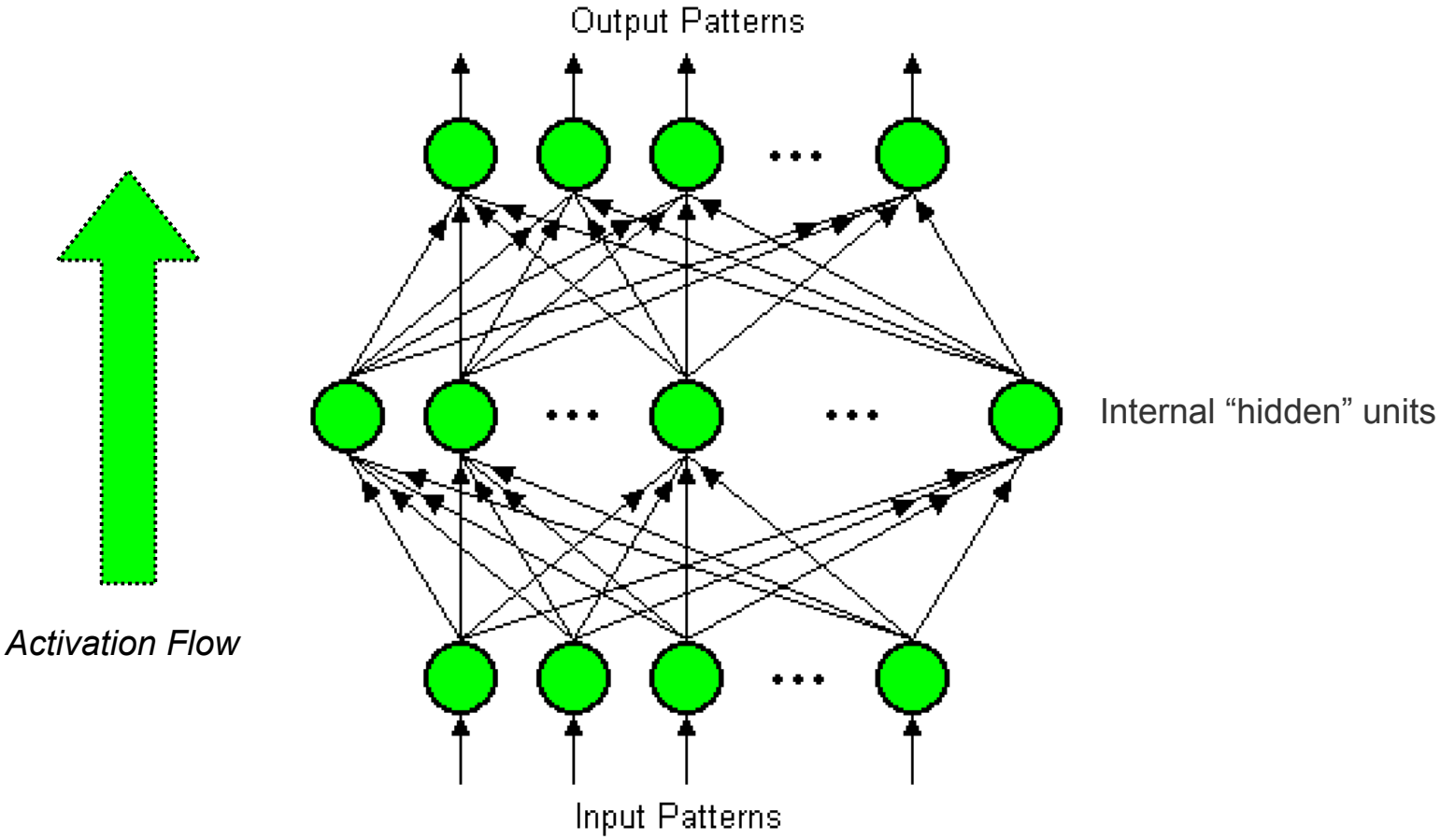
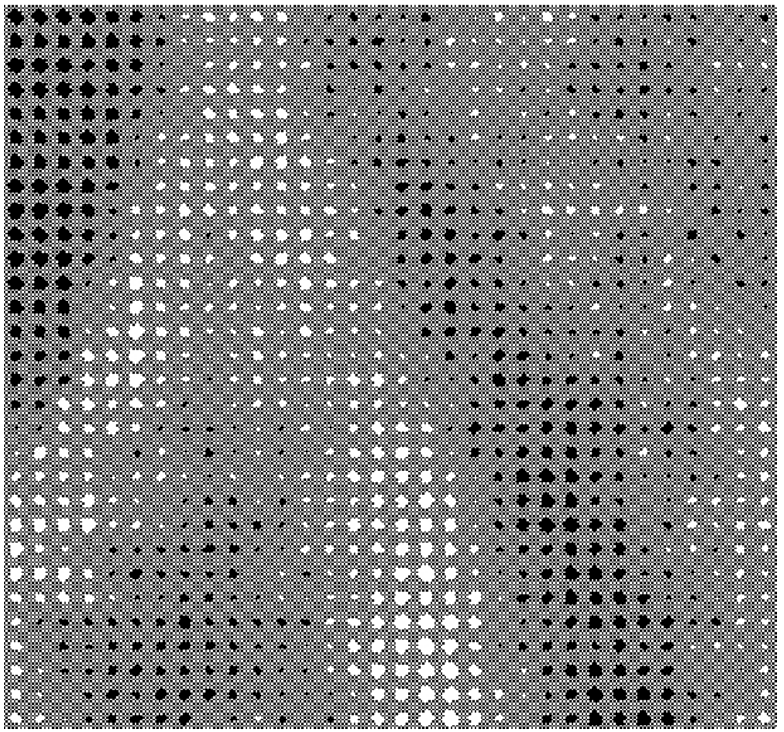
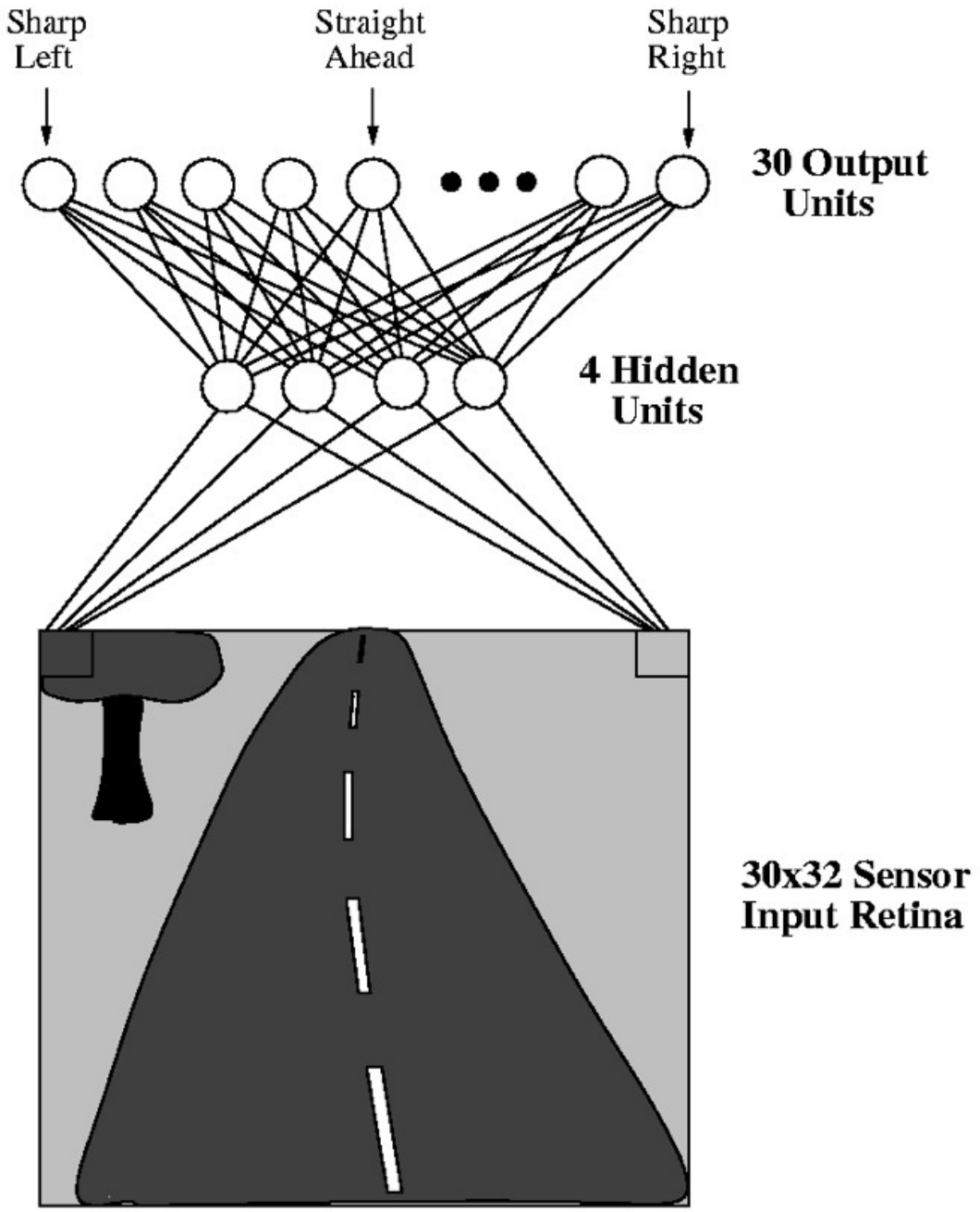


Pattern Associator Networks

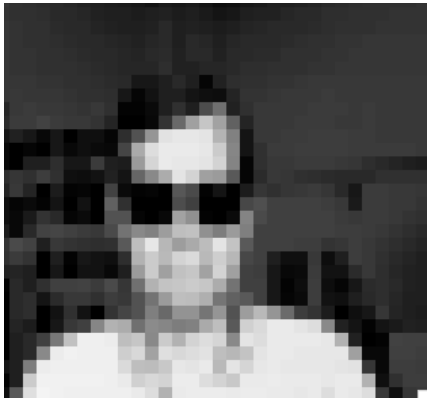
- Units are arranged into successive layers
- Feed-forward connections only
- Layer activations represent stimulus/response associations

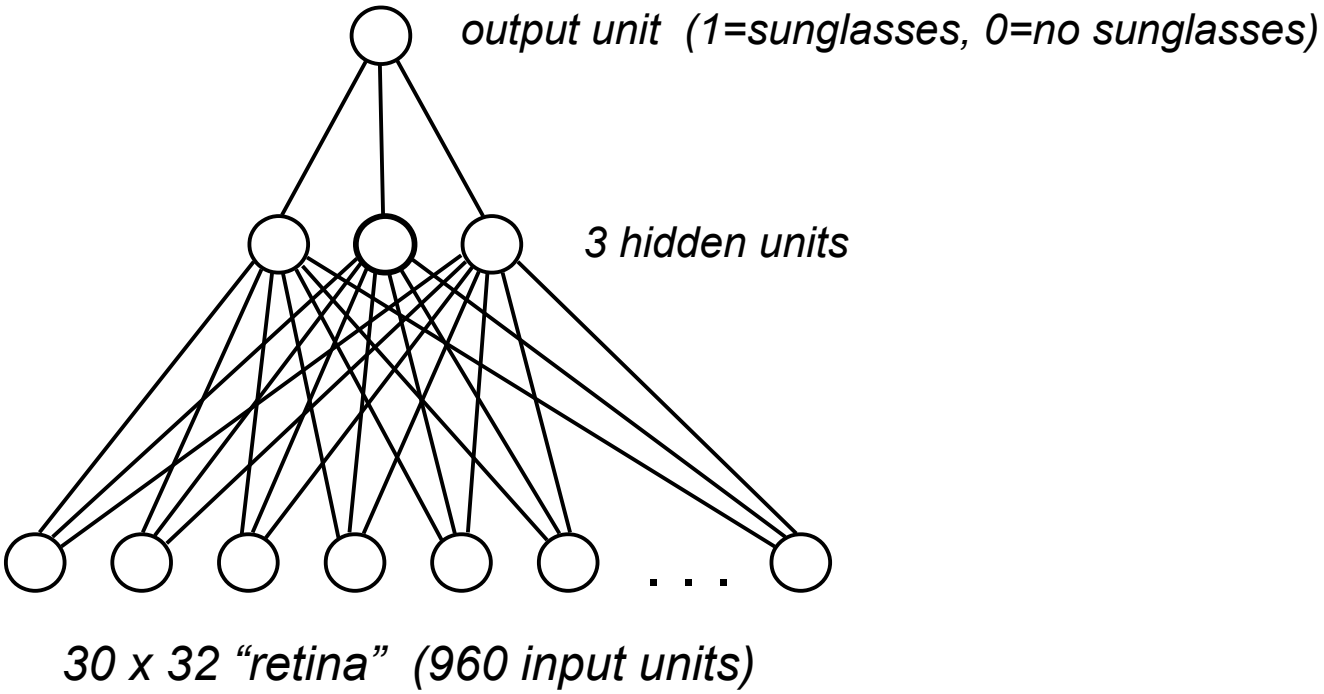





Sharp Left
Straight Ahead
Sharp Right
30 Output Units
4 Hidden Units
30x32 Sensor Input Retina

Recognizing Sunglasses





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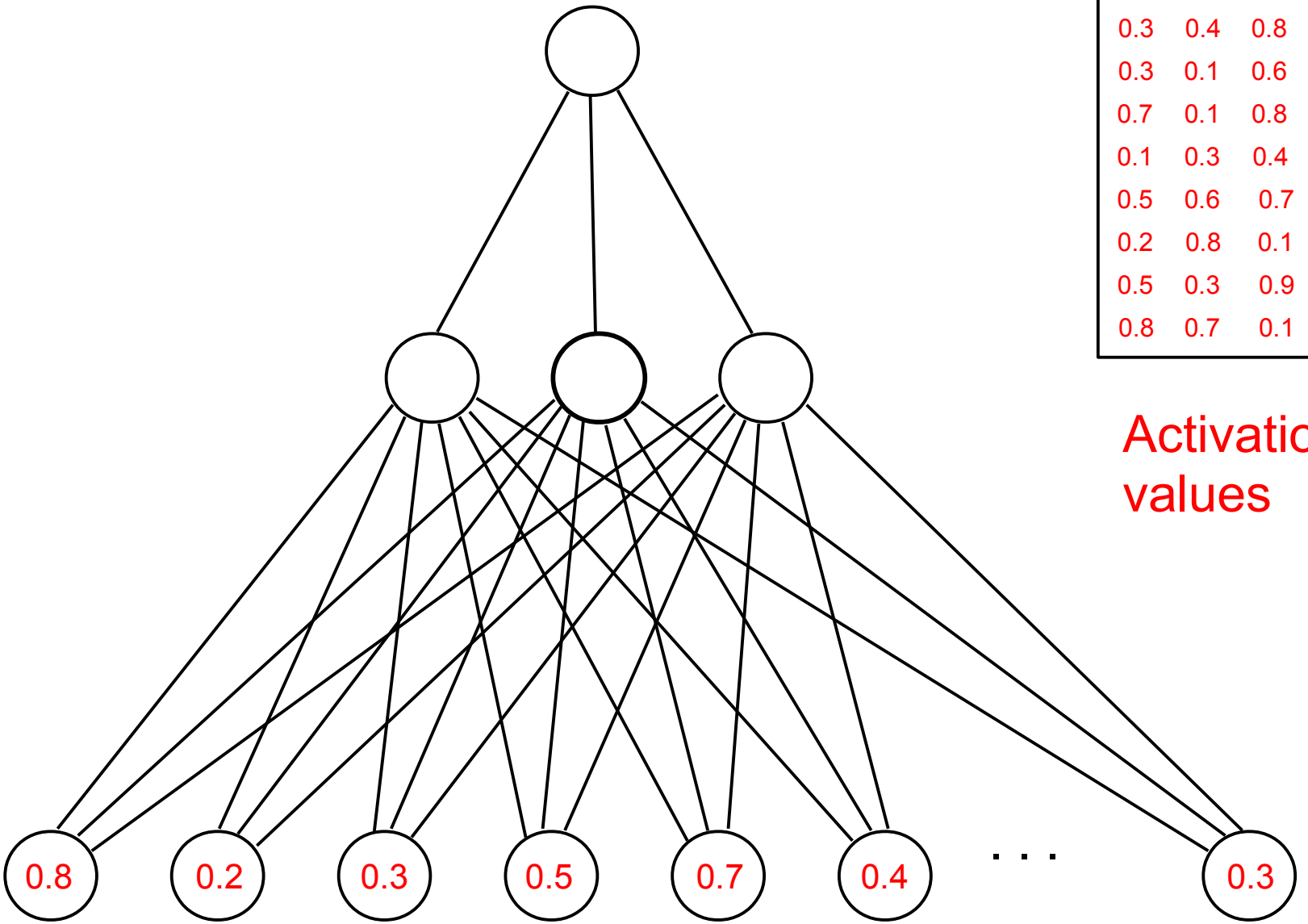
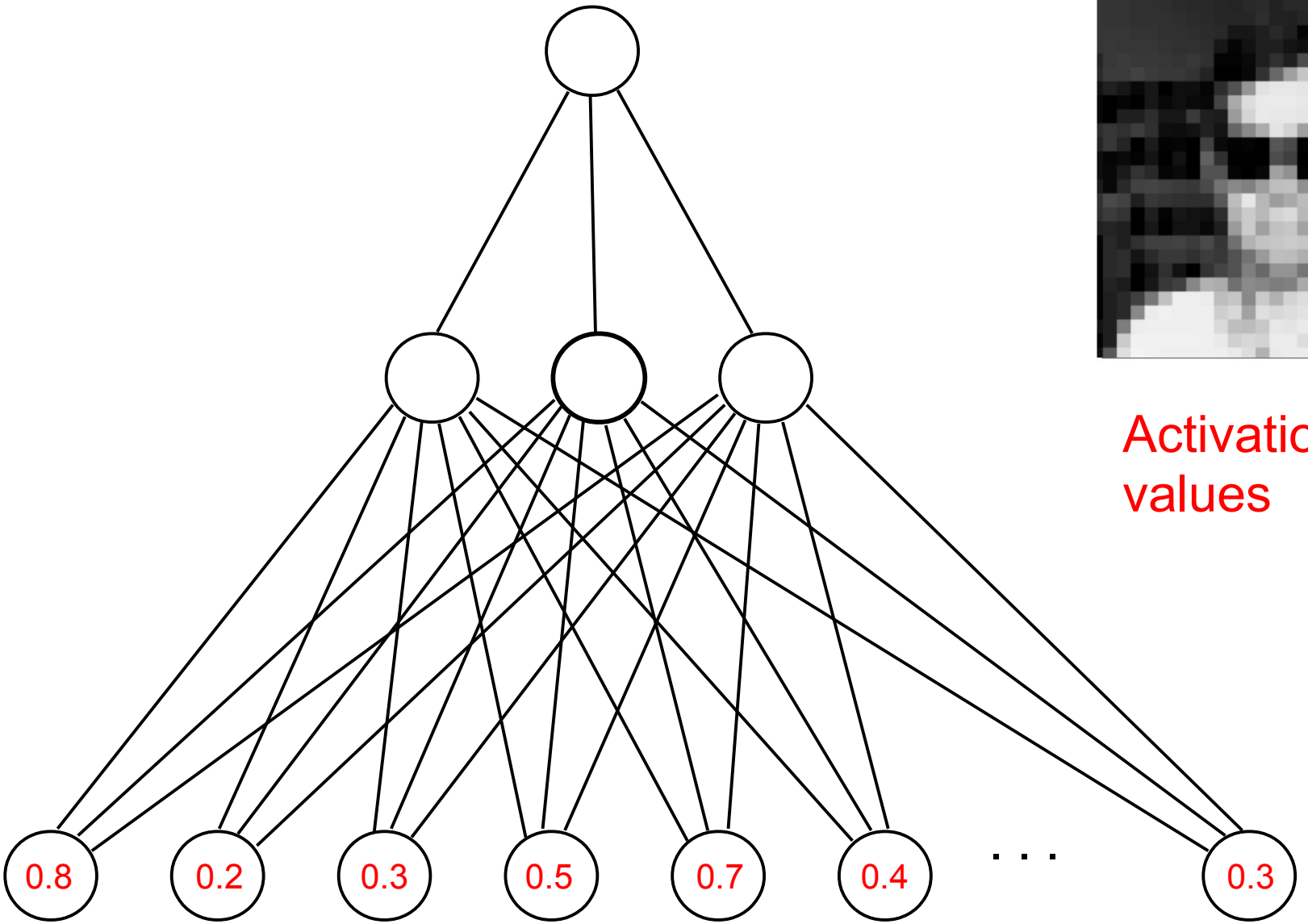


0.8	0.2	0.3	0.5	0.7	0.4
0.3	0.4	0.8	0.3	0.5	0.0
0.3	0.1	0.6	0.5	0.0	0.8
0.7	0.1	0.8	0.2	0.4	0.1
0.1	0.3	0.4	0.0	0.9	0.6
0.5	0.6	0.7	0.5	0.8	0.3
0.2	0.8	0.1	0.8	0.7	0.9
0.5	0.3	0.9	0.5	0.2	0.4
0.8	0.7	0.1	0.9	0.1	0.2

Activation values

Recognizing Sunglasses

Activation values



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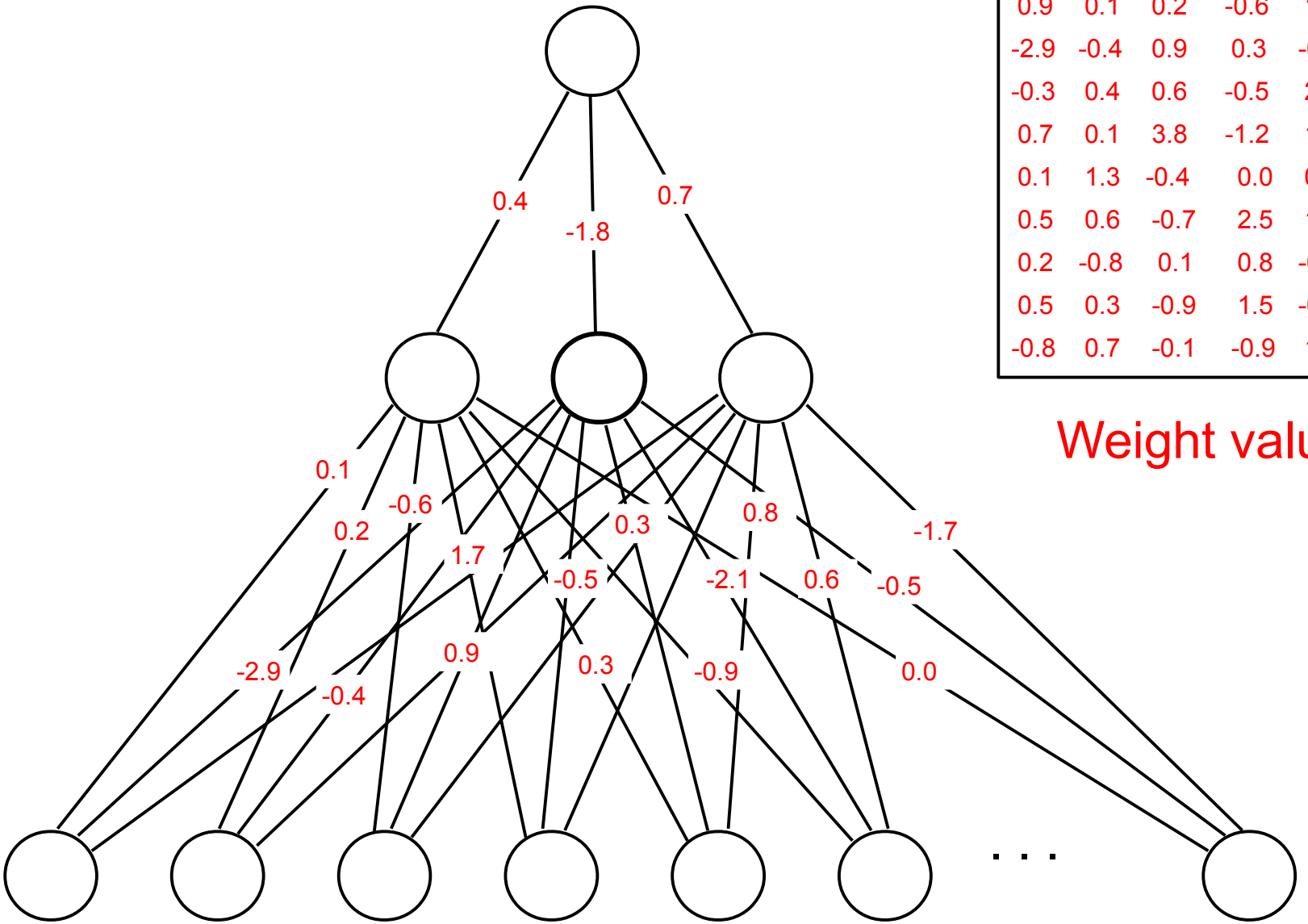
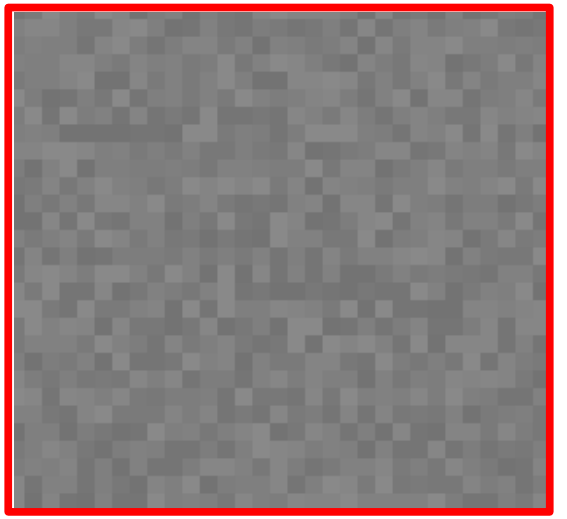


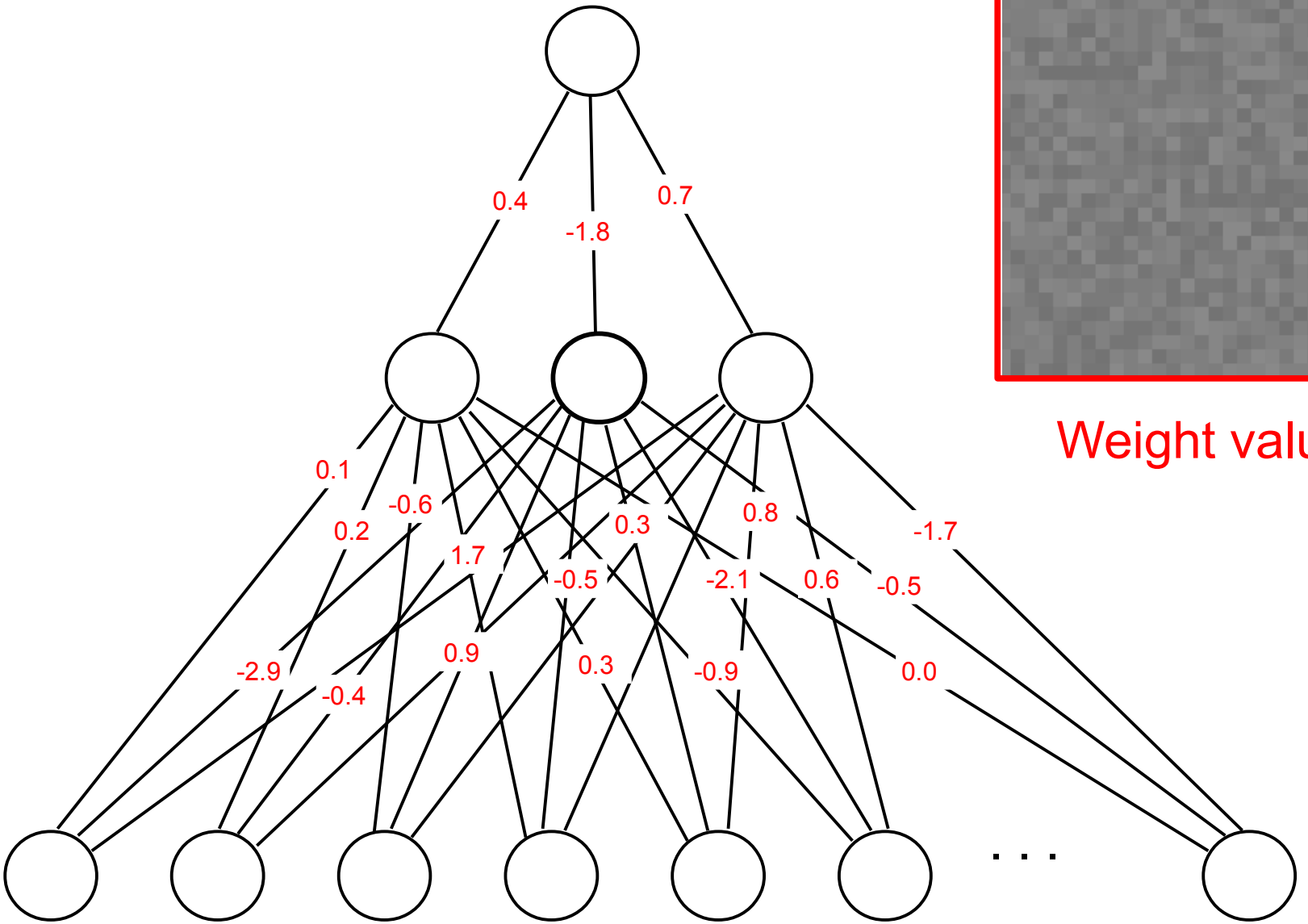
0.9	0.1	0.2	-0.6	1.7	-0.5
-2.9	-0.4	0.9	0.3	-0.5	0.0
-0.3	0.4	0.6	-0.5	2.0	0.8
0.7	0.1	3.8	-1.2	1.4	0.1
0.1	1.3	-0.4	0.0	0.9	0.6
0.5	0.6	-0.7	2.5	1.8	0.3
0.2	-0.8	0.1	0.8	-0.7	1.9
0.5	0.3	-0.9	1.5	-0.2	0.4
-0.8	0.7	-0.1	-0.9	1.1	3.2

Weight values

Recognizing Sunglasses



Weight values



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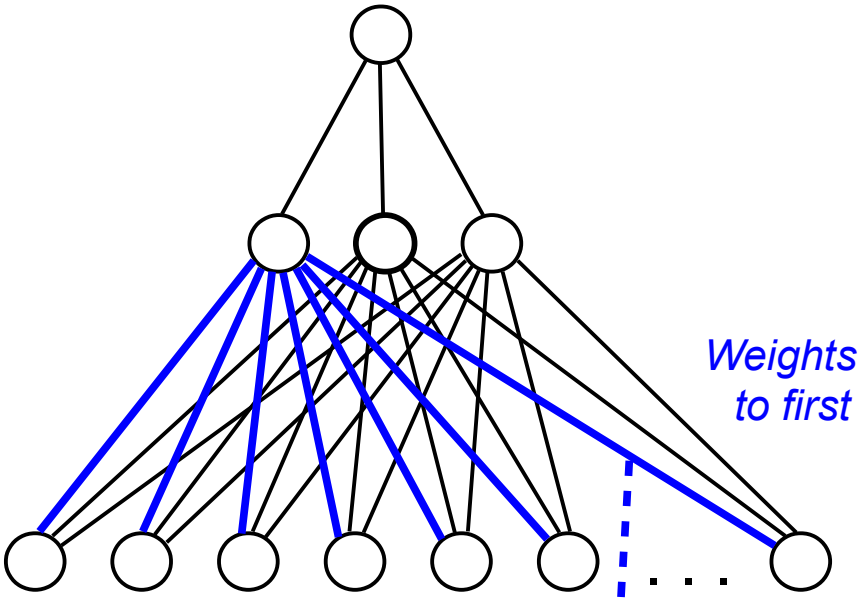
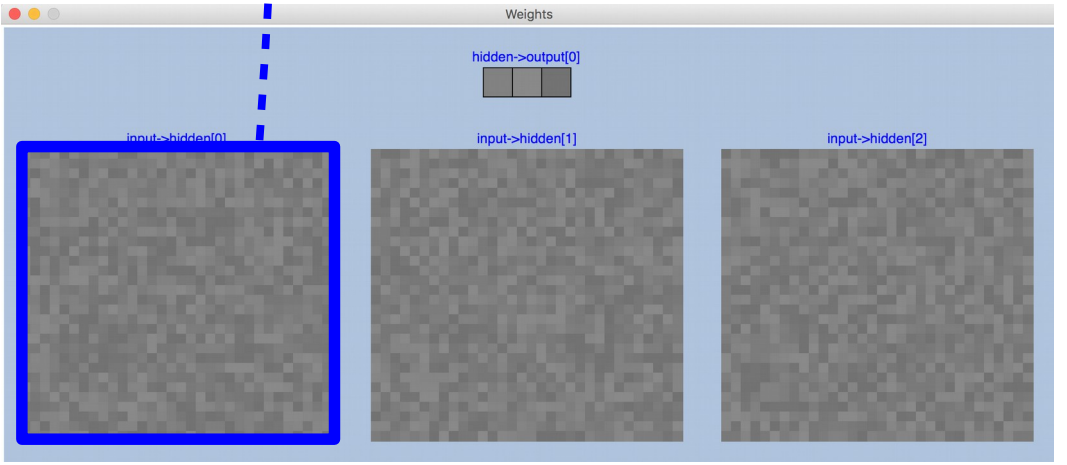


Weights from “retina” to first hidden unit



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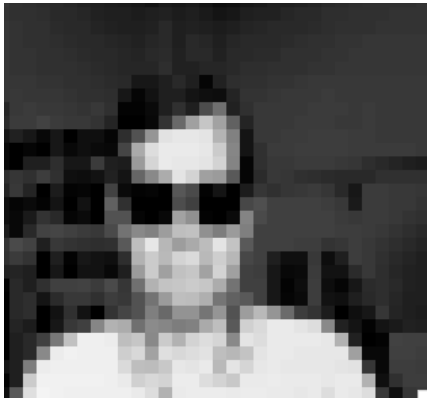
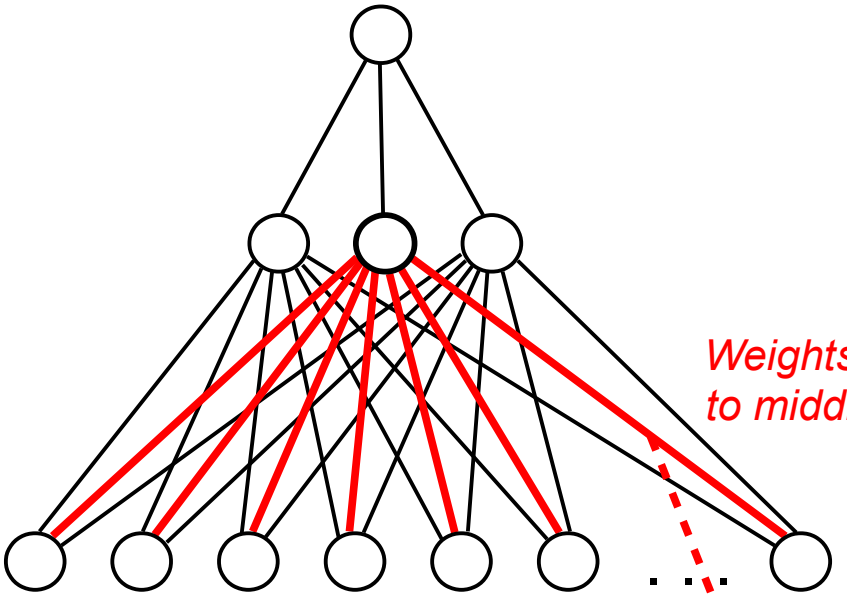
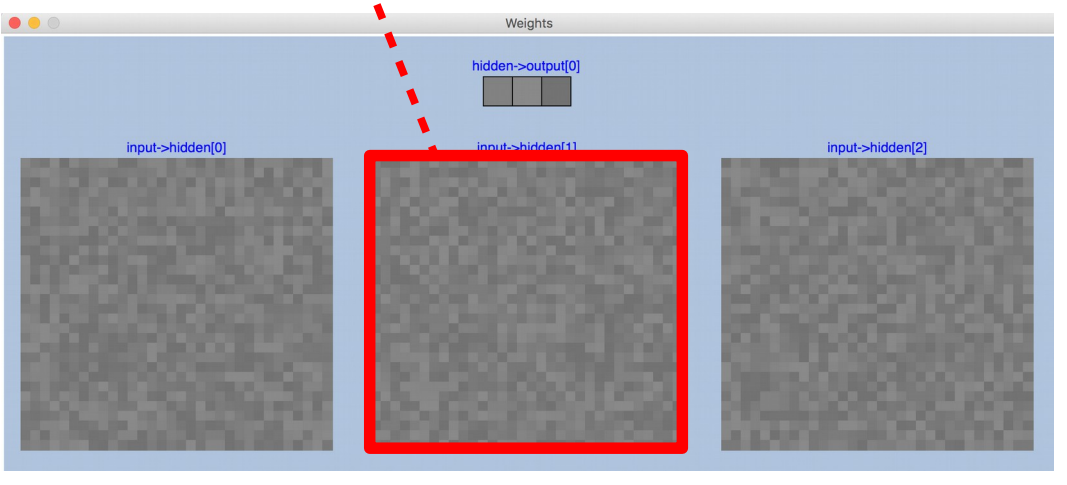




Weights from “retina” to middle hidden unit



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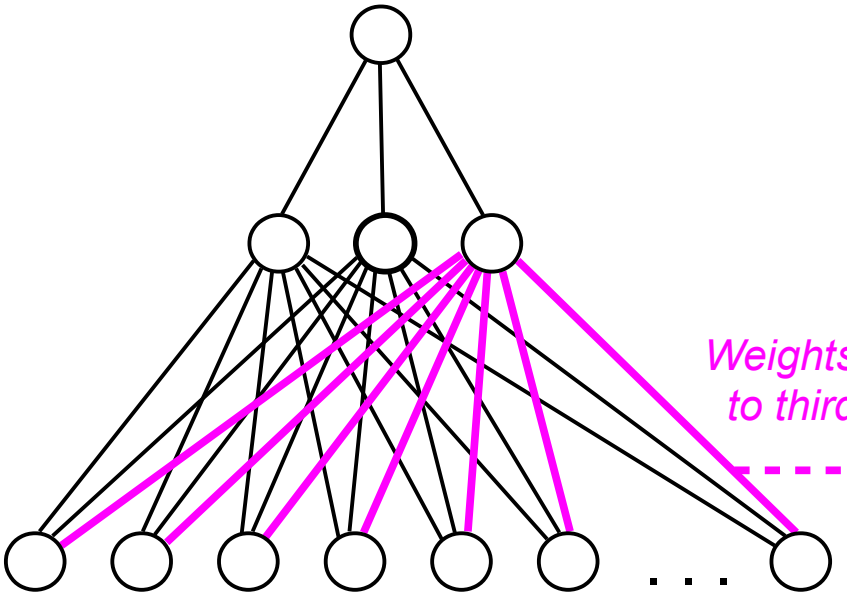
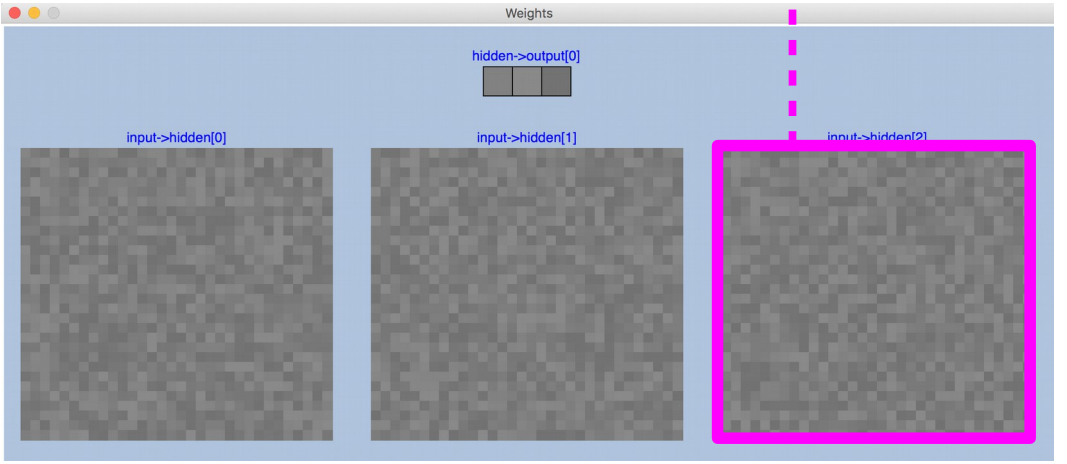


Weights from "retina" to third hidden unit



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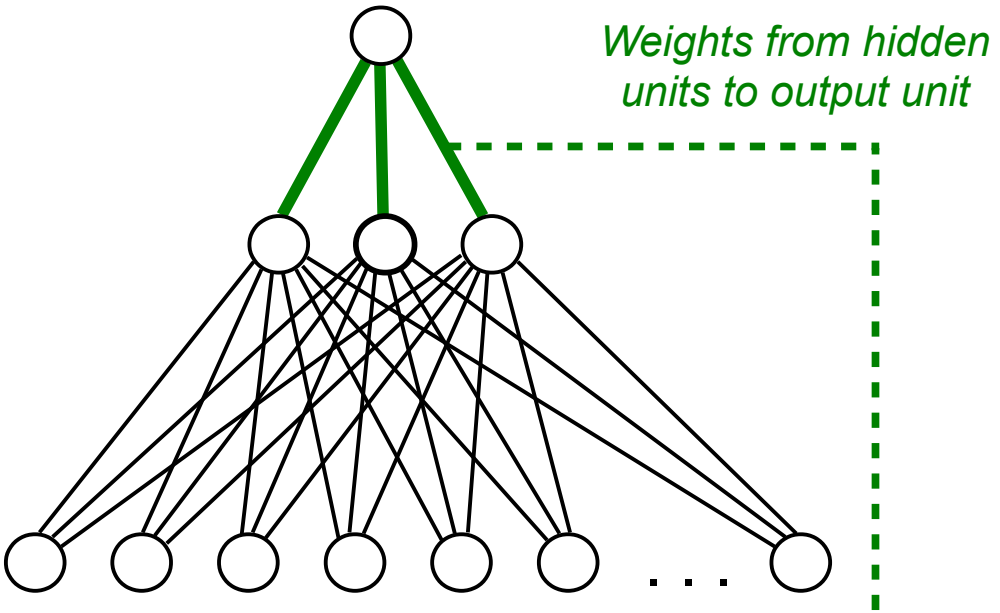

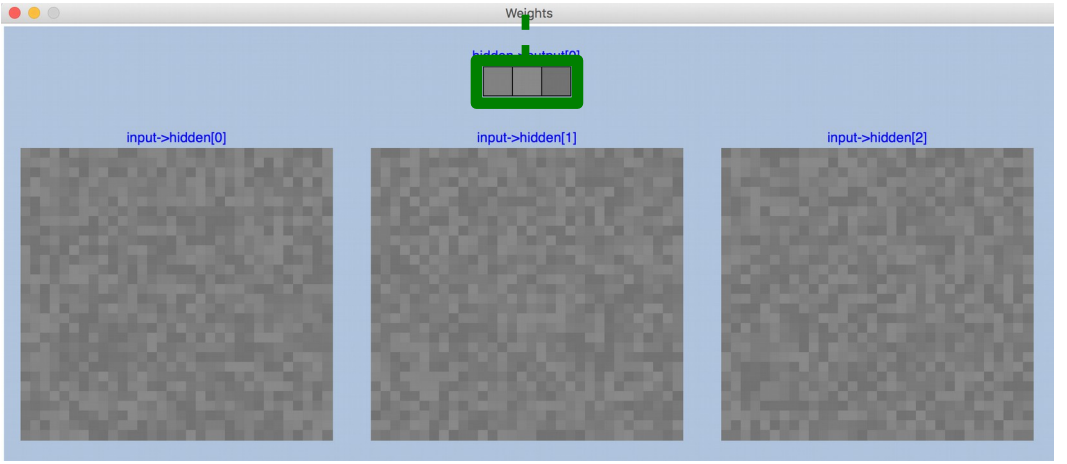

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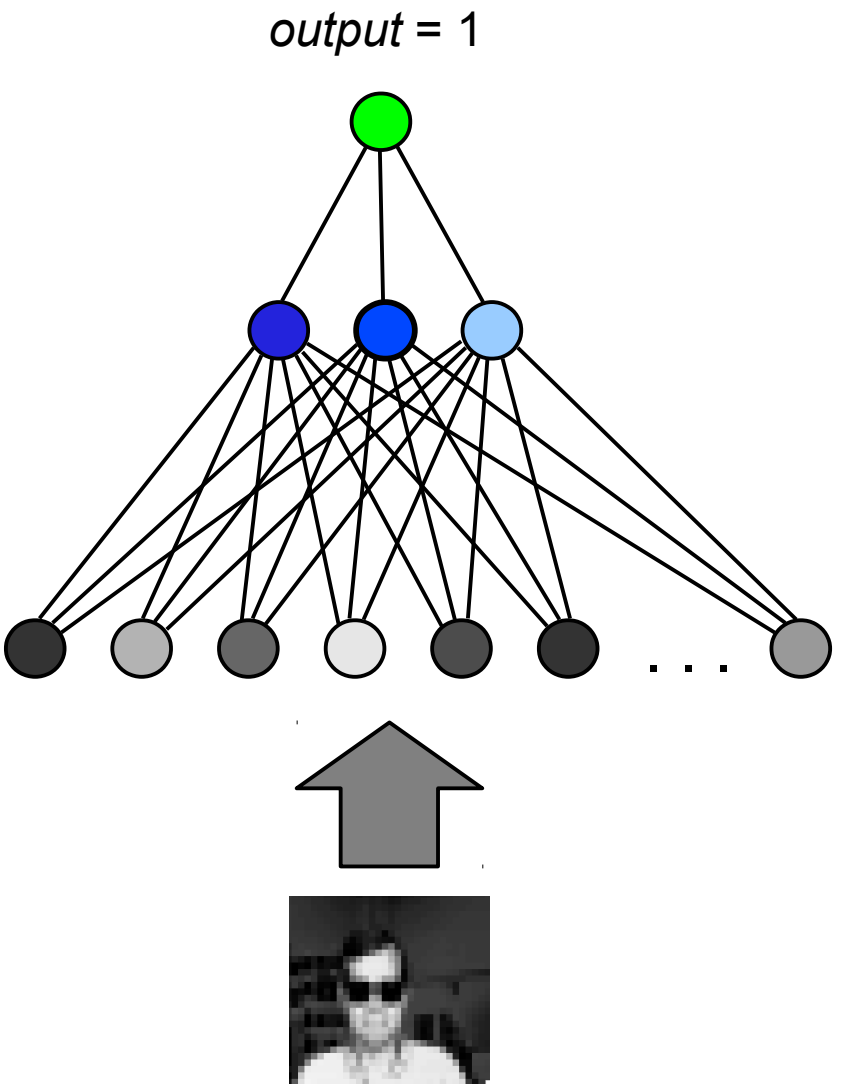

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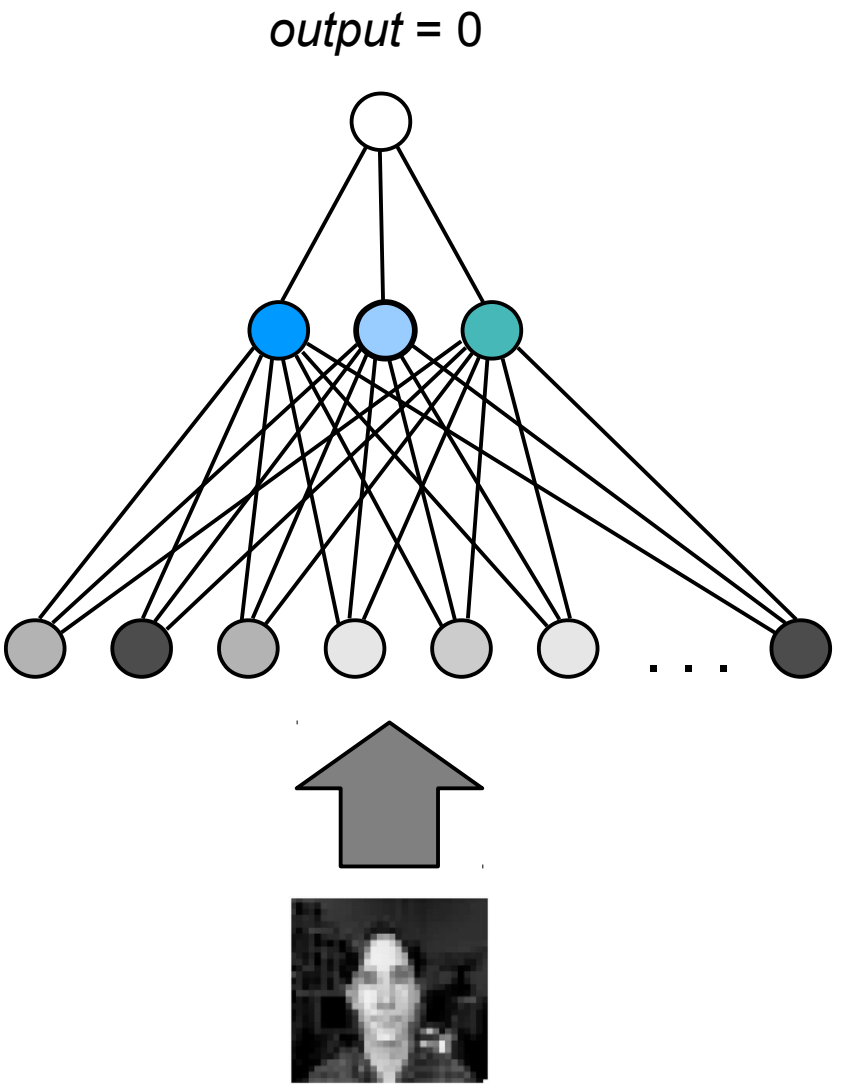
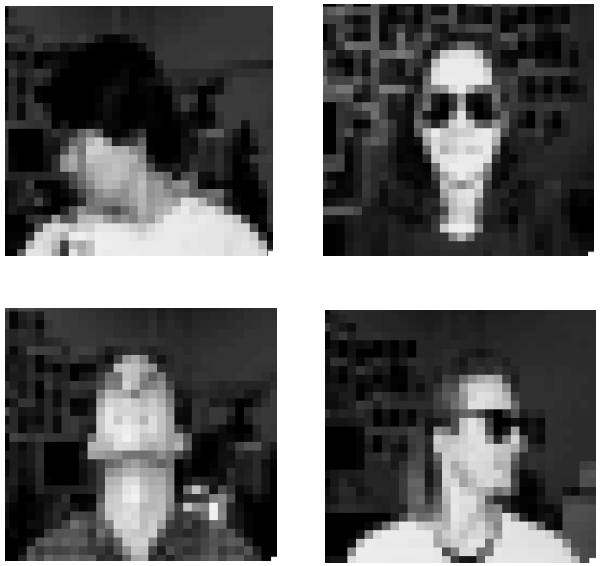
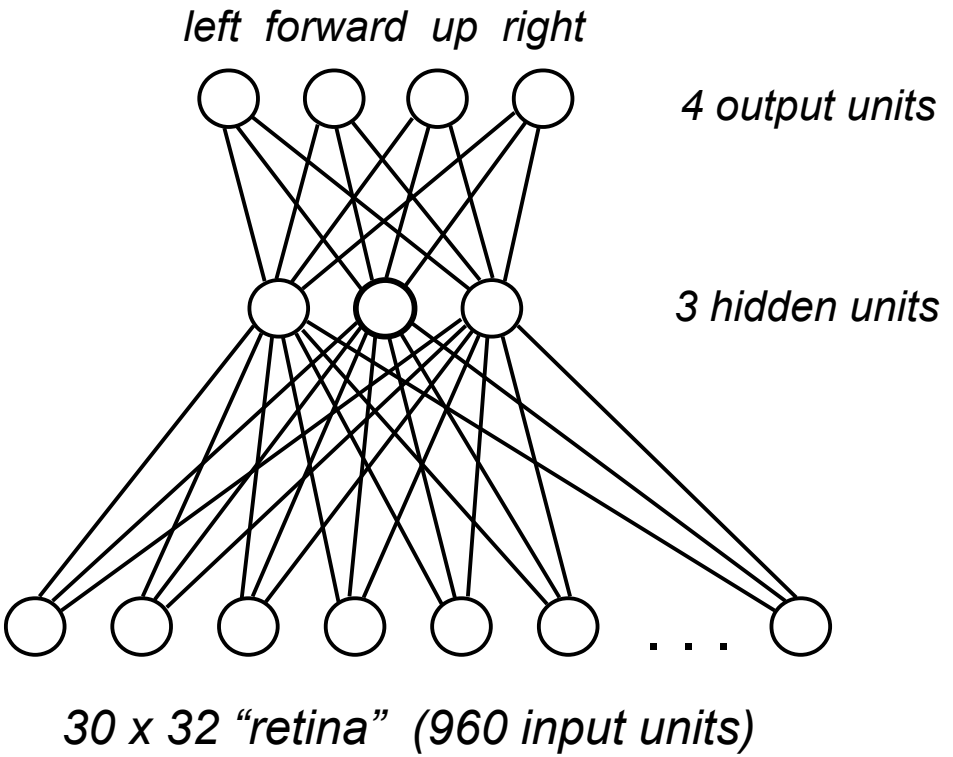


Sunglasses Recognizer Demo

Recognizing Poses





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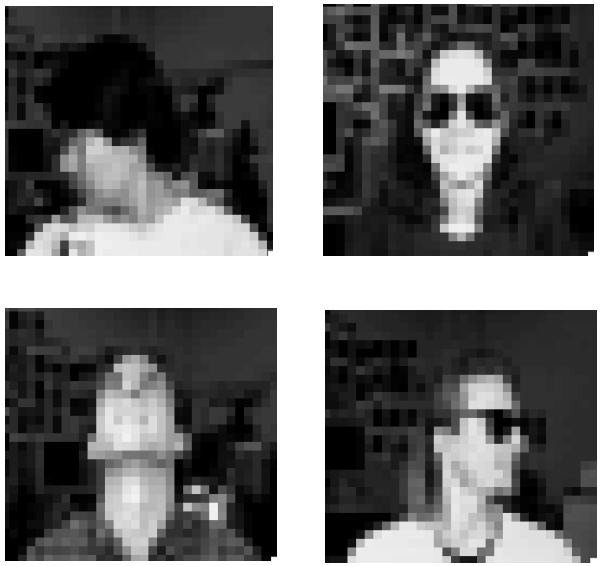

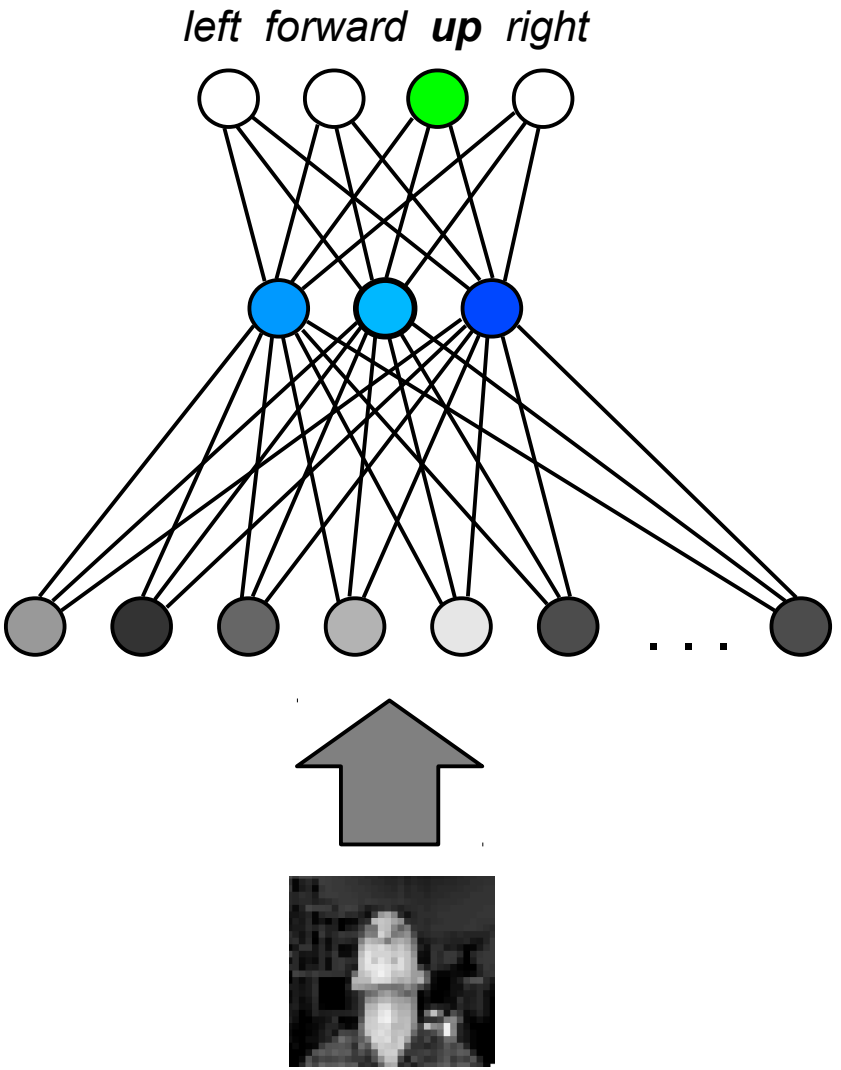

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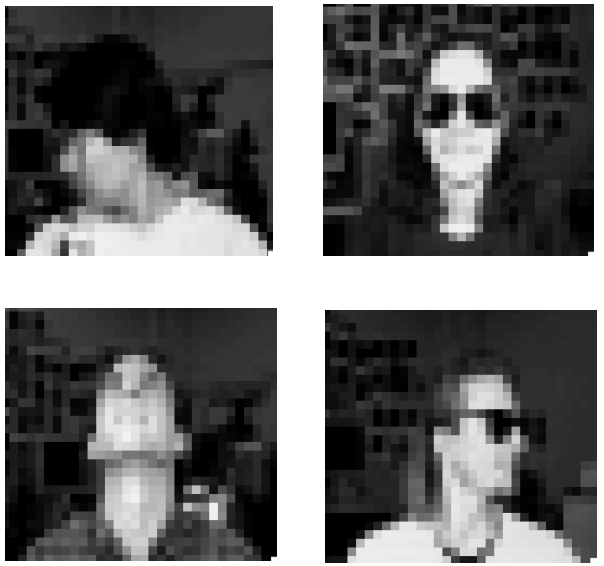

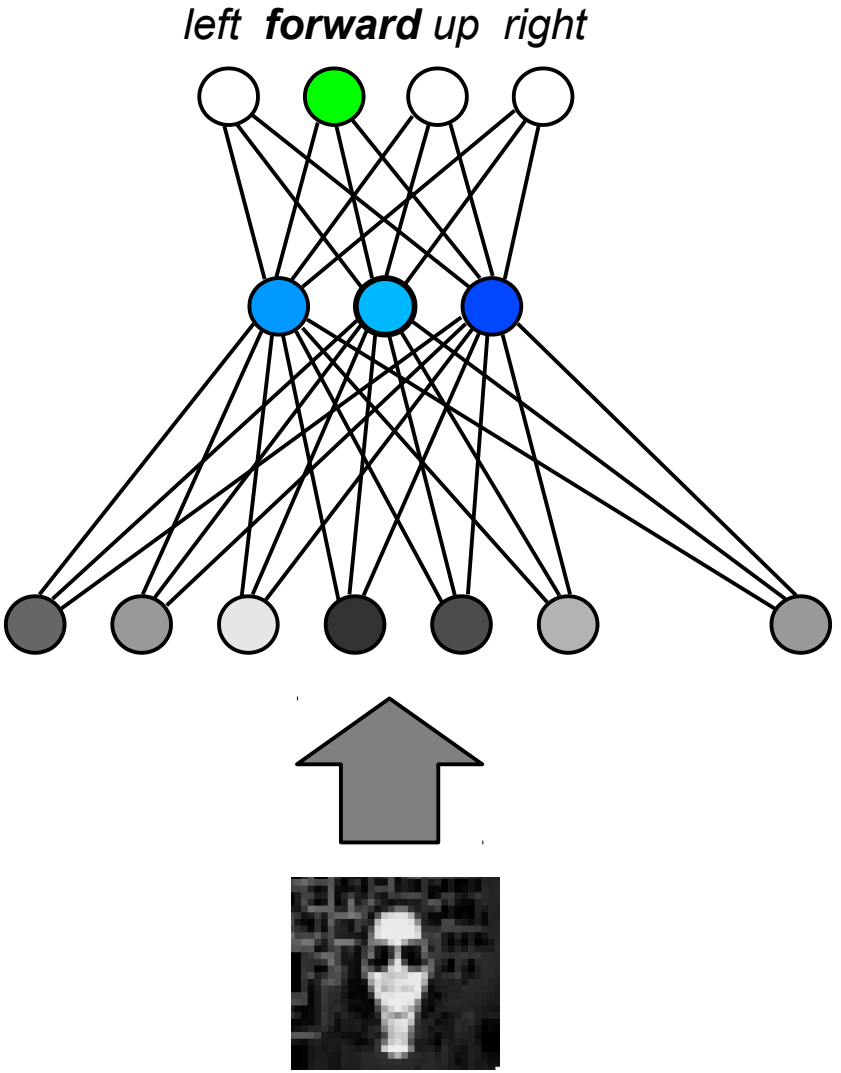

Pose Recognizer Demo