

V. Can you calculate this by hand? [No.5: Seven Layers]
My five hands-on exercises to teach the basics of deep learning

[Exercise 5 of 5: Seven Layers, aka. Multi-Layer Perceptron (MLP)]

Unlike the previous four exercises, this exercise uses a compact form, making two simplifying assumptions:

- 1. All biases are zeros.
- 2. ReLU is directly applied to each cell (except for the output layer), for example, crossing out -5 and replacing it with 0.

Using this compact form, we can easily stack many layers to form a deeper network, like this seven layer network.

This exercise allows students to practice the following:

- 1. Inputs: The network takes a batch of two input vectors (x1, x2)
- 2. Layers: The network has seven layers.
- 3. Draw links between two layers of nodes
- 4. Shade corresponding weights (left) and links (right) in matching colors
- 5. Apply ReLU to "deactivate" negative values to 0 (except for the output layer).
- 6. Calculate one missing value in each layer

Layer 1: $0 \times 3 + 1 \times 4 + 1 \times 5 = 9$

Layer 2: $0 \times 5 + 0 \times 4 + 1 \times 3 + 1 \times 7 + (-1) \times 9 = 1$

Layer 3: $1 \times 6 + 2 \times 1 = 8$

Layer 4: $0 \times 7 + (-1) \times 5 + 1 \times 8 = 3$

Layer 5: $1 \times 2 + 0 \times 3 = 2$

If you missed the earlier exercises, you can review them below:

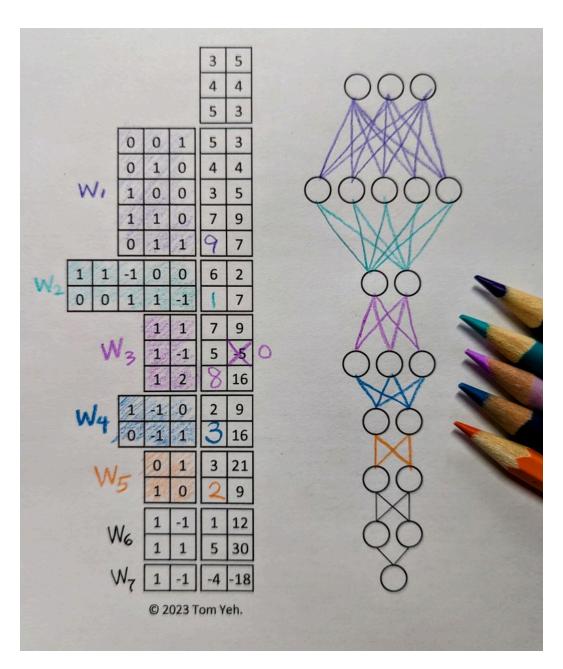
- [1] Single Neuron: https://lnkd.in/gKqEGPgf
- [2] Four Neurons: https://lnkd.in/gc-qwJ6X
- [3] Hidden Layer: https://lnkd.in/gwDXEGsM
- [4] Three Inputs: https://lnkd.in/eMjpAZta
- [5] Multi Layer Perceptron (MLP): https://lnkd.in/gjJRxPsv

This picture contains a couple errors in the last few layers for the second input, can you spot them?

By completing these five hands-on exercises, many of my students told me they finally feel they have seen through the "blackbox" of a deep neural network. If you feel the same way, please [Like] this post.

Moreover, if you are comfortable with math and feel you understand how to calculate the five missing values in this deep neural network, please give a [Celebrate] reaction.

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