APS360 Fundamentals of AI

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Agenda

Last Class:

- Introduction
- Biological Neurons
- Mathematical Model of an Artificial Neuron

Today:

- Train our first neural network
- Training and test sets
Review: Biological Neuron

- Dendrites: Impulses carried toward cell body
- Nucleus
- Cell body: Impulses carried away from cell body
- Axon: Branches of axon
- Axon terminals
Review: Information flow

- (Axon of previous cell)
- (Synapse)
- Dendrite
- Cell Body
- Axon
- Synapse
- (Dendrite of the next cell)
Review: Artificial Neuron

![Diagram of an artificial neuron](image)

- **Axon from a neuron**: $x_0$
- **Synapse**: $w_0 x_0$
- **Dendrite**: $w_1 x_1$
- **Cell body**: $\sum_i w_i x_i + b$
- **Activation function**: $f\left(\sum_i w_i x_i + b\right)$
- **Output axon**: $f$
Review: Artificial Neural Network

- fully-connected, feed-forward network
- \( x_1, \ldots = \) the neurons activation of input layer neurons
- \( h_1 = \) the neuron activation of a hidden layer neuron
- \( y = \) the neuron activation of the output layer neuron
When we describe models (like neural networks), we usually:

- first describe how to make predictions
- then describe how to train the model

This seems a little backward, but it is difficult to understand how to train a network without first describing how to use that network.
Training our first neural network:

Here is how we will train our artificial neural network:

1. Make a prediction for some input data, whose output we already know.
2. Compare the predicted output to the *ground truth* (actual output).
3. Adjust the *weights/biases* to make the prediction close to the ground truth.
4. Repeat steps 1-3 for some number of iterations.
Task for the day

- **Input:** An 28x28 pixel image
- **Output:** Whether the digit is a **small** digit (0, 1, or 2)
  - output=1 means that the digit is small
  - output=0 means that the digit is not small
Task for the day

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Is this a supervised or unsupervised learning problem?
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Is this a supervised or unsupervised learning problem?

Is this a regression or classification problem?
Let’s write some code!