LAB 14: PERCEPTRON CLASSIFICATION

AMBER WANG

FINAL LAB !!!1!11!!1!

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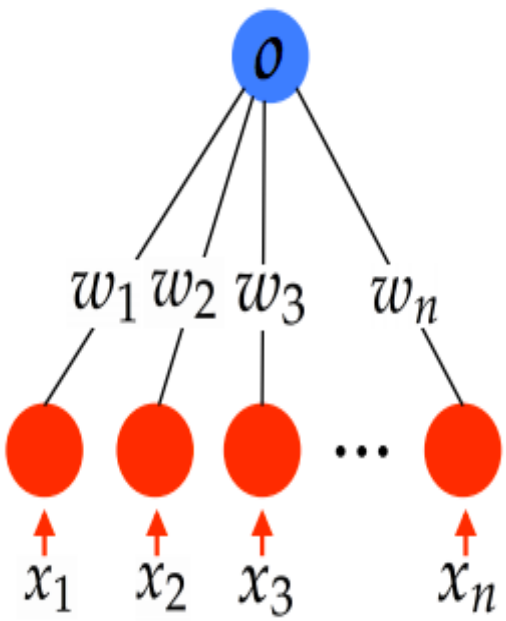
CONTEXT: PERCEPTRON

- Our perceptron machine learning algorithm = *supervised* learning algorithm
  - We know the desired output, and "train" the perceptron based on how closely its output is to our desired one with each iteration
- Perceptron:
  - *n* input neurons, each with a synapse, all leading to a single output
  - Each input neuron receives an input x_i, the effect of the stimulation on the output neuron depending on synaptic strength w_i.
  - Synaptic strengths are updated with each iteration of training stimulation



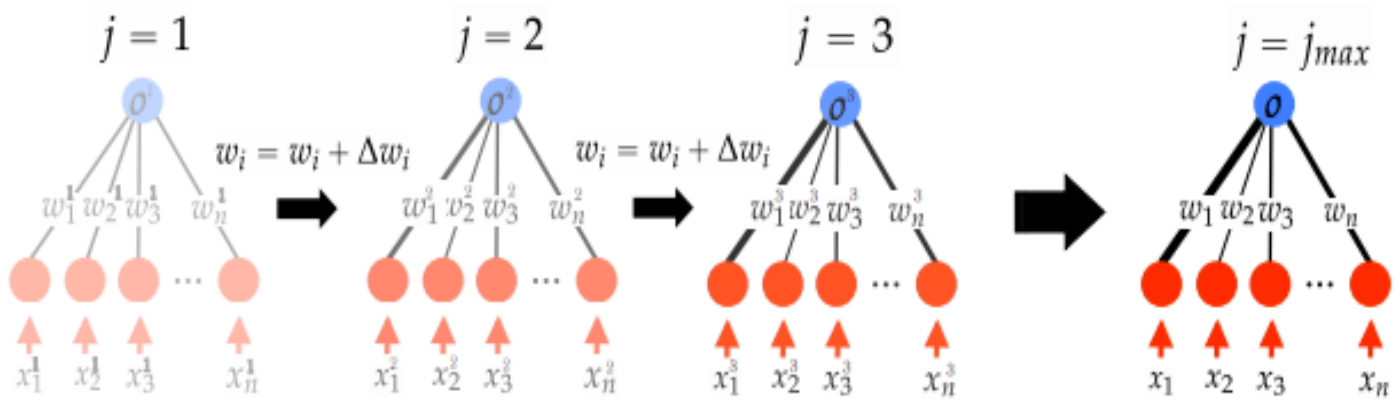
CONTEXT: TRAINING ROUTINE

- Binary inputs/outputs
  - Each input neuron is either stimulated ($x_i = 1$) or not ($x_i = 0$), and the output (weighted sum of inputs) is either 1 or 0.
- Neural firing (output o = 1 or 0)
  - All-or-nothing, represented by 1-or-0
  - If weighted sum of inputs exceeds threshold of 0, the output neuron will fire ($o = 1$), otherwise ($o = 0$)

$$o^j = f\left(\sum_{i=1}^{n} w_i x_i\right) \text{ where } f(\theta) = \begin{cases} 1, & \text{if } \theta > 0. \\ 0, & \text{if } \theta \leqslant 0. \end{cases}$$

CONTEXT: LEARNING ALGORITHM

- For each iteration *j*, the perceptron calculates the output based on the input vector combos of the neural inputs and synaptic weights, then updates based on difference between *o* and the desired output *y*.

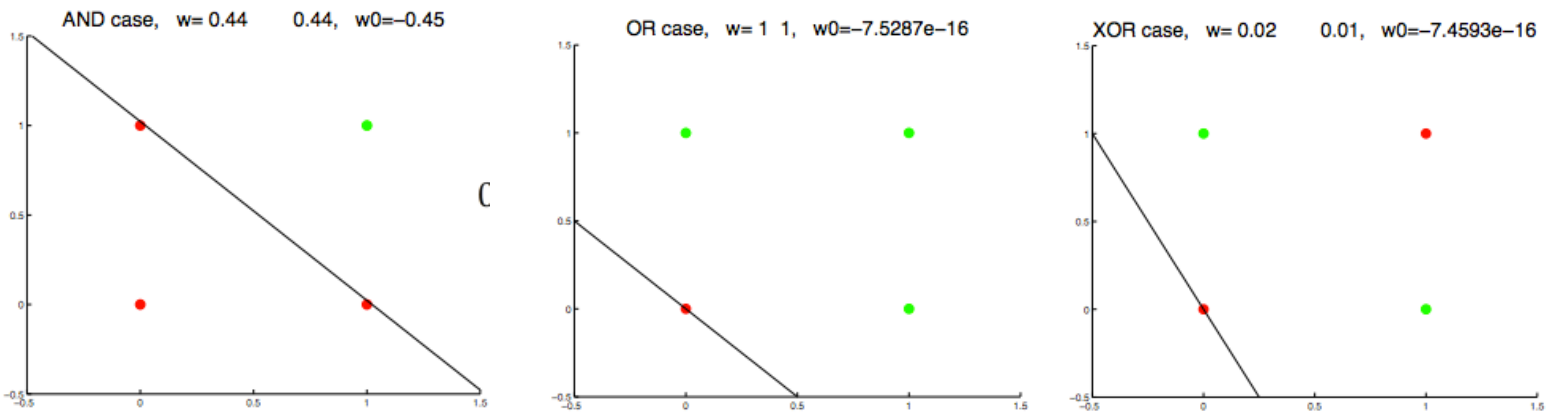


PROJECT: CLASSIFICATION PROBLEMS

- Use learning algorithm to solve three classification problems
  - AND: all input neurons must be stimulated to fire
  - OR: at least one input neuron must be stimulated to fire
  - XOR: exactly one input neuron must be stimulated to fire
- Seek the vector of weights such that each classification's condition for firing is met
- Project Outline:
  1. pdrive (driver)
     - Run the function perceptron on the the AND, OR, XOR problems
     - Visualize the solutions given by perceptron
  2. [w, w0] = perceptron(x, y)
     - x = number of different inputs
     - y = desired outputs for each combination of inputs
     - Code the perception learning algorithm

FUNCTION PDRIVE

1. Call the function perceptron to run on the AND, OR, XOR problems
2. Visualize the solutions from perceptron using a scatter plot and color-coding the input pattern



FUNCTION [W, W0] = PERCEPTRON(X, Y)

1. Code the learning algorithm
2. Algorithm should accommodate an arbitrary length(x) and pass each x(i, :) for i=1:length(x) over jmax = 1000 iterations
3. Update weights until desired output is reached
   - w = vector of correct weights for each synapse
   - w0 = bias bit; assigned to any input that is always 1