
Artificial Neural Networks

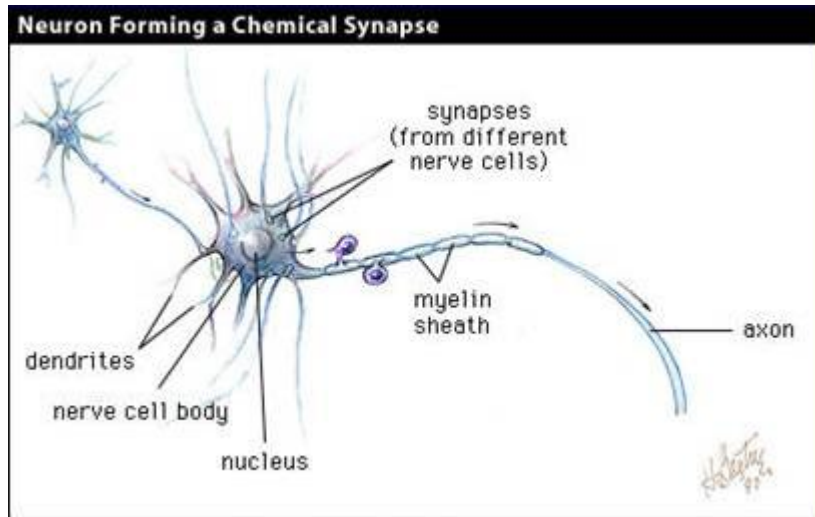
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Overview

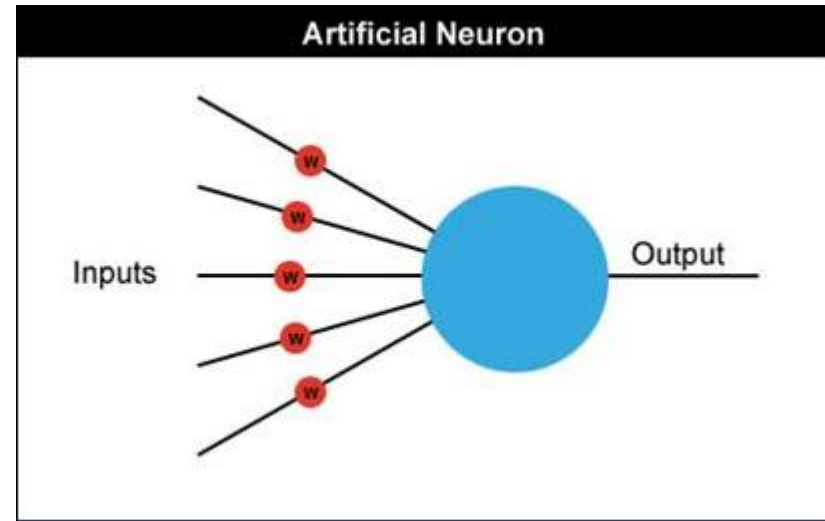
- What is an artificial neural network
- Perceptron
- Feed forward
- Backpropagation
- Learning rate/momentum

What is a neural network?

Human



Artificial



Neurons

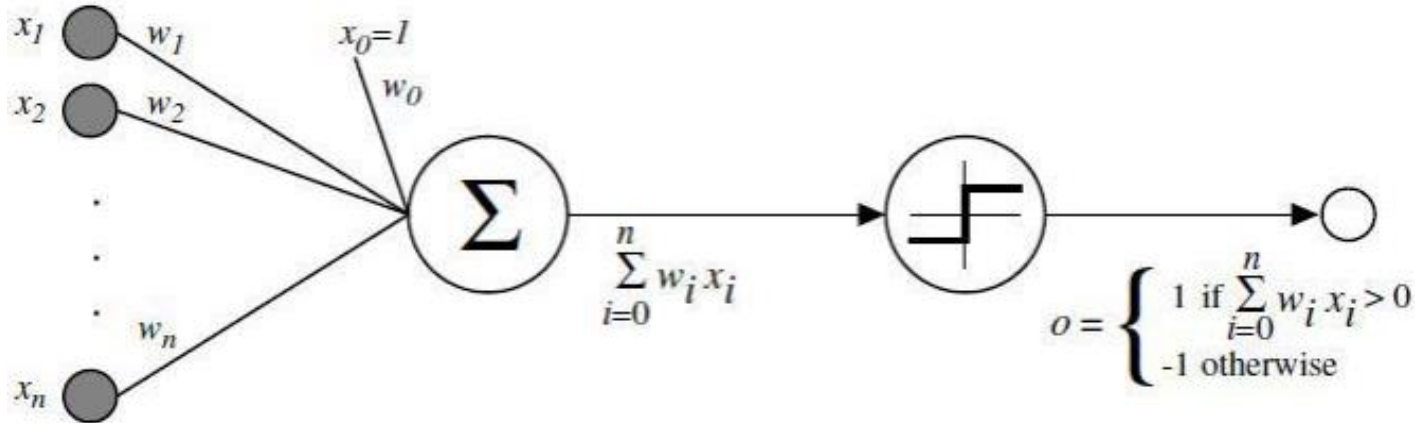
- Each neuron has inputs
 - Each input has a weight
- Input is multiplied by weight
- Inputs are summed
 - If a Bias node is present, it is added to the sum
- Activation function (transfer function) is used to calculate the output

Weights

- Determine how much influence the input has on a node
- Used in linear regression in each node
- Can be adjusted based on error

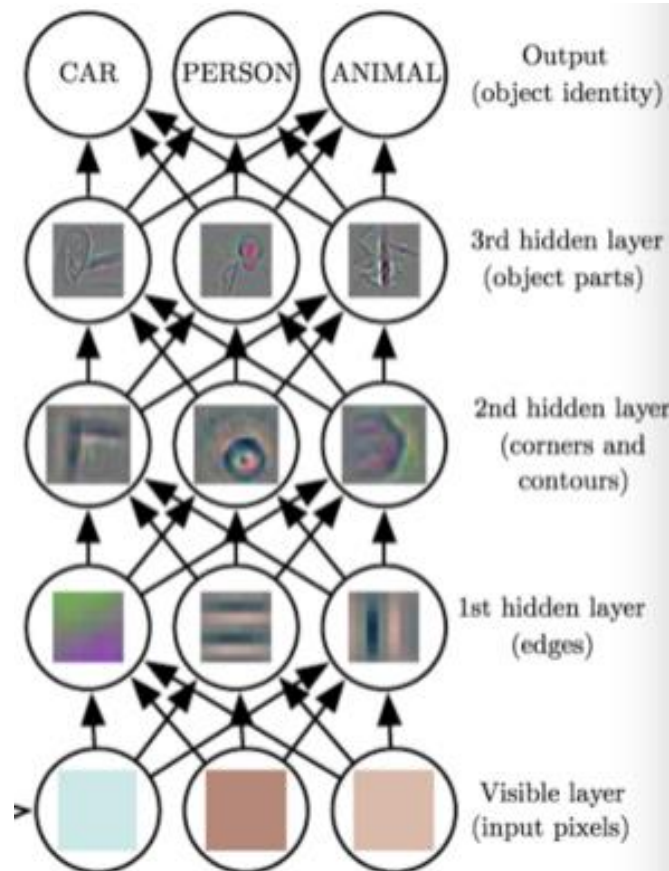
Perceptrons

- Most basic neural network algorithm
- Solve linear separable problems
- Uses the step function



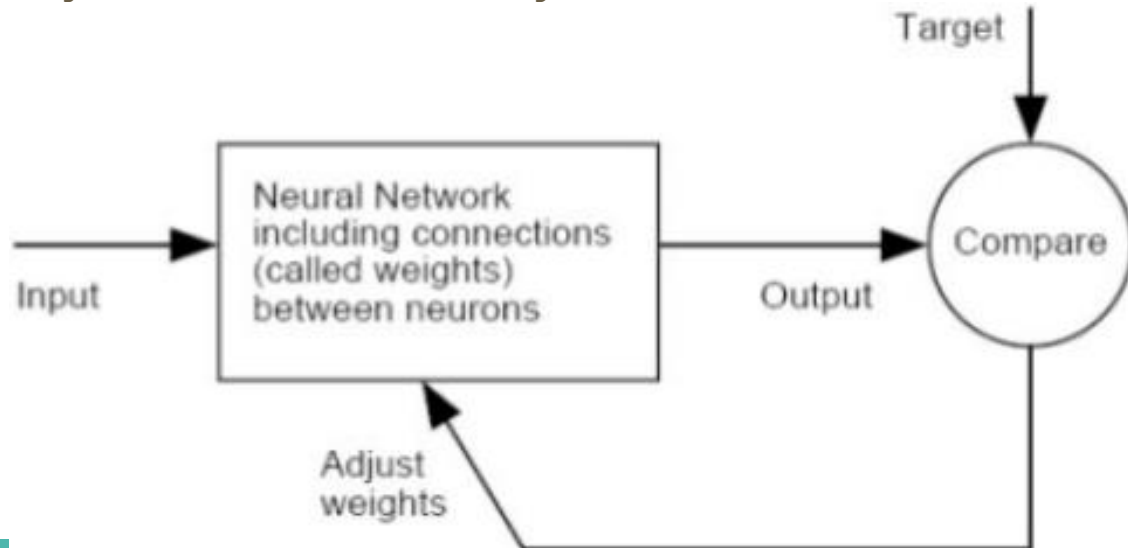
Feed Forward

- Takes input from previous layer
 - Outputs to nodes in next layer
- Uses hidden layers
 - “Each hidden layer neuron has a template. It becomes activated, and sends signals of its own to the next layer, precisely when the pattern of information it's receiving from the preceding layer matches (within some tolerance) that template.”
 - Calculations are done in the hidden layer



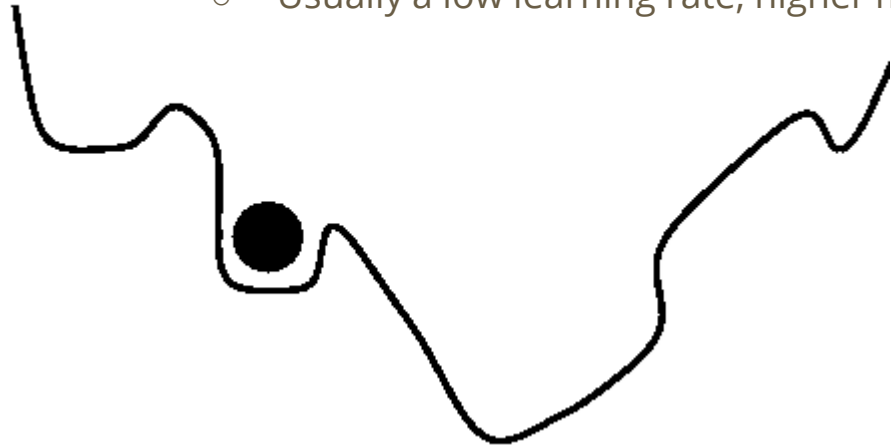
Back Propagation

- Key in helping a neural network “learn”
- Compares final output to expected output
 - = error rate
- Error rate is used to make adjustments for each layer



Learning rate and momentum

- Learning rate determines how quickly the neural network “learns”
 - Higher learning rate = network changes its mind more frequently
 - Lower learning rate = network needs more examples to change its mind
- Momentum
 - Controls the size of steps taken
 - Usually a low learning rate, higher momentum is ideal



Complications

Normalizing data

Segmentation faults

Design flaw

Mario example

<https://www.youtube.com/watch?v=qv6UVOQ0F44>

Works Cited

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[Figure-61-Sample-of-a-feed-forward-neural-network.png](#)

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