2025

4Geeks Academy: data science cohort 12

DAY 27: INTRO. TO DEEP LEARNING

TODO

DEEP LEARNING	Neural networks: types, training, hyperparmameters
TIME SERIES PROJECT	Finish Alternative time series project (Time series module), if you haven't done so already
IMAGE CLASSIFICATION PROJECT	Work on image-classifier-project-tutorial (Intro to Deep Learning module), plan to finish by next Wednesday

TOPICS

01 NEURAL NETWORKS

02 TRAINING A NEURAL NETWORK

03 HYPERPARAMETERS

NEURAL NETWORKS

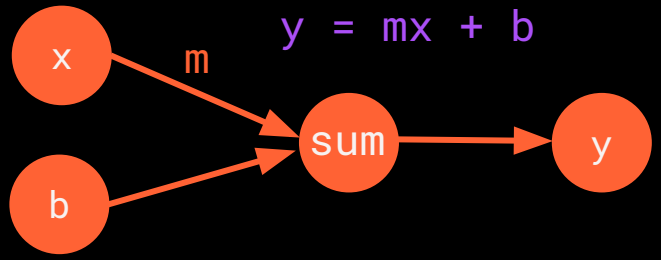
WHAT Set of interconnected units (neurons) that minimizes the difference between its outputs and the true labels by changing the strength of connections.

WHY

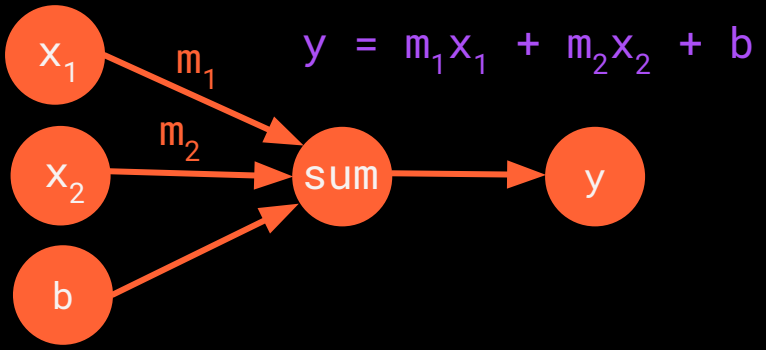
- **Extremely powerful** - a large enough network can learn any continuous function (see universal approximation theorem)
- **Flexible** - neurons can be connected in many different ways to build networks with desirable properties
- **Extensible** - can be updated to handle new data without fully re-training (see fine-tuning)

HOW **Linear regression** - each feature is multiplied by a slope and added together with an intercept term to get the output....

One feature



Two features



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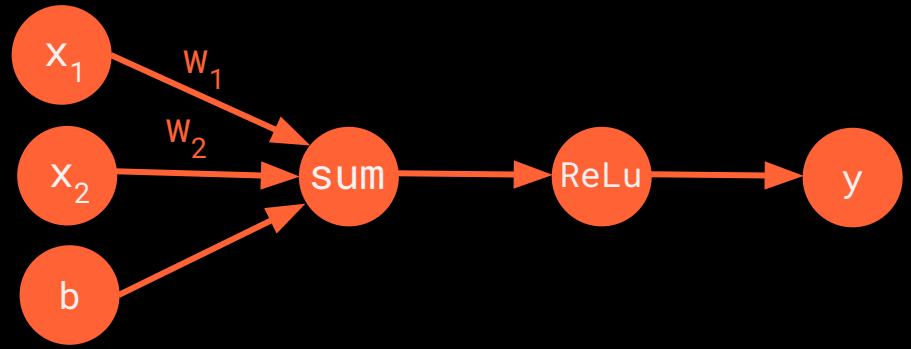
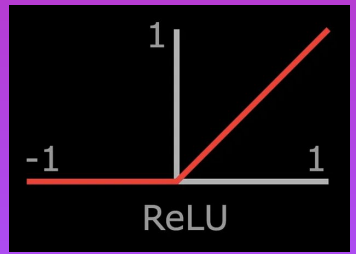
HOW

Artificial neuron works the same way!

- **Inputs:** x1 & x2
- **Weights**: w1 & w2, 'slope'
- **Bias**: b, 'intercept'
- **Activation function**: ReLu (others exist)
- **Output**: y





NEURAL NETWORKS

WHAT

Set of interconnected units (neurons) that minimizes the difference between its outputs and the true labels by changing the strength of connections.

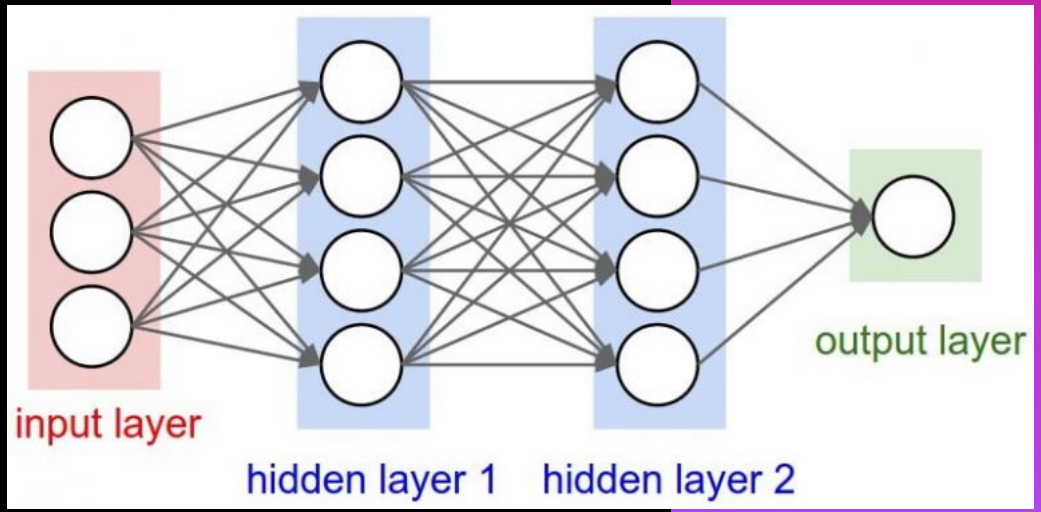
Deep neural network has 2 or more hidden layers between inputs and outputs

Each unit is a neuron - in the diagram:

- **Input layer**: takes values from features
- **Hidden layer 1**: each unit takes three inputs
- **Hidden layer 2**: each unit takes 4 inputs
- **Output layer**: takes 4 inputs

Building a neural network involves defining the:

1. Input shape
2. Number of hidden layer & units
3. Output shape and activation



TRAINING A NEURAL NETWORK

DATA PREPARATION

Similar to other model types:

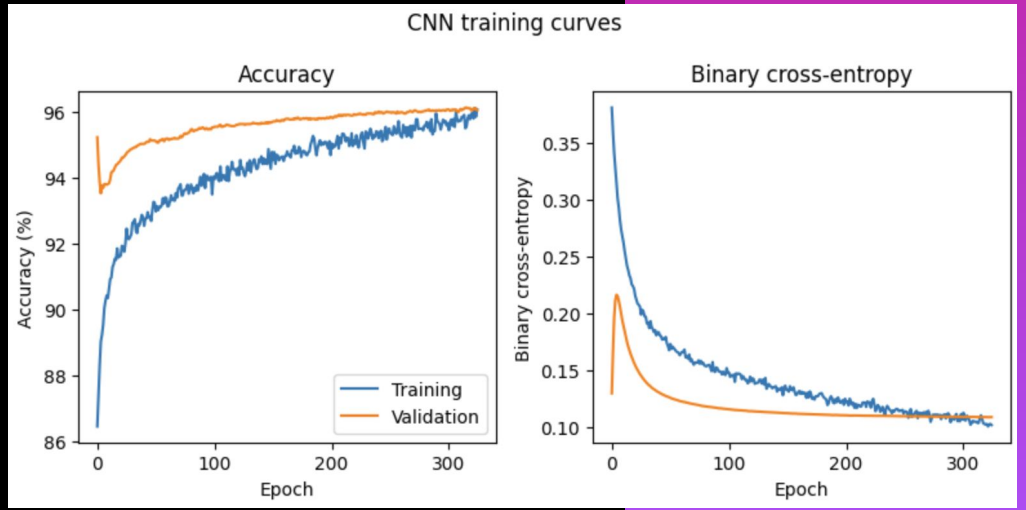
- Cleaning missing data
- Encoding string features
- Selecting features
- Transforming/scaling features
- Dealing with extreme values
- Training/testing/validation, metrics etc.

THE TRAINING LOOP

Neural networks are trained iteratively in a series of rounds called ‘epochs’.

During each epoch

1. Data is split into batches
2. Network makes predictions for the batch
3. Batch predictions are scored against the labels
4. Weights are updated to improve the predictions
5. Goto step 2, until we run out of data
6. Evaluate the model on the validation data



HYPERPARAMETERS

TRAINING SPEED

- **Learning rate**: specifies scaling factor for size of each weight update
- **Batch size**: how many example are scored before the weight update is calculated

MODEL ARCHITECTURE

- **Number of layers:** how ‘deep’ is the network
- **Units per layer**: how ‘wide’ is each layer