IntroToNeuralNetworks - Basics - 1

One should look for what is and not what he thinks should be. (Albert Einstein)

Basics: Topic introduction

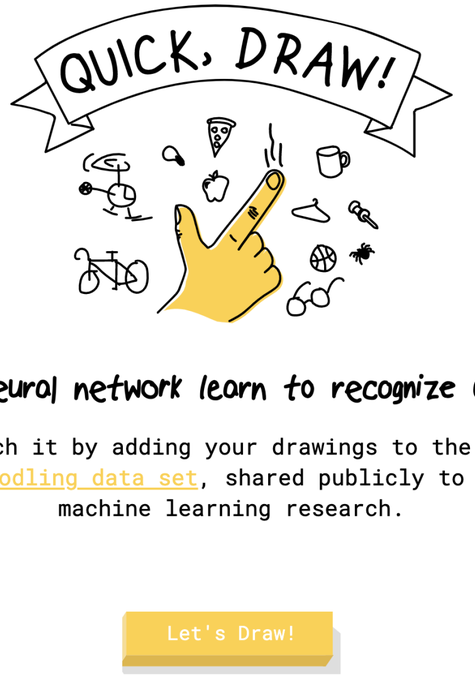
In this part of the course, we will cover the following concepts:

- Introduction to neural networks
- Neural networks use cases

Module completion checklist

Objective	Complete
Summarize what neural networks are and identify some of their use cases	
Define a simple neural network and identify its components	

Warmup: Let's play Quick, Draw!



- Visit this website to play a game: ***https://quickdraw.withgoogle.com/***
- How many of your doodles were correctly recognized?
- A video we watch later in this course will shed some light on how a **neural network** "learns" to recognize things like doodles, cat pictures, and a lot of other useful things

Neural networks: what are they?

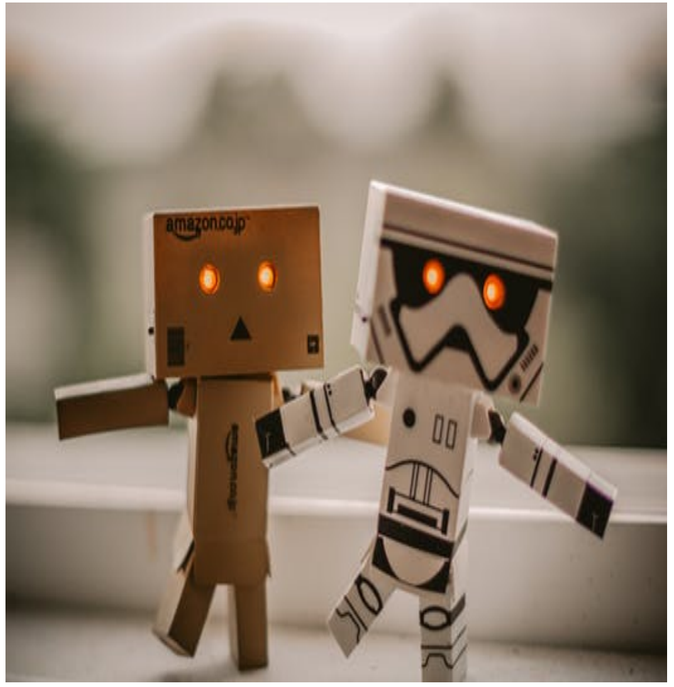
- A neural network is what our brain uses to process information in the world around us
- An **artificial neural network (ANN)**, often referred to as a **neural network (NN)**, is a host of well-known machine learning algorithms that attempts to mimic the neural network our brains use
- We are going to start our exploration of NNs with a fun example

Artificial neural networks - meet A.N.N

Meet A.N.N.

Neural networks use cases

- There are many instances where neural networks would perform well, including:
  - AI-assisted drug discovery: ***Concepts of Artificial Intelligence for Computer-Assisted Drug Discovery***
  - Communication and signal processing: ***Neural networks for channel estimation from compressed measurements***
  - Robotics: ***Deep Learning in Robotics: A Review of Recent Research***
  - Finance: ***Deep Learning in Asset Pricing***



Use cases by data type

Data type	Use case
Raw text	Analyze emails and chats from customer support database to detect most common issues customers face
Audio data	Help identify whether a person is under distress by analyzing recorded phone calls to a hotline
Stock prices	Determine price trends, detect anomalies, asses risk
Sensor data	Insight into preventing fatalities, based on data collected from car sensors

Use cases by algorithm type

Algorithm type	Use case
Classification	This image represents a horse; this email looks like spam; this transaction is fraudulent
Clustering	These two sounds are similar; these documents belong to the same topic / domain
Recommender systems	Given their web activity, this customer looks like they are going to stop using your service

- Can you think of use cases from projects that you have been working on?

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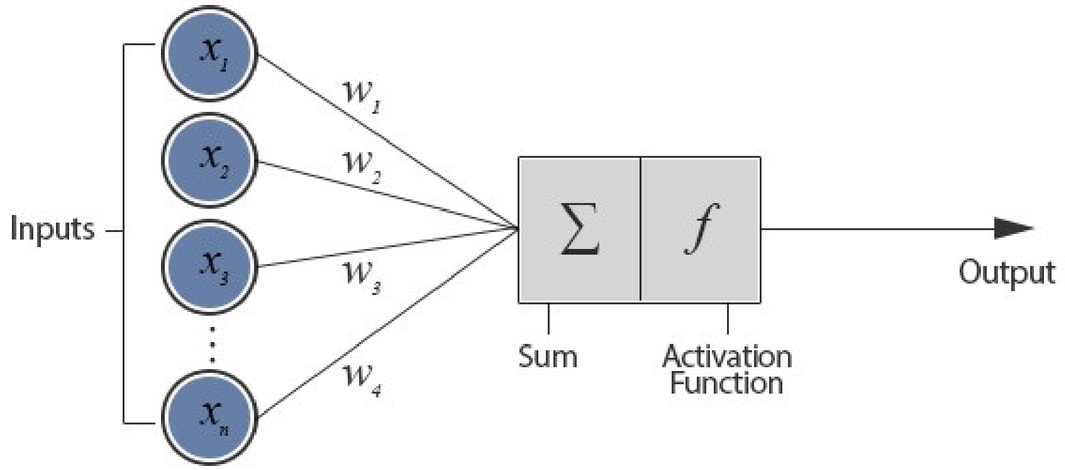
Where we're headed

- Now that we've discussed why we'd use neural networks, we're going to walk through a simple neural network to give you an understanding of what they are
- Later in the course we'll go through a more complex neural network, also known as **deep learning**

Perceptron

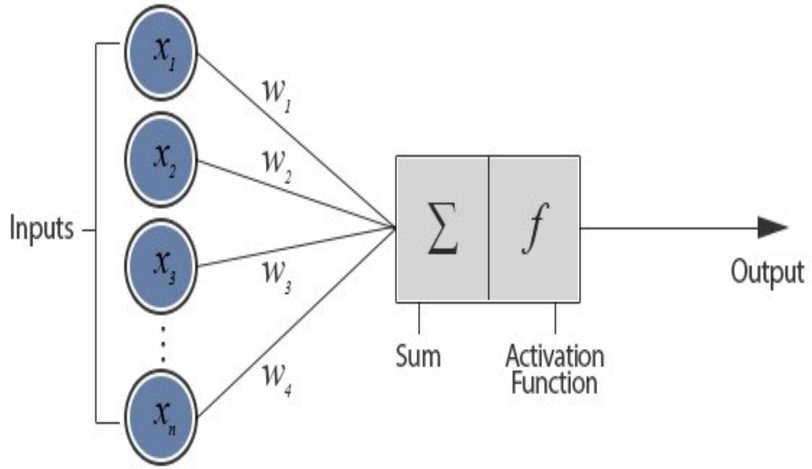
- The figure below depicts a **perceptron**, which is a neuron connected with *n* other neurons
- It is the simplest type of neural network
- Let's discuss each of the components



Model of an artificial neuron

Neural networks: layers

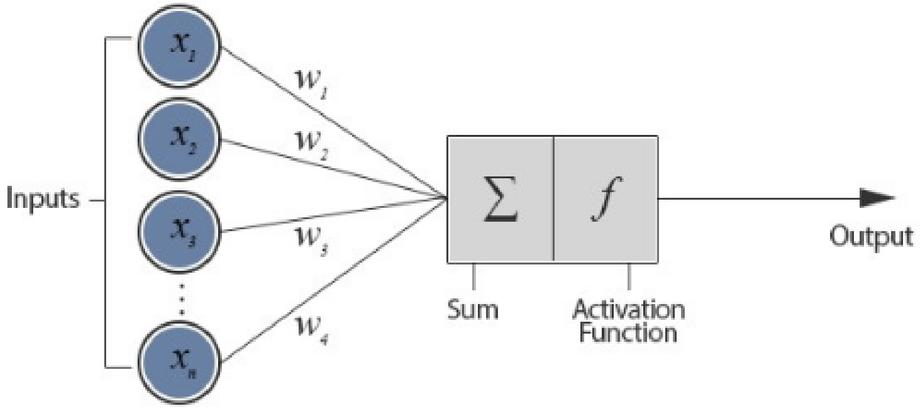
- The major components of a neural network are the:
  - inputs
  - weights
  - summation processor
  - activation function
  - outputs



Model of an artificial neuron

Inputs

inputs: your features either as row vectors representing observations, or the variables that go into the model to predict the outcome

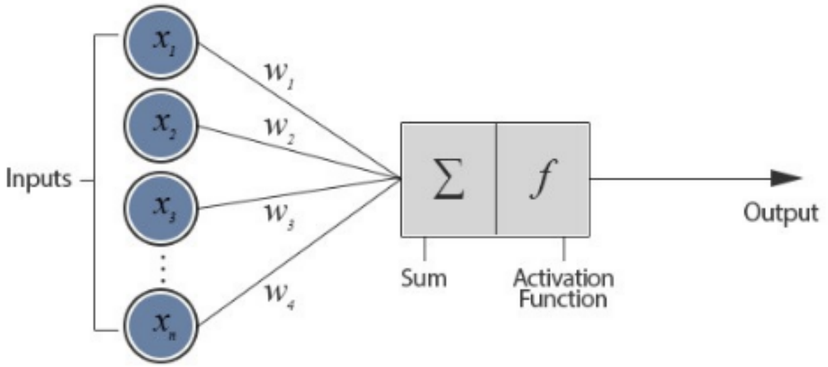


Model of an artificial neuron

Weights

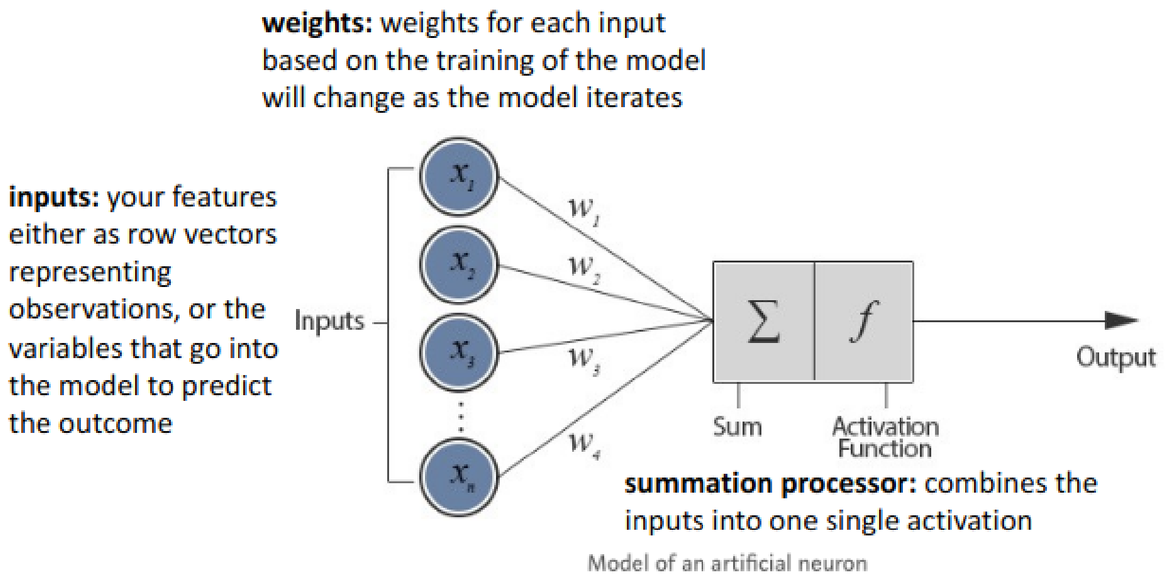
weights: weights for each input based on the training of the model will change as the model iterates

inputs: your features either as row vectors representing observations, or the variables that go into the model to predict the outcome



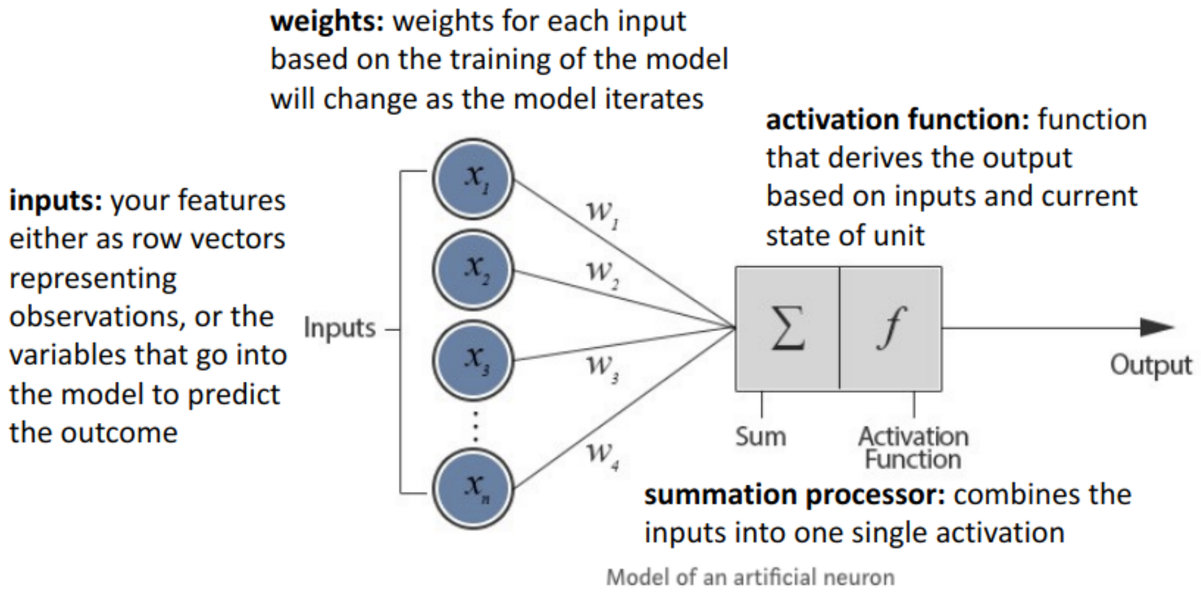
Model of an artificial neuron

Summation processor



- Before the summation processor "squeezes," the computation goes through one or more *hidden* layers (this is where the "black box" concept of a neural network comes from)
- A simple neural network will have up to two hidden layers
- Anything over *two hidden layers* becomes a type of deep learning network

Activation function



Model of an artificial neuron

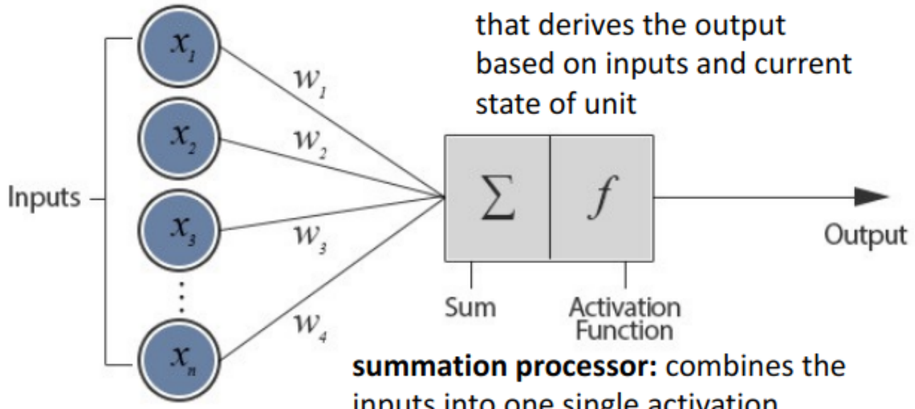
- There are many types of activation functions such as `ReLU`, `sigmoid`, `tanh`, and `softmax`
- Based on the inputs, the function derives its current state, and outputs an activation value

Outputs

weights: weights for each input based on the training of the model will change as the model iterates

activation function: function that derives the output based on inputs and current state of unit

inputs: your features either as row vectors representing observations, or the variables that go into the model to predict the outcome

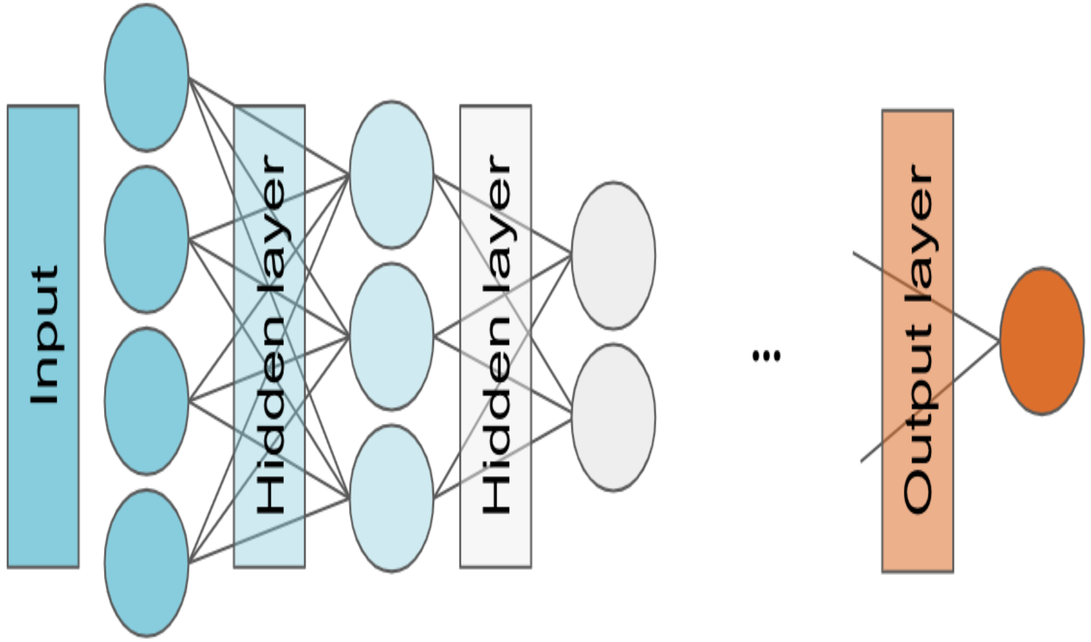


output: the target variable you are attempting to predict

summation processor: combines the inputs into one single activation

Model of an artificial neuron

NN architecture

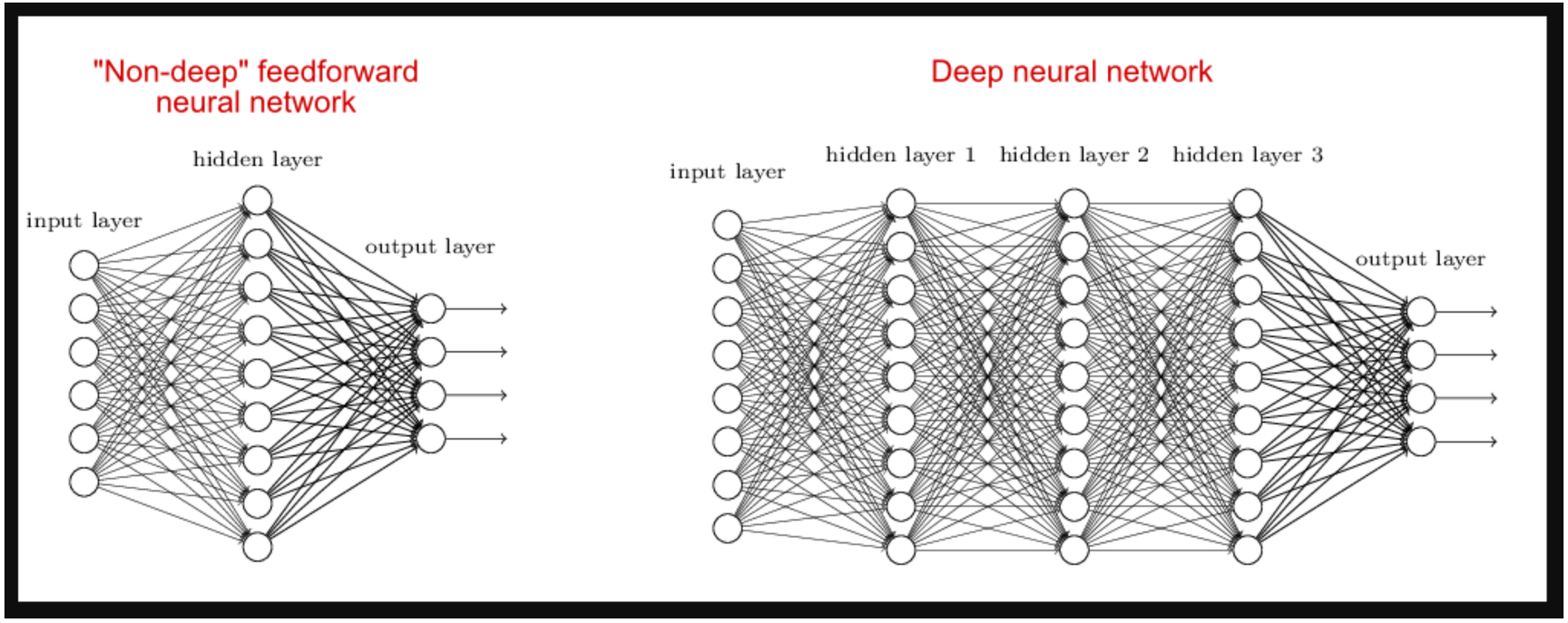


- **Note:** there is no single NN architecture that works well for all problems!

- The general architecture of any NN looks like a piece of layered cake
- Depending on the *number of hidden layers*, each *layer type and its configuration* (e.g., the number of neurons in it, the activation function and other parameters) each NN architecture might yield drastically different results for the same problem
- Choosing the right NN architecture for the problem and tuning the model is instrumental to successful NN implementation

Deep learning vs simple neural networks

- Typically, one or two hidden layers are enough for most problems
- Deep learning is a branch of machine learning that uses deep neural networks
- Deep neural networks (DNNs) are essentially the same thing as artificial neural networks (ANNs) with more complex architecture that calls for use of multiple layers
- Here is a diagram of how the two differ architecturally:



Knowledge check

Link: ***https://forms.gle/eohBKnNTs5i1mQox8***

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Basics: Topic Summary

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Congratulations on completing this module!