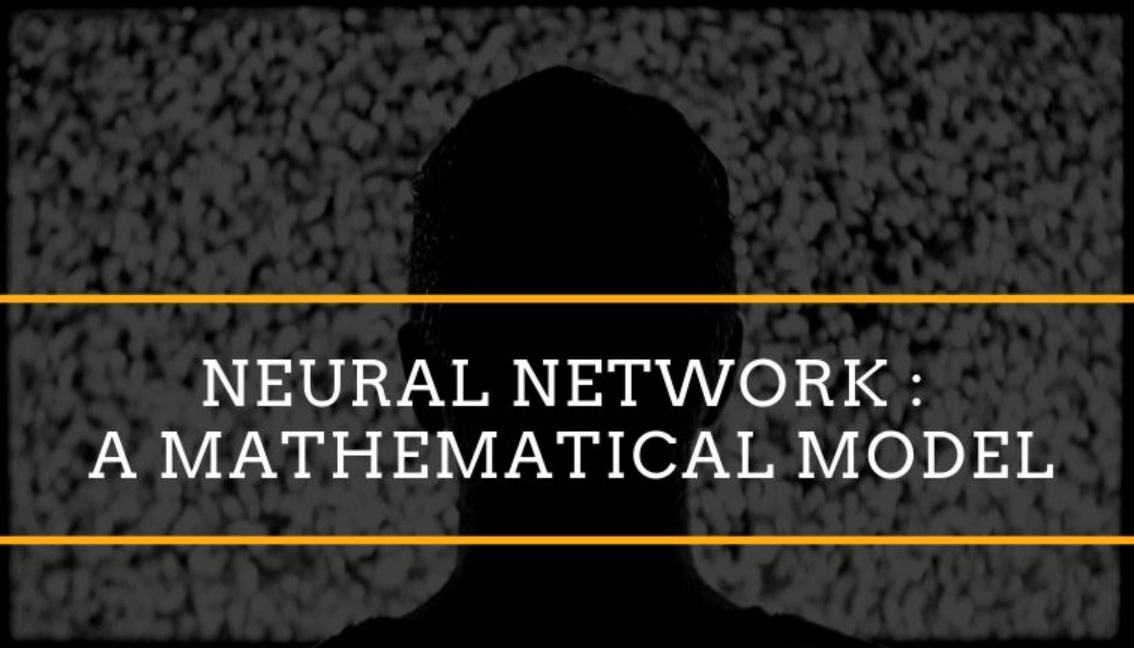
DSC NSEC

08

Chapter

NEURAL NETWORK : A MATHEMATICAL MODEL



UNIT THREE

SEP 23, 2019

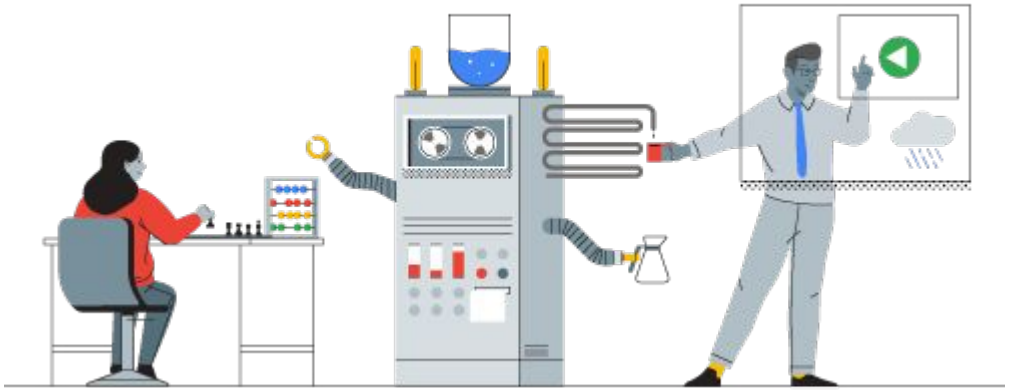
AYUSH THAKUR

Intro to ML with DSC NSEC

About Me

- Deep Learning for Computer Vision
- Chair, IEEE EDS Student Branch Chapter, NSEC
- Winner of few competitions.
- Human <3

Chapter 8: Neural Network: A Mathematical Model (Peekaboo)



Agenda

- Mathematical Modeling
  - What?
  - How?
  - Example
- Intelligence
  - ! Human
  - Modelling Brain- Artificial Neuron
  - Learning

Disclaimers

Biology Ahead

“Stay with me.”

Some Maths Too

Agenda

- Mathematical Modeling
  - What?
  - How?
  - Example
- Intelligence
  - ! Human
  - Modelling Brain - Artificial Neuron
  - Learning

Modeling is a process that uses

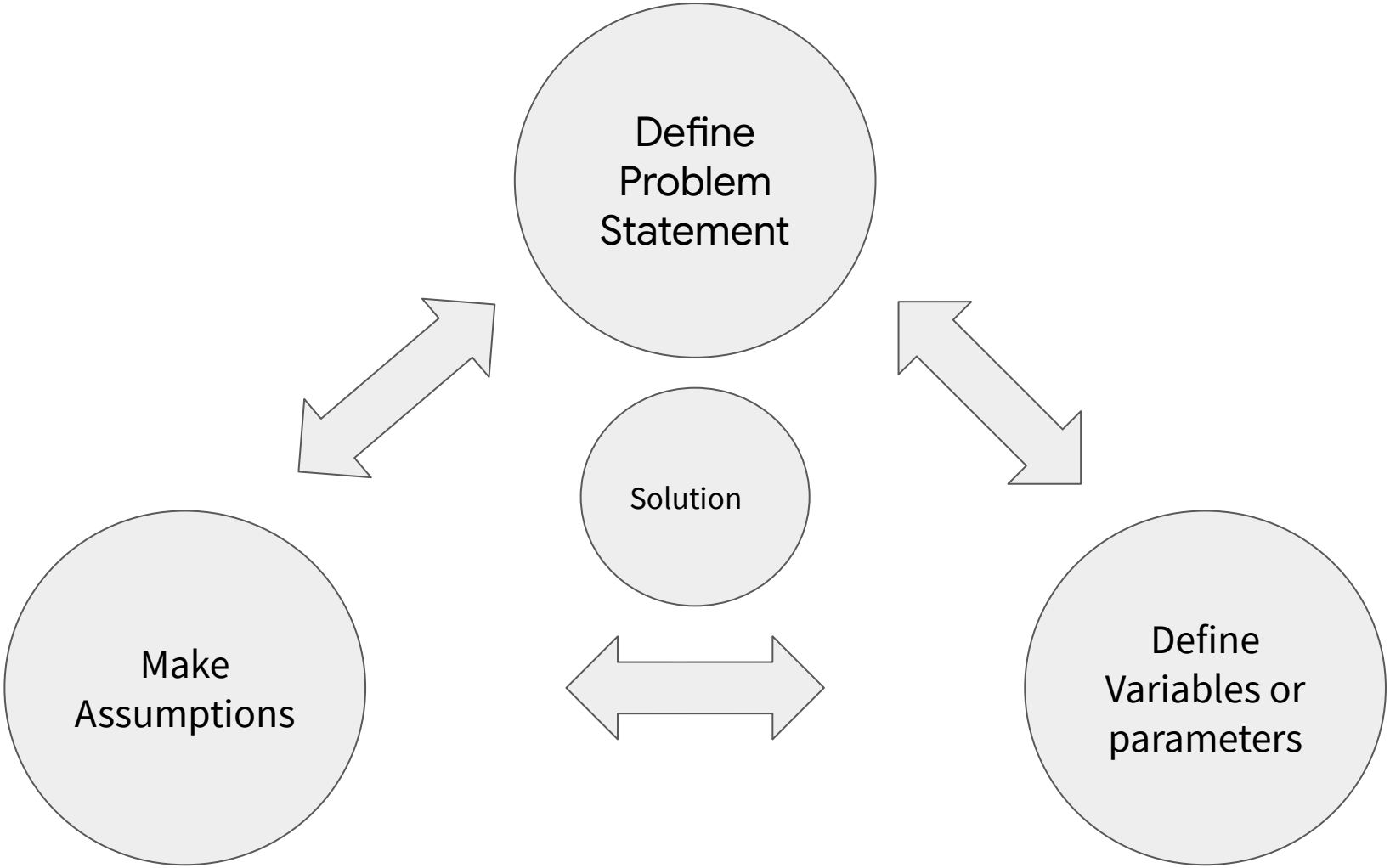
Math

to represent, analyze, make predictions or otherwise provide insight into real-world phenomenon.

It’s an abstraction of Real life scenario, system or event that uses mathematical language to predict the behaviour, dynamics and evolution of said scenario, system or event.

Agenda

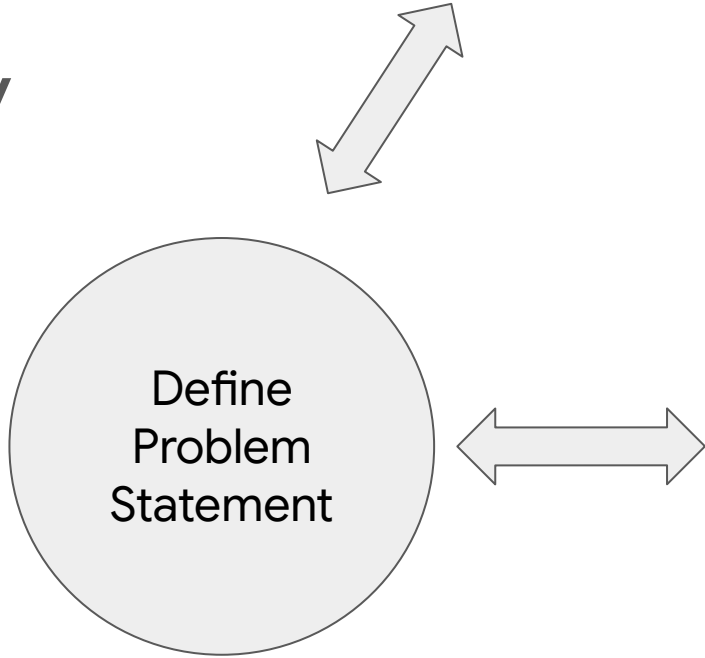
- Mathematical Modeling
  - What?
  - How?
  - Example
- Intelligence
  - ! Human
  - Modelling Brain - Artificial Neuron
  - Learning


Define Problem Statement
Solution
Make Assumptions
Define Variables or parameters

Agenda

- Mathematical Modeling
  - What?
  - Why?
  - Example
- Intelligence
  - ! Human
  - Modelling Brain - Artificial Neuron
  - Learning

Let’s Leave Earth’s Gravity



Defining problem statement: #1

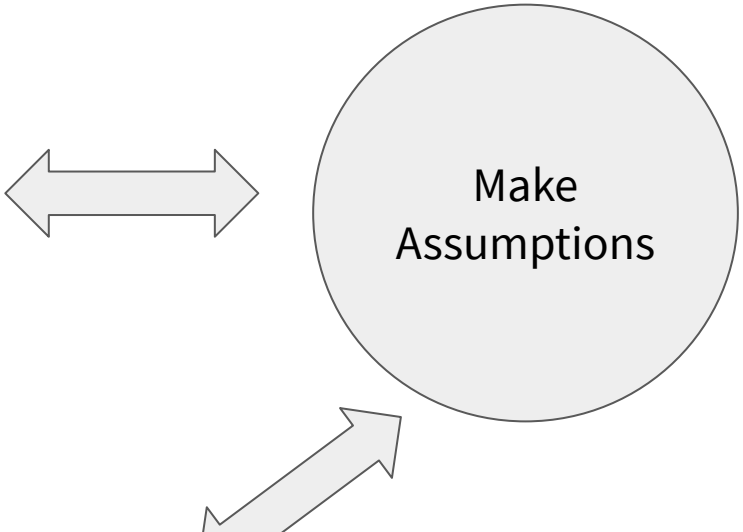
- What is Gravity?
- How to leave earth’s gravity?

Defining problem statement: #2

- Escape Velocity: Enough velocity to overcome gravitational pull.

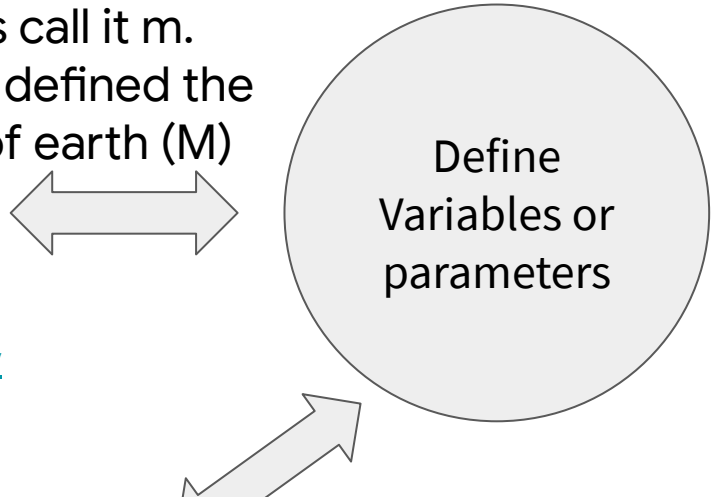
Assumptions

- If minimum escape velocity is computed, any object with more velocity can leave earth.
- Factors like drag by air is not considered in the modelling process.
- Won't bother about achieving that velocity. Let's just find out the velocity.



Defining Parameters

- We have a mathematical model for gravity (Courtesy: Sir Newton). Hence related parameters are known and defined. For Ex: Gravitational constant or G.
- Since velocity is to be computed let's call it Vesp.
- The object to leave earth will have mass. Let's call it m.
- While defining gravity of earth we must have defined the parameters like radius of earth(R) and mass of earth (M)

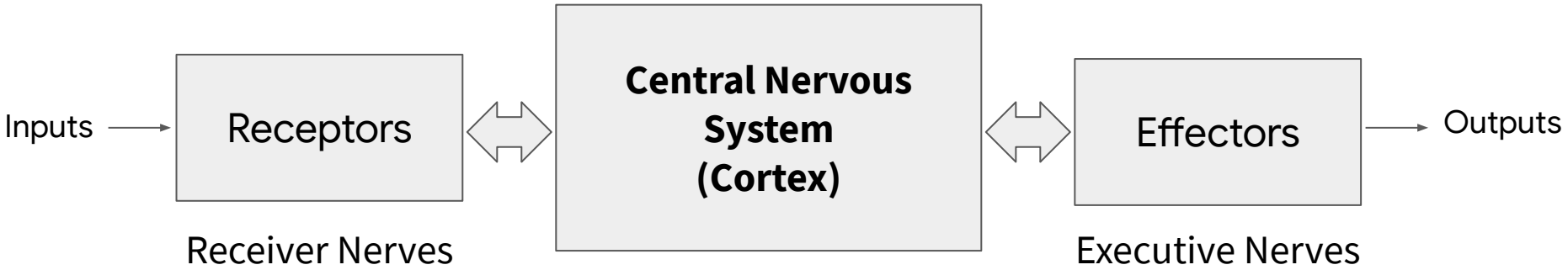


SOLUTION: https://www.wikihow.com/Calculate-Escape-Velocity

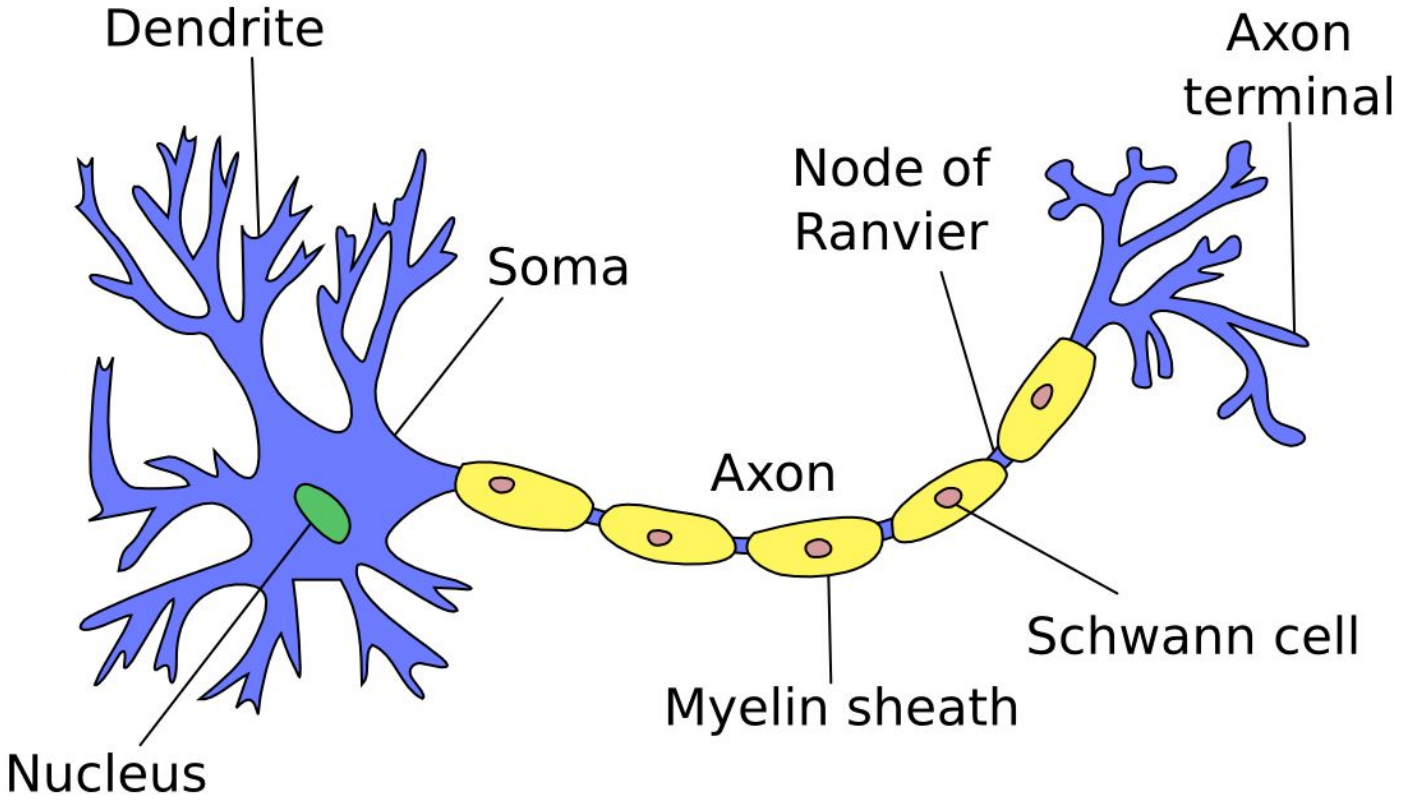
Agenda

- Mathematical Modeling
  - What?
  - How?
  - Example
- Intelligence
  - ! Human
  - Modelling Brain - Artificial Neuron
  - Learning

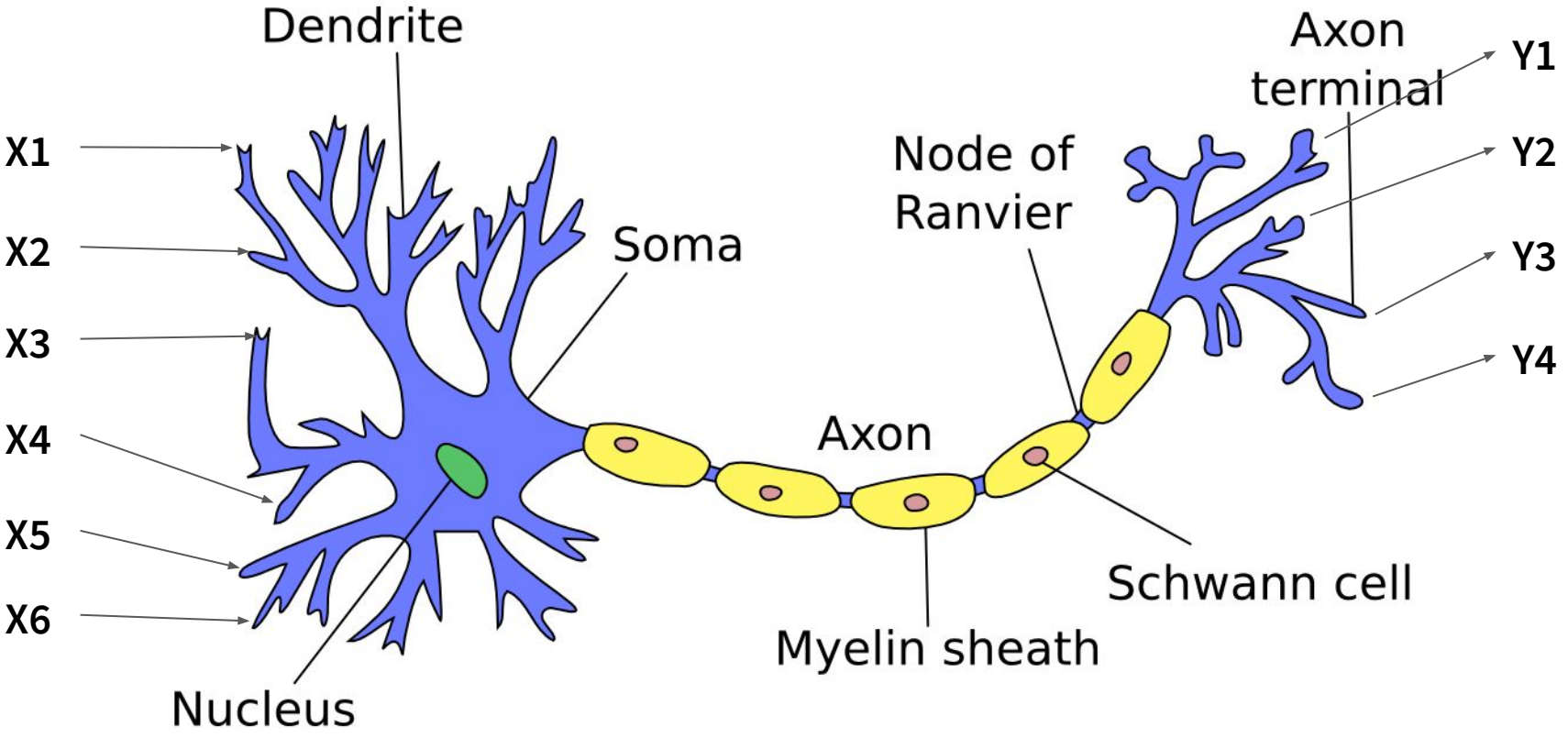
Human Nervous System



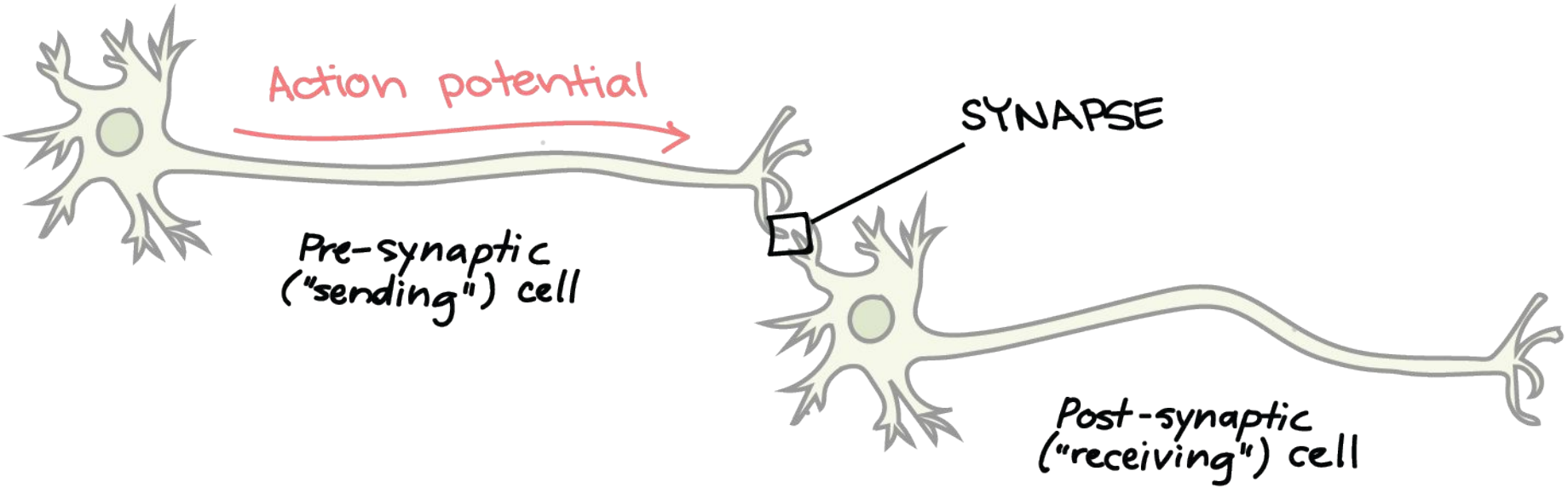
Biological Neurons



Biological Neurons



Connection Between Neurons



A **synapse** serves as a unique inter-neuron interface to transfer the information.

At the early stage of the human brain development (the first two years from birth) about 1 million synapses (hard-wired connections) are formed per second.

Synapses are then modified through the learning process.

Summary

- Input
- Neurons
- Connected neurons via synapses
- Modification of synapses through learning process
- Output

Agenda

- Mathematical Modeling
  - What?
  - How?
  - Example
- Intelligence
  - ! Human
  - Modelling Nervous System - Artificial Neuron
  - Learning

Mathematical Model of Single Neuron

Defining problem:

Dynamic generation of dynamic output based on dynamic input.

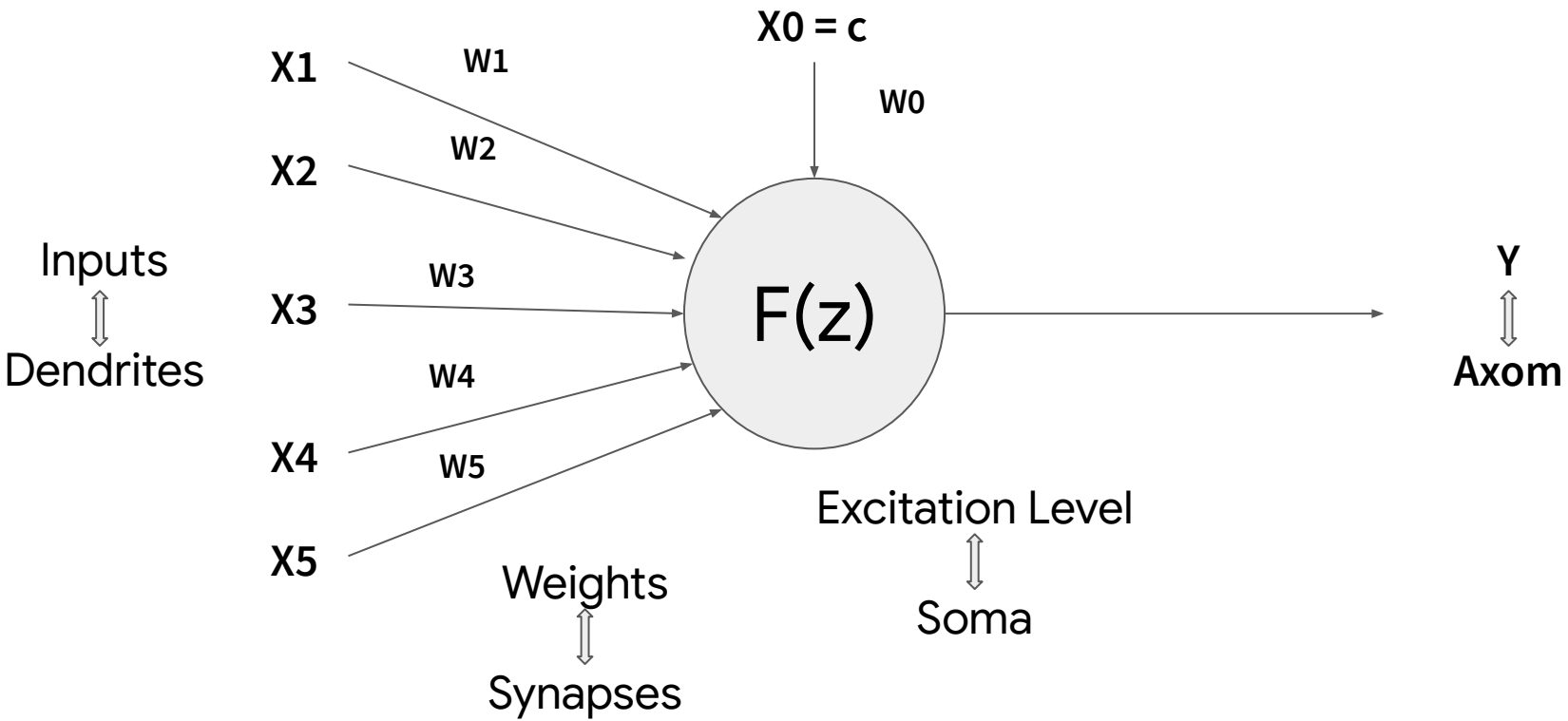
Assumptions:

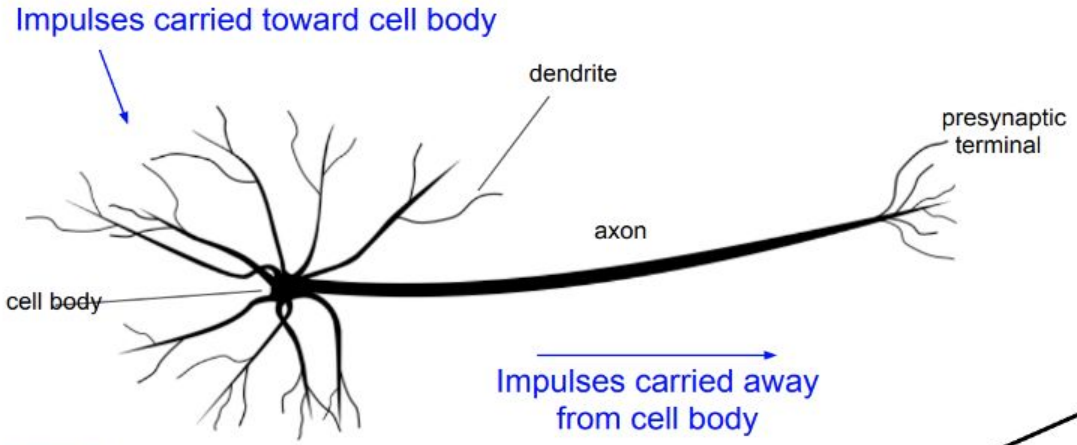
- Output is dependent variable.
- Input is independent variable.

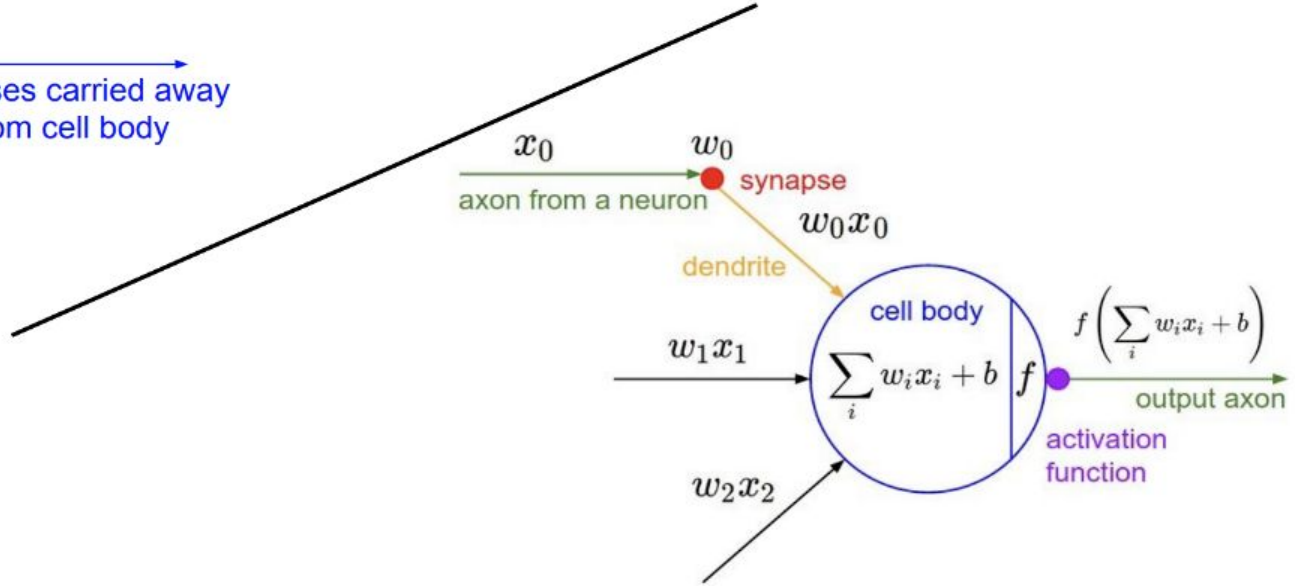
Define Variables:

- Inputs as x1, x2, x3 and so on.
- Outputs as y1, y2, y3 and so on.

Inspiration from Biological Neuron

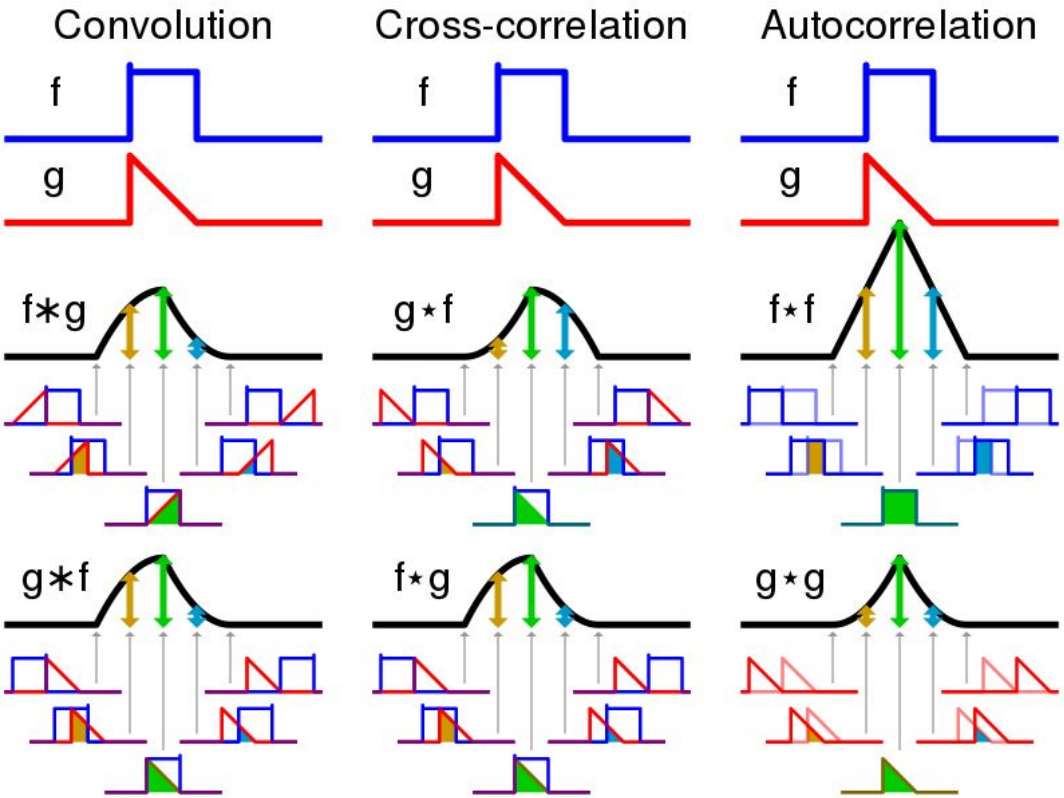






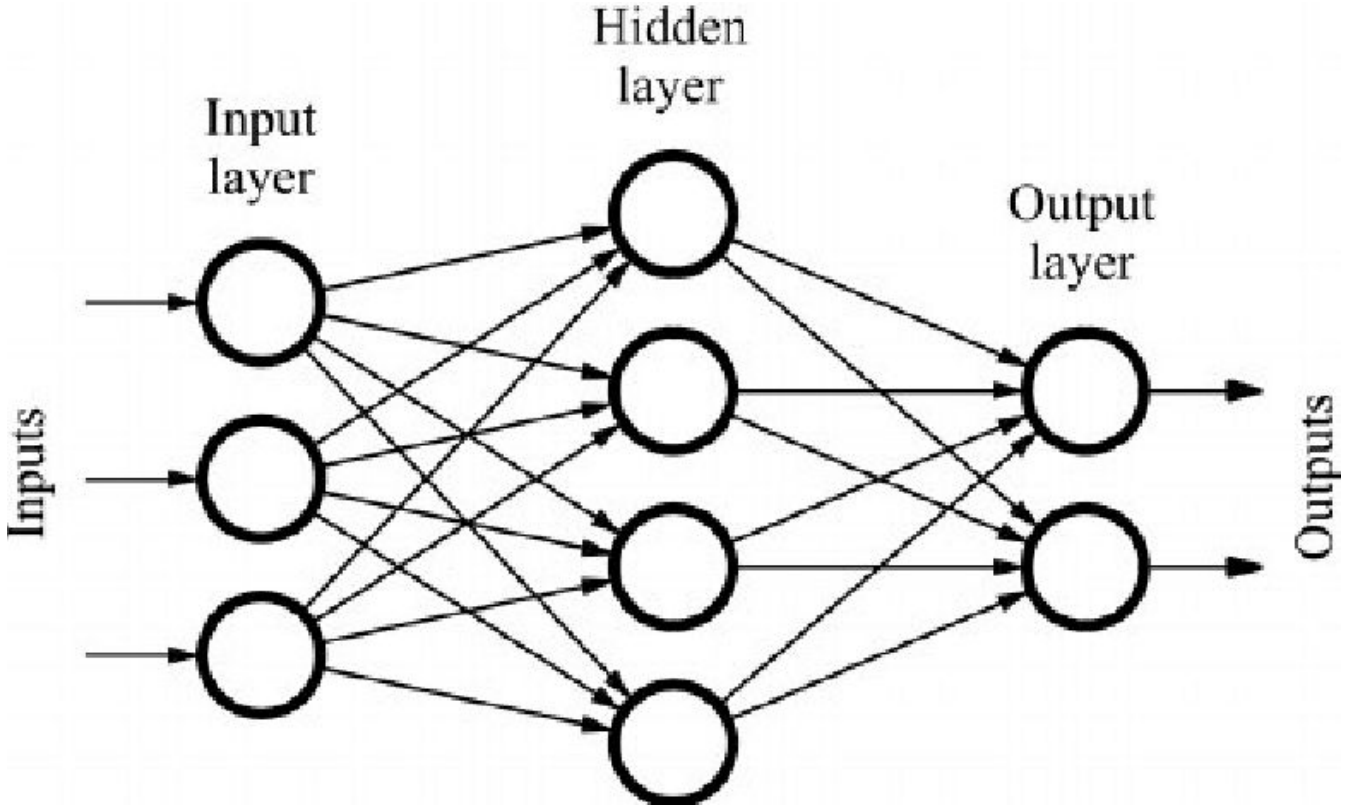
Head over to Colab: https://tinyurl.com/prelu

AutoCorrelation - An Analogy



- We started with random weights.
- This is an approximation of the inputs.
- Autocorrelation gives the similarity between same signals.
- Decrease dissimilarity.
- Hence weights are approximating better.
- Learning happened.

Feed Forward Network - Topology



Activations

- Let’s see some polynomials.
- Linearity: Limited by complexity.
- Non-Linearity: Able to capture complex features.

Famous activations:

- Sigmoid
- Tanh
- Relu

Up for Questions

! Humans

Thank You

Connect me on:

Mail to: mein2work@gmail.com

Connect: Linkedin

Find slide on github: ayulockin/talks