

Artificial Neural Networks

Why neural network?

10^{11} neuron.

10^{-32} \rightarrow Switching time.

Attention to certain tasks.

System Contains: processing units & memory.

Diff bet humans & System.

* 10^{11} neurons.

* 10^{-13} sec - Switching time.

* It works continuously & parallel.

* Human can learn

Human contains neurons

* 10^9 processing units.

* 10^{-9} sec

\Rightarrow Does switching time in fraction of sec.

* It works in serial access.

* System cannot learn.
(By Data sets)
learn by training samples.

* It contains both processing units & memory.

\Rightarrow Char: Self Organization
& learning capability.
generalization.
fault tolerance.

\Rightarrow characteristics that must be adopted from human.

* classical way:

* way of learning:

* It works similar but functions differs.

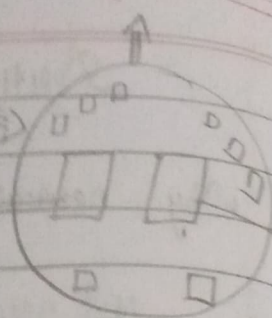
* Whenever it sense, it pass the signal to motor.

Hence, the value get changed from previous value.

Now, the mapping func becomes.

$$f: \mathbb{R}^8 \rightarrow \mathbb{R}^2$$

$H=1 \Rightarrow \text{halt.}$



$$I \in \mathbb{R}^8$$

& Actions

of Robot $\begin{cases} H=0 \Rightarrow \text{Move.} \\ H=1 \Rightarrow \text{halt.} \end{cases}$

mapping func: $f: \mathbb{R}^8 \rightarrow \mathbb{R}^2$

It is Based on sensor values.

Eg: Robot with 2 Motors & 8 Sensors.

(classical way)

History of neural n/w's. (Show the researcher)

* The beginning 1943 - 1950

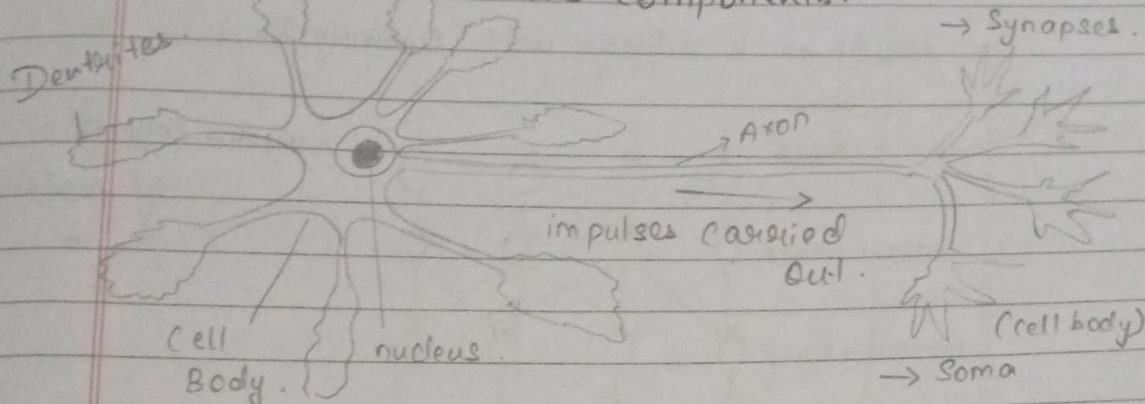
* Golden Age 1951 - 1969

* Slow reconstruction 1972 - 1983

* Renaissance 1985, 1986, till time.

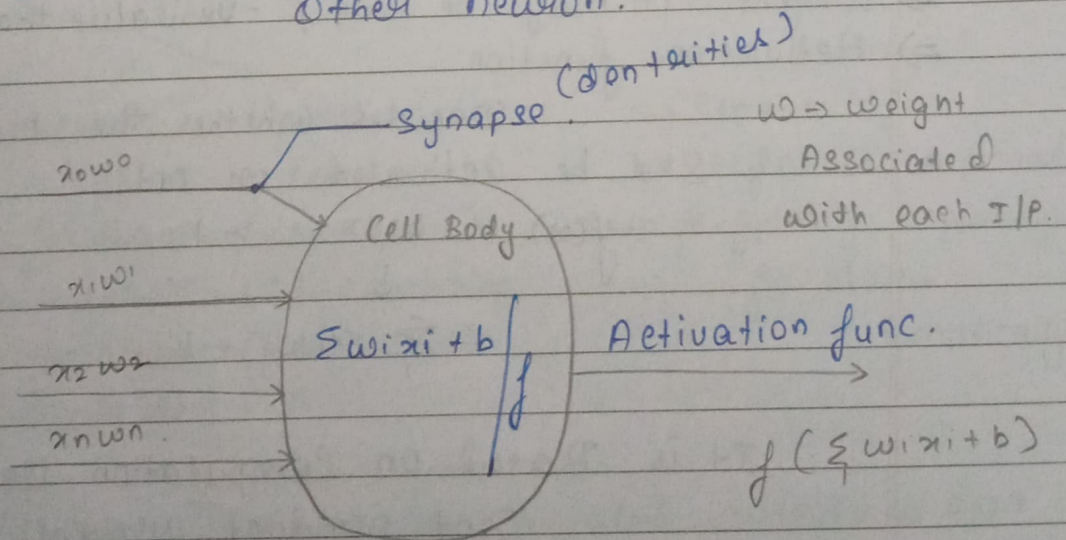
Neuron Structure

2 its Components:



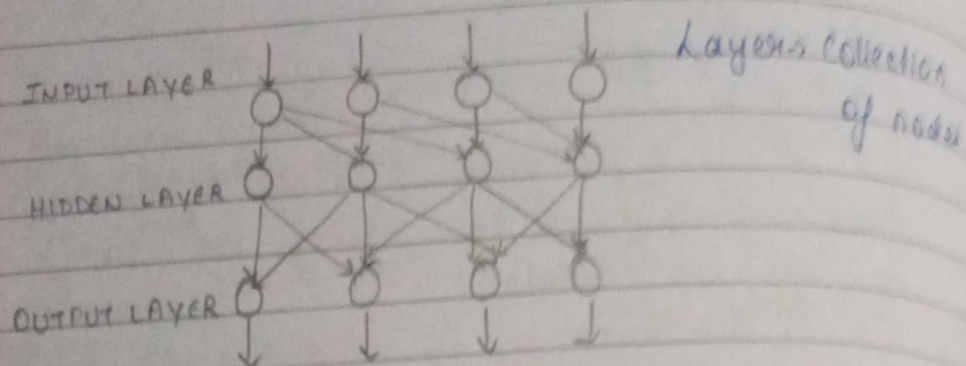
neurons are interconnected, to pass the signals

- ⇒ **Dendrites**: Role of receiving signals.
- ⇒ **nucleus**: process the signals.
- ⇒ **cell body**: also known as Soma.
- ⇒ **Axon**: The info which are processed by nucleus & cell body, impulses carried out.
- ⇒ **Synapses**: Space bet one Dendrites to other neuron.



Architecture of Neural Networks

Node \rightarrow is a Basic unit Connected



I/p : will receive info & pass to next layer.

Hid: will receive I/p from input layer & process it.

O/p layer will map the input func to desired o/p. (Activation layer).

- \Rightarrow Connection: The O/p of j in the input of i .
(i.e) j is the Successor of i (i.e. j is connected to i)
- \Rightarrow weight: it may be +ve / -ve value that decides
- \Rightarrow Activation function:

Decides whether the neuron should be activated or not

$$f(x) = w \cdot x > 1$$

\downarrow

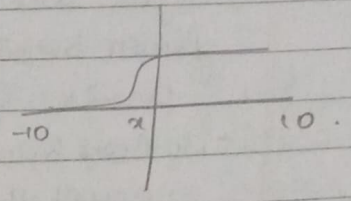
$$\sum x_i w_i + b.$$

It is Based on Computation Value Dot product. weight.

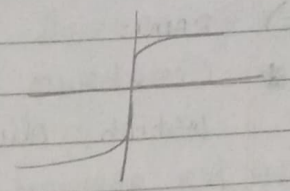
- \Rightarrow Learning rule: It is the Algo, which modifies the parameters of the neural network in order for go input to favoured o/p

Example of Activation fun:

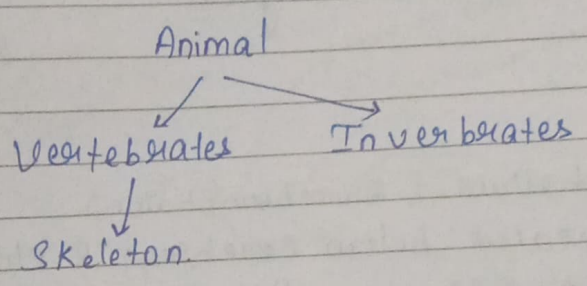
* Sigmoid $\sigma(x) = \frac{1}{1 + e^{-x}}$



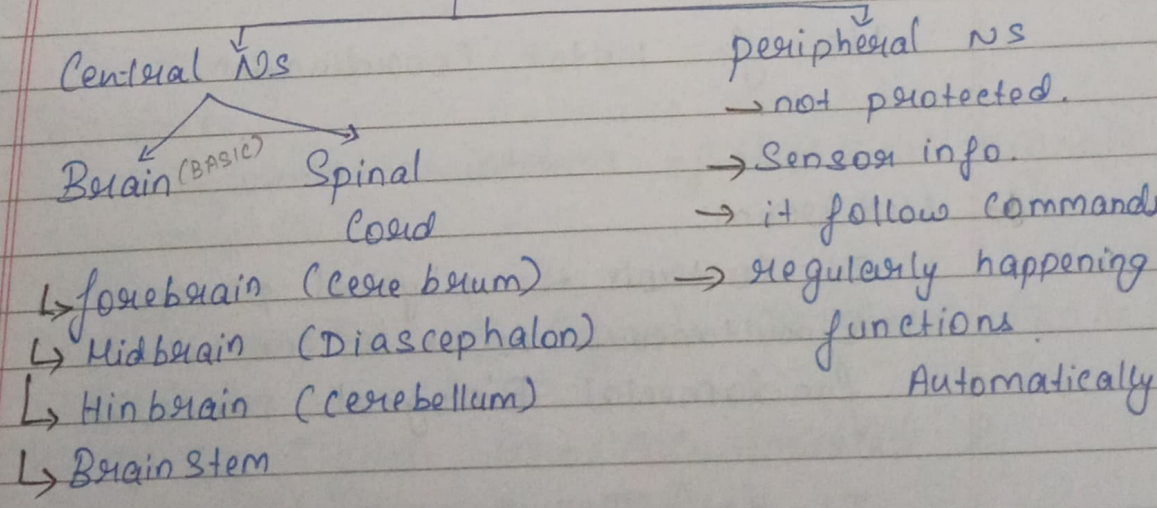
* $\tanh(x)$



Biological Neural Network (BNN)



Nervous System (NS)



- (perins) * The nerves which are situated outside \rightarrow PNS
- \Rightarrow it forms very Dense network, not protected by the bone or spine.
 - \Rightarrow it Conveys commands to all parts of the Body.
 - \Rightarrow It functions Automatically \rightarrow Blood flow, breathing.

⇒ CNS:

infos are stored & managed.
from brain the info is passed to all
parts of the Body.

Cerebrum 83% → major part of brain.
Cerebellum 11% → Smallest part.

⇒ BRAIN:

* Cerebrum (Telencephalon)

which divided into (Cortex) → 2 to 4 mm.

Responsible for abstract thinking
area

(Nerve base → middle line)

primary cortical
field.

Association
Cortical field.
Resp for sensory
info.

* Cerebellum (Rhombencephalon)

located below cerebrum & close to Spinal cord.
It occupies 11%.

Posture maintenance & Balancing.

Main fn: Motor Coordination.

* Mid Brain:

It controls the physical process.
Simultaneous work is controlled.
fundamental Biological processes.

It has Thalamus



Alertness

Hypothalamus



Body temp.

* Brain Stem:

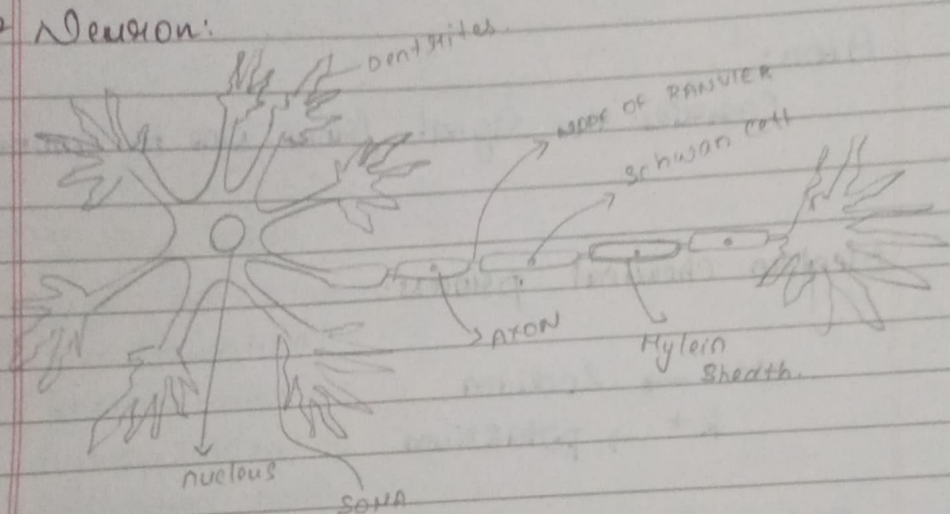
→ Senses of Sight → Balancing.

Cerebrum.

- (i) primary
cortical.
auditory
cortex
visual cortex.

- (iii) Association
cortical field.
→ abstract association.
eg: Decision making
Reasoning.

23/8/22 Neuron:



Dendrite

information in terms of electrical signals

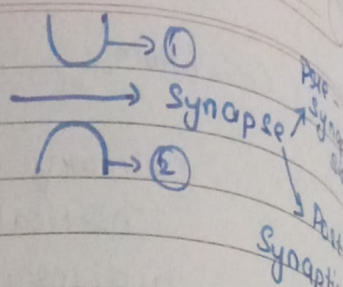
Soma

To process the signals received from dendrites.

All the signals are accumulated & then they are processed it.

Once it reaches the threshold value then it is activated then transmitted to neuron.

Synapses:



The transmission from pre to post
(Electrical to chemical)
↳ neuro-transmitter.

Axon:

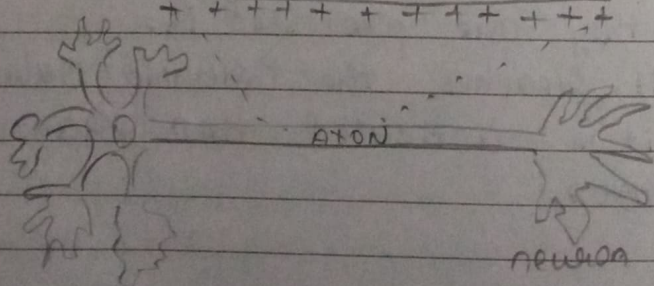
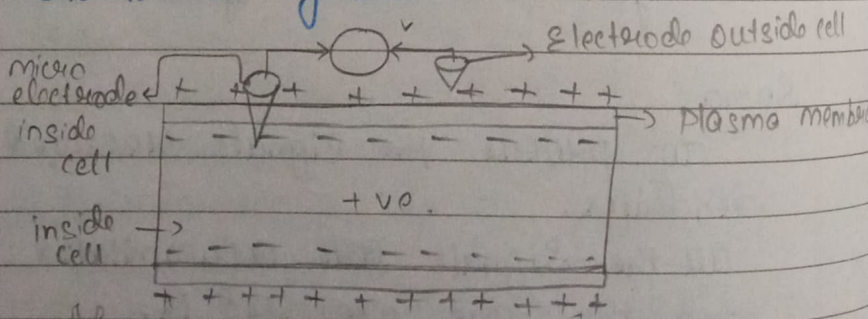
Carries the signal from one to another.

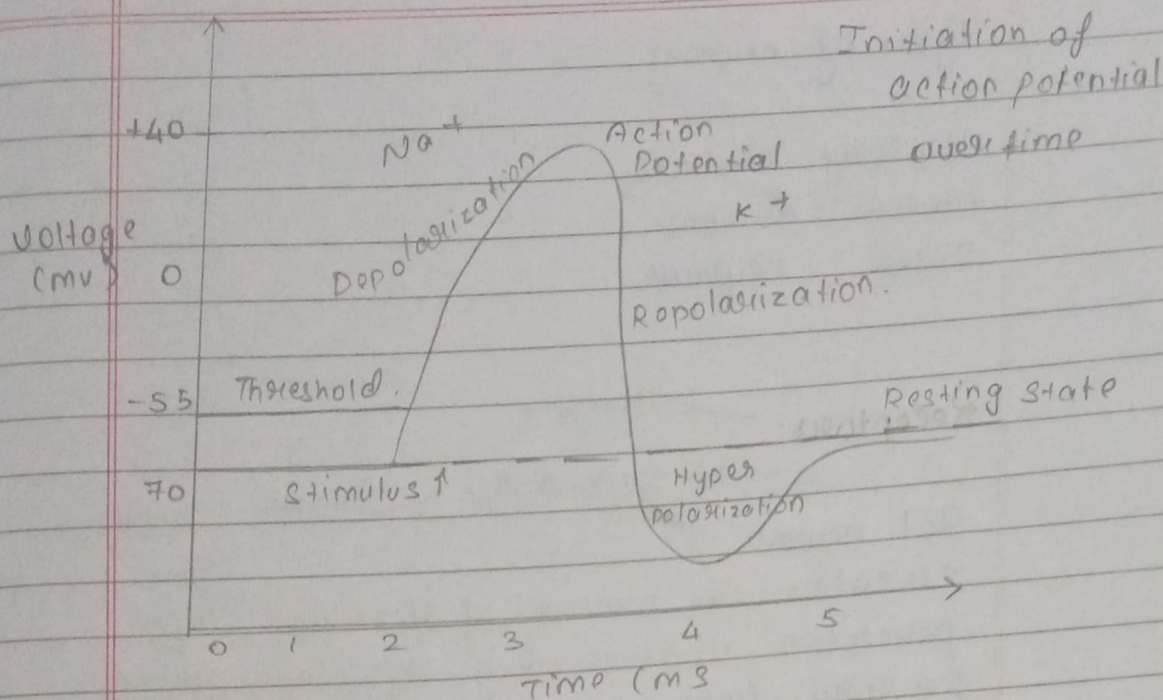
Electro chemical process:

$\text{Na}^+ \rightarrow$ Sodium

$\text{K}^+ \rightarrow$ potassium

Potential
Membrane potential
Concentration gradient





Resting State

Stimulation State

Depolarization

Repolarization

Hyperpolarization

Activation point

membrane potential

Concentration gradient

Schwann Cell

node of Ranvier

myelin sheath

Amplification: conductive

↳ use to conduct info

Saltatory conduction

↳ pulse conduction

↳ amplify & carry

the conduction from one neuron to one other.

Types of neurons:

Sensory neurons

motor neurons

Inter neurons

Receptors:
 → Primary
 → Secondary → Sensory neurons.

Spl neuron

sensation the process of receiving info.

perception understanding info, info getting

Sensory Receptor

Sensory transduction

interpreted

Receptor interoceptors

Exteroceptors.

Stimuli energy

Stimulus conducting apparatus

eyes photoreceptors → light sensing

ear mechanical Receptor → Sound

nose olfactory Receptor → Odour.