The ANN model (*Artificial Neural Network*) derives from Biological neural networks that have the structure of the human brain. It contains neurons(nodes) interconnected to one another in various layers of the network.

The ANN model consists of three layers: Input layer, Hidden layers (can be several of them) and Output layer. The input layer accepts inputs in several formats, the hidden layer is in-between the inputs and outputs and performs calculations to find hidden features and patterns. The output layer outputs the results of calculations.

A close-up of a network

Description automatically generated

TRANSFER FUNCTION -> ANN takes input and computes WEIGHTED SUM of inputs and includes a bias.

ACTIVATION FUNCTION -> Chooses whether a node should fire or not. Only those WHO ARE FIRED make it to the output layer. Activation functions are distinctive depending on task that is performed.

**ADVANTAGES:**

* **Parallel processing**
* **Capability of work with incomplete knowledge**
  + **“ANN TRAINING”**
  + Information may produce output even with inadequate data
* **Succession of network is directly proportional to chosen instances.**
* **Network having fault tolerance**

**DISADVANTAGES:**

* Assurance of proper network structure
* When ANN produces testing solution, does not provide insight concerning why and how.
* **Depends on hardware –** Processors with parallel processing power
* Presentation mechanism to be resolved have direct impact on network performance. -> **ANNs work with numerical data as INPUTS AND OUTPUTS (TOKENS!!)**
* Duration of network is **unknown**

ANN receives input signal from EXTERNAL SOURCE in form of a  **pattern** & image in the form of a **vector ->** mathematically assigned by notations x(n)

**HOW DOES ANN WORK?**

**FROM LEFT TO RIGHT!**

Each input is multiplied by its corresponding weights (**details utilized by ANN to solve specific problem – importance of input**)

WEIGTHS -> strength of interconnections between neurons

**All weighted inputs are SUMMARIZED inside computing unit**

Weighted sum of inputs cannot be 0, SO if this is zero then **BIAS** is added to make it non-zero. BIAS has the same input and **weight equals to 1.** Each neuron has its BIAS.

The total sum of weighted inputs can be from 0 to plus infinity. Maximum value is **benchmarked** to keep the response in the limits.

The total of weighted inputs is passed through the ACTIVATION FUNCTION

**ACTIVATION FUNCTIONS:**

Set of transfer functions used to achieve the desired output.

**Binary activation function:**

* Output is either 1 or 0.
* If net weighted input of neurons is more than 1 then output is 1.
* Else the output of function is 0.

**Sigmoidal Hyperbolic activation function:**

* S shaped curve
* Tan hyperbolic function is used to approximate output from actual net input.

**F(x) = (1/1 + exp(-????x))**

**FEEDBACK** ANN

* Feedback networks feed information back to itself.
* Internal system error corrections **utilize feedback ANNs**

**FEED-FORWARD** ANN

* Input layer 🡪 Neuron layer(at least one) 🡪 Output layer
* Assessment of output by reviewing its inputs
* It figures out how to evaluate and recognize input patterns.