$$o = f(\text{net}) = \begin{cases} \\ -1; & \text{net} < T \end{cases} \quad \text{or} \quad 0 = f(\text{net}) = \begin{cases} +1; & \text{net} \geq 0 \\ -1; & \text{net} < 0 \end{cases}$$

3.3 NEURAL NETWORK ARCHITECHTURES

An Artificial Neuron Network is defined as a data processing system consisting of a large number of simple highly interconnected processing elements (artificial neurons) in an architecture inspired by the structure of the cerebral cortex of the brain (Tsoukalas and Uhrig, 1997). Generally, an ANN structure can be represented using a directed graph. A graph G in an ordered 2-tuple (V, E) consisting of a set E of edges. When each edge is assigned an orientation, the graph is directed and is called directed graph or a digraph. Figure 3.8 illustrates a digraph. Digraphs assume significance in Neural Network theory since signals in NN systems are restricted to flow in special directions.

The vertices of the graph may represent neurons (input/output) and the edges, the synaptic links. The edges labelled by the weights attached to the synaptic links.

There are several classes of NN, classified according to their learning mechanisms. However, we identify three fundamentally different classes of Networks. All the classes employ the digraph structure of their representation.

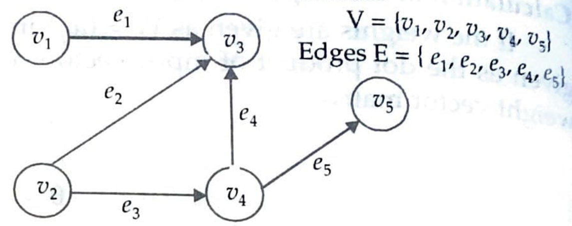

Fig. 3.8 : An Example Digraph

3.4 SINGLELAYER FEEDFORWARD NETWORK

This type of network comprises of two layers, namely the input and the output layer. The input layer neurons receive the input signals and the output layer neurons receive the output signals. The synaptic links carrying the weighs connect every input neuron to the output neuron but not vice-versa. Such a network is said to be feedforward in type or acyclic in nature. Despite the two layer, the network is termed single layer since it is the output layer, alone which performs computation. The input layer merely transmits the signals to the output layer. Hence, the name single layer feedforward network. Figure 3.9 illustrates an example network.

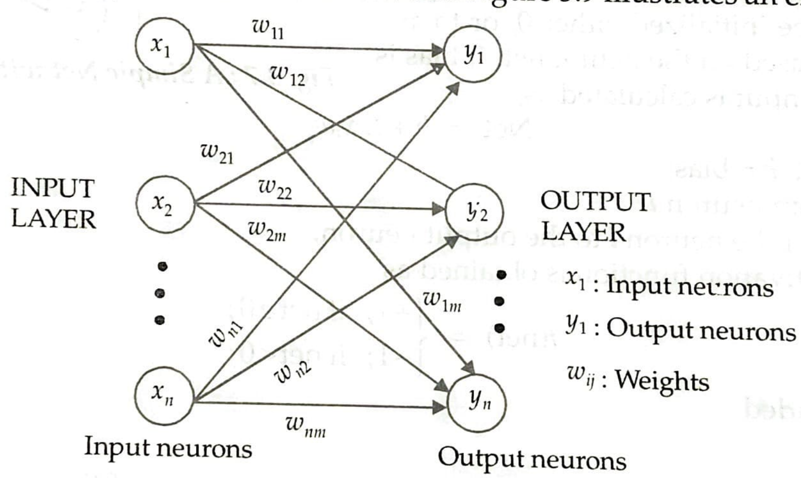

Fig. 3.9 : Single Layer Feedforward Network

Multilayer Feedforward Network

This network, as its name indicates is made up of multiple layers. Thus, architectures of this class besides possessing an input and an output layer also have one or more intermediary layers called hidden layers. The computational units of the hidden layer are known as the hidden neurons or hidden untis. The hidden layer aids in performing useful intermediary computations before directing the input to the output layer. The input layer neurons are linked to the hidden layer neurons and the weights on these links are referred to as input-hidden layer weights. Again, the hidden layer neurons are linked to the output layer neurons and the correponding weights are referred to as hidden-output layer weights. A multilayer feedforward network with 1 input neurons m_1 neurons in the first hidden layer, m_2 neurons in the second hidden layer and n output neurons in the output layer is written as $1 - m_1 - m_2 - n$.

Figure 3.10 illustrates a multilayer feedforward network with a configuration $1 - m - n$.

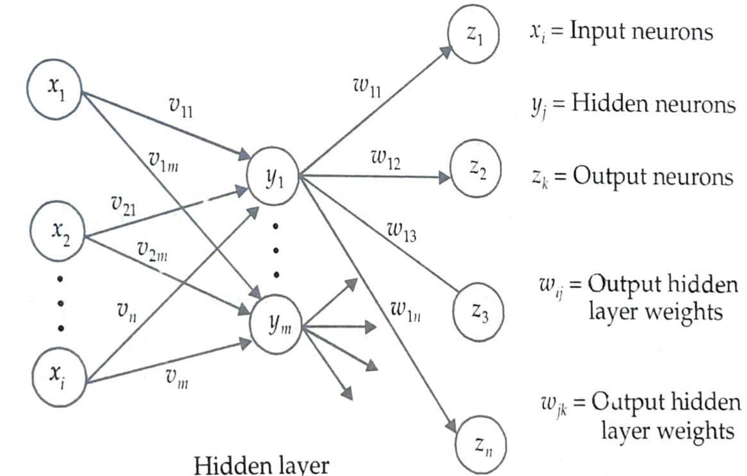

Fig. 3.10 : A Multilayer Feedforward Network (l-m-n Configuration)

Recurrent Networks

These networks differ from feedforward network architectures in the sense that there is at least one feedback loop. Thus, in these networks, for example, there could exist one layer with feedback connections as shown in Fig. 3.11. There could also be neurons with self-feedback links, i.e., the output of a neuron is feedback into itself as input.

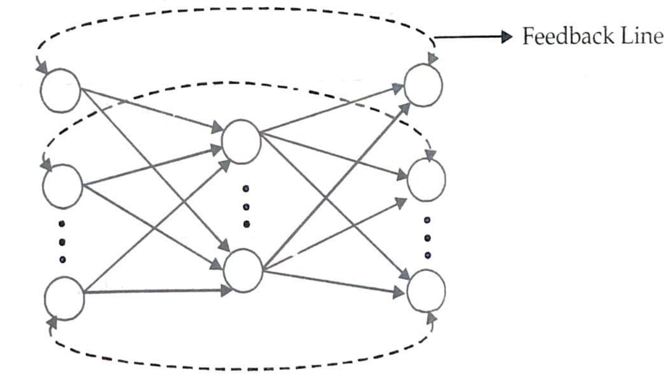

Fig. 3.11 : Input Layer Hidden Layer Output Layer

...AL NETWORK ARCHITECTURES