Lesson 2: Relationship Between the Human Brain and ANN

2.1 Neurons as specialized Cells

Neurons are specialized cells that are capable of sending electrical as well as chemical signals. Most neurons contain dendrites, which receive these signals, and axons that send signals to other neurons or tissues.

2.2 Functional Classification of Neurons

Based on their roles, the neurons found in the human nervous system can be divided into three classes: sensory neurons, motor neurons, and interneurons.

Motor neurons:

Interneurons:

2.2.1 Sensory

Sensory neurons usually help people to taste, smell, hear, see and feel thing around them.

2.2.2 Motor

Motor neurons play a role in movement, including voluntary and involuntary movements. These neurons allow the brain and spinal cord to communicate with muscles, organs, and glands all over the body.

2.2.3 Interneurons

Interneurons are neural intermediaries found in your brain and spinal cord. They're the most common type of neuron. They pass signals from sensory neurons and other interneurons to motor neurons and other interneurons. Often, they form complex circuits that help you to react to external stimuli.

2.3 Morphological classification of Neurons

Neurons can also be classified based on the number of processes that emerge from the somata. The cells can either be multipolar, bipolar, unipolar or pseudounipolar. Multipolar cells are most predominant in the brain and spinal cord and are inclusive of motor neurons as well as interneurons. These cell types have a single axon extending from one end of the cell body and several dendrites

branching as they protrude from the other side of the cell body. Because of the numerous branching, the cells appear fusiform or polygonal.

2.3.1 Pseudo-unipolar

Pseudounipolar cells relate to an older nomenclature used to describe unipolar cells. The cell body, which is found in dorsal root ganglia, has one single process that serves both the role of the axon and the role of the dendrite. This process bifurcates close to the cell body and one branch (the central or axonic) travels from the cell body to the spinal cord, while the other (the peripheral or dendritic) travels from the periphery to the cell body. These cells are associated with proprioception and joint position

2.3.2 Multipolar

Multipolar cells are another subtype of neurons. They have a single axon projecting from the spherical cell body, while other regions of the cell membrane are devoid of dendritic branches. These cells are usually encountered in peripheral nerves and sensory ganglia.

2.3.3 Bipolar

Bipolar cells are only associated with afferent impulses. They have a single axon projecting from one end of the oval cell body and a lone dendritic tree extending from the other end. These cells are found in the vestibulocochlear (hearing), olfactory and ocular (viz. retina) systems.

2.4 Glial Cells and their importance in neural Communication

Glial cells (or neuroglial cells) have a structural role within the central nervous system and also regulate nerve firing rates, brain plasticity (guiding early brain development), and immune responses.

2.5 Similarities between Human Brain and ANN

The human brain has a biological neural network which has billions of interconnections. As the brain learns, these connections are either formed, changed or removed, similar to how an artificial neural network adjusts its weights to account for a new training example.

An artificial neural network (ANN) is similar, but a computing network in science that resembles the properties of the human brain. ANN can model the original neurons of the human brain, so its processing parts are called “artificial neurons.”

2.6 Differences between Human Brain and ANN

i. Human brains are far more complex and sophisticated than neural networks.
ii. Human brains are able to learn and adapt much more quickly than neural networks.
iii. Human brains are able to generate new ideas and concepts; while neural networks are limited to the data they are given.

2.7 Lesson 2 Questions

Why is it important to learn about the relationship between human brain and the ANN?