Neurons are incredibly important to our daily lives. The cells deliver sensory impulses or input in order for us to have proper motor and sensory functions. They send proteins from one neuron to another through the synapse in order to transmit protein signals. As a result, the cell body dry mass changes significantly. It is crucial that we study the connections between neurons and their cell body dry mass in order to analyze their state of functionality when in danger and in health.

Introduction

Because pre-processing the neuron images requires intense algorithmic applications, I learned how to implement a KNN algorithm from scratch. I developed an algorithm that transformed an image into NumPy arrays and clustered the data points into 4 clusters, making the lines less blurry on the image. Then, I worked on my actual research, which was to analyze the Cell Body Dry Mass of a neuron. As a result of neurons transmitting proteins, the Cell Body Dry Mass often fluctuates and changes, informing us that the neuron is healthy and functioning. However, TBI (Traumatic Brain Injury) Neurons are unhealthy and weak neurons. The unhealthy neurons can lead to severe motor and sensory loss and can even cause a patient to be brain dead.

Research & Learning Process

Because I took AP Psychology and AP Computer Science A, I had great knowledge on the project in constructing the networks and how the structure of the neurons would be affected after the brain had gone through severe brain trauma.

Methods & Results

1. Use the NumPy array input to load the node and adjacency graph image of the set of TBI neurons at t = 0.

Fig3. The pre-processed image of the logo.

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In the image above the red neuron has had severe damage as its dendrites and axons have lost its connections, destroying the network and damaging certain motor/sensory functions.

I had to learn how to analyze the different NumPy arrays that were derived from the images. This meant that I had to study the nodes matrix, adjacent matrix, and the mass matrix. The nodes matrix contains the different position of the neurons that is used to assign the corresponding mass of the neuron to another matrix. Additionally, the

Objective & Impact of Professor’s Research

My Professor’s lab is about using machine learning algorithms and mathematical models to analyze time series data, networks, and/or biological systems. This lab develops cyber physical systems through algorithms and mathematical models that are designed to analyze certain networks or models. Neurons act like networks as they are treated like nodes with edges used to support the body’s main functions. Professor Bogdan’s lab analyzes networks like these in order to produce results related to its functionality. Because neurons are essentially the fundamental units of the brain and the nervous system, researching and analyzing neurons and their connections to other neurons is very crucial in order to further understand MRI scans and other brain scans.

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Citations


Next Steps for You

I hope to continue to work on using machine learning and mathematical models to analyze biological systems. I have watched documentaries where scientists have used machine learning to create an app that could scan skin blemishes to determine if it is a sign of skin cancer. Furthermore, I plan to learn more about neuron networks and how to use machine learning models to analyze images containing neurons and their nodes/connections.