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Implementation of learning models (STDP & RSTDP)

- Here we have used previous LIF models. (Implemented in previousprojects)

- and we have used the previous population that in this populationclass we have applied STDP learning

- In SNN we have built a network by which the RSTDP model has been implemented and reinforcement learning has been done on it, then it has been tested.

• Information coding is used by the Rate Coding method and also theinput current to each post-synaptic neuron is determined using a timecourse function and cumulatively according to the activity of pre neurons.

In general, in this method, the coding of the activity of pre neurons that have accumulated over time will be done according to the post-synaptic neurons according to the coefficient.

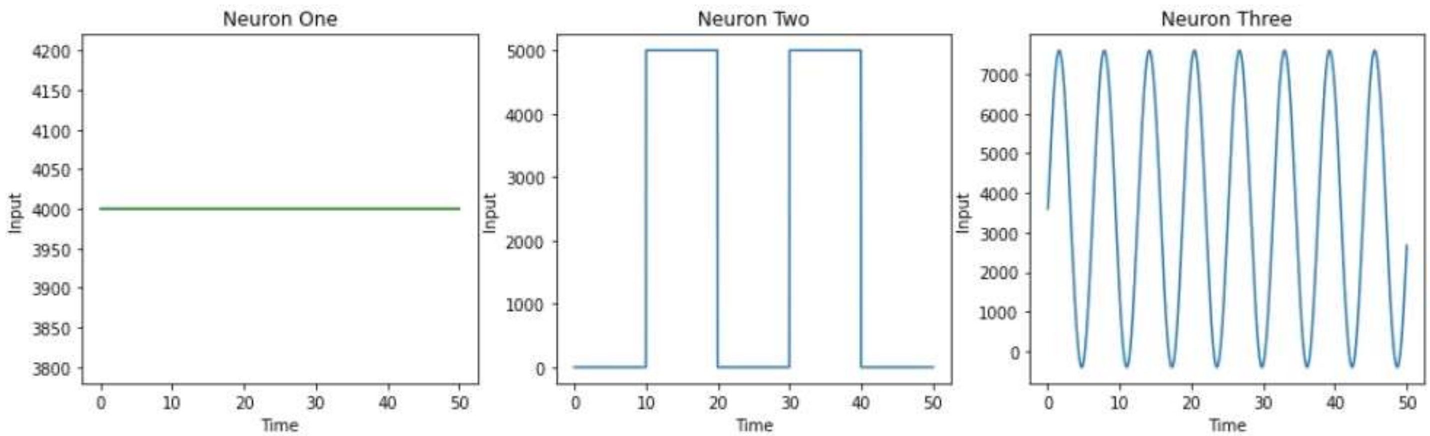
In the first part of the project we will have:

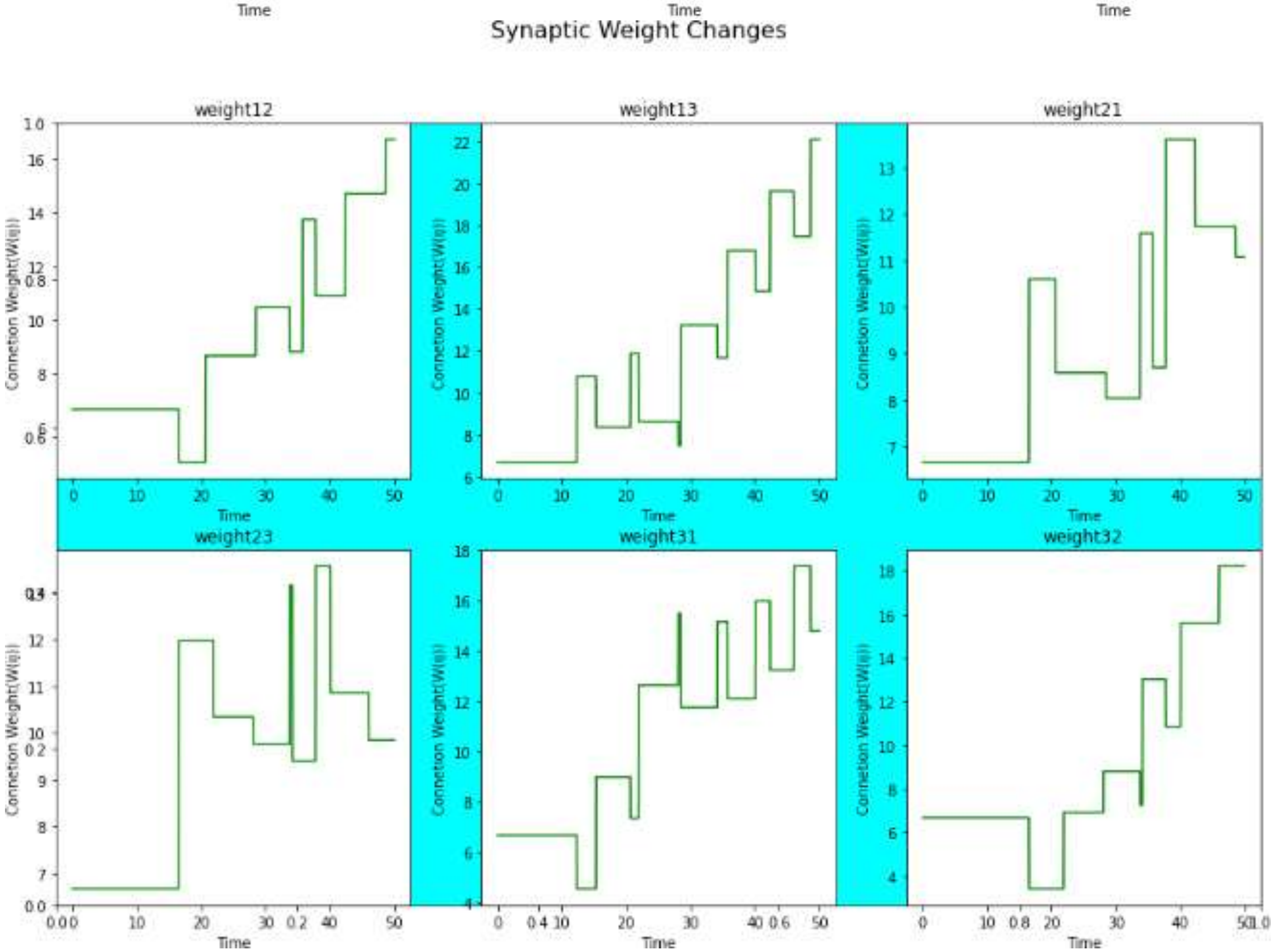
The first part of the project:

Here, STDP learning will be done as we mentioned in the first part ofthe article (we used pairing of this model to implement it).

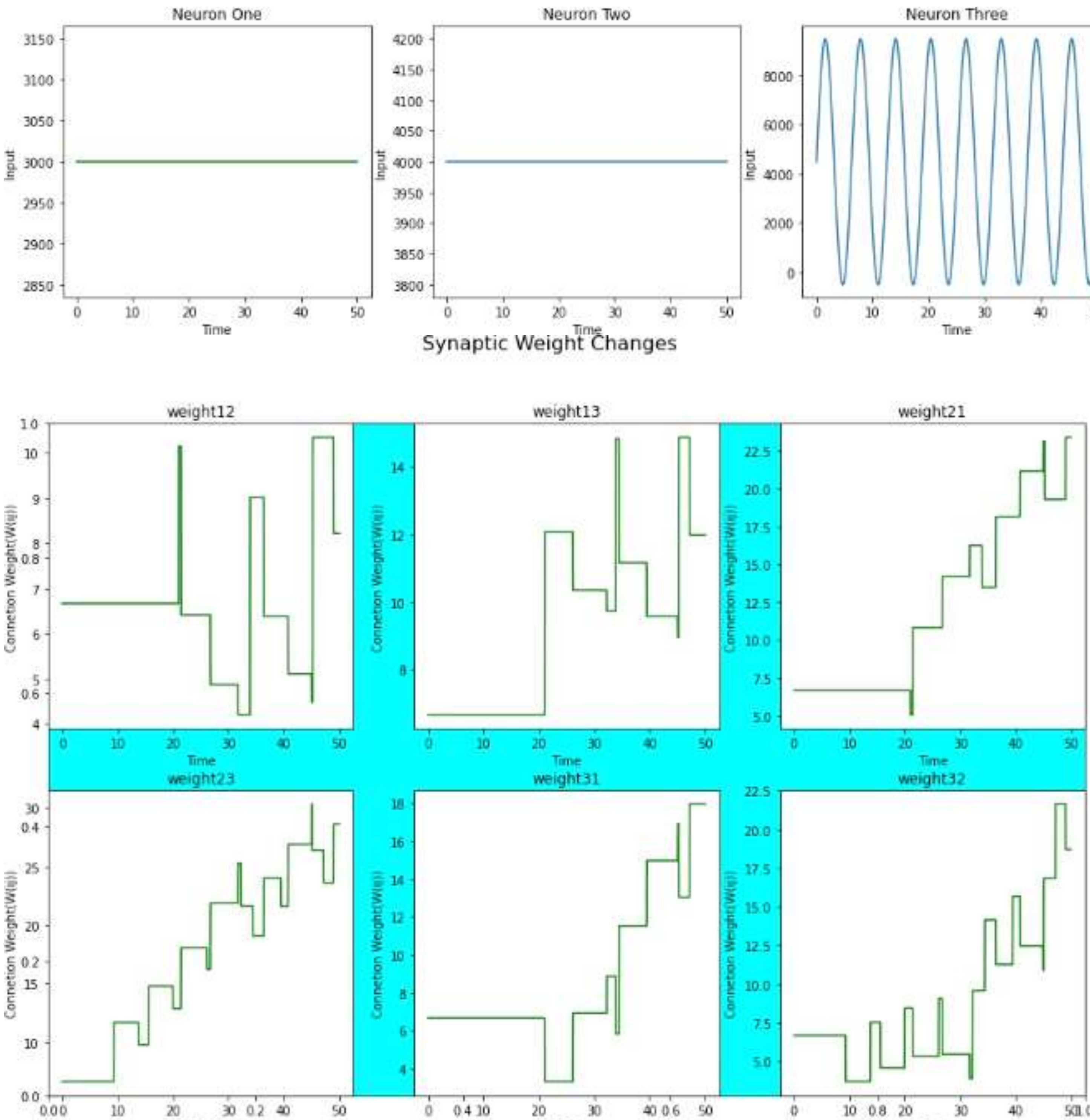
At the beginning of the work, three neurons are connected in a full connection and three different types of currents will enter this modelas follows:

The first type of input: fixed, sine, fixed step

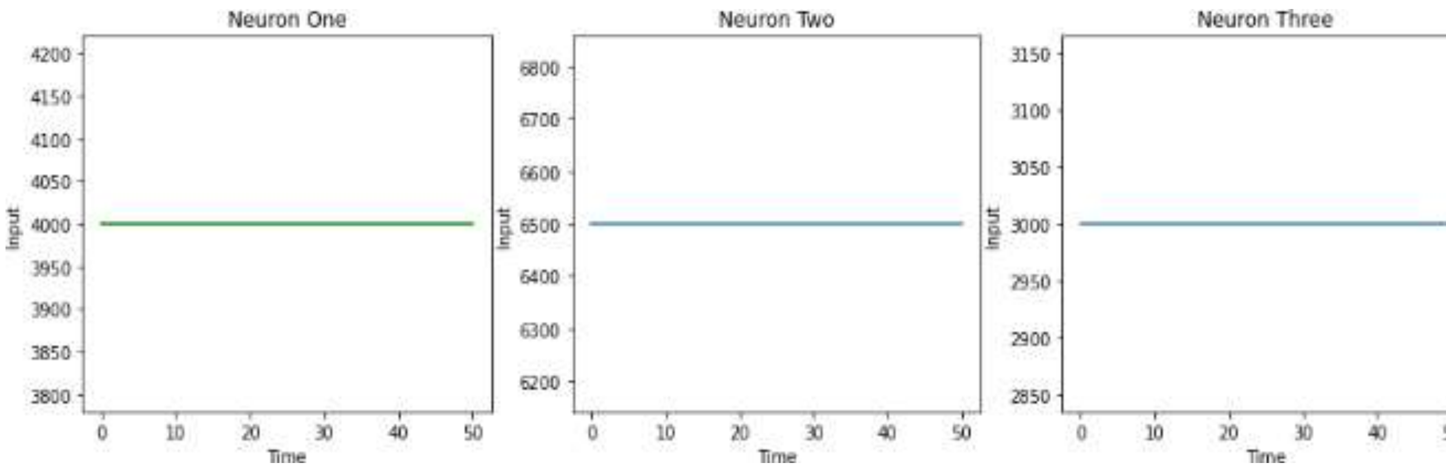


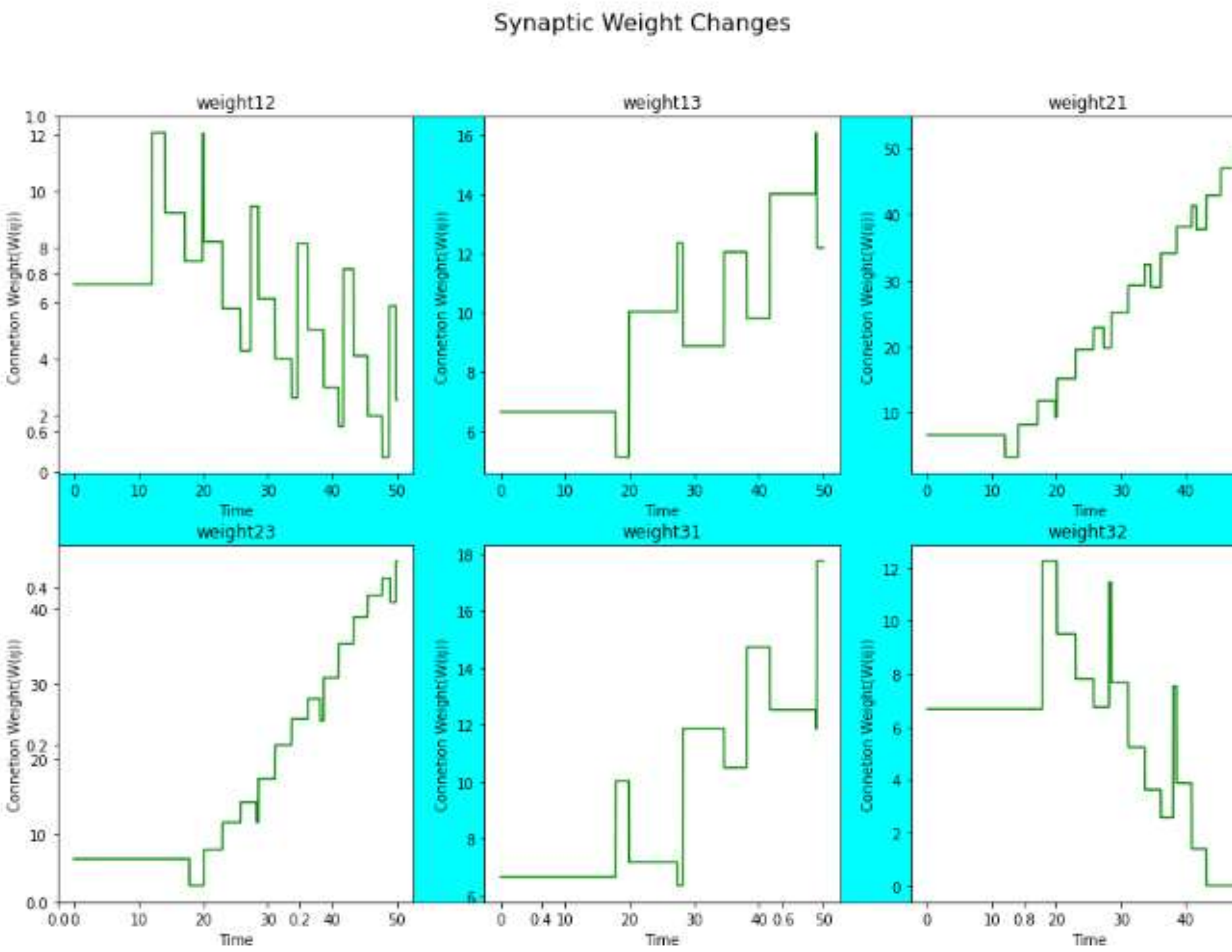


The second type of current: two one-sine constants


Neuron One
Neuron Two
Neuron Three
Input
Time
Synaptic Weight Changes
weight12
weight13
weight21
weight23
weight31
weight32
Connetion Weight(W(ij))
Time

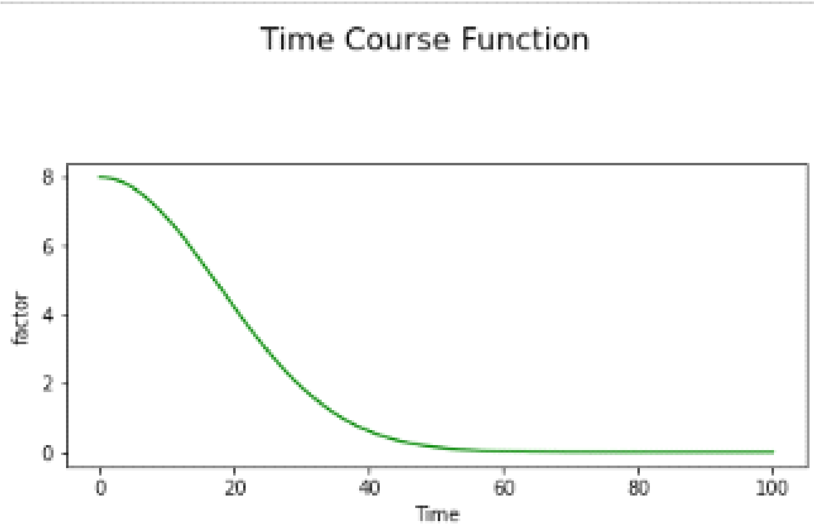
Type 3: Three constant currents:


Neuron One
Neuron Two
Neuron Three
Input
Time


Synaptic Weight Changes
weight12
weight13
weight21
weight23
weight31
weight32
Connetion Weight(W(ij))
Time

Results from different entrance exams:

First we need to examine the time course function and the amount ofinitial weights also depends on it.

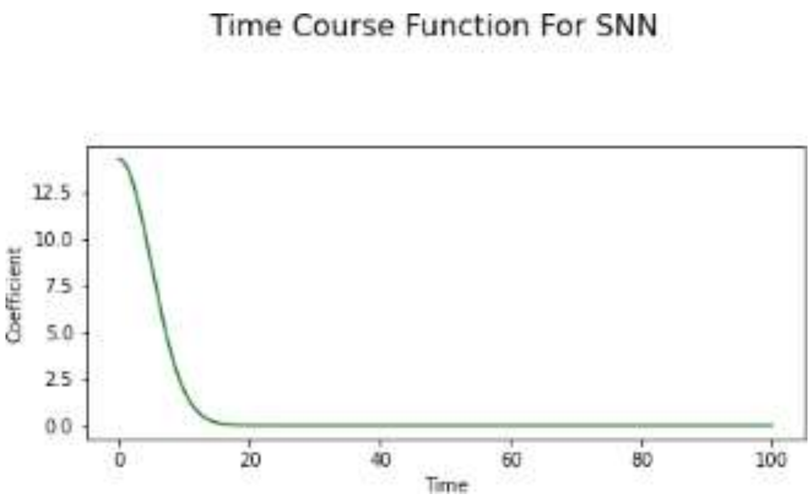


As we already know in the lesson, it is very clear that:

- If the pre neurons fire first, the amount of weights will increase.
- Also, when the opposite happens, the amount of synaptic weightswill decrease.
- In the parts that have post-firing neurons, it will be observed that thesynaptic weight differences will be very negative, but this algorithm will not be observed and guaranteed at all times, because if the pre-neuronsfire faster than the post-neurons, this The issue will be violated and they will neutralize each other.

The second part of the project:

In this section we are going to implement the reinforcement learningalgorithm with the help of SNN. First we need to define the time course function for the learning pattern of an SNN.



Now we can read the data we have from the Excel file and multiply it by ten thousand to prepare the data, and we will also start learning andcheck the two values of train and test, which can be checked after this.It was concluded that the model has learned Lerning to an acceptable extent, first we will have the input, then the most and test:

Out[142]:

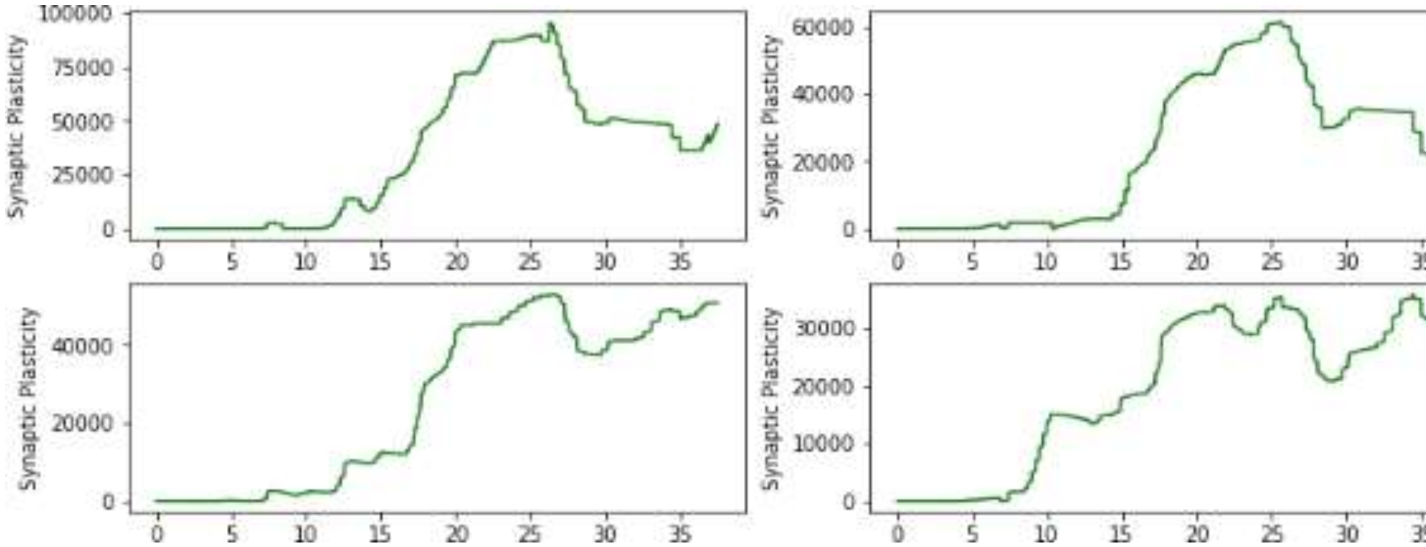
	test	Unnamed: 1	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	U
0	inpput_neuron_number	train_1	train_2	train_3	train_4	train_5	train_6	train_7	train_8	train_9	
1	1.0	1.0	2.0	3.0	2.0	1.0	1.0	0.0	0.0	0.0	
2	2.0	1.0	1.0	1.0	0.0	1.0	0.0	1.0	0.0	0.0	
3	3.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
4	4.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	1.0	0.0	
5	5.0	0.0	0.0	0.0	0.0	1.0	2.0	0.0	1.0	1.0	
6	output_neuron_number	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	0.0	
7	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
8	test	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
9	inpput_neuron_number	train_1	train_2	train_3	train_4	train_5	train_6	train_7	train_8	train_9	
10	1.0	1.0	0.0	0.0	2.0	1.0	1.0	3.0	0.0	1.0	
11	2.0	0.0	1.0	2.0	2.0	2.0	0.0	1.0	0.0	2.0	
12	3.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	2.0	0.0	
13	4.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	1.0	
14	5.0	0.0	0.0	0.0	0.0	0.0	3.0	3.0	2.0	1.0	
15	output_neuron_number	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0	

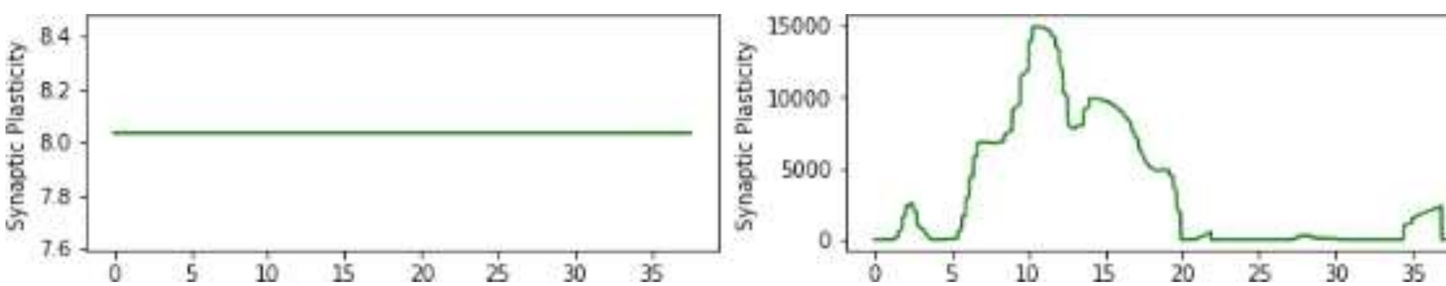
For accuracy testing: 40%

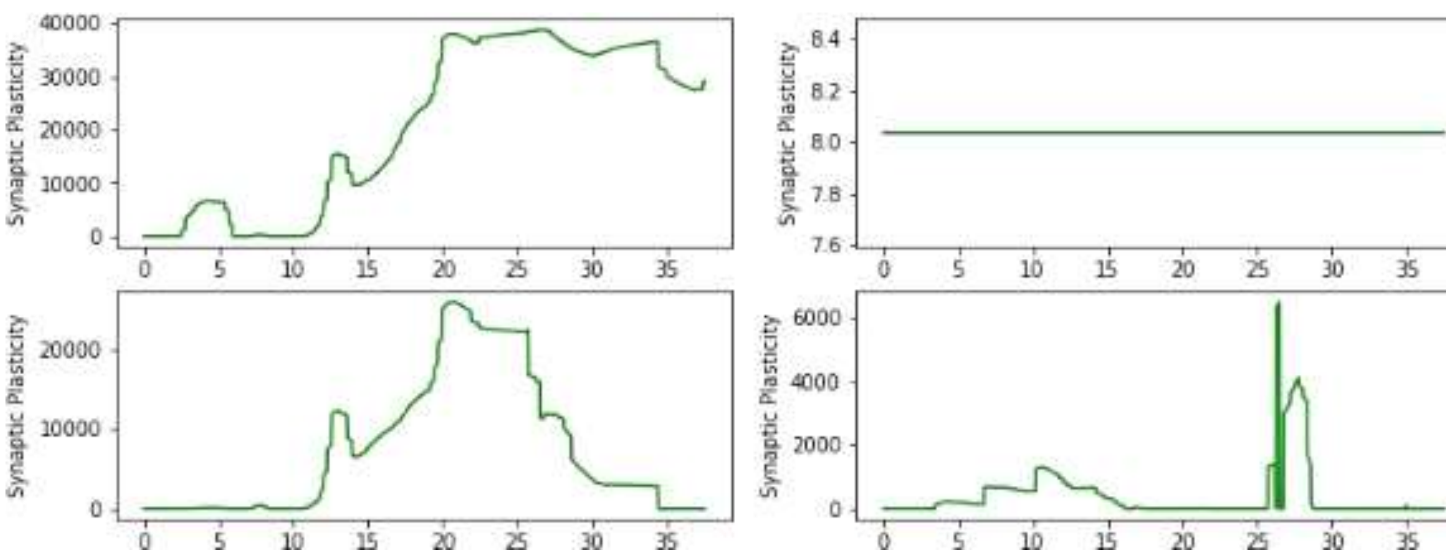
For train accuracy: 40%

This will be the case in most experiments.

Here we can see that the model is well trained and for a better view ofsuch changes we can examine and analyze changes in synaptic weight.


Synaptic Plasticity


Synaptic Plasticity


Synaptic Plasticity

As you can see, synaptic weight changes, which are a model for learningneural models and neural networks, can provide a better view.