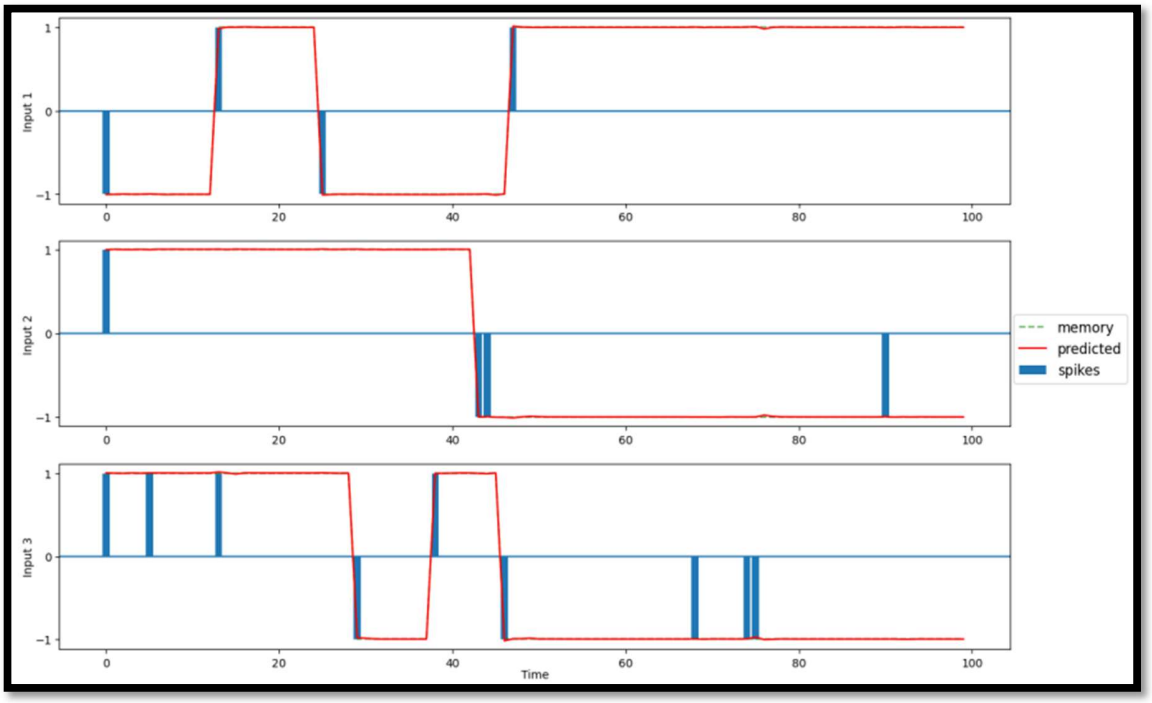
Experiments:

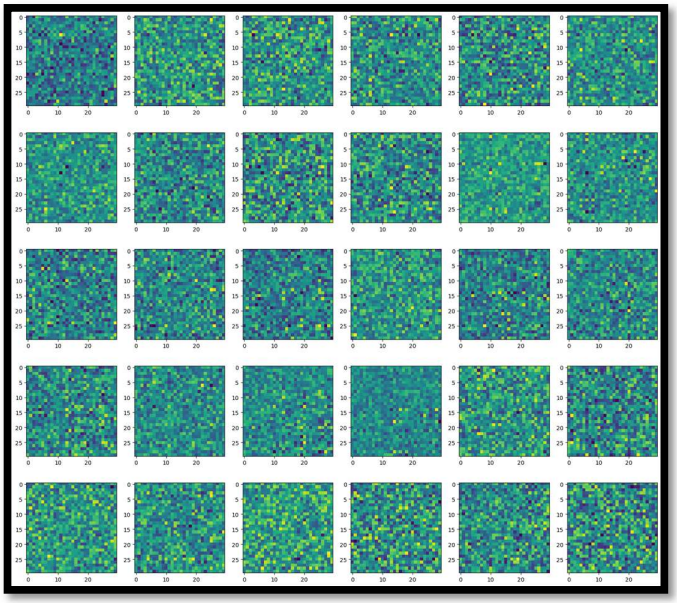
1) Check Relu activation.
2) Low rank approximation:
    a. Low rank 2 way → full rank 2-way.
        i. Predictions of $K = r$.
    b. Low rank 3 way → full rank 3-way.
    c. Low rank 2 way → full rank 3-way.
    d. Low rank 3 way → full rank 2-way.
    e. For each, show:
        i. Losses plots.
        ii. Analyze fix points.
        iii. Neuron activity plot.
        iv. Connectivity $\mathcal{W}$.
3) High rank approximation:
    a. full rank 2 way → full rank 3-way.
4) Sin task and findings

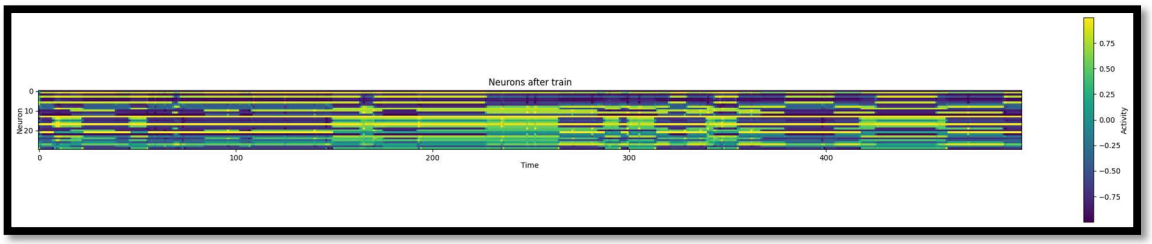
Reports:

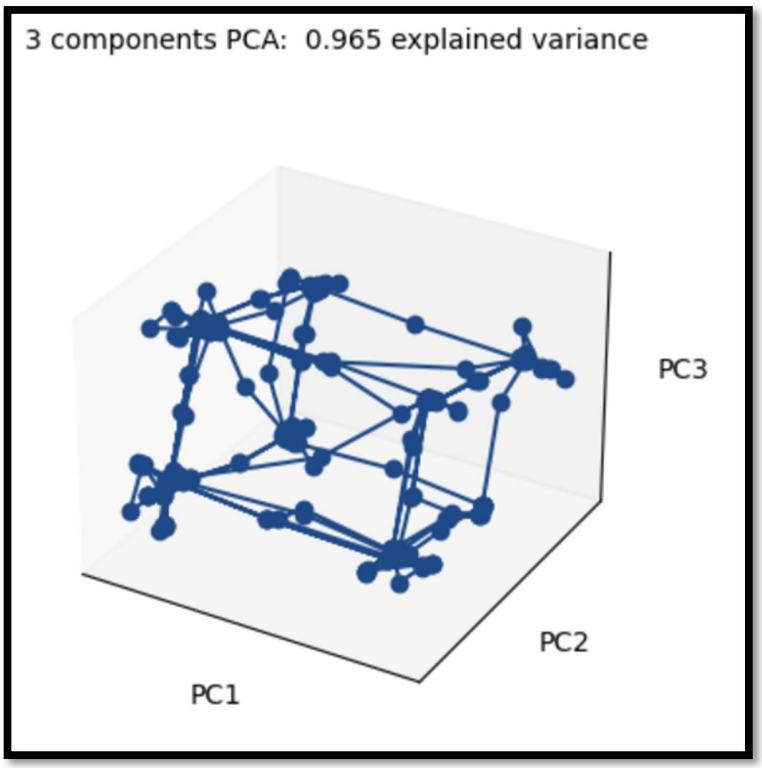
1) *K Bit Flipflop* with $K = 3$, $tanh$ activation.

Task diagram after train:

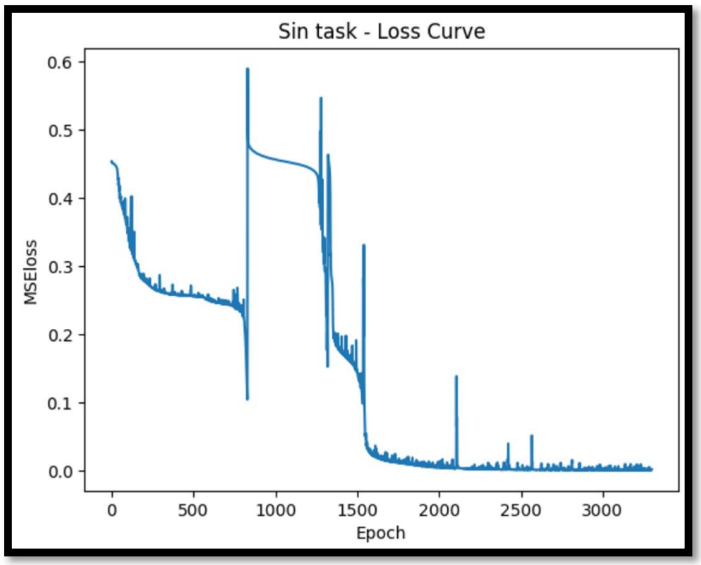


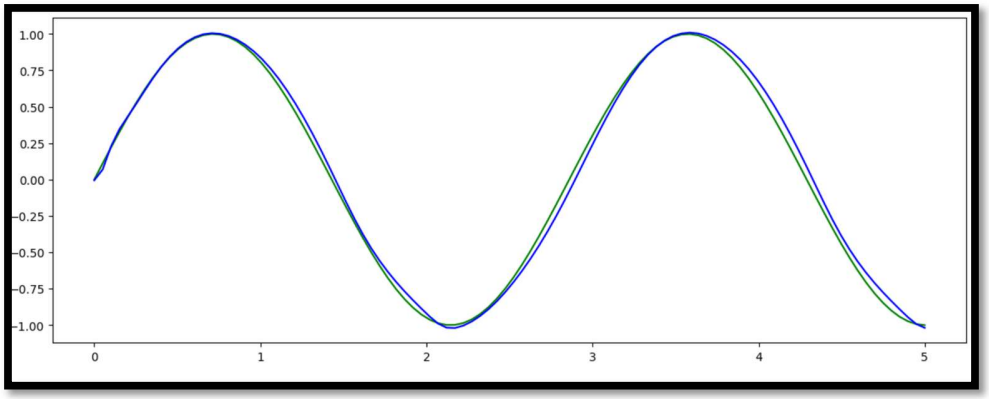


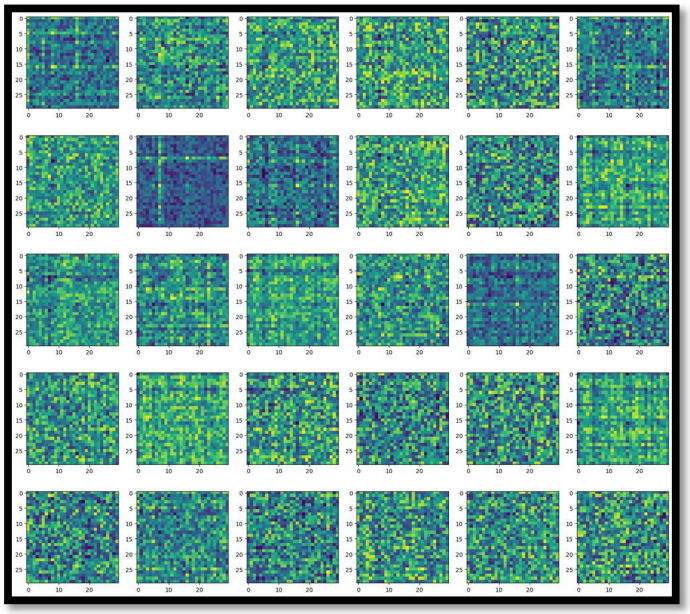

Neurons after train
Neuron
Time
Activity
0
10
20
0
100
200
300
400
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75

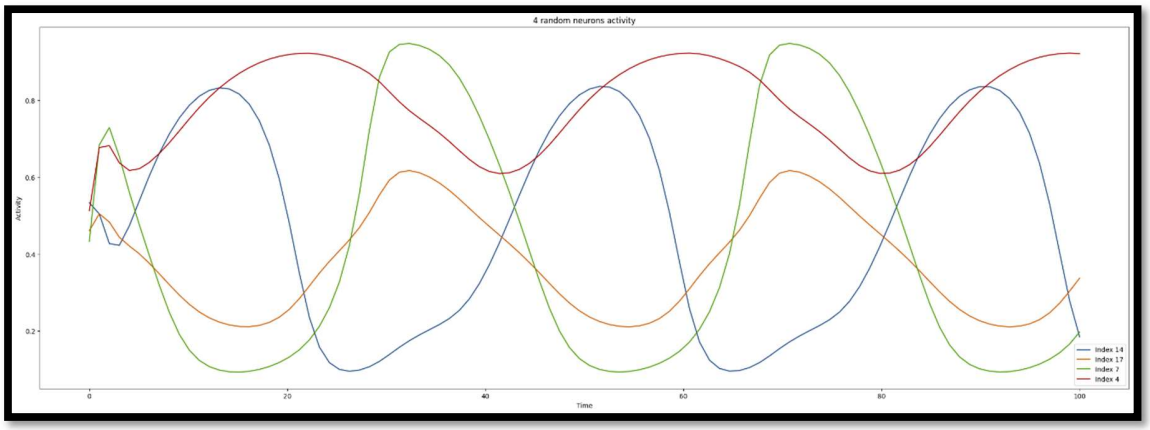

3 components PCA: 0.965 explained variance
PC3
PC2
PC1

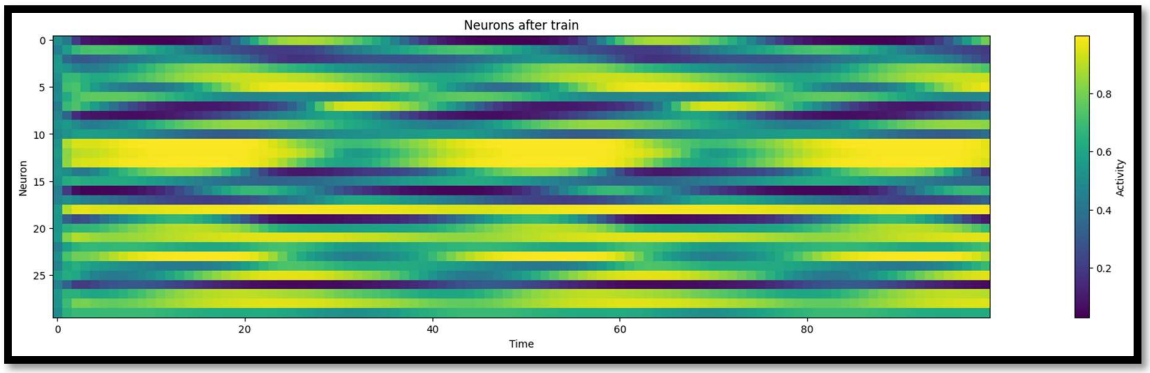
2) *Sin prediction, sigmoid* activation.

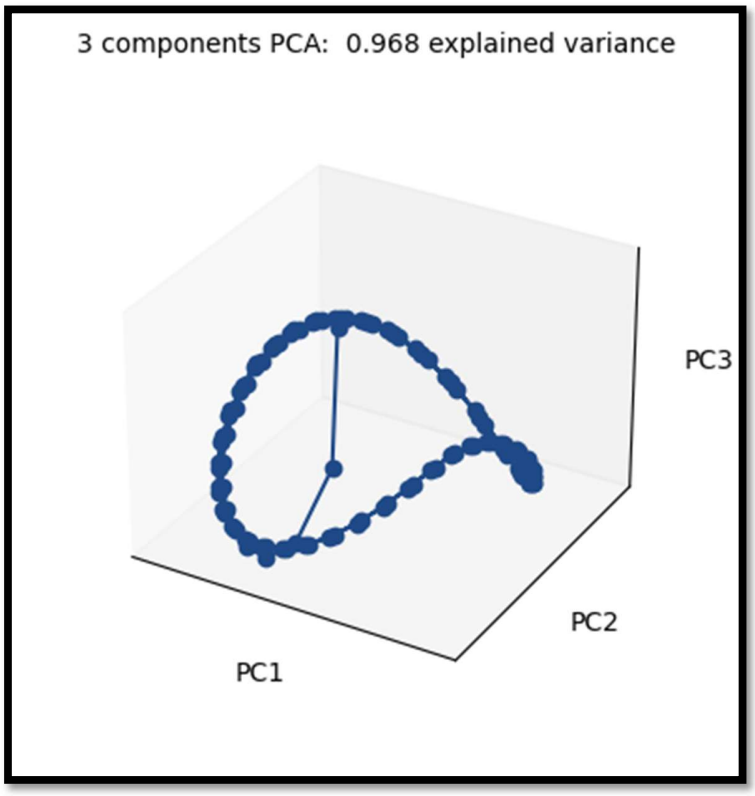







4 random neurons activity
Activity
Time
Index 14
Index 17
Index 7
Index 4

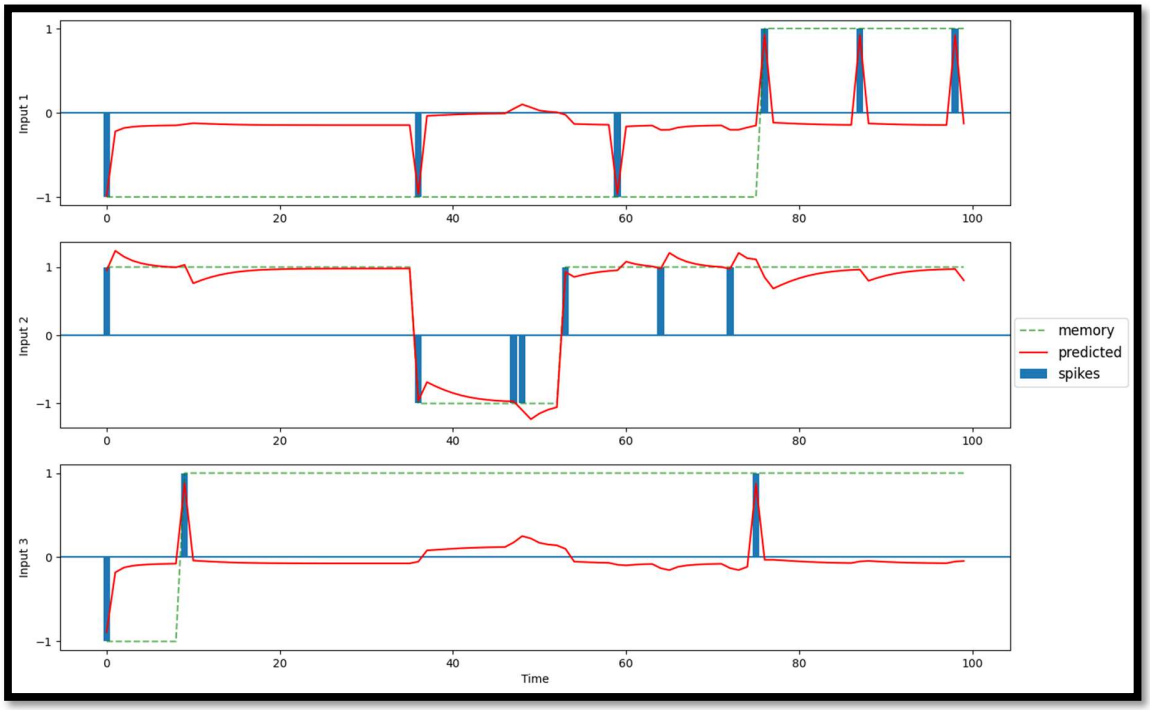

Neurons after train
Neuron
Time
Activity


3 components PCA: 0.968 explained variance
PC1
PC2
PC3

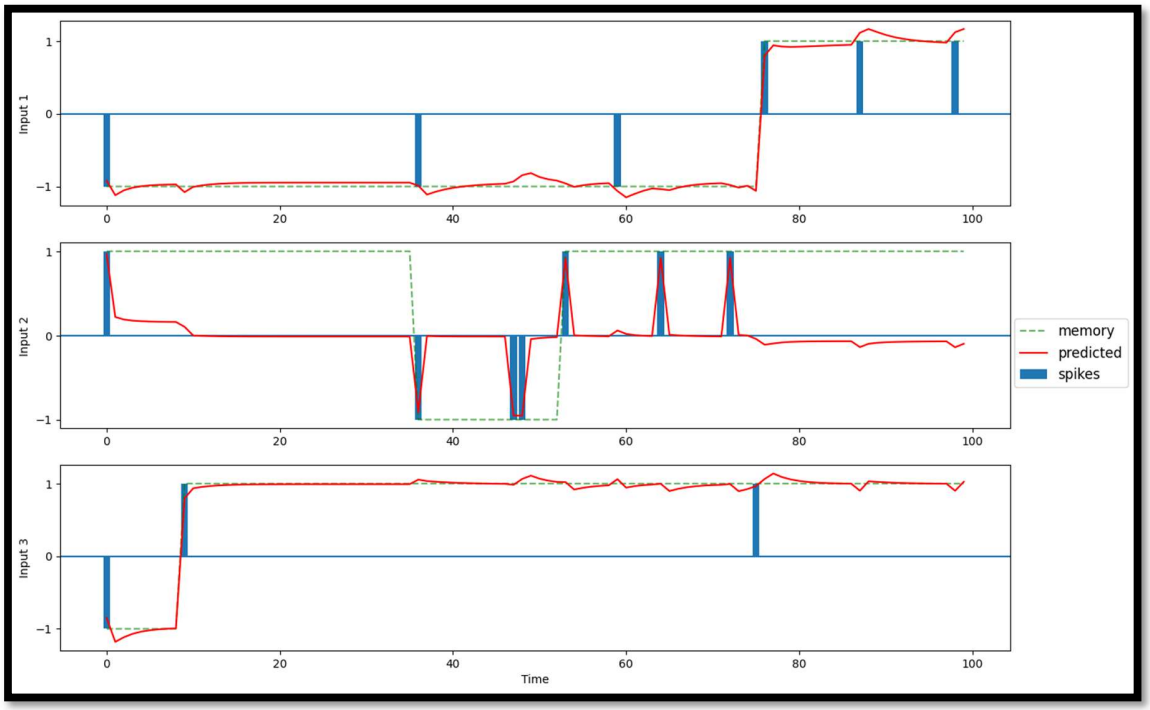
3) Train low rank RNN to mimic full rank RNN:

$$K = 3, activation \in \{tanh, sigmoid\}, rank \in \{1,2,3,4,5\}$$

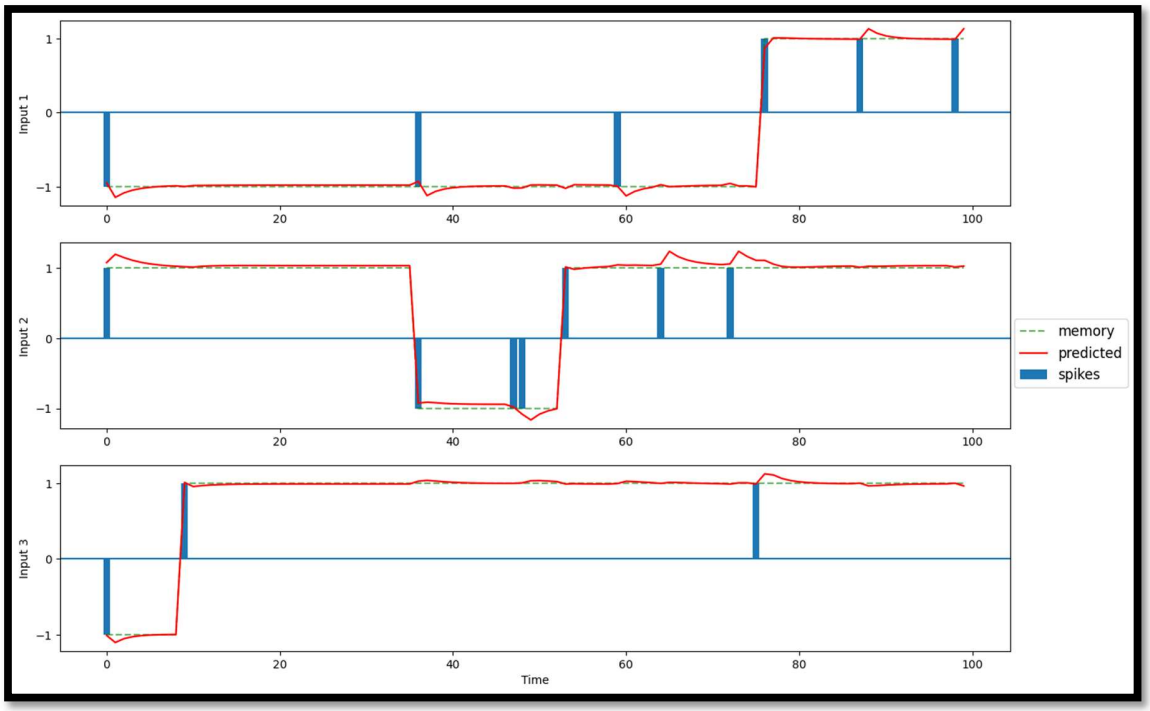
Rank = 1:

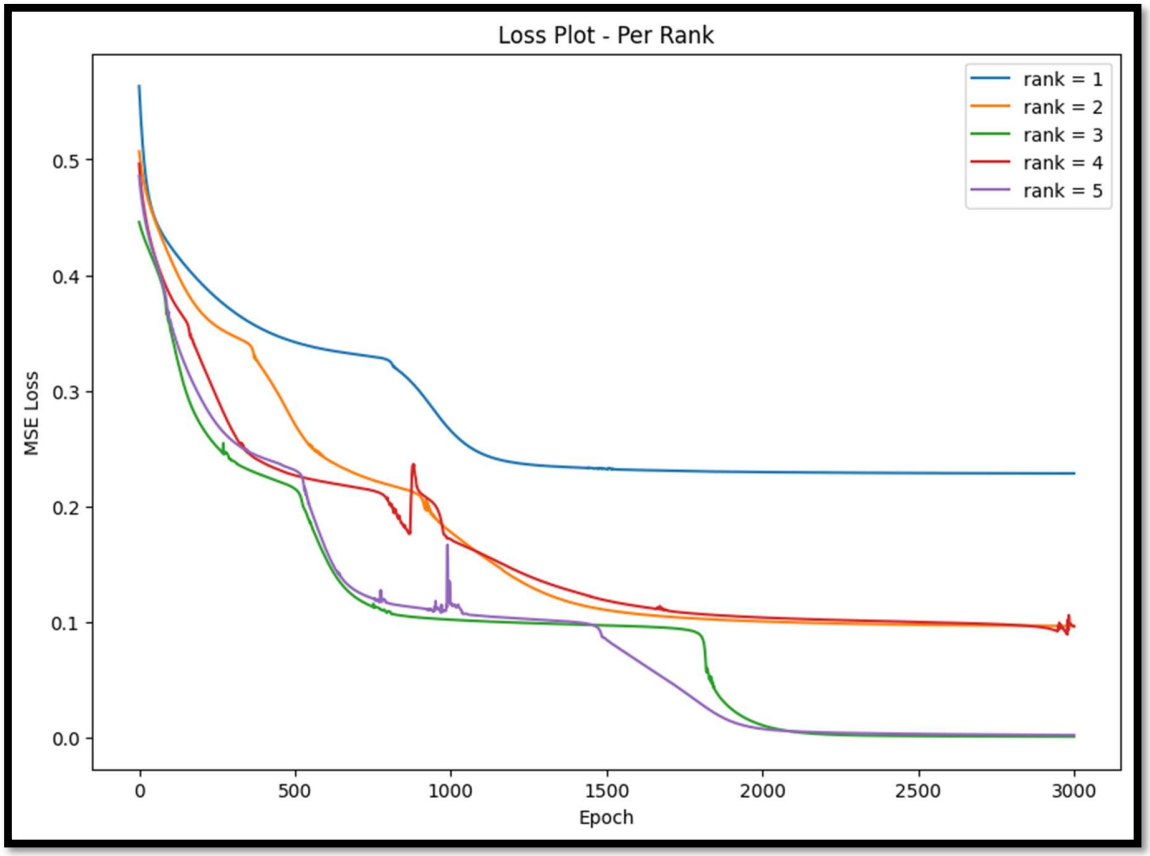


Rank = 2:



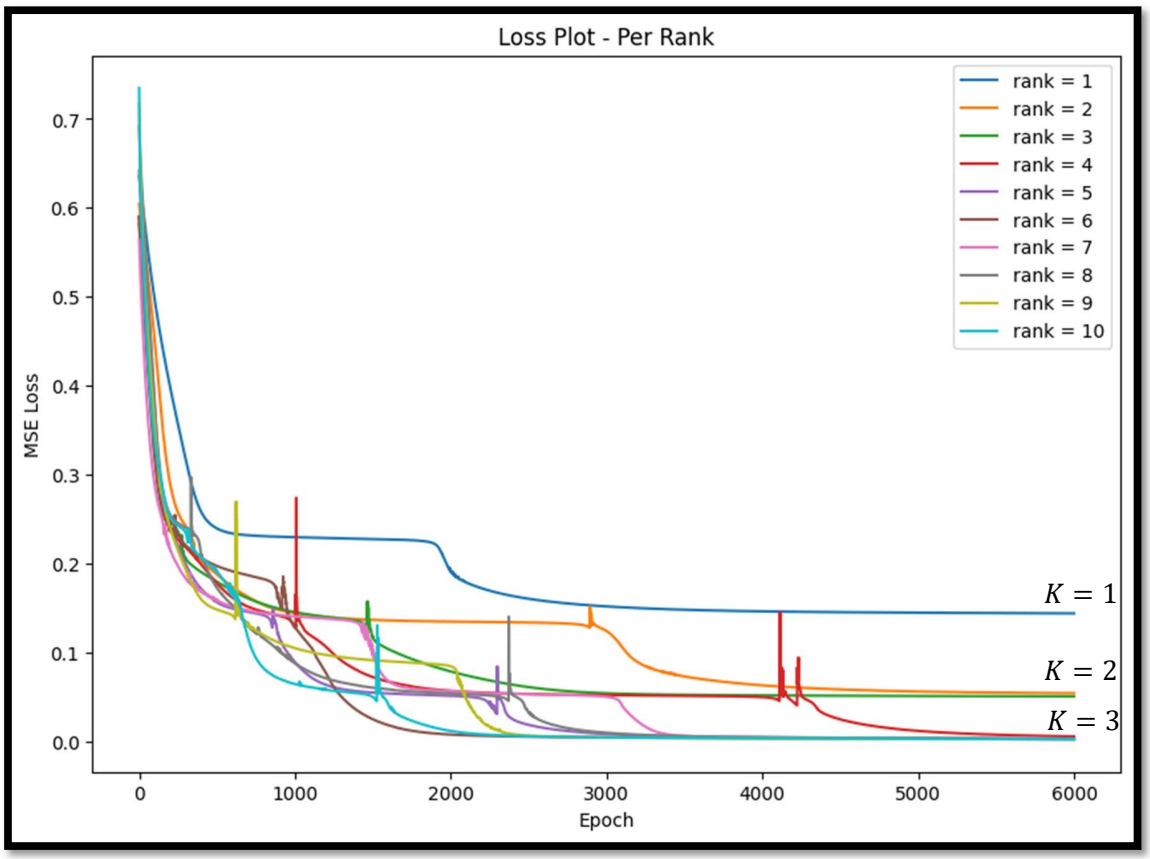
Rank = 3:


Input 1
Input 2
Input 3
Time
memory
predicted
spikes

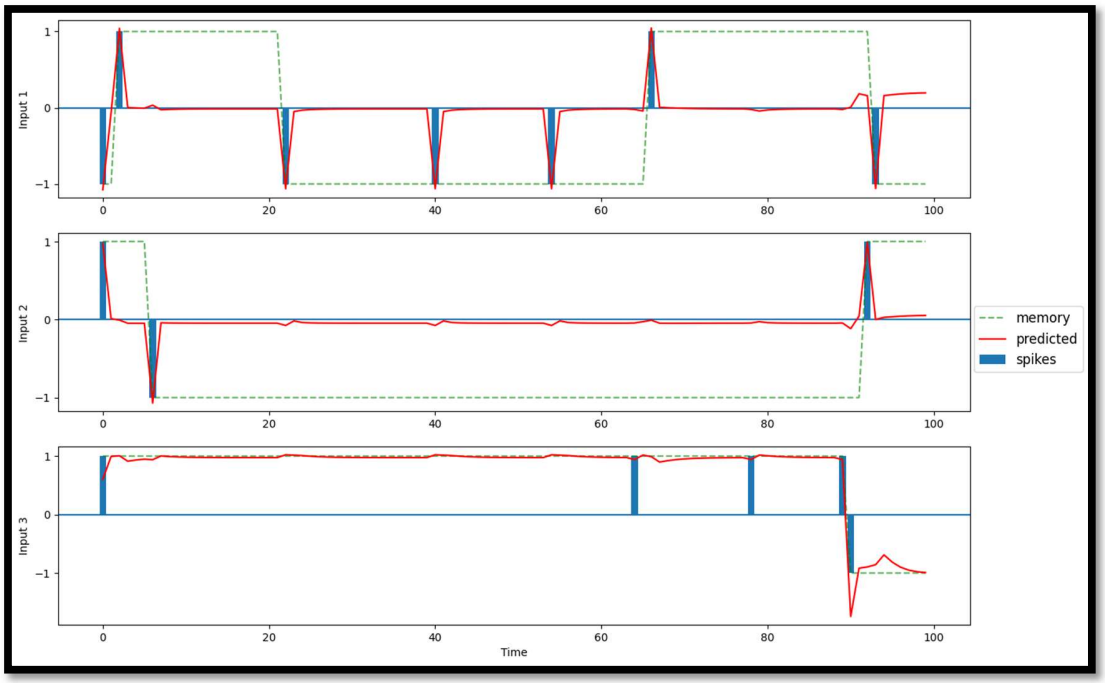

Loss Plot - Per Rank
MSE Loss
Epoch
rank = 1
rank = 2
rank = 3
rank = 4
rank = 5

4) Train low rank RNN to mimic full rank three bodies RNN.

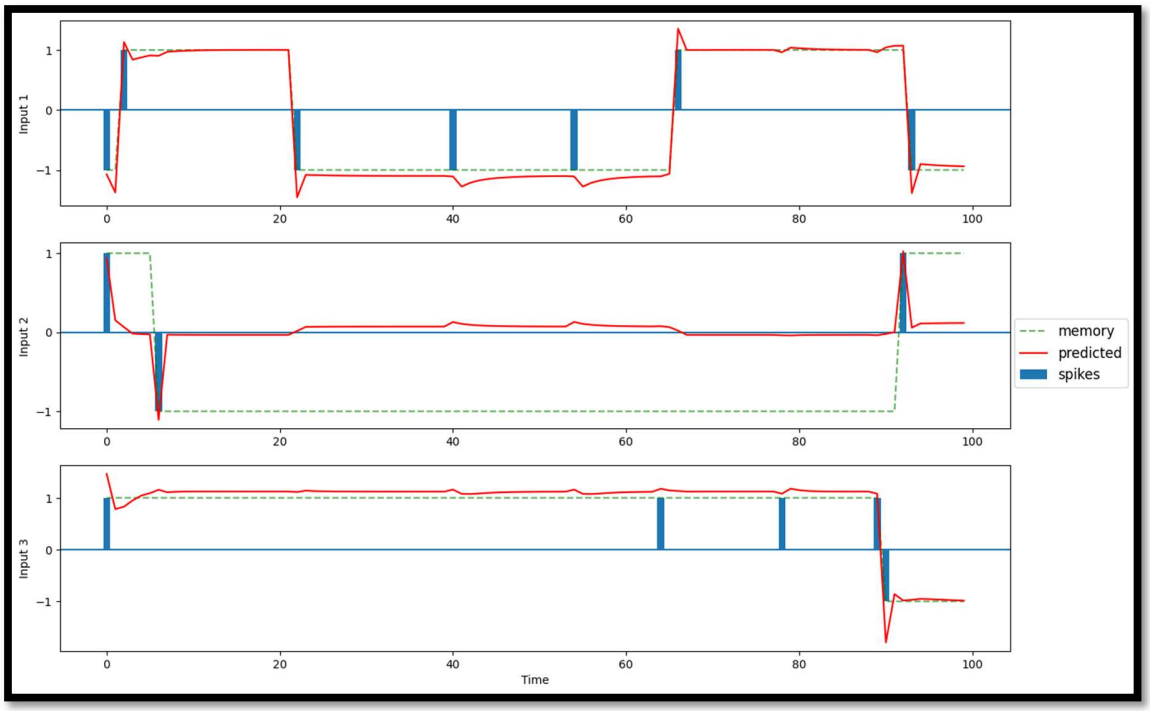
$$K = 3, activation \in \{tanh\}, rank \in [10]$$



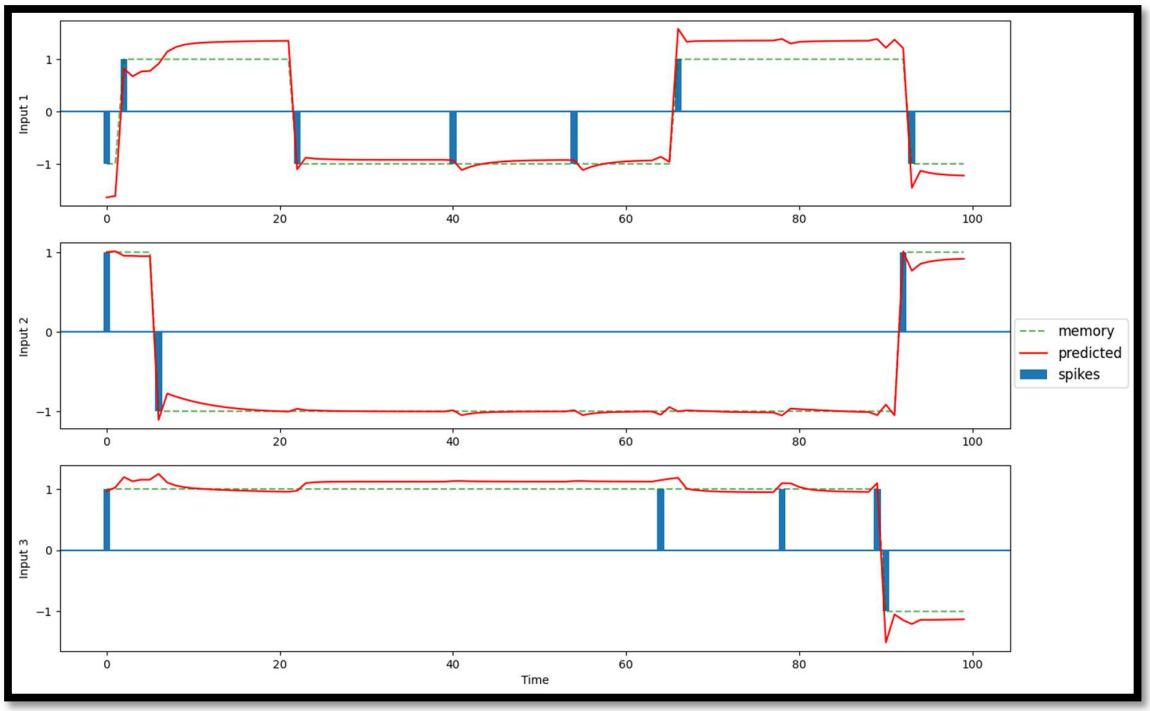
Rank = 1:


Input 1
Input 2
Input 3
Time
memory
predicted
spikes

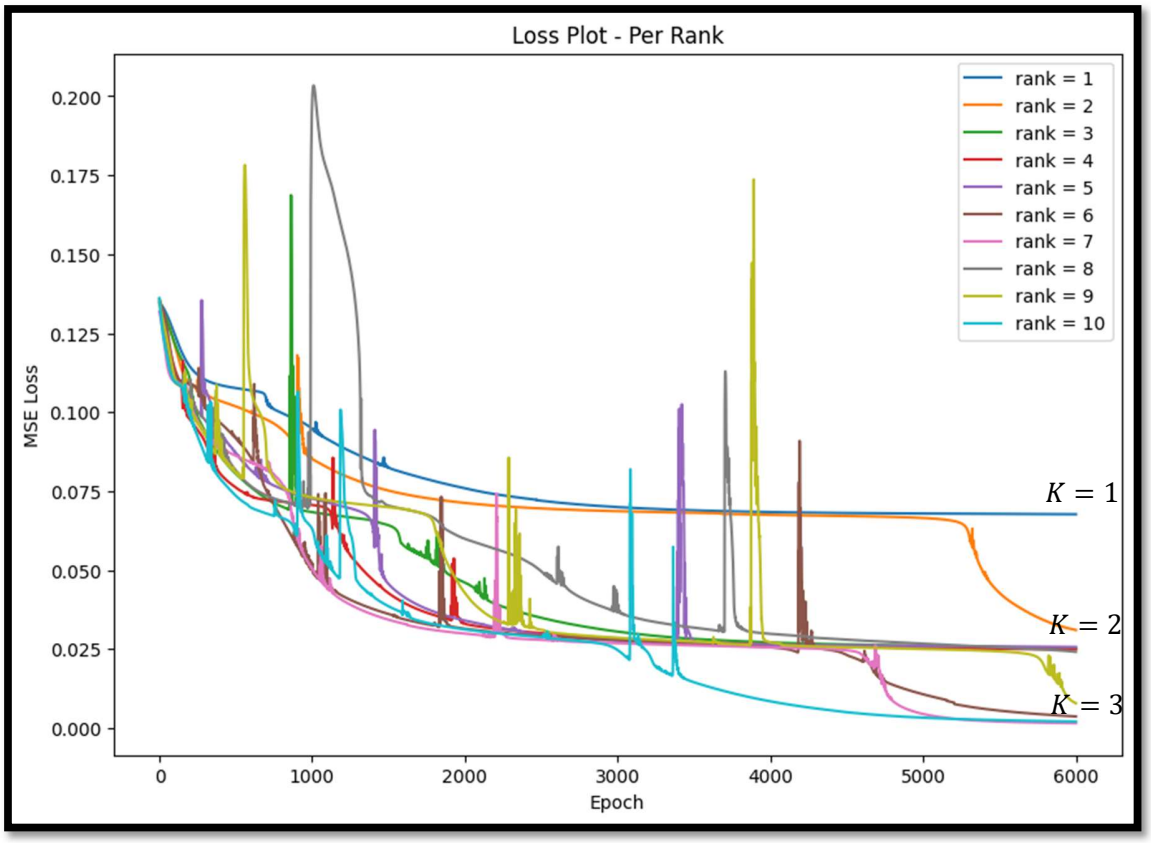
Rank = 2:


Input 1
Input 2
Input 3
Time
memory
predicted
spikes

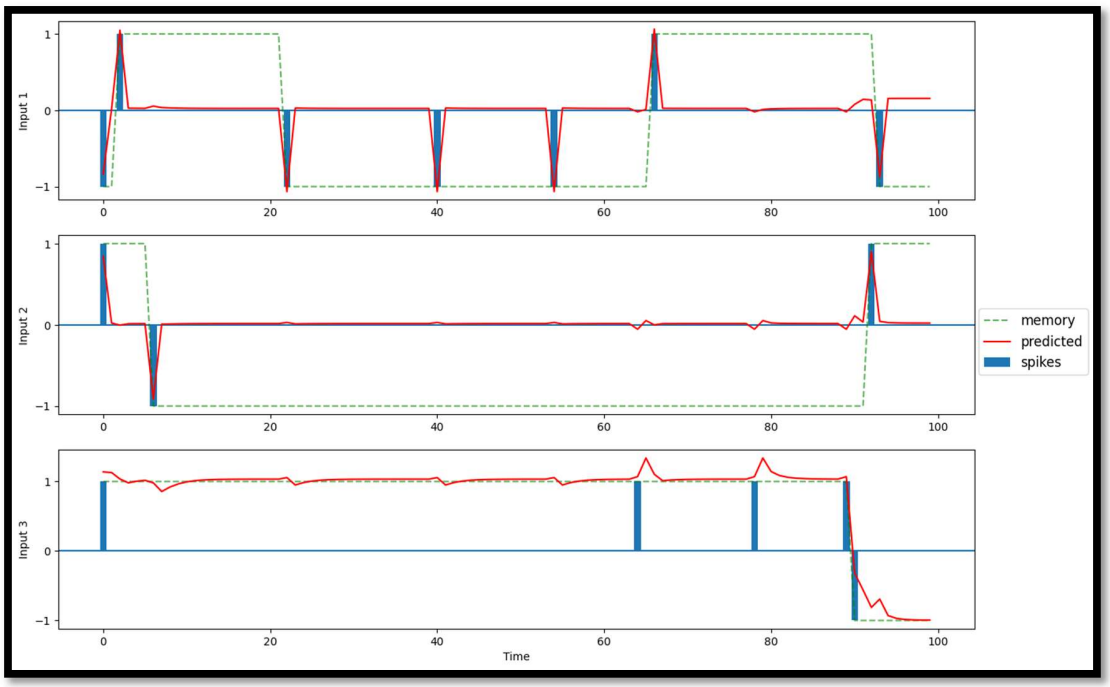
Rank = 4:



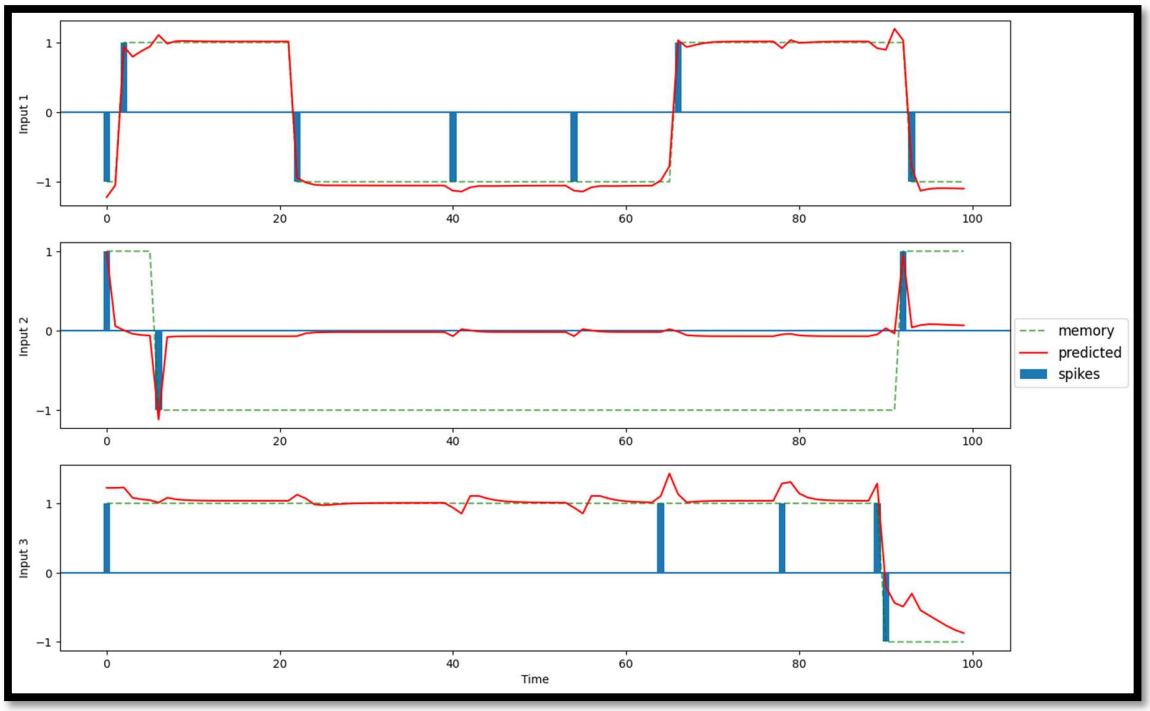
5) Train low rank three bodies RNN to mimic three bodies full rank RNN.



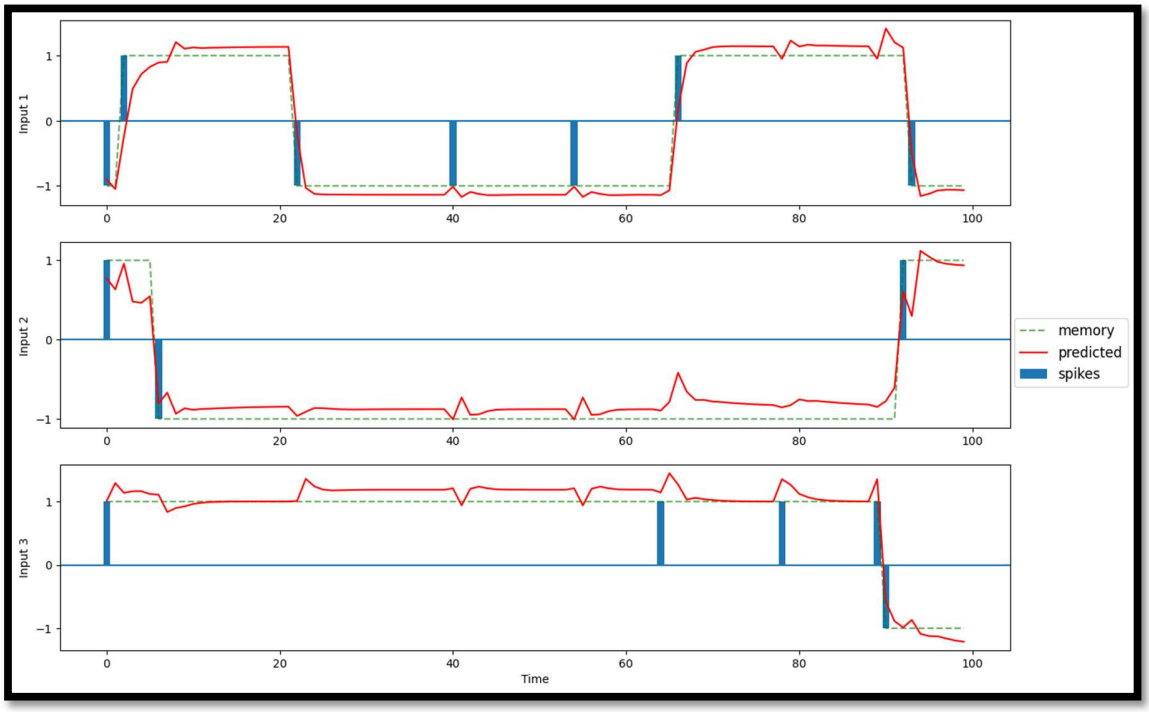
Rank = 1:



Rank = 3:


Input 1
Input 2
Input 3
Time
memory
predicted
spikes

Rank=6:


Input 1
Input 2
Input 3
Time
memory
predicted
spikes