A Segmented Attractor Network for Neuromorphic Associative Learning

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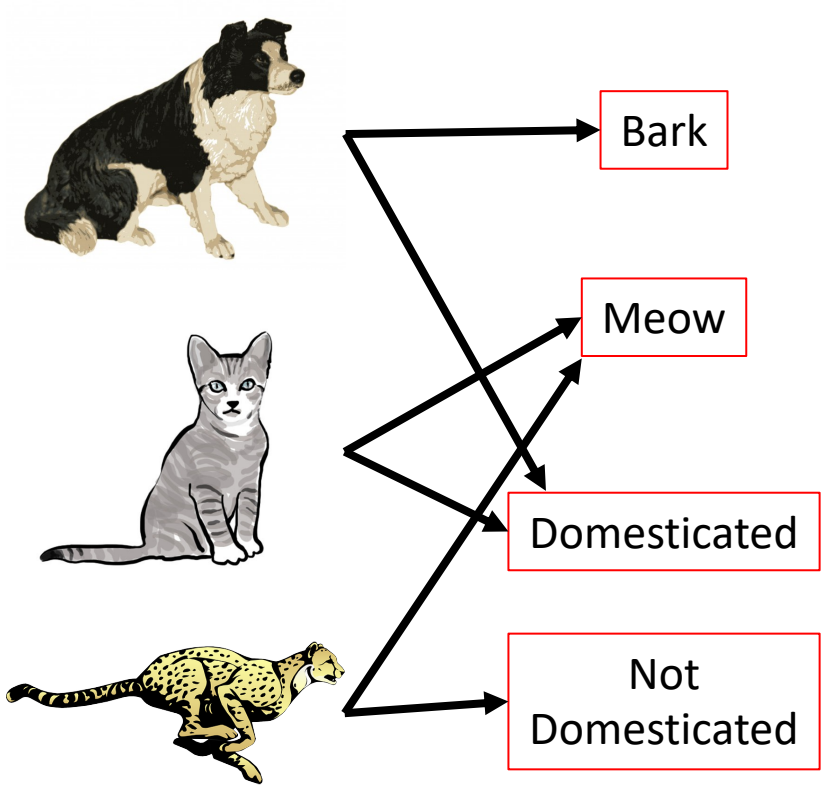
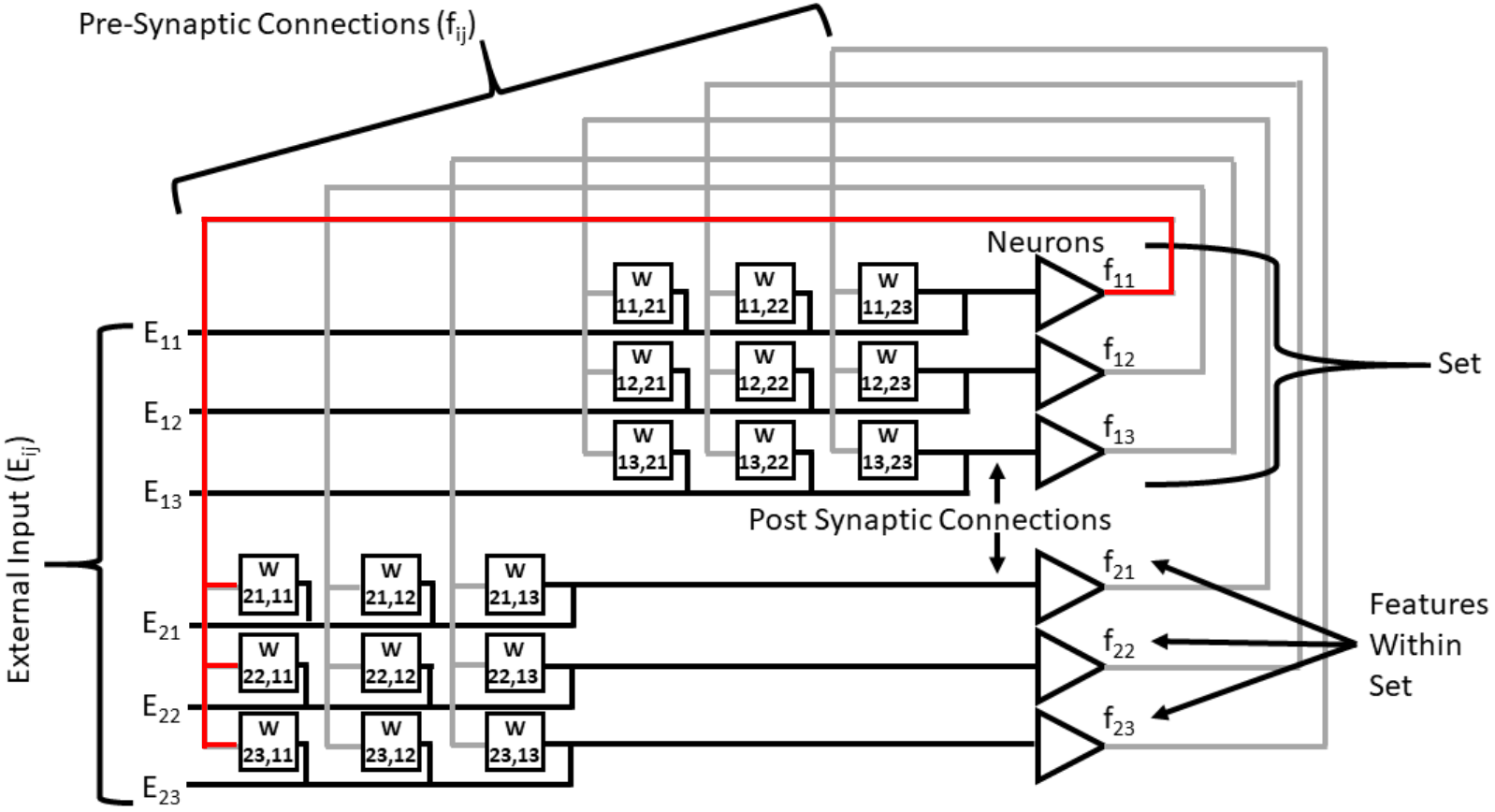
Associative Memory and Attractor Networks

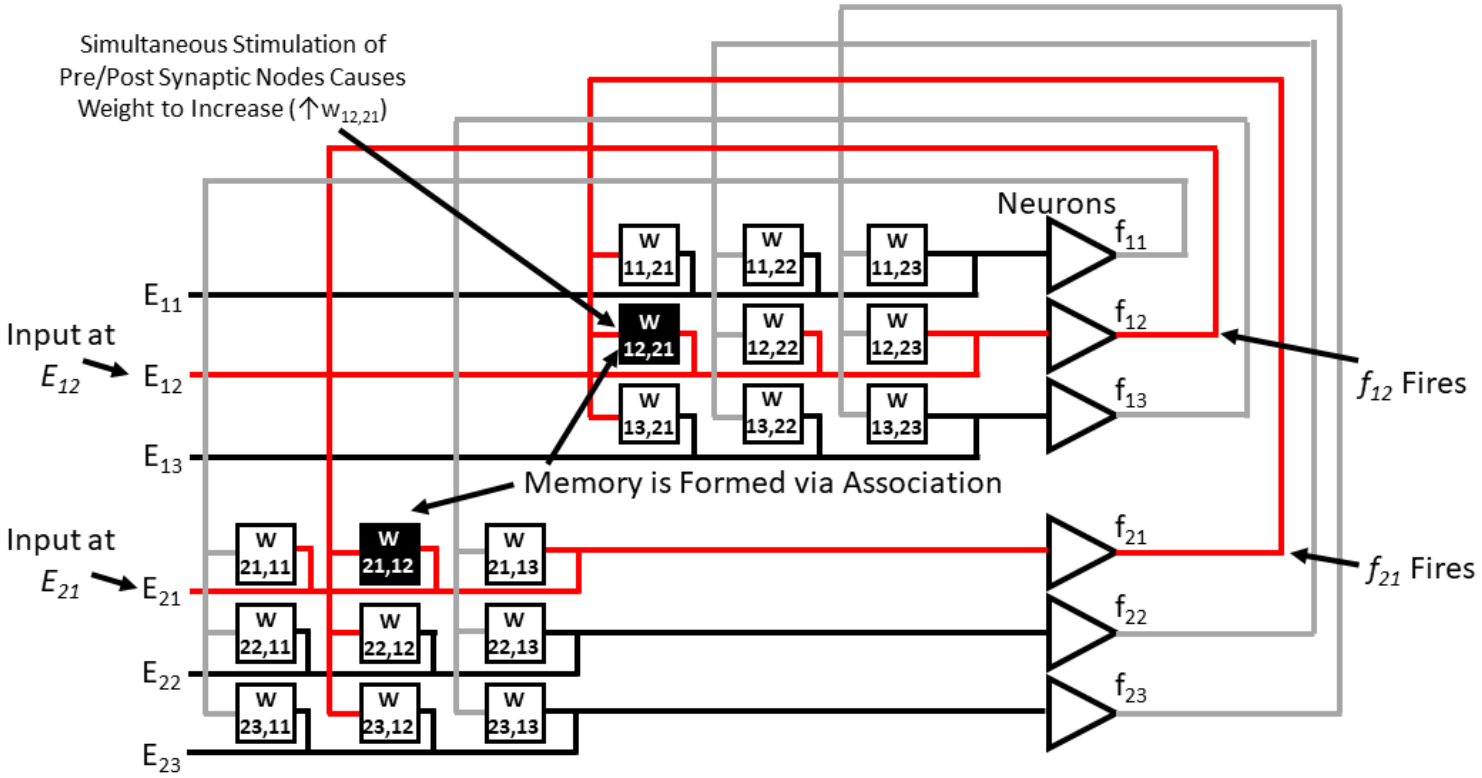
- Neural networks are based around association.
- "Associative memory" is specifically using memory to associate certain events, features, etc. with one another.
- Attractor networks can implement associative memory.
- Many flavors of attractor networks.



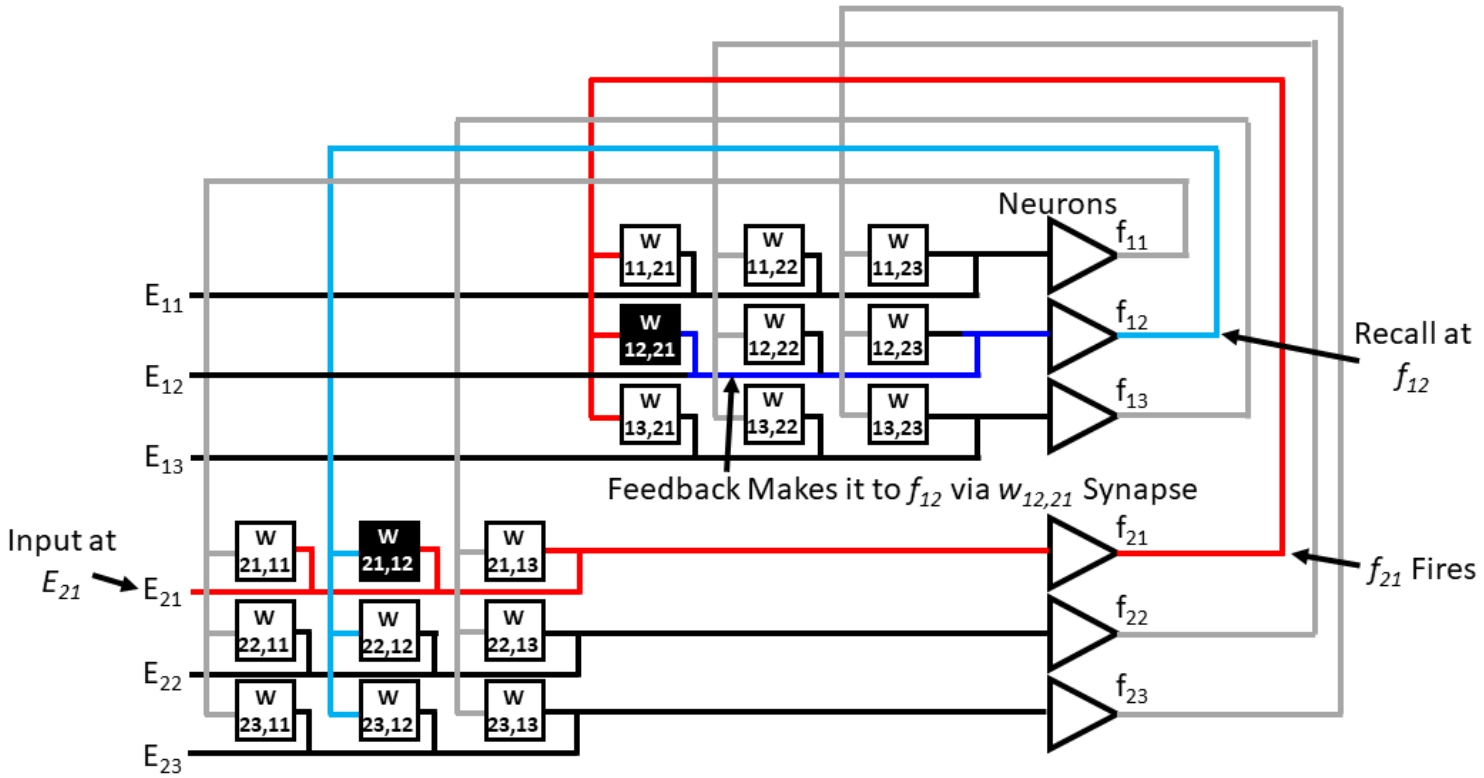
Segmented Attractor Network Setup



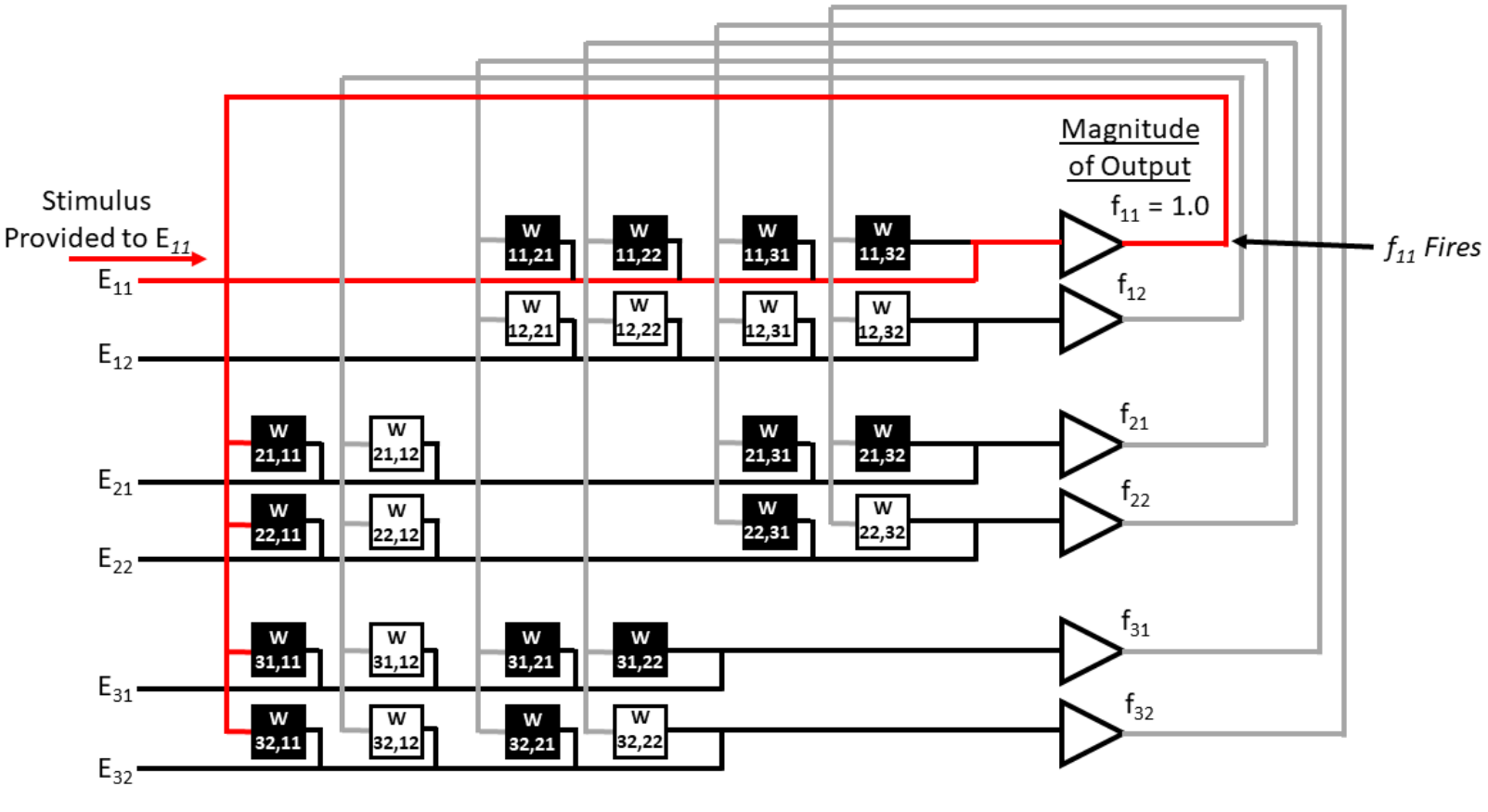
Memory Formation and Recall



Memory Formation and Recall

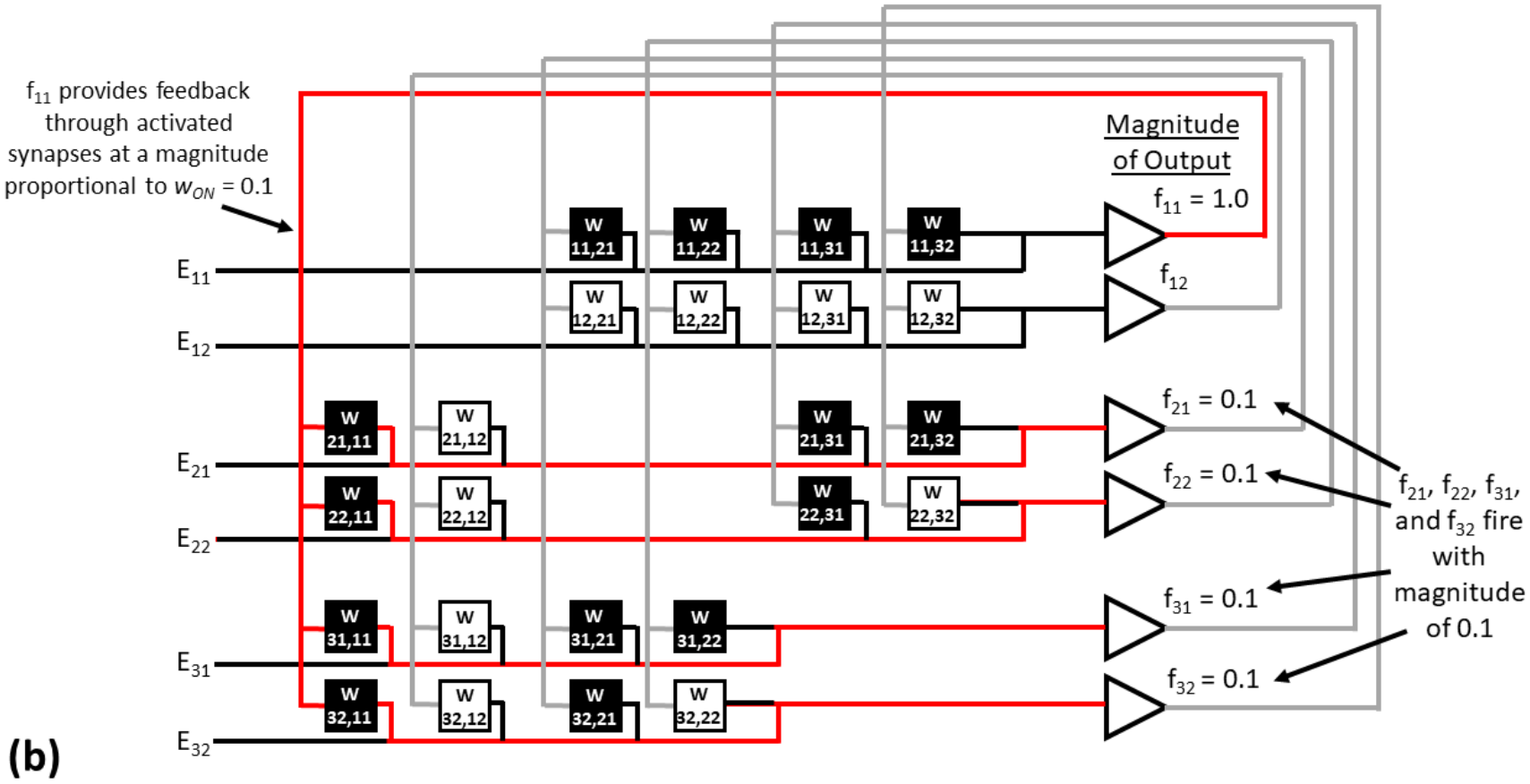


Step by Step Example



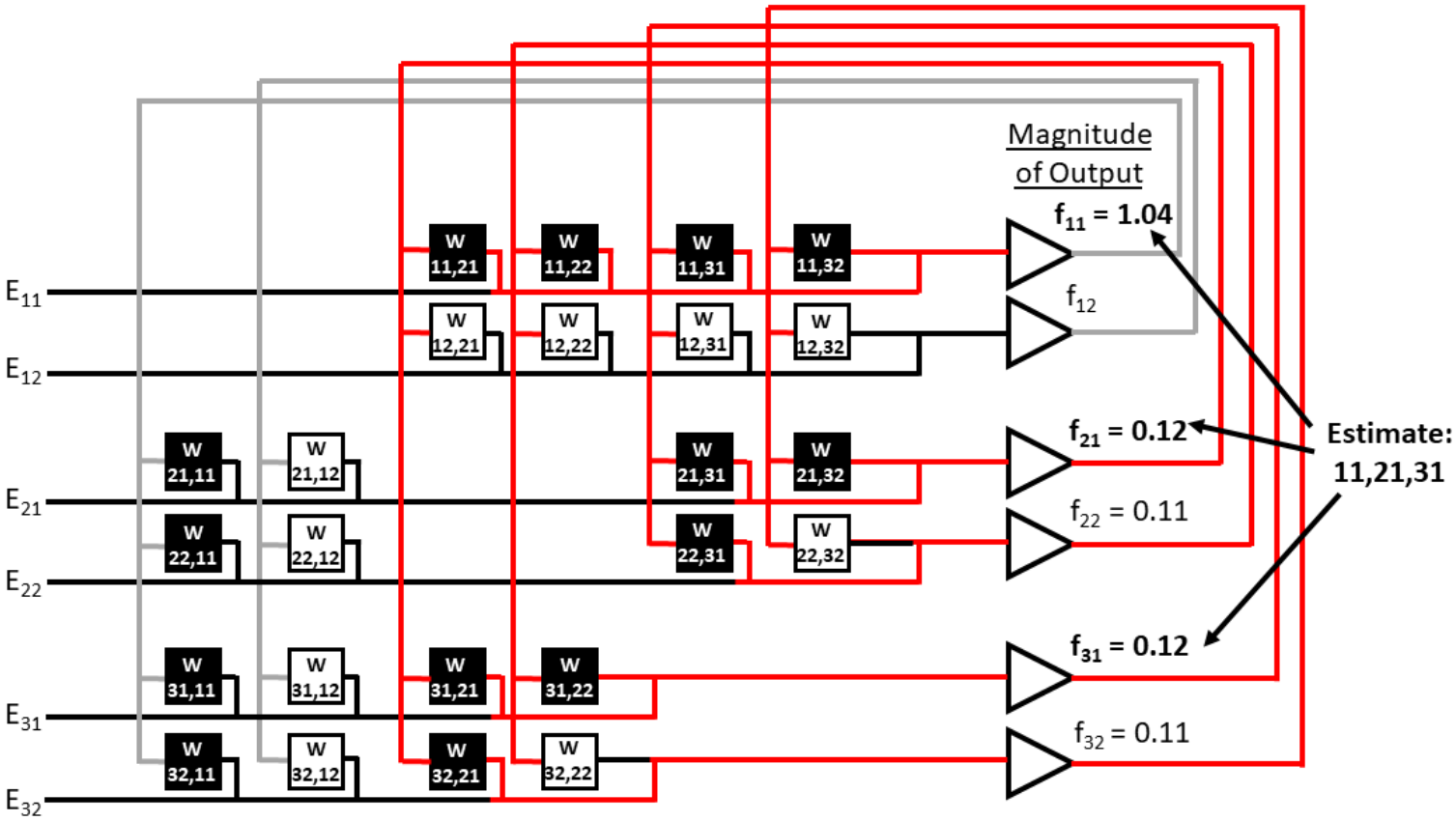
(a)

Step by Step Example



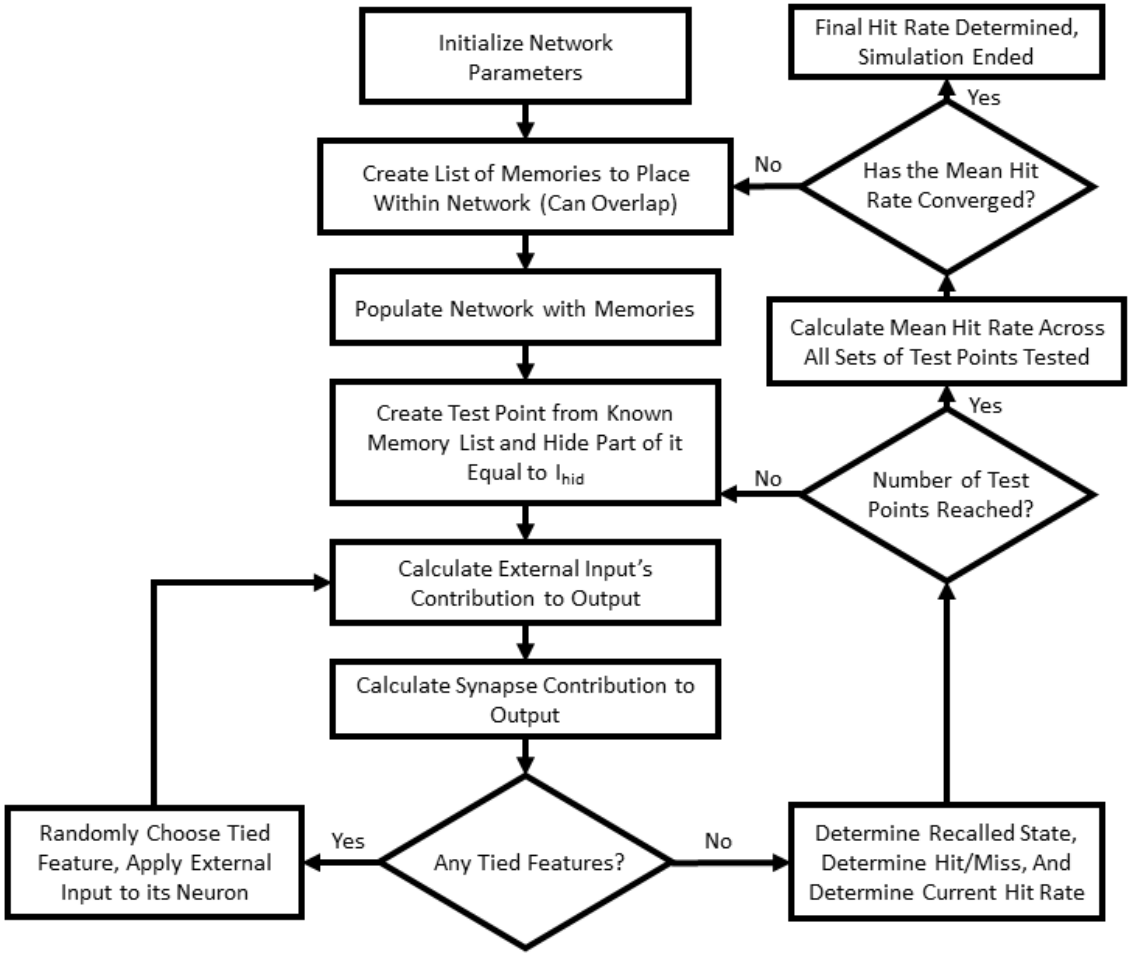
(b)

Step by Step Example

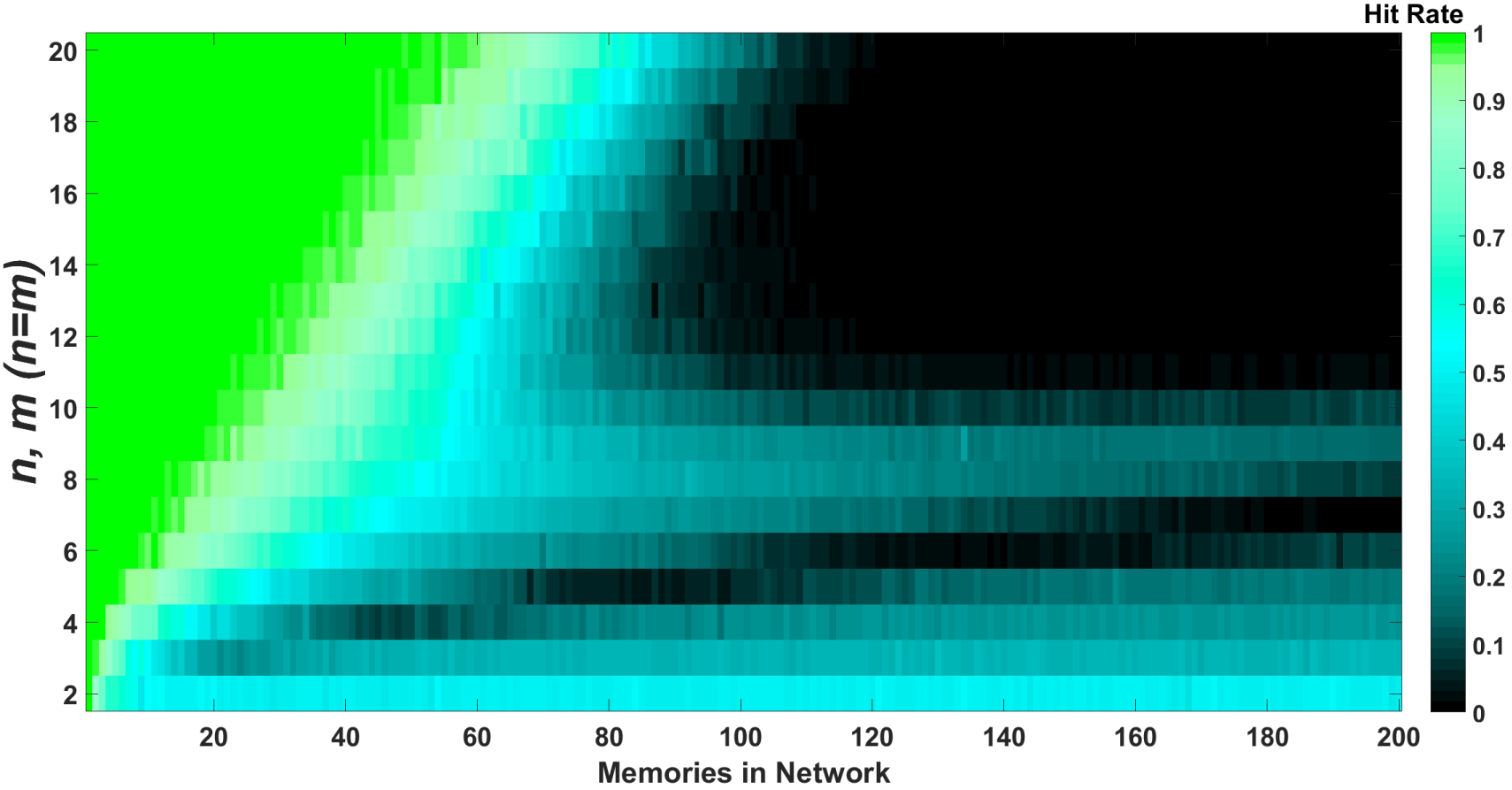


(c)

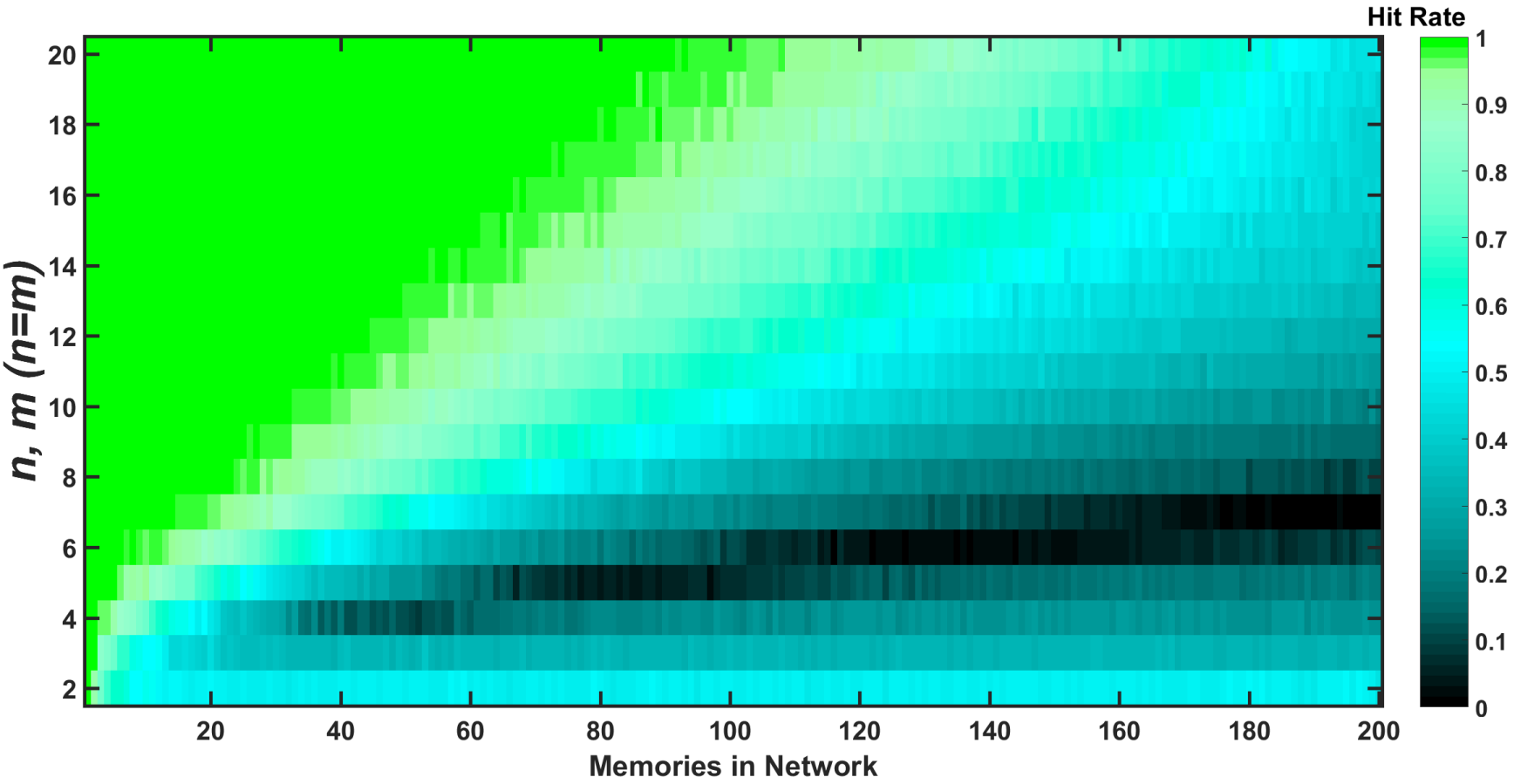
Algorithm


Initialize Network Parameters
Create List of Memories to Place Within Network (Can Overlap)
Populate Network with Memories
Create Test Point from Known Memory List and Hide Part of it Equal to I_{hid}
Calculate External Input's Contribution to Output
Calculate Synapse Contribution to Output
Any Tied Features?
Yes
Randomly Choose Tied Feature, Apply External Input to its Neuron
No
Determine Recalled State, Determine Hit/Miss, And Determine Current Hit Rate
Number of Test Points Reached?
No
Yes
Calculate Mean Hit Rate Across All Sets of Test Points Tested
Has the Mean Hit Rate Converged?
No
Yes
Final Hit Rate Determined, Simulation Ended

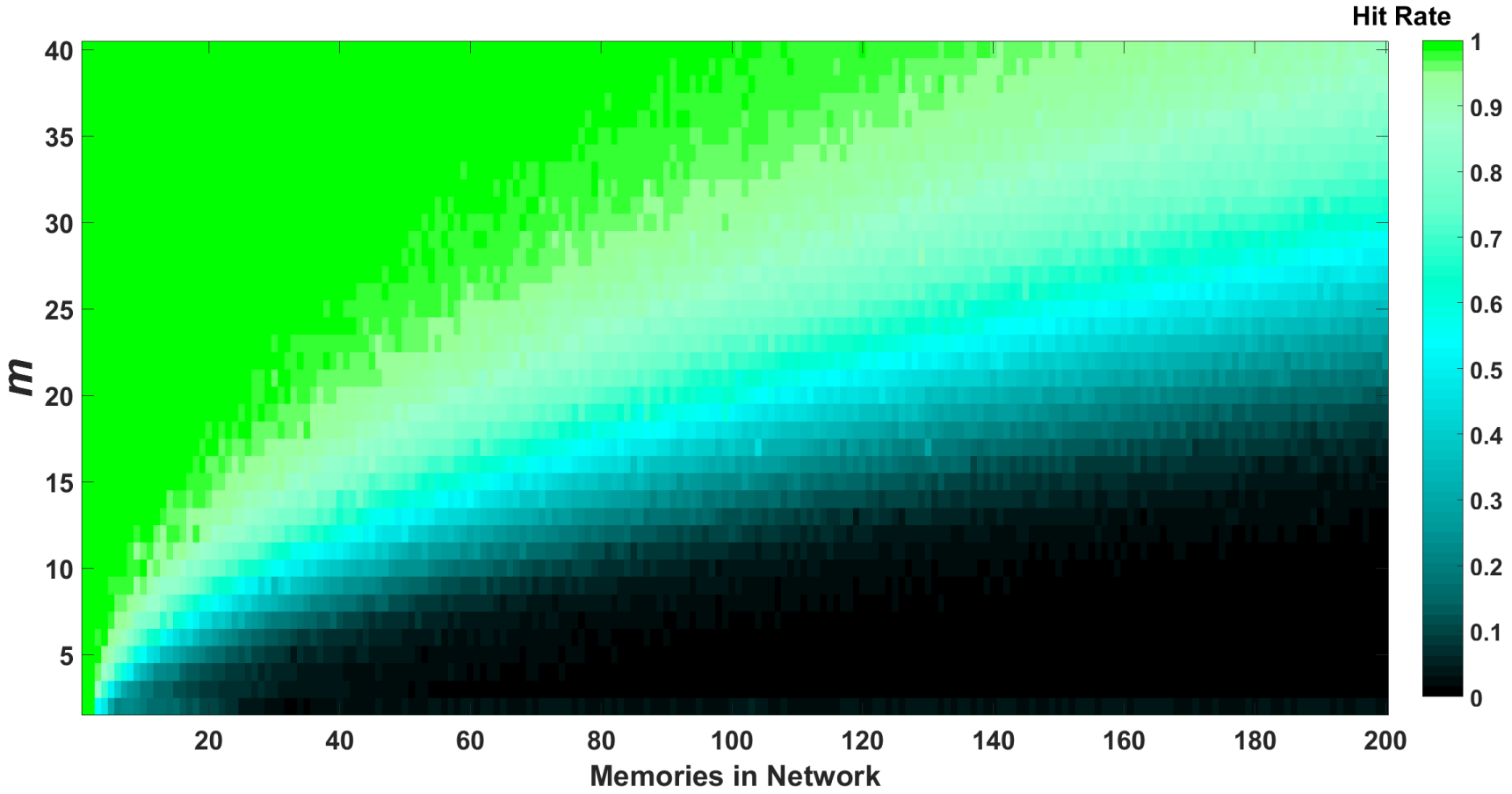
Increasing the Size of the Network



Increasing Size of the Network (With Lower w_{ON})



Increasing the Number of Features Per Set



Conclusions

- Magnitude of individual synaptic feedback can cap memory capacity.
- Increasing the features per set increases memory capacity.
- Memory capacity of network can surpass that of a standard Hopfield network.
- Hit rate can saturate if the number of features per set isn't increased while the number of sets increases.

Acknowledgements

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