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CS420
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Lab 3: Hopfield Networks - Report

Graphs:

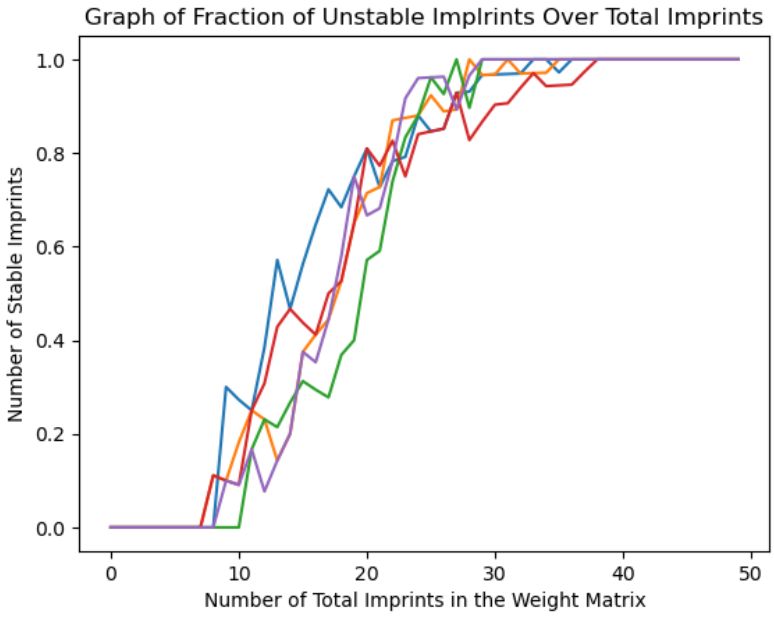

Fig: 1

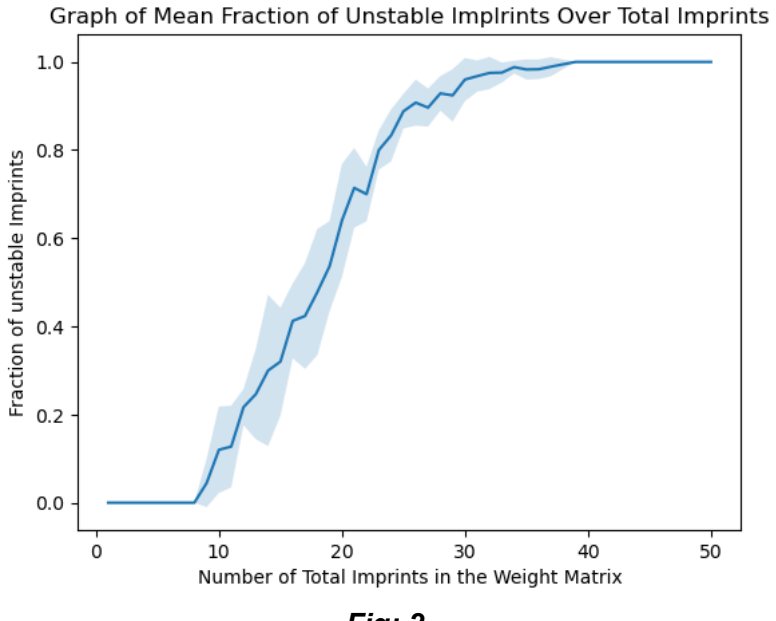

Fig: 2

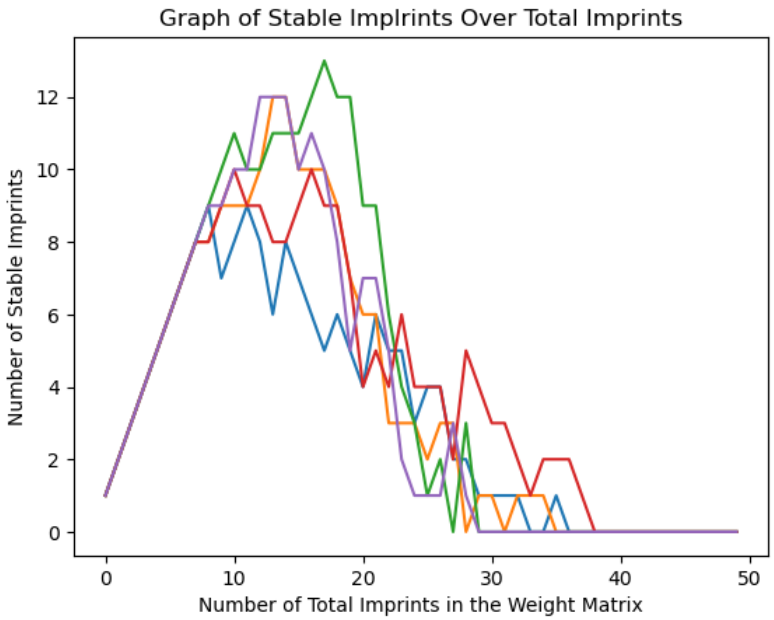

Fig: 3

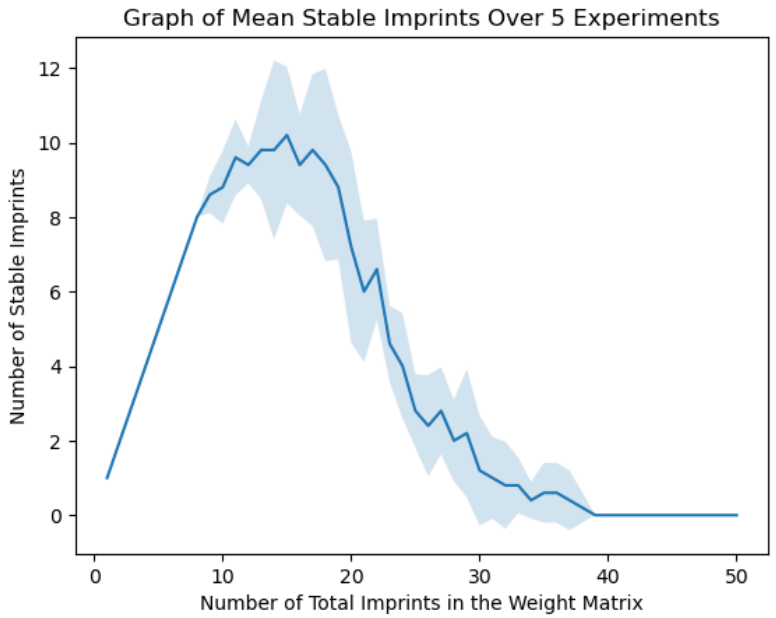

Fig: 4

Discussion:

Q1: How much variation did you see in capacity across the different experiments? Were there significant differences across experiments?

As you can see by the graphs above, there was a fair bit of variation between experiments, but generally only in the inner 30 imprints. In ***Fig. 4,*** you can see that the standard deviation is 0 up until imprint 10 through imprint 40 in which it converges back to 0 again, and this behavior is the same in ***Fig. 2***. This behavior is simple to explain as it shows that there were no unstable imprints up until the tenth imprint and there were never any stable imprints after imprint 40. However, there was a fair bit of variation- especially between imprints 10 and 20. As you can see in ***Fig. 3,*** the blue experiment had a peak stable imprint of just 9 while the green experiment had a peak stable imprint of 13, and all 5 experiments averaged to a peak of 10 stable imprints as shown in ***Fig 4.*** After imprint 20, all experiments started to approach 0 stable imprints so the variation was not as high.

Q2: Does it appear that there's a maximum capacity of the network? When does the maximum capacity occur?

Yes, it does appear that there is a maximum capacity to the network, and it seems as if trying to put more data into the network corrupts the rest of the data that was previously stable. As we discussed in the last question, the five experiments that I ran averaged to a maximum of 10 stable inputs with a minimum of 9 and a maximum of 12. This makes it seem pretty clear that the expected capacity of the network should be 10. However, the answer isn't really that simple. When defining something such as "maximum capacity", it is important to consider what is actually being done. In this case, we are storing data, so it is very unfavorable to have *any* unstable imprints because corrupted data points could be very costly if we were applying this storage to an algorithm. This means we have to find the value that maximizes the number of imprints in *all* cases. Looking at ***Fig. 4 and Fig. 2,*** you can see that, in all experiments, the number of unstable imprints is zero until imprint 9. Therefore, it can be concluded that the maximum safe capacity of the network is 8 imprints. Additionally, if we were *very* strict on our tolerancing for this storage, it would be safest to assume that the capacity of the network is 7 imprints. This storage capacity is likely determined by the number of neurons in our network, and adding more neurons will increase the capacity by a factor of 1.4N where N is the number of neurons.