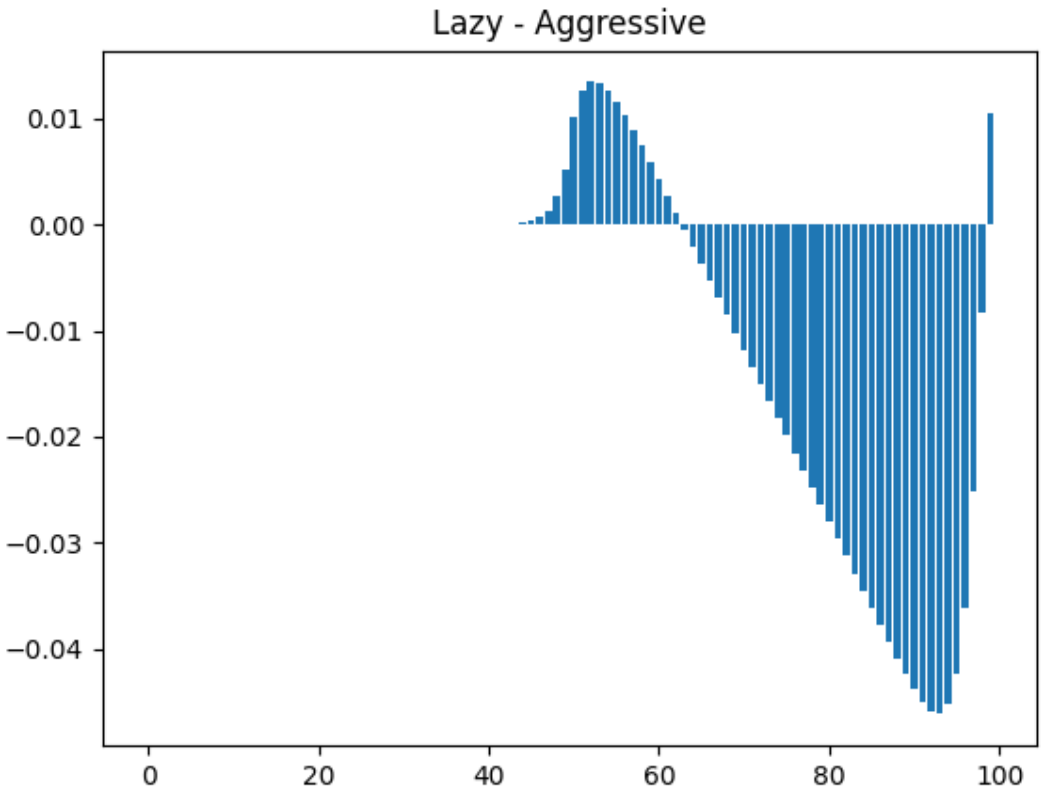
Reinforcement Learning Problem Set 1

Problem 1

Below we see the difference between the value function of Lazy Policy and Aggressive Policy.



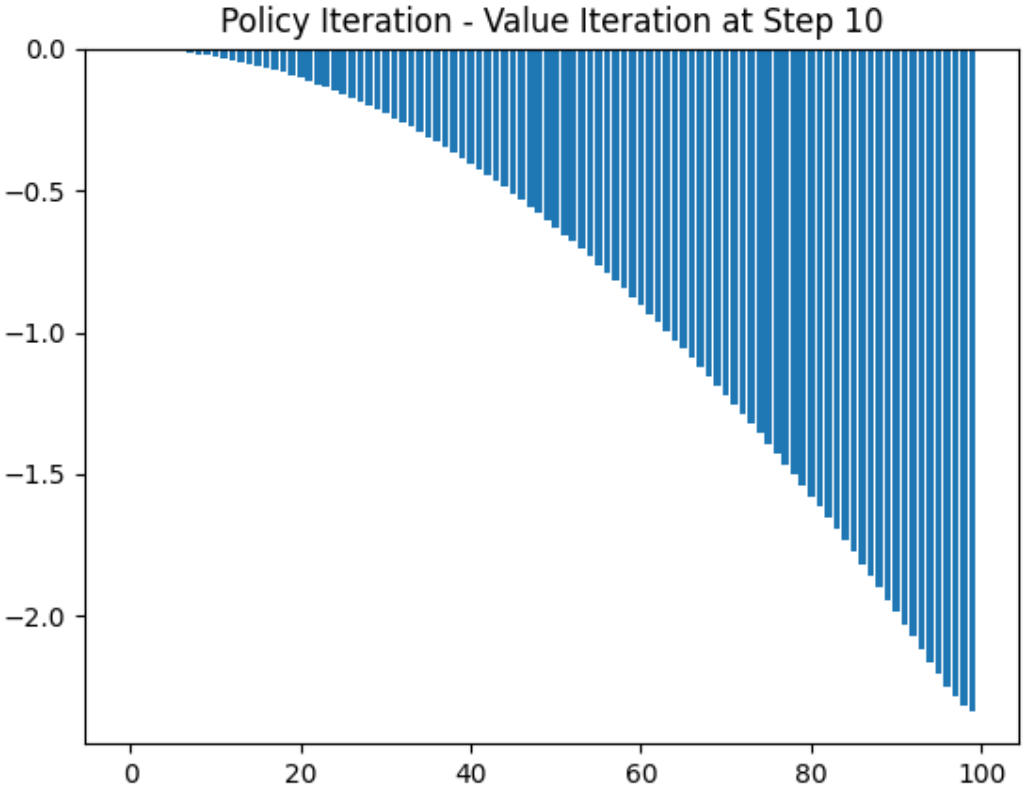
Difference at timestep 50 is 0.010109890229023755 : Lazy Policy is better
Difference at timestep 80 is -0.027995644663423747 : Aggressive Policy is better.

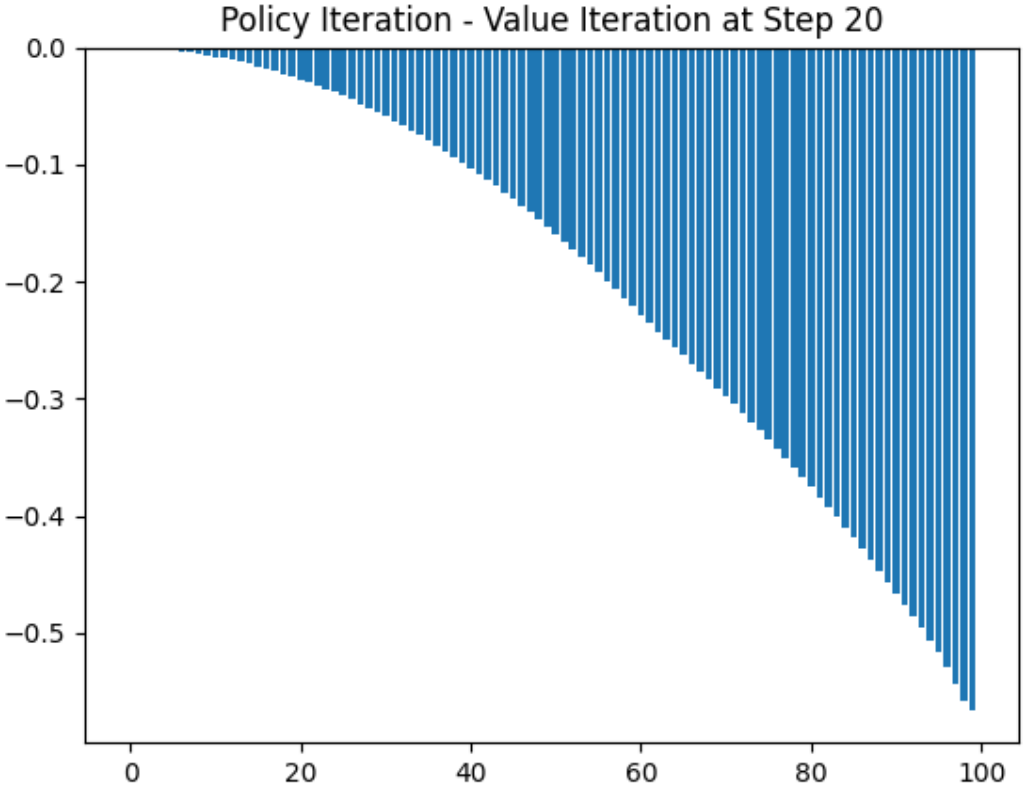
Problem 2

Policy iteration took 1 iterations and 0.96875 s
Value iteration took 127 iterations and 0.140625 s
Policy Iteration time for 100 steps 0.96875
Value Iteration time for 100 steps 0.109375

Below are plots showing the difference between the value function of Policy Iteration and Value Iteration at different timesteps.

All the code used for the project can be found here: https://github.com/aakash94/UPFRL/tree/main/src/hw1





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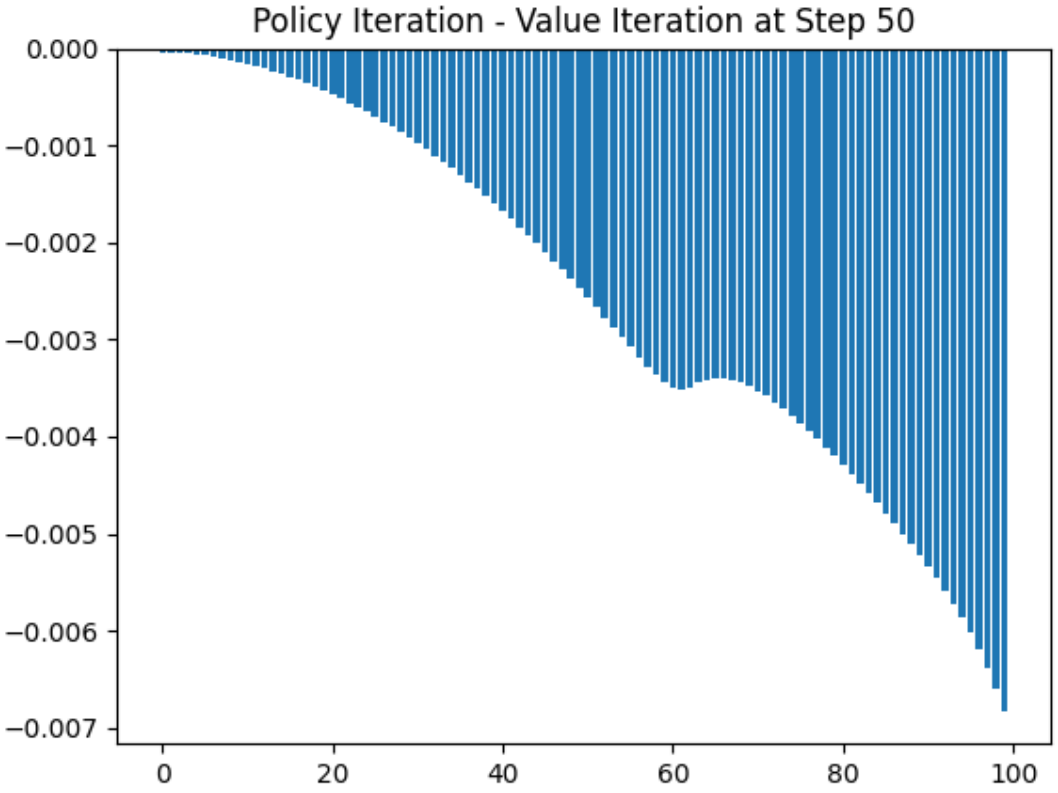

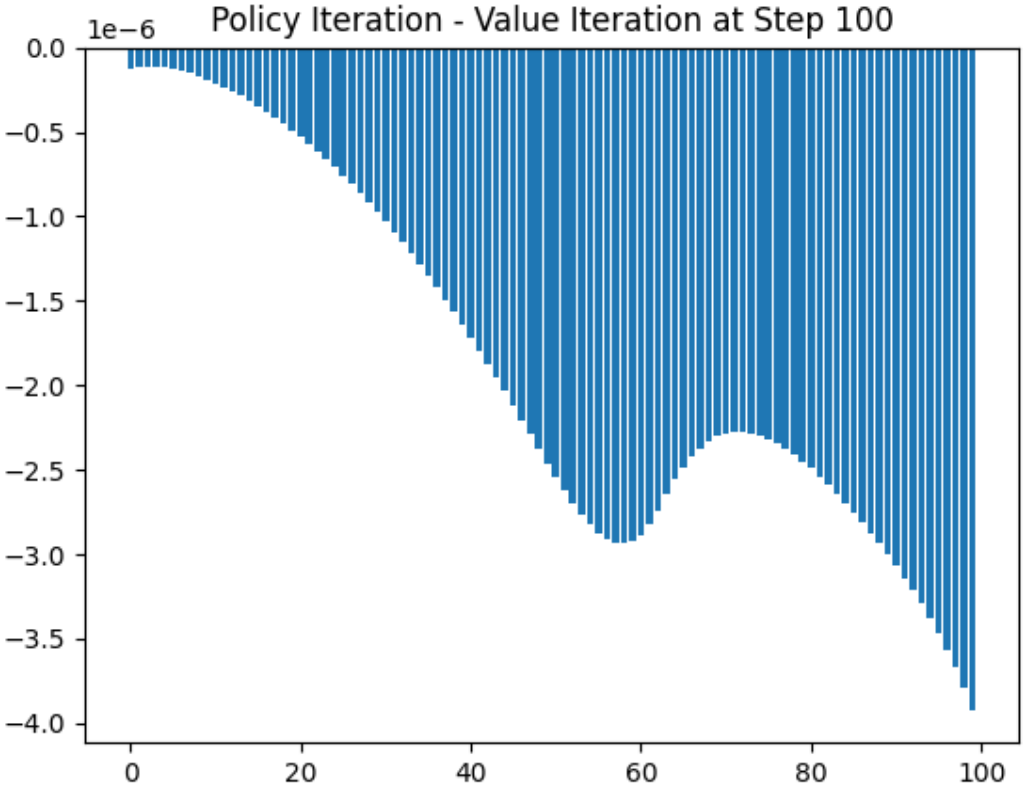

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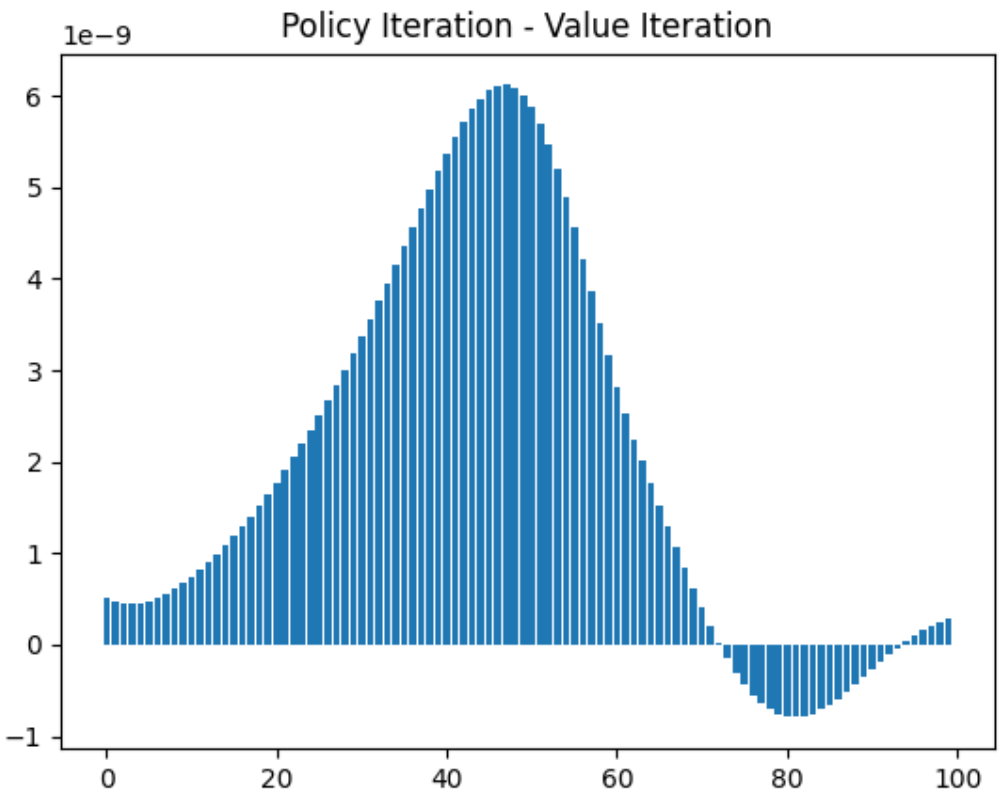
We see that the difference between the Policy Iteration and Value Iteration's Value functions get smaller with timesteps and finally converge to the optimal value function. The difference between the final Policy Iteration Value function and final Value Iteration Value function is shown below.



Policy Iteration and Value Iteration both converge to the same value function (within margin of error that is *theta=1e-8*).
Value iteration takes more steps, but the steps are much faster, hence taking less time in total. Whereas Policy Iteration takes one longer step to converge.

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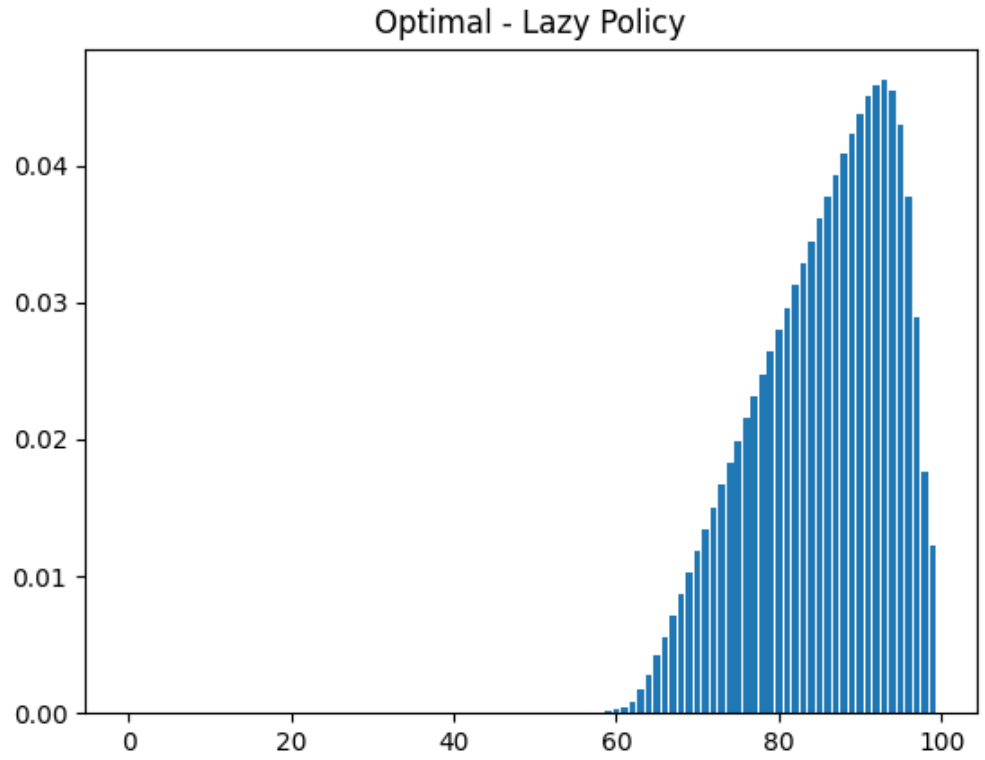
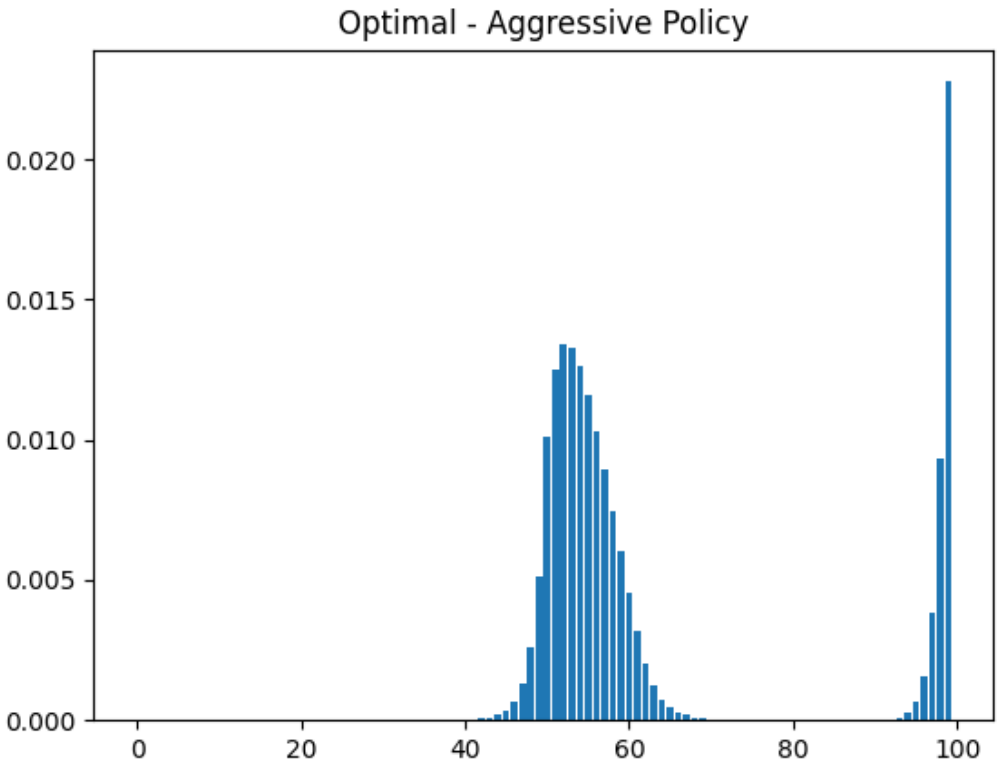
Comparison with Problem 1





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Conclusion

Looking at the difference between Optimal Policy and and the Lazy and Aggressive Policies, we can conclude that the Optimal Policy's Value function is either greater than or equal to the value function function of the other policies at every state. Hence, we can state that the Optimal Policy strictly improves over other policies.

All the code used for the project can be found here: https://github.com/aakash94/UPFRL/tree/main/src/hw1