

Search and Optimization

AI Assignment 2 – Spring 2025

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April 6, 2025

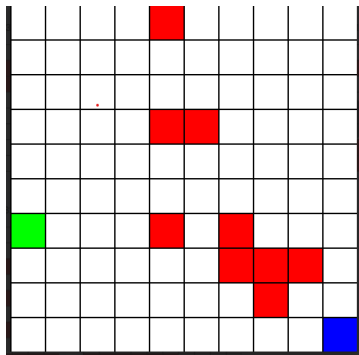
- **Algorithms Implemented:**

- Branch and Bound (BnB)
- Iterative Deepening A* (IDA*)
- Hill Climbing (HC)
- Simulated Annealing (SA)

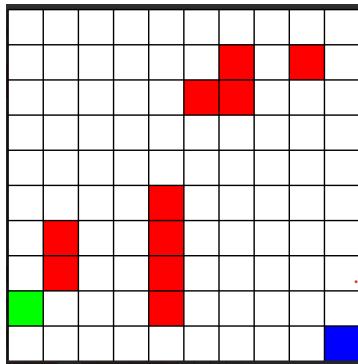
- **Environments Used:**

- Frozen Lake (BnB, IDA*)
- Ant Maze (IDA*)
- Traveling Salesman Problem (HC, SA)

Frozen Lake with BnB and Iterative Deepening A*



(a) GIF 1



(b) GIF 2

Click on the following link for GIF1: [Above GIF](#)

Click on the following link for GIF2: [Above GIF](#)

Click on the following link for GIF3: [Above GIF](#)

Click on the following link for GIF4: [Above GIF](#)

Click on the following link for GIF5: [Above GIF](#)

Plot of Average time for BnB and IDA* for Frozen Lake

● Performance Metrics:

- Avg. Time for BnB and IDA* is 2.15, 1.9 resp.
- Heuristic Function is Manhattan Distance here.

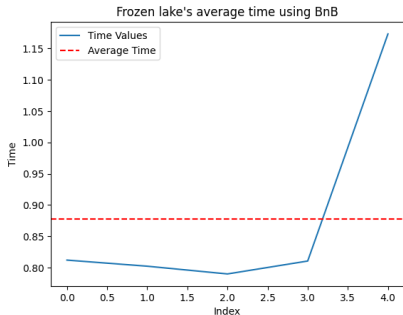


Figure: Plot 1

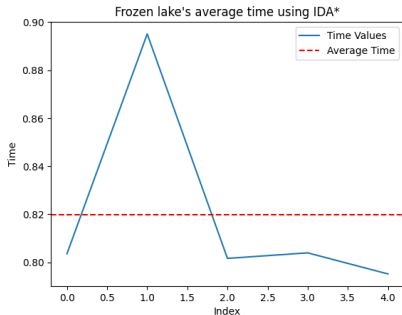
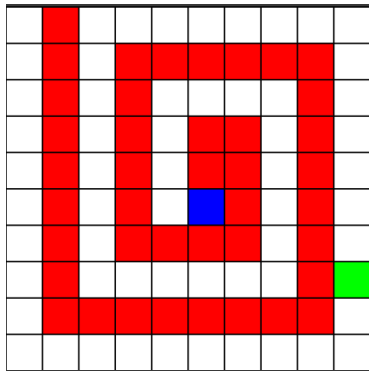
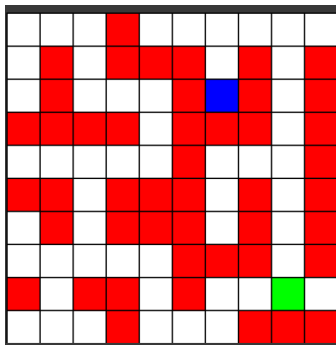


Figure: Plot 2

Antmaze with BnB and Iterative Deepning A*



(a) GIF 1

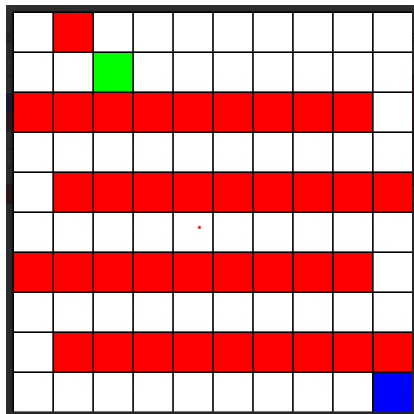


(b) GIF 2

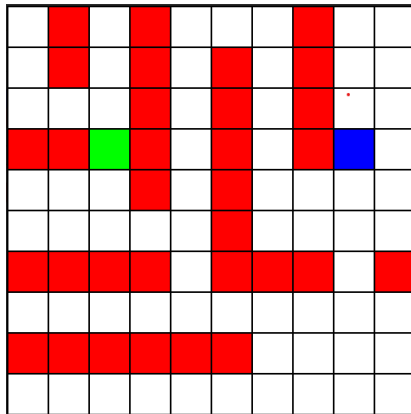
Click on the following link for GIF1: [Above GIF](#)

Click on the following link for GIF2: [Above GIF](#)

Antmaze with BnB and Iterative Deepning A*



(a) GIF 3



(b) GIF 4

Click on the following link for GIF3: [Above GIF](#)

Click on the following link for GIF4: [Above GIF](#)

Plot of Average time for BnB and IDA* for Ant Maze

● Performance Metrics:

- Avg. Time for BnB and IDA* is 2.149, 2.151 resp.
- Heuristic Function is Euclidean Distance here.

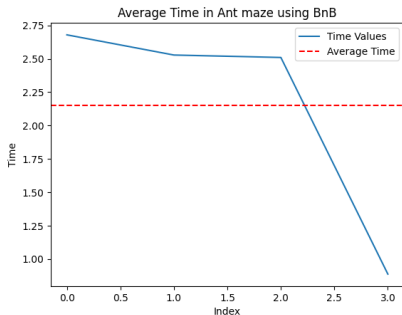


Figure: Plot 1

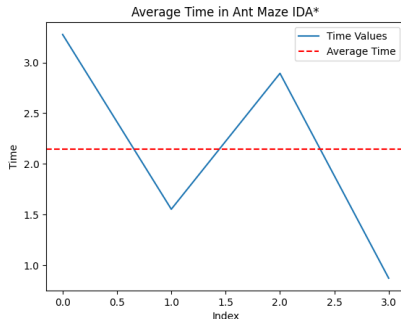
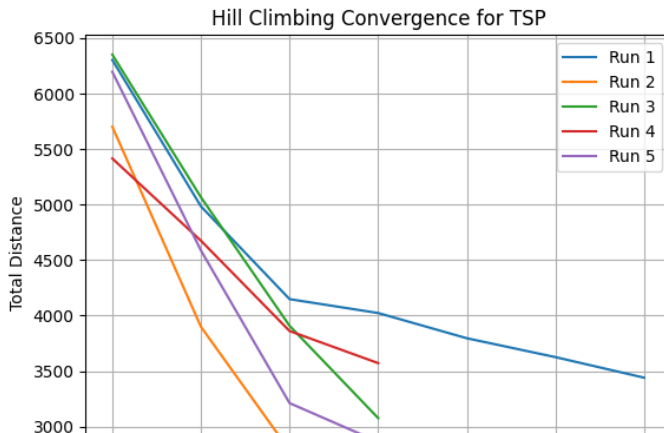


Figure: Plot 2

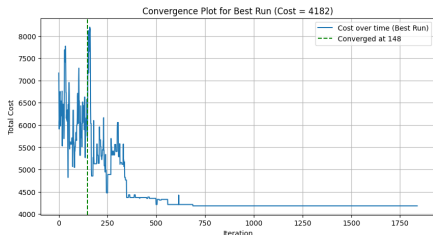
Hill Climbing on TSP

- **Heuristic Used:** Total Tour Length
- **Performance Metrics:**
 - Avg. Time to Reach is 0.0033 seconds
 - Number of Cities: 10
 - In best Path number of Convergence Iteration is 3.

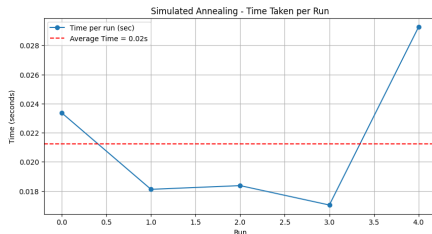


Simulated Annealing: Performance Visualization

- Avg. Time to Reach is 0.0033 seconds
- Number of Cities: 10
- In best Path number of Convergence Iteration is 3.



Simulated Annealing Convergence



Time Plot for 5 Runs

Conclusion and Insights

- **BnB**: High accuracy, but time-intensive for larger states.
- **IDA***: Balanced performance, low memory usage.
- **HC**: Fast but risks getting stuck in local optima.
- **SA**: Slower, but finds better global solutions in TSP.
- **Observation**: Trade-off between computation time and optimality.