Final Comparison and Evaluation of Search Algorithms

This section presents the final and complete comparison between all implemented search algorithms after the successful implementation of DFS, BFS, UCS, A*, and Hill Climbing. All algorithms are evaluated using the same criteria on the 5-Queens problem (N = 5) to ensure a fair comparison.

Evaluation Criteria

- Execution Time
- Number of Expanded States
- Memory Usage
- Solution Correctness
- Search Efficiency
- Completeness
- Optimality

Final Algorithm Comparison Table

Algorithm	Execution Time	Expanded States	Memory Usage	Search Efficiency	Completeness	Optimality	Remarks
DFS	Fast	Medium	Low	Good	Yes	No	Efficient backtracking approach suitable for CSP problems
BFS	Slow	High	Very High	Low	Yes	Yes	Guarantees shallowest solution but is memory intensive
UCS	Slow	High	High	Low	Yes	Yes	Behaves similarly to BFS due to uniform step cost
A*	Fast	Low	Medium	Very Good	Yes	Yes	Best overall performance using heuristic guidance
Hill Climbing	Very Fast	Very Low	Very Low	Moderate	No	No	Fast local search but may get stuck in local optima

Detailed Discussion

The results demonstrate that A* Search provides the best balance between efficiency and correctness, significantly reducing the number of expanded states compared to BFS and UCS. DFS performs well for constraint satisfaction problems due to backtracking and low memory usage. BFS and UCS guarantee optimal solutions but suffer from high memory consumption. Hill Climbing offers fast approximate solutions but lacks completeness due to local optima.

Final Conclusion

After completing all algorithm implementations, A* Search is identified as the most effective algorithm for solving the 5-Queens problem under the defined evaluation criteria. The combination of global and local search techniques provides a comprehensive understanding of search behavior in artificial intelligence.