TSP Algorithms - Comparative Analysis

Generated on: 2025-11-17 13:15:45

1. Performance Ratio Analysis (Distance / Optimal)

Algorithm	Mean Ratio	Median Ratio	Min Ratio	Max Ratio	Std Dev
Nearest Neighbor	0.305	0.001	0.000	3.813	0.951
Genetic Algorithm	0.313	0.001	0.000	3.527	0.890
Brute Force	0.305	0.001	0.000	3.813	0.951
Branch and Bound	0.305	0.001	0.000	3.813	0.951

Interpretation: A ratio of 1.0 means the algorithm found the optimal solution. Ratios < 1.0 indicate better-than-optimal results (may indicate data discrepancy). Ratios > 1.0 indicate suboptimal solutions. Lower ratios are better.

2. Execution Time Analysis

Algorithm	Mean Time (s)	Median Time (s)	Min Time (s)	Max Time (s)
Nearest Neighbor	0.0011	0.0011	0.0003	0.0015
Genetic Algorithm	1.7154	1.7461	0.8052	1.9717
Brute Force	0.0012	0.0012	0.0003	0.0018
Branch and Bound	0.0012	0.0011	0.0002	0.0016

3. Algorithm Comparison by Benchmark

Benchmark	Cities	Optimal	NN Ratio	GA Ratio	BF Ratio	BB Ratio
ali535	100	202339	0.006	0.008	0.006	0.006
att48	48	10628	3.813	3.527	3.813	3.813
att532	100	27686	0.675	0.939	0.675	0.675
d1291	100	50801	0.000	0.000	0.000	0.000
d1655	100	62128	0.000	0.000	0.000	0.000
d198	100	15780	0.001	0.002	0.001	0.001
d493	100	35002	0.000	0.000	0.000	0.000
d657	100	48912	0.000	0.001	0.000	0.000
fl1400	100	20127	0.001	0.001	0.001	0.001
fl3795	100	28772	0.001	0.001	0.001	0.001
fnl4461	100	N/A	N/A	N/A	N/A	N/A
gr431	100	171414	0.002	0.003	0.002	0.002
pa561	100	2763	0.080	0.098	0.080	0.080
pcb3038	100	137694	0.000	0.000	0.000	0.000
pla7397	100	23260728	0.075	0.123	0.075	0.075
rat575	100	6773	0.220	0.303	0.220	0.220
rl11849	100	923288	0.000	0.000	0.000	0.000

4. Key Findings and Conclusions

Best Average Performance: Nearest Neighbor with average ratio of 0.305

Fastest Algorithm: Nearest Neighbor with average time of 0.0011 seconds

Algorithm Characteristics:

• **Nearest Neighbor:** Fast, greedy heuristic. Good for quick solutions but may not be optimal.

• **Genetic Algorithm:** Population-based metaheuristic. Can find good solutions but requires more time.

• **Brute Force:** Exact algorithm but only feasible for small instances (≤10 cities).

• **Branch and Bound:** Exact algorithm with pruning. Efficient for medium-sized instances (≤20 cities).

Limitations Observed:

• Some benchmark results show significant discrepancies with optimal values, suggesting possible data format differences.

• For large instances, exact algorithms (Brute Force, Branch and Bound) use heuristic fallbacks.

• Genetic Algorithm performance depends on parameter tuning and problem characteristics.