Comparison of Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) for TSP

1. Methods

In this report, we applied Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) to solve the Traveling Salesman Problem (TSP).
Both algorithms aimed to minimize the total distance of visiting a set of cities exactly once and returning to the starting point.

• Genetic Algorithm (GA): GA is inspired by natural selection and evolves a population of candidate solutions. Key components are:

- Initialization: Randomly generated paths
- Selection: Based on fitness (shorter distances preferred)
- Crossover: Combining paths to generate new solutions
- Mutation: Randomly modifying parts of solutions
- Elitism: Preserving the best solutions across generations

• Particle Swarm Optimization (PSO): PSO models a population of particles moving through a solution space. Key components are:

- Initialization: Randomly initialized paths
- Velocity Update: Adjusting solutions based on global and personal bests
- Position Update: Moving towards optimal solutions in search space

2. Results and Analysis

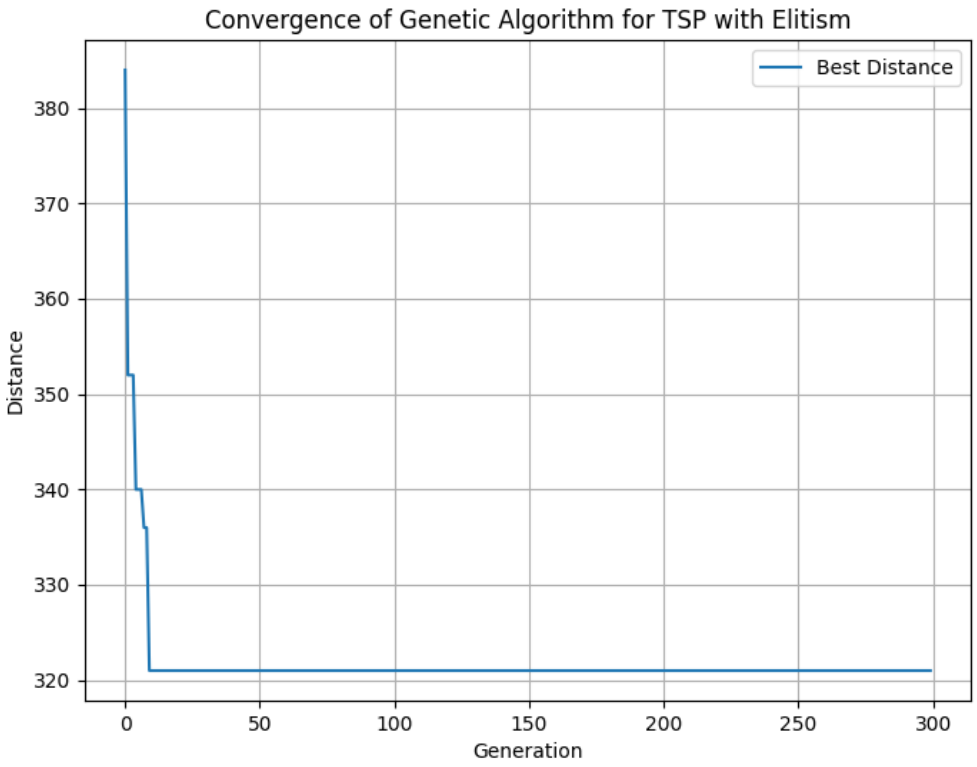
The following results were obtained by running GA and PSO algorithms for the same TSP instance consisting of a set of cities:

• Execution Time and Best Results:

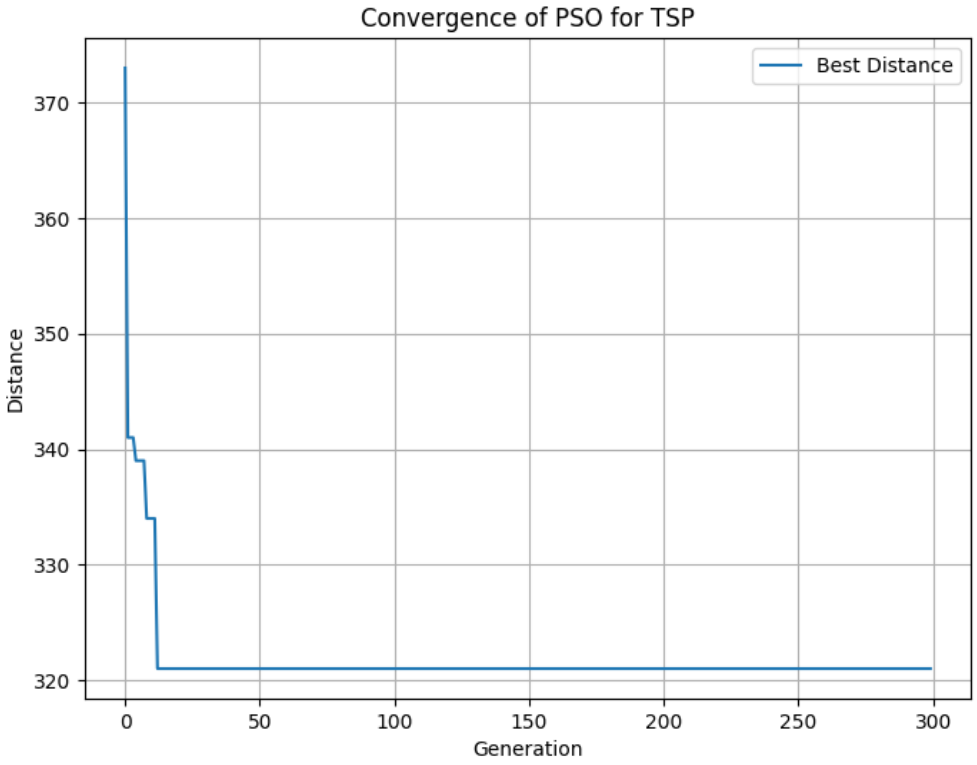
- Genetic Algorithm (GA): 0.7894 seconds, Best Distance = 321.00
- Particle Swarm Optimization (PSO): 0.6120 seconds, Best Distance = 321.00

Both algorithms converged to the same minimum distance of 321.00, but PSO achieved this result with slightly less execution time.

Convergence of Genetic Algorithm for TSP with Elitism:



Convergence of PSO for TSP:



3. Conclusion

In this comparison, both GA and PSO achieved the same optimal distance (321.00). However, PSO outperformed GA in terms of execution time, taking approximately 0.6120 seconds compared to GA's 0.7894 seconds.
This difference can be attributed to the simpler nature of PSO, which avoids genetic operations like crossover and mutation, focusing instead on global and local searches.

Conclusion: PSO performed slightly better than GA for the given TSP instance due to faster convergence and reduced execution time.