Assignment 1 Report Document

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Technical Specifications and Algorithm Configuration

- **ILS:**
  - **Experimental Setup:**
    - Initial Solution Generation: Random shuffle of campuses except Hatfield.
    - Local Search Algorithm: Hill Climbing with perturbation.
    - Perturbation: Random shuffle of the route.
    - Termination Criteria: Maximum number of iterations reached (MAX_ITERATIONS).
- **SA:**
  - **Experimental Setup:**
    - Initial Solution Generation: Random shuffle of campuses except Hatfield.
    - Temperature Decrease: Exponential cooling schedule (T = T0 / log(t+1)).
    - Neighbor Generation: Perturbation through random shuffle.
    - Acceptance Criteria: Accept with probability based on temperature and delta cost.

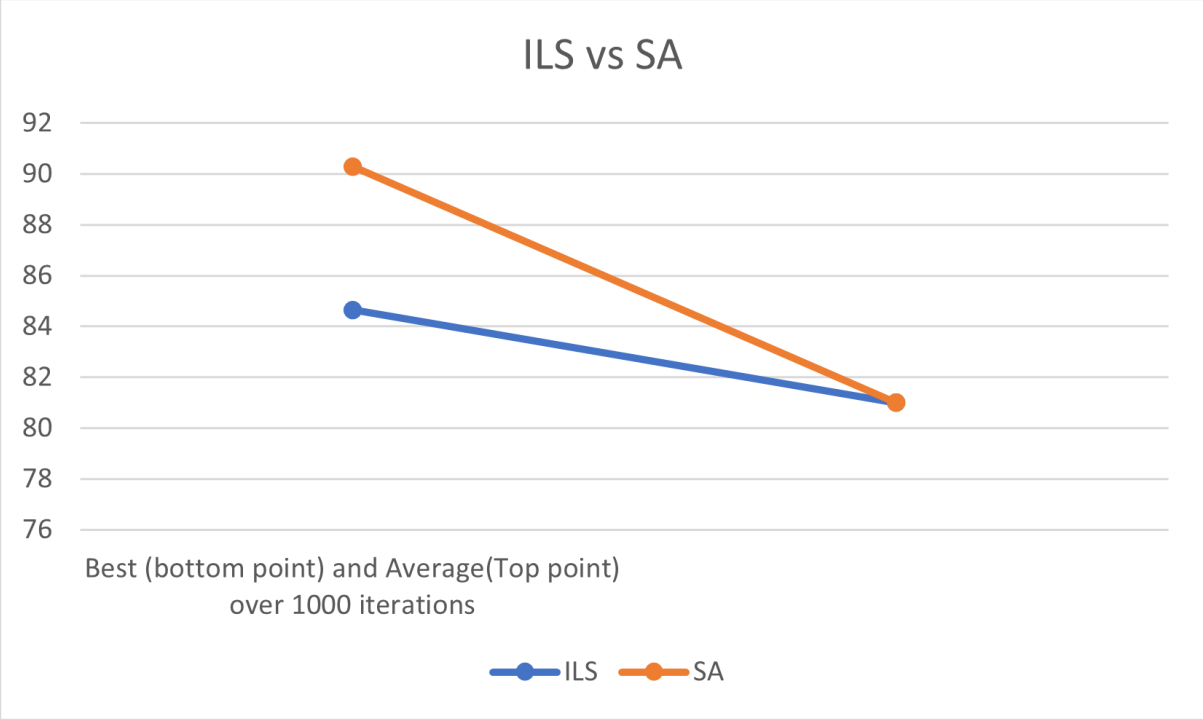
Presentation Table

Keywords: Hatfield (H), Hillcrest (HC), Groenkloof (G), Prinshof (P), Mamelodi (M)

Problem Set	ILS	SA
Best Solution (Route)	H → M → P → G → HC → H	H → HC → G → P → M → H

Problem Set	ILS	SA
Objective Function Value	81	81
Runtime (Seconds)	0.0881433	0.000549542
Average Objective Function	84.646	90.2959

Plot Representation



Discussion and Conclusion

The objective of this assignment was to implement and compare the effectiveness of Iterated Local Search (ILS) and Simulated Annealing (SA) algorithms in finding the shortest possible route for a student visiting all UP campuses to get her clearance form signed by module coordinators while minimizing the total distance traveled.

Keywords: Hatfield (H), Hillcrest (HC), Groenkloof (G), Prinshof (P), Mamelodi (M)

Results Analysis

- **Best Solution (Route):** The ILS and SA algorithms both found the optimal route with a total objective value of 81. While they had the same objective value, they both had different traversal paths. ILS traversed the

campuses in the order H → M → P → G → HC → H. SA traversed the campuses in the order H → HC → G → P → M → H.

- **Objective Function Value:** Both ILS and SA algorithms achieved the optimal objective function value of 81 units, indicating that they found routes with the shortest total distance possible.
- **Runtime:** ILS took approximately 0.088 seconds to execute, while SA executed significantly faster at around 0.0005 seconds.
- **Average Objective Function:** The average objective function values across iterations were 84.646 for ILS and 90.296 for SA, showcasing the consistent performance of ILS in finding near-optimal solutions.

Comparative Analysis

- **ILS Strengths:**
  - ILS demonstrated effectiveness in finding the optimal route with minimal total distance, as evidenced by its lower average objective function values compared to SA.
- **SA Strengths:**
  - SA showed better computational efficiency, with a significantly faster runtime compared to ILS.
  - Despite the faster runtime, SA achieved competitive results with a route of equal total distance.
- **Algorithm Suitability:**
  - For scenarios where precision in route optimization is paramount and computational time is not a primary concern, ILS proves to be effective in finding the optimal or near-optimal solutions.
  - On the other hand, if computational speed is crucial and acceptable trade-offs in route optimization can be made, SA offers a compelling solution.

Conclusion

In conclusion, based on a single run of the algorithms (with both having a limit of 1000 max iterations), Iterated Local Search (ILS) demonstrated strengths in finding the optimal route with minimal total distance, while Simulated Annealing (SA) showcased superior computational efficiency. The choice between these

algorithms depends on the specific priorities and constraints of the problem, balancing between optimization accuracy and computational resources.