



Simulated Annealing

Part 2: Simulated Annealing for TSP



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Solution Representation

- A solution can be represented by a vector indicating the order the cities are visited

- Example:

1	5	3	4	2	6	7	8
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- Numbers in the solution vector are interpreted as cities and not as positions in the solution vector

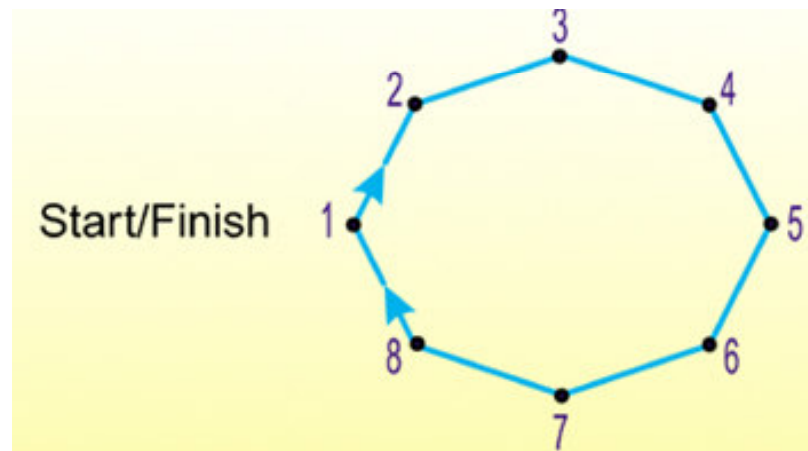
Initial Solutions

- A good feasible, yet not-optimal, solution to the TSP can be found quickly using a greedy approach (**the nearest-neighbor heuristic**).
- Starting with the first node in the tour, find the nearest node.
- Each time find the nearest unvisited node from the current node until all the nodes are visited.

Simulated Annealing: Part 1

Neighborhood Structure

- Neighbor solution can be found based on three operations:
 - Translation (insertion)
 - Switching
 - Inversion

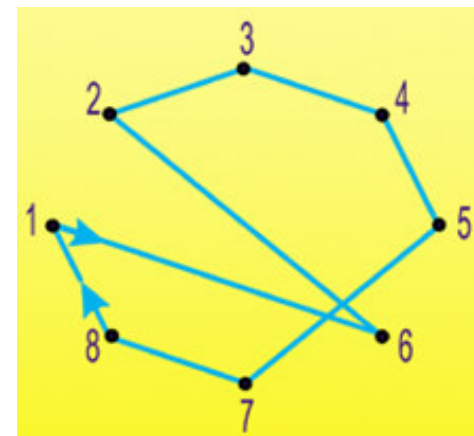
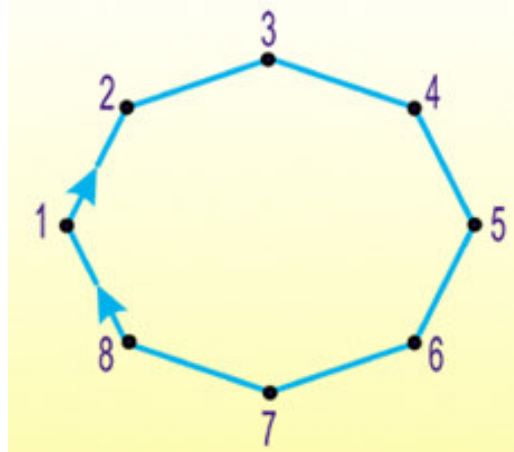


1	2	3	4	5	6	7	8
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Neighborhood Structure

- **Translation (Insertion)**

- Pick **two city** at random
- **Move the second** to follow the first, shifting the rest along to make room

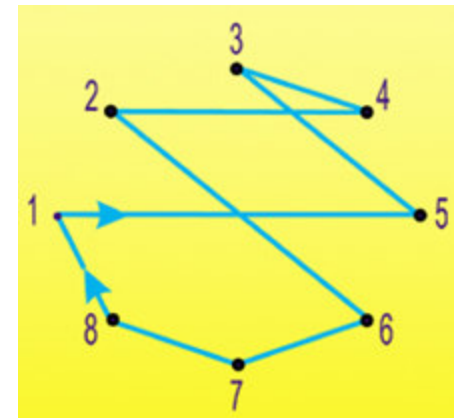
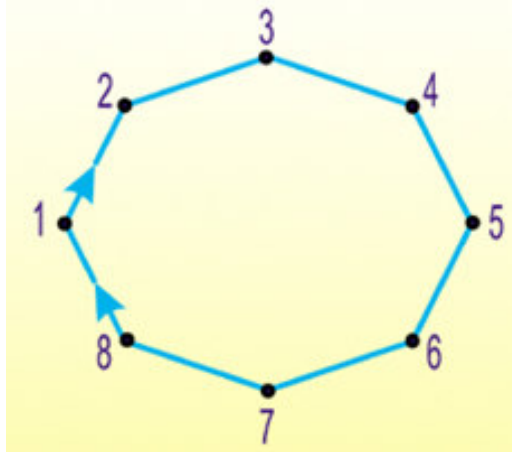


Simulated Annealing: Part 1

Neighborhood Structure

- **Switching**

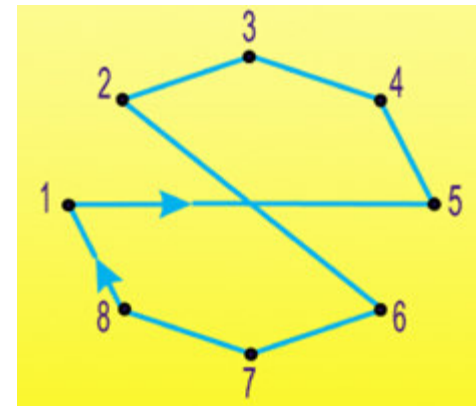
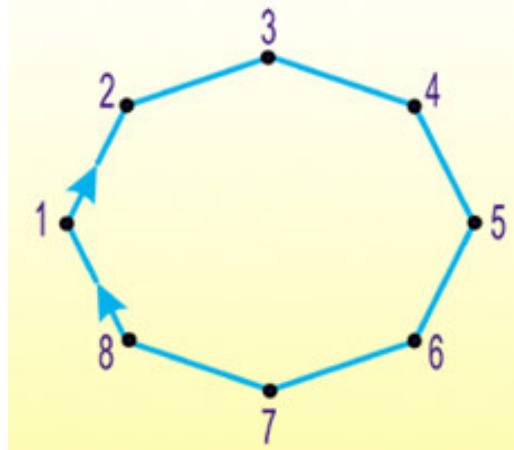
- Pick two cities at random and **swap** their positions
- In this method 4 links broken



Neighborhood Structure

- **Inversion**

- Pick two cities at random and then invert the substring between them.
- Two links broken



Neighborhood Structure

- Randomly chose inversion, insertion, or switching at each iteration
- Tuning required to choose “good” probabilities of selecting these operators

Cooling Schedule

- Geometric schedule

$$T_{i+1} = \alpha \cdot T_i$$

- Tuning required to choose α

Stopping Condition

- There is no improvement in the solution for last pre-specified number of successive temperature.



The End