5. Simulated Annealing
5.3 Simulated Annealing for TSP

Fall 2010

Instructor: Dr. Masoud Yaghini

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

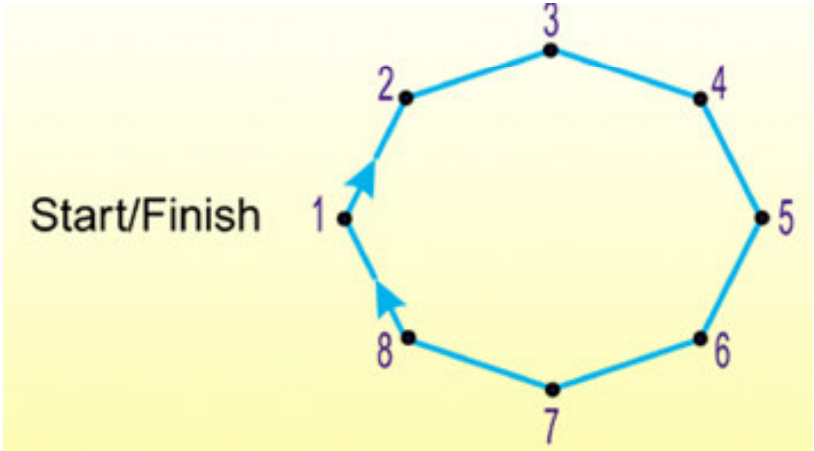
  - Numbers in the solution vector are interpreted as cities and not as positions in the solution vector

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.

Neighborhood Structure

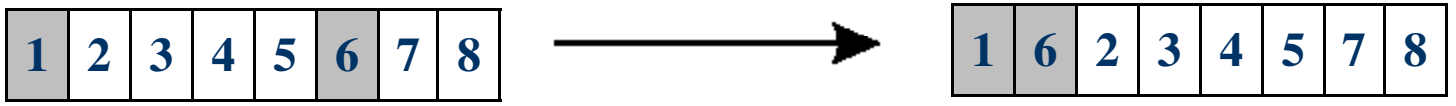
- Neighbor solution can be found based on three operations:
  - Translation (insertion)
  - Switching
  - Inversion

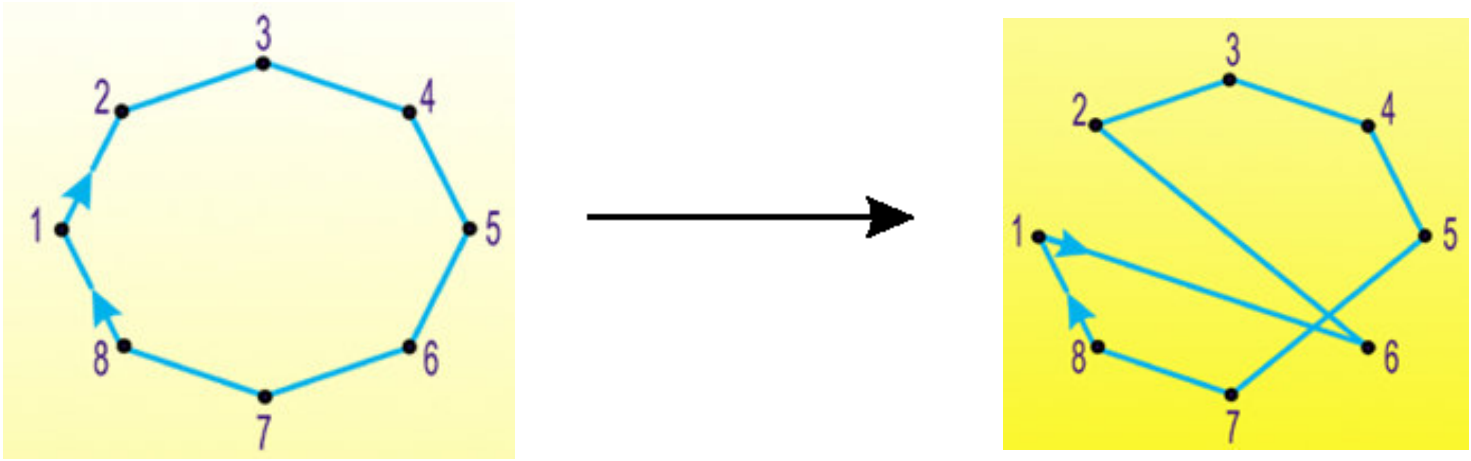


1	2	3	4	5	6	7	8

Neighborhood Structure

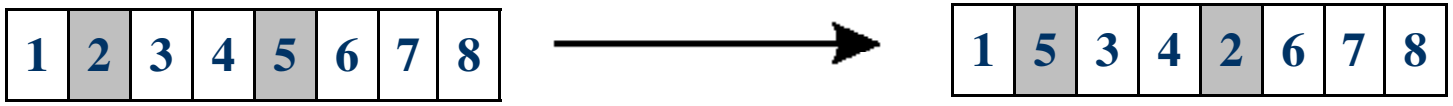
- **Translation (Insertion)**
  - Pick **two city** at random
  - **Move the second** to follow the first, shifting the rest along to make room

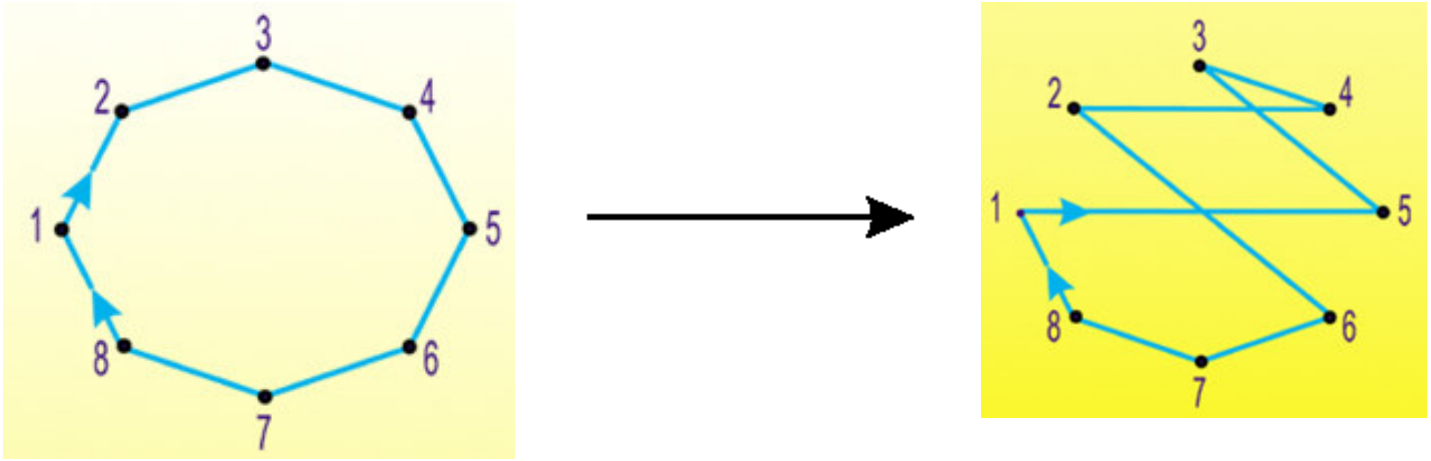




Neighborhood Structure

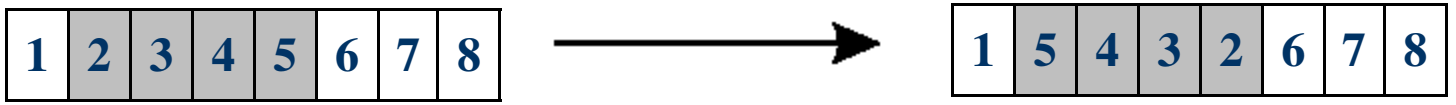
- **Switching**
  - Pick two cities at random and **swap** their positions
  - In this method 4 links broken

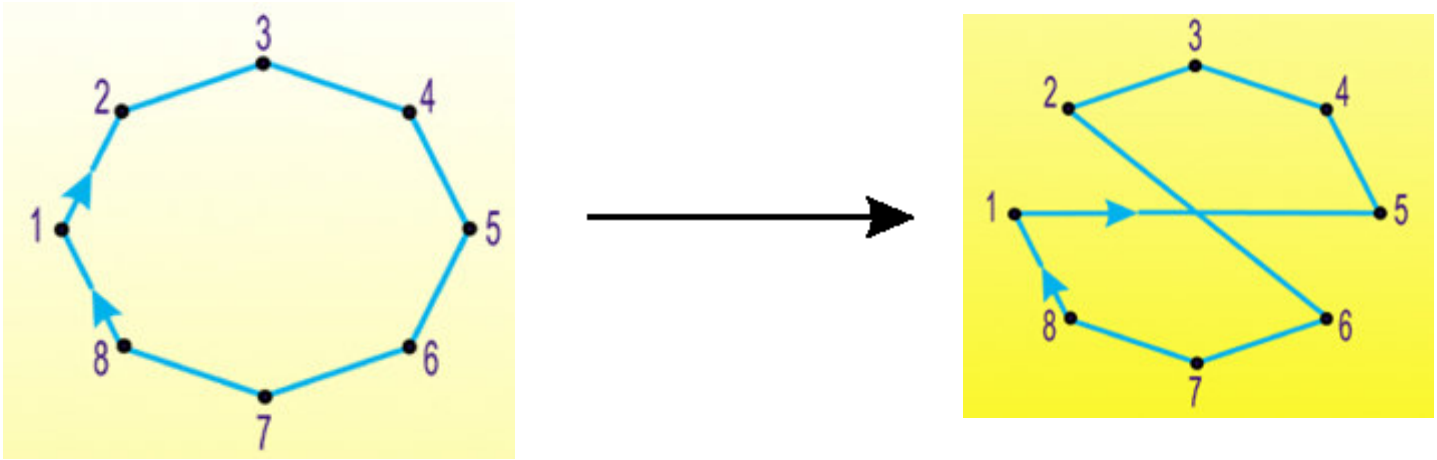




Neighborhood Structure

- **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

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

- Tuning required to choose α

Stopping Condition

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

The End