

# AI CUP 2007

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## Asymmetric Traveling Salesman Problem

Biaggi, Gaia, Godenzi, Rigotti

# ATSP problem

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Given a number of cities and the costs of traveling from any city to any other city, what is the cheapest round-trip route that visits each city exactly once and then returns to the starting city?

From: Wikipedia

# Brute-force approach

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Computer 1000 times faster than common ones.

Cities	Time
50	< 10 sec
56	1 hour
62	1 day
70	1 year
77	100 years
80	1000 years

# Our task

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- Applying algorithms learned in class
- Problems from 47 to 443 cities
- 3 minutes for each problem
- Try to find the optimal solution

# Algorithms used

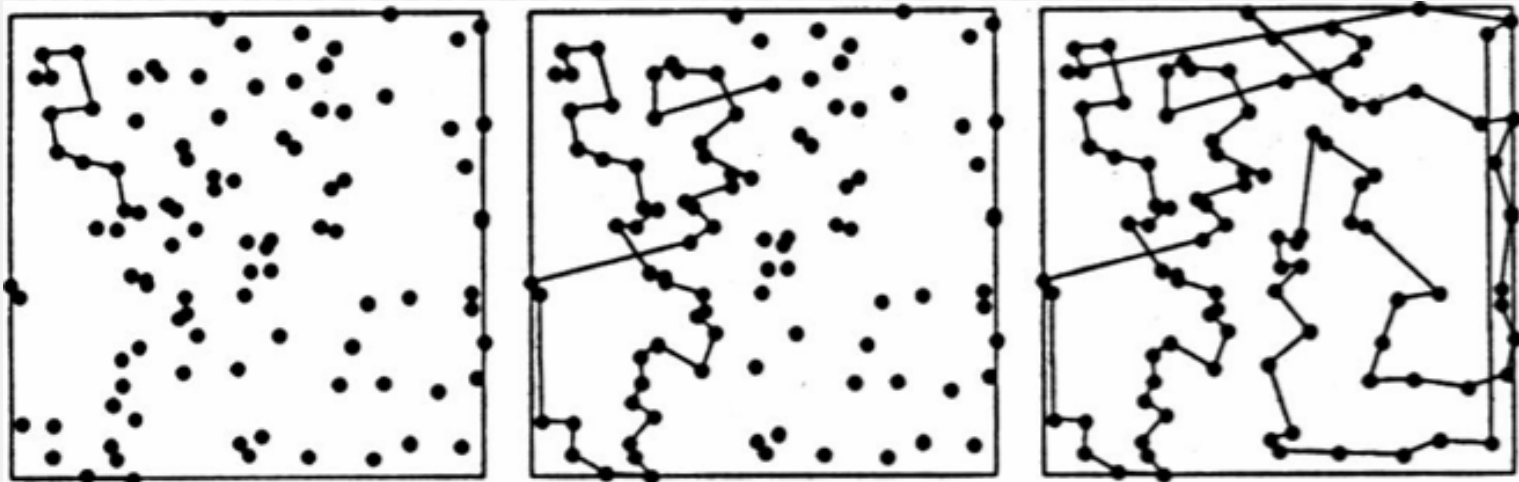
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- Nearest Neighbor
- 3-opt
- Double Bridge (4-opt)
- Simulated Annealing
- Genetic Algorithm
- Ant Colony Optimization

# Nearest Neighbor

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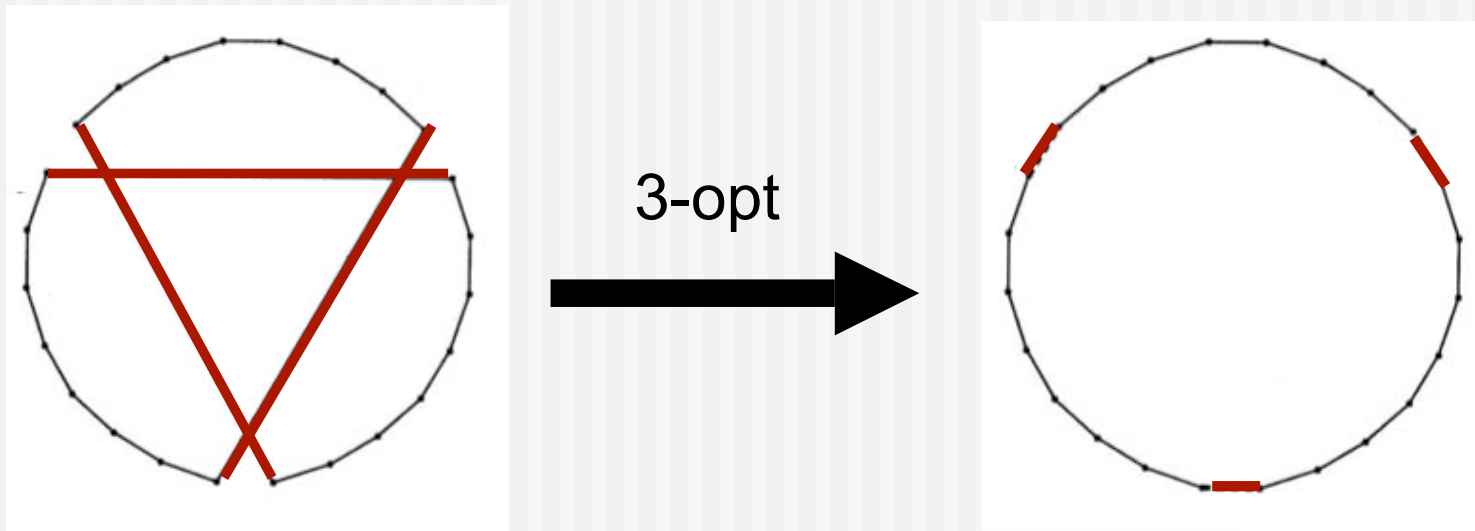
- Starts from a random node in the graph
- Connects the free node which is closest to one of the edge nodes



# 3-opt & 4-opt

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Optimize the solution by the exchange of 3 edges



4-opt works in a similar manner, but with 4 edges

# Simulated Annealing

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- Simulated annealing imitates the cooling of metals
- Temperature parameter that keeps decreasing
- At each step a neighbor solution is computed
- Better solution: we keep it
- Worse solution: we maybe keep it, depending on the temperature

# Genetic Algorithm

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- It's based on Darwin's theory of evolution
- At each iteration parents (solutions) of the next population are chosen from the best individuals of the current generation
- Parents undergo mutation and crossover procedures in order to simulate evolution

# Ant Colony Optimization

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- Virtual ants move from a city to another deciding whether to exploit or explore
- Exploit: chose the road covered with most pheromone
- Explore: chose the road stochastically

# Algorithms utilization

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Name	NN	3-opt	4-opt	SA	GA	ACO
Biaggi	X	X	X	X		
Gaia		X	X	X		
Godenzi		X	X		X	
Rigotti	X	X				X