Ant System & Traveling Salesman Problem

Métaheuristique pour l'optimisation

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Inspiration

- Swarm Intelligence
  - Collective Behavior
  - Emergence in Complex Systems
  - Decentralization
  - Auto-Organization
- Pheromone
  - Chemical to attract
  - Evaporation (temporary effect)

Ant System Algorithm

- Adapt Pheromone Trail to solve TSP
- Visibility: $\eta_{ij} = \frac{1}{d_{ij}}$
- Trail Intensity: $\tau_{ij}(t)$
- m (# of ants)

Algorithm 1

for all $t = 1, ..., t_{max}$ **do**
    for all ant $k = 1, ..., m$ **do**
        choose a city at random
        while there exists a city not visited **do**
            choose a city j according to (1)
        end while
        mark a path according to (3)
    end for
    update all paths according to (2)
    Keep the best of solutions obtained at last iteration
end for

$$p_{ij}^k(t) = \begin{cases} \frac{(\tau_{ij}(t))^\alpha (\eta_{ij})^\beta}{\sum_{l \in J} (\tau_{il}(t))^\alpha (\eta_{il})^\beta} & \text{if } j \in J \\ 0 & \text{otherwise} \end{cases} \tag{1}$$

$$\tau_{ij}(t+1) = (1-\rho)\tau_{ij}(t) + \sum_{k=1}^{m} \Delta\tau_{ij}^k(t) \tag{2}$$

$$\Delta\tau_{ij}^k(t) = \begin{cases} \frac{Q}{L^k(t)} & \text{if ant } k \text{ used edge } (i,j) \text{ in its tour} \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

Choice of Parameters

- α= 1, β= 0.5, ρ=0.1
- $Q = L_{nn}$, $\tau_0 = \frac{1}{L_{nn}}$
- m , t_{max}

Work to Do

- Run AS on two dat files, and report fitness (length of path)
- Visualize path/trajectory
- Analyze influence of m and tmax on quality of solutions
- Compare results with greedy repeated 10 times
- Randomly generate 4 TSP Problems of size n=50, 60, 80, & 100
- For the latter case, report and comment on mean, standard deviation, and execution times
- Compare and discuss performance of AS(Ant System) vs SA(Simulated Annealing) applied on TSP in terms of solution quality and execution time
- Include a short description on the meaning of the various parameters used in AS Algorithm, and discuss their advantages and drawbacks