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Ant Colony Optimization

The forgaging behaviour of ants has inspired the development of optimization algorithms that can solve complex problems such as the Travelling Salesman Problem (TSP). Ant colony Optimization simulates the way ants find the shortest path between food sources and their nest.

Algorithm

Initialise pheromone values $\forall i, j \in [1, n] : \tau_{ij} \mapsto \tau_0$
repeat
  for each ant $k \in [1 \ldots m]$ do
    initialise selection set $S \mapsto \{1 \ldots n\}$
    randomly choose starting city $i_0 \in S$ for ant k
    move to starting city $i \mapsto i_0$
    while $S \neq \emptyset$ do
      remove current city from selection set $S \mapsto S \setminus \{i\}$
      choose next city j in tour with probability $p_{ij} = \frac{\tau_{ij}^{\alpha} \cdot \eta_{ij}^{\beta}}{\sum_{h \in S} \tau_{ih}^{\alpha} \cdot \eta_{ih}^{\beta}}$
      update solution vector $\pi_k(i) \mapsto j$
      move to new city $i \mapsto j$
    end while
    finalize solution vector $\pi_k(i) \mapsto i_0$
  end for
  for each solution $\pi_k, k \in \{1, \ldots m\}$ do
    calculate tourlength $f(\pi_k) \mapsto \sum_{i=1}^{n} d_{\pi(i)\pi(j)}$
  end for

end for
for all (i, j) do
evaporate pheromone $T_{ij} \longmapsto$
$(1-\rho) \cdot T_{ij}$
end for
determine best solution of iteration.
$\pi^{+} = \arg\min f(\pi_l)\ l \in [1, m]$
if π^{+} better than current best π^{*}, ie
$f(\pi^{+}) < f(\pi^{*})$ then set $\pi^{*} \leftarrow \pi^{+}$
end if
for all $(i, j) \in \pi^{+}$ do
reinforce $T_{ij} \longmapsto T_{ij} + \Delta/2$
end for
for all $(i, j) \in \pi^{*}$ do
reinforce $T_{ij} \longmapsto T_{ij} + \Delta/2$
end for
until condition for termination met.

Output

Best path : [0, 4, 9, 5, 1, 3, 2, 6, 8, 7, 0]
Best distance : 258.41696.