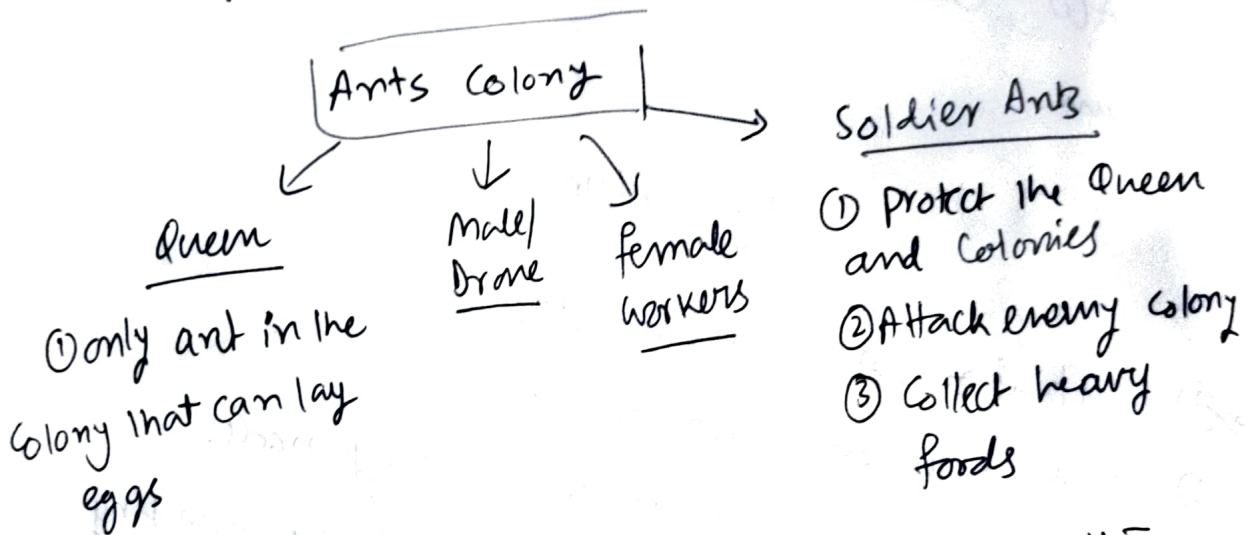
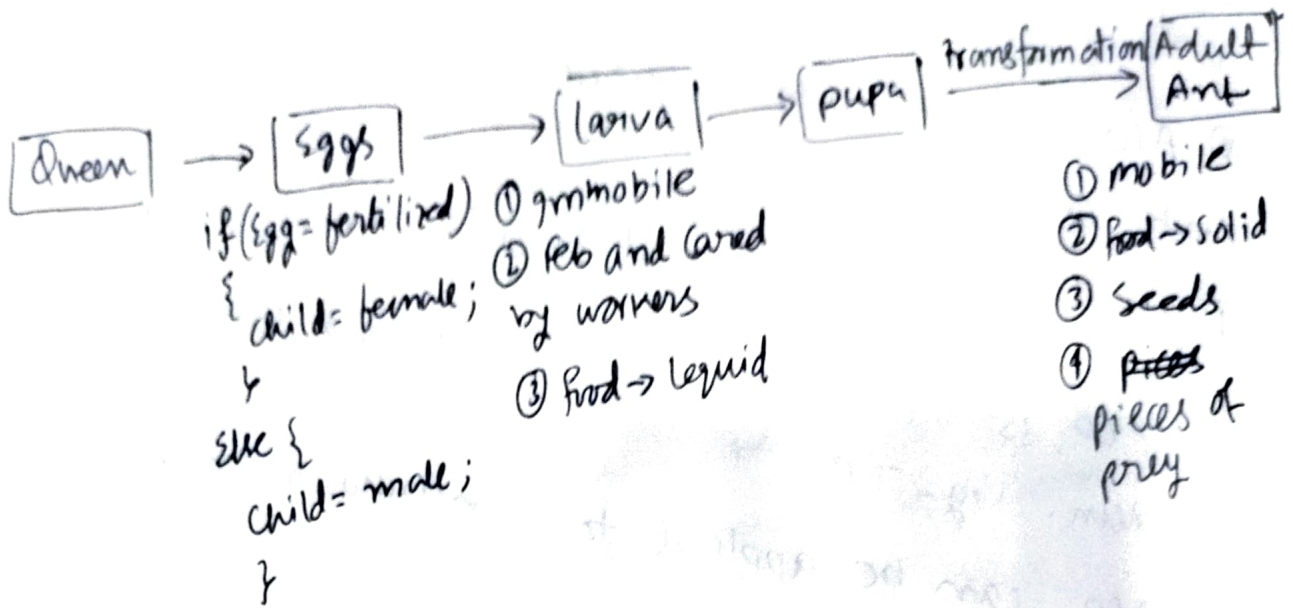


Ant Colony Optimization

on KCP



- Pheromones → ① Ant's easily communicate with each other using pheromones
- ② Chemical signal and used by ants for communication in the environment
- ③ ant's release pheromones in danger (to ~~other~~ alert other ants)
- ④ detect pheromones through their antennas.
- ⑤ ants leaves pheromones on the soil. that can detect / followed by another ants.

④ ACO is inspired by social behaviour of real ants.

④ ACO is basically inspired by pheromones based Ant Communication

④ the technique is used to find optimal paths.

④ ACO is used for routing and load Balancing problem. eg - TSP

④ ACO can be applied to continuous optimization problems.

ACO Algorithm

- ① initialize ACO parameters
- ② Ant Solution Construction
- ③ Position Each ant in the starting node.
- ④ Each ant will select next node by applying
- [~~⑤ Repeat until ant Build~~] state transition rule.
- ⑤ Repeat until ant Build the best solution, then compute the fitness value.
- ⑥ update the best solution.
- ⑦ apply offline pheromone update
- ⑧ Display the best result.

① Initialize ACO parameters :-

Population Size (K) = 20; [% total no. of artificial ant or agents]
 MaxT = 200; [% maximum no. of iterations]
 Tau = 0.9; [% pheromones initial value]
 Alpha = 1; [% pheromones exponential weight]
 Beta = 1; [% Pheromone ~~to~~ heuristic weight]
 rho = 0.005; [% pheromone evaporation rate]

② ACO Solution Construction :-

1st Start with main loop

Current Iteration = 1 to maximum number of iteration

Current Iterations = 1 to MaxT

Current Iterations = 200

③ Position Each ant in the starting node

$K \rightarrow$ no. of ant.

$P_{ij} \rightarrow$ ant move from node i to node j

K th ant move from node i to node j with probability [transition probability]

$$P_{ij}^k = \frac{(\tau_{ij}^\alpha)(\eta_{ij}^\beta)}{\sum_{z \in \text{allowed}_i} (\tau_{ij}^\alpha)(\eta_{ij}^\beta)}$$

\uparrow
probability

[$\eta \rightarrow \tau \cdot \rho$]

① $p_{ij}^k \rightarrow$ ant
probability of moving from
node i to node j .

② $\tau_{ij}^k \rightarrow$ total pheromone deposit by
ant on path ij

③ $\eta_{ij}^k \rightarrow$ value of path ij

④ $n=4$ (population size). $\{k\} \rightarrow$ population
size

⑤ Repeat ~~the~~ until ant build the best solution,
then compute the fitness value.

⑥ Update the best solution.

Compare the Best solution with each ant solution $(\Rightarrow k)$

If (Ant(3) solution < Best solution)

{
 Consider Ant(3) Best solution
}

Ant ($k \rightarrow$ population size).

$k = 1, 2, 3, 4, 5, \dots, 20.$

⑦ Apply offline pheromone update.

⑧ pheromone trails are updated when all
ants completed the Cost/Solution.

① for [Best] solution \Rightarrow increase level of pheromones trails.

② for [Worst] solution \Rightarrow decrease level of pheromones

pheromone updating equation :-

$$\tau_{ij} \leftarrow (1-\rho) \tau_{ij} + \sum_k^m \Delta \tau_{ij}^k$$

τ_{ij} \leftarrow total pheromones deposit by ant on path ij .

$(1-\rho)$ τ_{ij} \leftarrow pheromone evaporation

$\sum_k^m \Delta \tau_{ij}^k$ \rightarrow no. of ants \rightarrow total pheromones deposit by k^{th} ant on path ij

$$\tau_{ij} \leftarrow (1-\rho) \tau_{ij} + \sum_k^m \Delta \tau_{ij}^k$$

$$\Delta \tau_{ij}^k = \begin{cases} \frac{Q}{L_k} & \text{if ant } k \text{ uses curve } ij \text{ in its path} \\ 0 & \text{otherwise} \end{cases}$$

$$\Delta \tau_{ij}^k = \frac{Q}{L_k} \quad \left\{ \begin{array}{l} Q \rightarrow 1 \text{ (constant)} \\ L \rightarrow \text{path length} \end{array} \right.$$

Constant ($Q=1$) used in $\Delta \tau_{ij}^k$.

③ Display the Best Solution

loop will repeat untill maximum no. of iterations (eg $\rightarrow 200$) after that it will display best solution. (optimal solution).