Ant Colony Optimization Meta-Heuristic [1]

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SUMMARY

As demonstrated at the planning lab, optimum and optimal route planning may be achieved through graph search using depth-first, breadth first, or A* algorithms. Here we have a centralized computational agent, with acess to the complete route graphs that may (or not) calculate the optimum/optimal route for a delivery cargo agent[2].

With the advent of distributed computing in late 90's, it became possible the creation of multi-agent systems [4]. Instead of creating a single agent responsible for search the best routes (like the planning project), we create several agents, where the system intelligence emerge from the social interactions among the agents.

This phenomena know as stigmergy is observered in animal species with somekind of group interactions (bees, shoals, bird flocks, humans, etc) and is study by an AI field known as *swarm intelligence*[2].

The multi-agent system are classifed as:

- **Reactive systems:** each agent basically respond to enviroment input, without being capable of undersdand the whole problem, problem history, nor abstract enviroment model.
- **Cognitive systems:** each agent is capable of recognize other agents, learn from previous experiences and delegate resposabilities to others agents through hierarchy.

In 1996 Marco Dorigo published a revolutionary PhD thesis for searching paths in graph inspired by ant colony behaviors [1].

When an ant finds food in the environment, it uses pheromone to mark the path warning other ants about it.

Following the pheromone markes, the ants will start carring the food into the colony and eventually one ant will find an optimal (or optimum) route, thus it will carry food more frequently than the others.

The other ants are capable of identify the higher route frequency through the pheromone and than changes their own route in order to optimize its own.

Emulating the marker systems its not only possible to find optimal routes with a fraction of the computational cost, allowing to solve hard problems as traveling sales problem and routing in communication networks.

Here in Brazil the dominant fast delivery system in great urban centers (such as Sao Paulo and Rio de Janeiro) is the motocourier. Each rider has an app to receive a package delivery order, where a central cargo manager is aware of how much room each bike has available, origin/destiny, etc.

With the emerge of mobile phones (Android and iOS) with greate computational power, it is possible to use each phone as an reactive agent, allowing a rendevouz system.

Instead of a single rider carry the package through long routes, the agents could talk to each other informing a droppoint for cargo exchange. Thus, each rider would make the shortest path with maximum room occupancy.

REFERENCES

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