Tech-Soc SimChamp 2012

Ant Colony Simulation

Introduction:

We would like to study swarm intelligence by simulating the behaviour of an ant colony. Although ants are primitive creatures, they are able to perform complex tasks in groups, such as foraging efficiently for food, protecting their nests, etc.

The main assumption involved while modelling swarms is that each entity is a simple agent, which is able to interact only locally with fellow agents. There is no centralized, global control over each individual ant; every ant follows a simple set of rules, so that the colony as a whole appears to be displaying intelligent behaviour.

Ants are able to communicate through certain chemicals called pheromones, which they are able to release at will. For example, when a foraging ant finds a route from a food source to the nest, it marks it with a pheromone trail to alert other ants of the presence of food. Stronger the pheromone concentration more is its radius of influence.
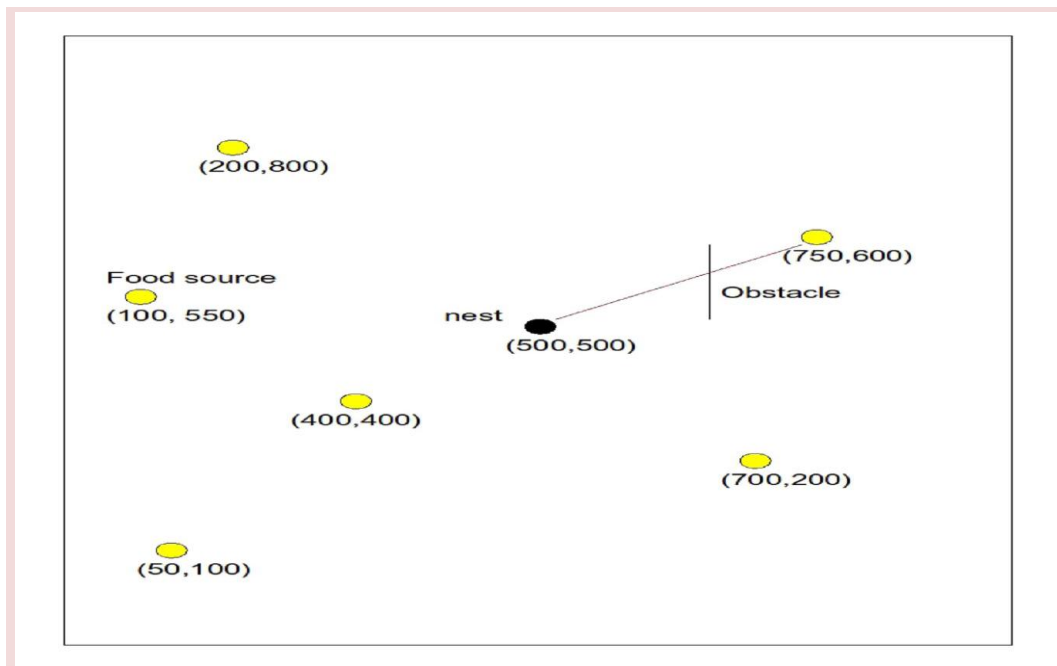

Problem Description:

Objective:

Simulate an ant colony behaviour and show how ants are able to pick out the optimum (shortest) paths from their nests to food sources.

Ant Attributes:

- Ants are born from a nest as per a model of your choice. Each ant lives for a certain period of time units, unless it dies prematurely from long periods without food. An ant replenishes its hunger whenever it reaches the nest or a food source.
- Pheromones are of two kinds- exploration and trail:
  - Exploration pheromones are laid out by ants that are searching for food and need a means to get back to the nest once they locate such food sources. These pheromones are followed only when the ants have food with them and need to return to the nest. An ant will only follow its own exploration pheromone. All exploration trails must have one of their ends at the nest.
  - Trail pheromones are laid out by ants carrying food, and returning to the nest. Once an ant has found food, it returns back to the nest and masks the exploration pheromone with a trail pheromone, which other ants may follow.
- Pheromones are volatile chemicals- they evaporate over time. You may experiment with different rates of evaporation. However, the rate of evaporation is a constant.
- An ant leaving the nest (after birth, or after depositing food, or returning empty handed) may choose to follow an existing trail pheromone or start exploring for new food sources probabilistically.
- Each ant is able to carry only a certain maximum amount of food units at a time.

Demonstrations:

- Vary different parameters such as ant age, max hunger span, birth rate, max quantity of food that can be carried etc. and show the effects on the simulation.
- Ants are known to follow the shortest path trails from the food to the nest, without following any pre-calculated routes. Is your model able to find a near-optimal path?
- A high pheromone evaporation rate would force ants to clear up food sources quickly lest the trail disappear. On the other hand, a low rate of evaporation would cause ants to follow trails to sources which have currently been depleted. Is there any optimum rate of pheromone evaporation? If so, how does it depend on factors such as quantity of food in the concerned food sources?

- [Bonus] Sometimes, established ant trails are disturbed by fallen obstacles. Randomly introduce an obstacle in one of the ant trails such as that shown in the figure. Show how the ants adapt and modify their trail to wind around the obstacle.

Files you need to submit

- Simulation code
- Design Document
- Any software used in simulation purpose

Administrivia

- Any plagiarism will be immediately disqualified. You may refer to the web for ideas but the code must be written completely on your own. Plagiarism within teams from the same hostel or between teams is also not permitted.
- In case of any doubt on using code from the web, please consult the coordinator first. His decision is final and binding in all matters.
- Teams can atmost have three members. They can be drawn from different hostels and in that case points will be split equally among different team members.
- **Registration:** Team names have to be registered with the coordinator by mailing them (rkr1991@gmail.com) by **January 10th** at the latest. It's ok if you give in team name and do not participate, but the reverse is not allowed since it will lead to the formation of dynamic teams on the fly.
- If you have any doubts call **Rajagopal@9884913659**
- **Submissions Deadline: January 26th 2012**. Place all the files you need to submit in a folder and zip it under the name teamname_hostel.zip. Mail the zip file to rkr1991@gmail.com. The mail should contain personal information like the participants' name, their respective Roll numbers and hostel name.