Report
AI Assignment 3
2015045

Assumptions:

- Ant is smart enough to not visit a node that it has already visited in the same tour.
- Ant knows how many nodes it has visited, how many nodes to visit, so that, it comes out of the tour, when all nodes are visited.
- Every city is connected to every other city; if you want to disconnect 2 cities, give a huge weight (distance) to the edge connecting both the cities.

Approach:

- Tour of an ant: it randomly selects a city to start with. It then selects the neighbour with the highest probability (depends on pheromone_in_the_path and visibility_of_the_path (1 / length_of_path)). If there are multiple nodes with same probability, it selects a node with minimum distance. While selecting a node, an ant makes sure that it doesn't select a node that has already been visited. If it visits all the nodes (visited_nodes = total_nodes), it immediately exits from its tour.
- All the ants make the above tour. Upon exiting from a tour, each ant updates the pheromone of all the edges that it has travelled through, using the formula - new_pheromone = (old_pheromone(1-pherm_evap_rate)) + (q/tour_distance).
- This is repeated 'k' times i.e 'k' iterations

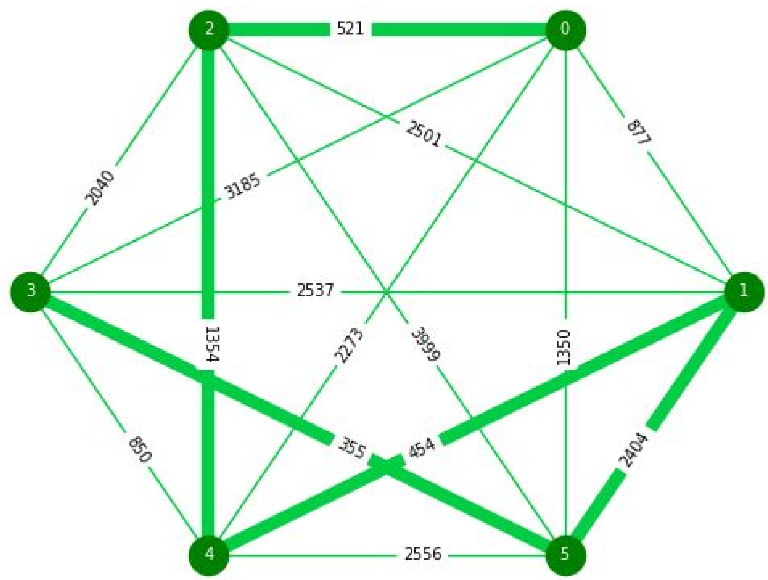
Observations:

All the examples given below, in the parenthesis, like 10, 100, 1, 0.9, 0.1 etc are tested for 5-7 cities; the definitions of low, average, high might change with no. of cities, but, the low, medium, high principles, still hold.

- Very high pheromone_evaporation_rate (0.9) gives bad results i.e doesn't make ants to follow any specific path (all the learning is evaporated); conversely, low (0.1) pheromone_evaporation_rate is ideal to make ants to learn about shorter paths more quickly.
- High no. of ants (100) or high no. of iterations is required for good results; however, low # of ants (1) and low # of iterations (1) give bad results (almost no learning). Average no. of ants (10) and average no. of iterations (10) give good results too.
- Very low values of 'q (new_pheromone = [old_pheromone[1-pherm_evap_rate]] + [q/tour_distance])' yields bad results; a 'q' which is at least as big as 'max value of distance between any city' would give good results.
- Less no. of cities (<= 5): would get acceptable results with less ants (1) and less iterations (1); high no. of cities (7) need more ants or more no. of iterations to get acceptable results.

Analysis:

- Most of the analysis done, is listed above, in the form of observations.
- Some of it would be demonstrated during demo, in the form of network diagrams, where, the width of the edges represents the pheromone level, something like below (ants starting at node 0) -



Conclusion:

To get good results, make pheromone_evaporation_rate low (0.1), 'have as many ants as possible (>= 10) or high no. of iterations (1 of these 2)', high 'q'.

References:

- Ant Colony Optimization: [link]