AI Assignment 4

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Assumptions:

- Termination condition is assumed to be “similarity of path taken by all the ants”
- The count of ants is taken as twice the count of cities, by default
- Other than these, ACO is implement as per the algorithm
- Alpha is the influence on pheromone level
- Beta is the influence of favorability of distance

Methodology:

- We initialize the cities at random coordinates and generate a distance matrix, which basically tells us the distance of a city with each other cities
- Now, we just have nodes on the graph which are waiting to be connected
- Here, connection refers to an ant choosing that edge during its travel
- Now we place the ants in initial city ‘zero’
    - We tell the ant to take all the paths that are not visited and return back
    - During the travel we store the total distance travelled and the path taken by the ant
    - We do this loop for all ants
    - During this process the ant will be depositing some amount of phenome in the path which will help the other ants to choose a path when multiple paths are available
    - And choosing of a city is done according to a probability which has a calculated amount of pheromone and the distance
- We have a pheromone evaporation level which tells us how much f the pheromone is evaporated during each iteration
- At a certain point all the ants will be taking the same path, this is considered as convergence
- The ants tend to find the shortest path with the probability selection of path on the pheromone

Algorithm:

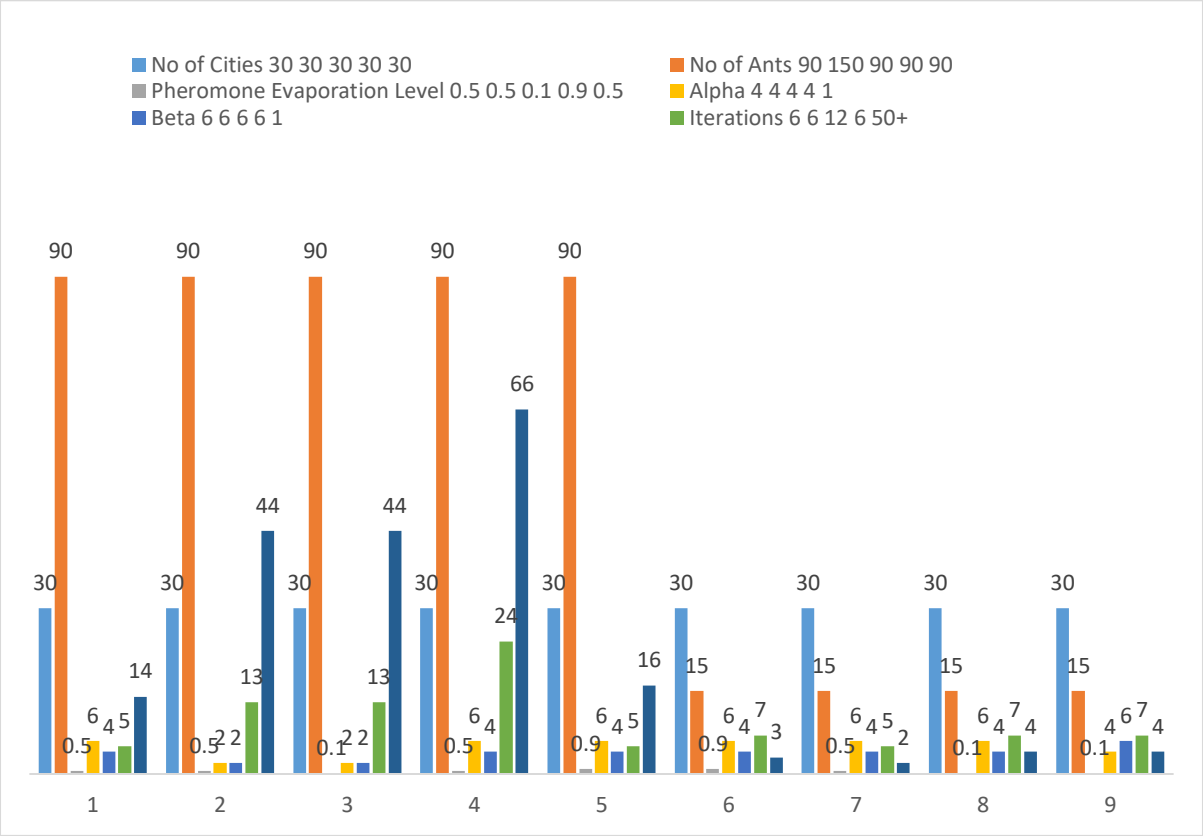
- Generate cities and ants
- Place ants in the initial city
- Repeat until convergence: (all ants take same path)
    - For every ant:
        - Repeat until a unvisited city exits:
            - Choose next city with the conditional pheromone probability
            - Store the path
        - Go back to the initial city
    - Update pheromone level

Observations:

- Though the ants are legally blind, they tend to choose the shortest path after certain iterations with the help of pheromone
- The combined ensemble approach of ants helps in finding the shortest distance
- The parameters alpha, beta, no of ants and the number of cities play a huge role
- Alpha >1 and beta > 0. These conditions are so that the formulation of probability doesn't get invalid.
- With basic alpha 1 and beta 1, the number of iterations are high
- With alpha 2, and beta 2, the number of iterations gets reduced
- With alpha > beta the ants seem to choose paths that are even longer
- With beta > alpha the ants seem to choose the shorter path helping to converge sooner.
- With increase in number of cities, more computation power is needed, taking more time to converge
- Increasing the number of ants will increase the computational capacity but can give a better result

Results:

No of Cities	No of Ants	Pheromone Evaporation Level	Alpha	Beta	Iterations	Time (sec)
30	90	0.5	4	6	5	14
30	90	0.5	4	6	6	18
30	150	0.5	4	6	6	29
30	90	0.1	4	6	12	36
30	90	0.9	4	6	6	23
30	90	0.5	1	1	50+	180+
30	90	0.5	6	4	5	14
30	90	0.5	2	2	13	44
30	90	0.1	2	2	13	44
30	90	0.5	6	4	24	66
30	90	0.9	6	4	5	16
30	15	0.9	6	4	7	3
30	15	0.5	6	4	5	2
30	15	0.1	6	4	7	4
30	15	0.1	4	6	7	4

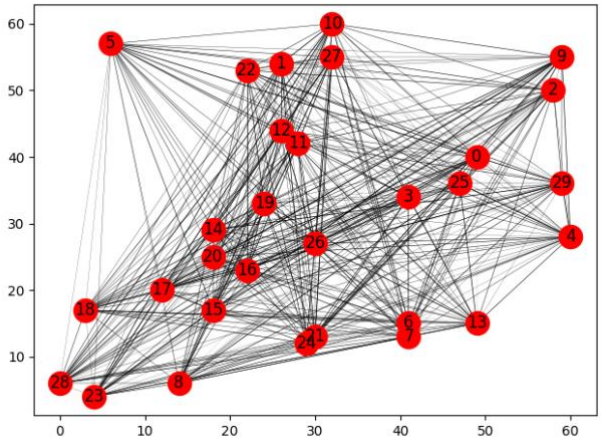


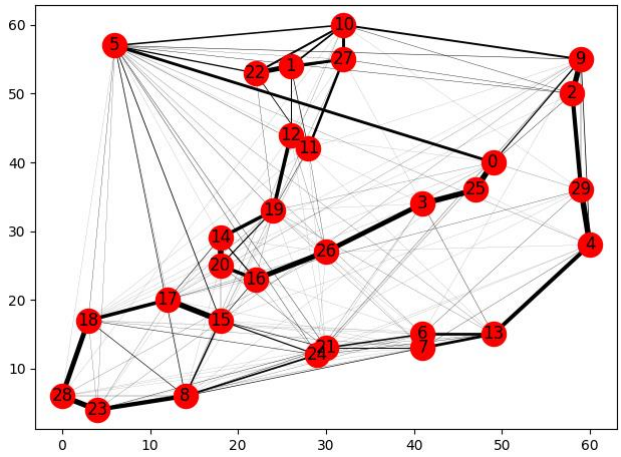
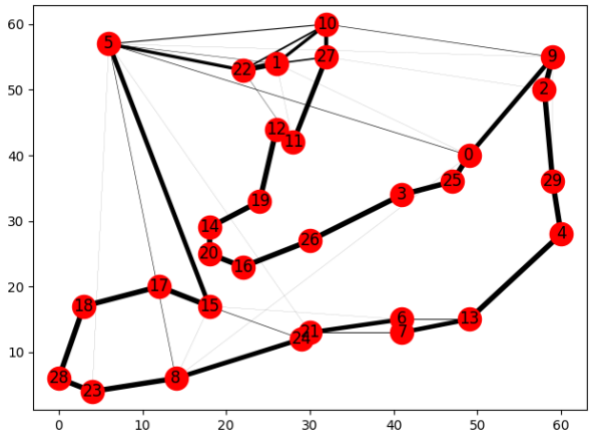
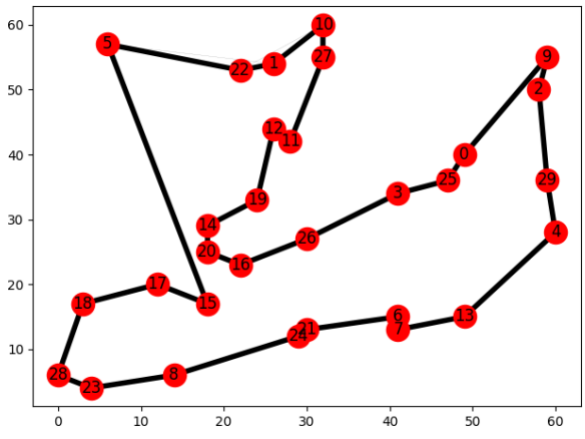
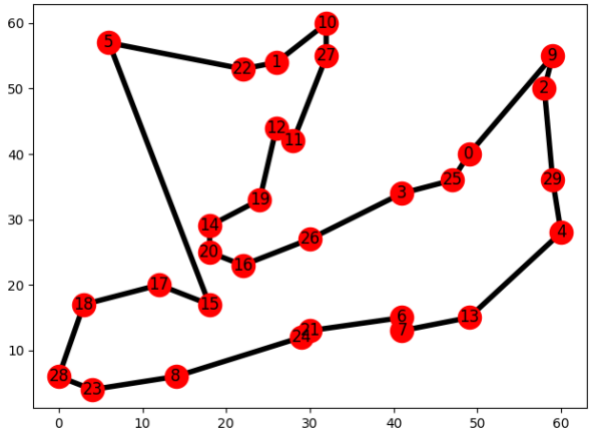
Result 1:

Cities: 30

Ants: 60

Iterations: 5



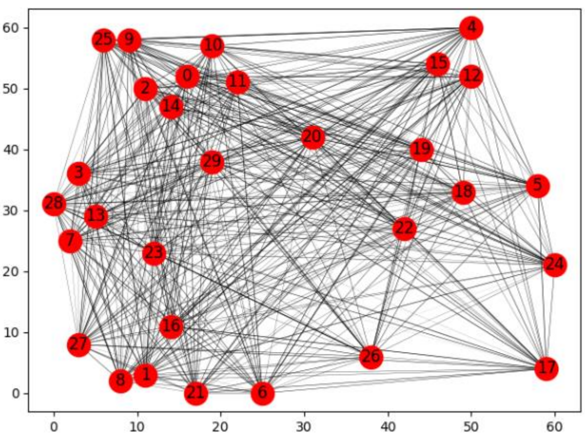





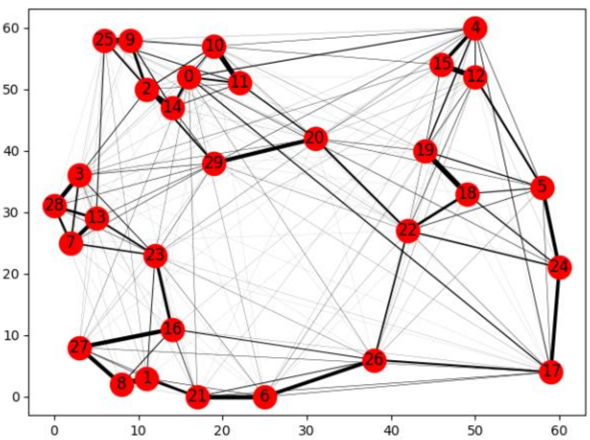
Result 2:

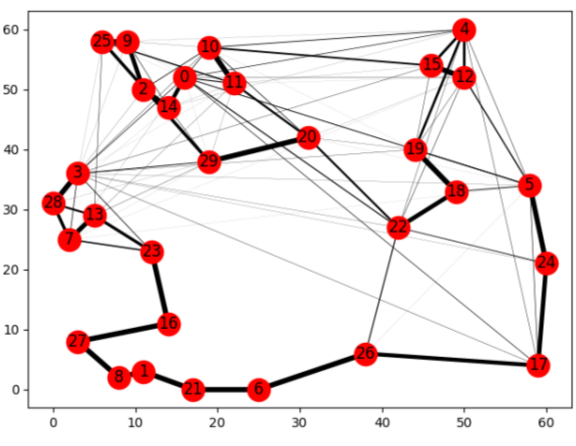
Cities: 30

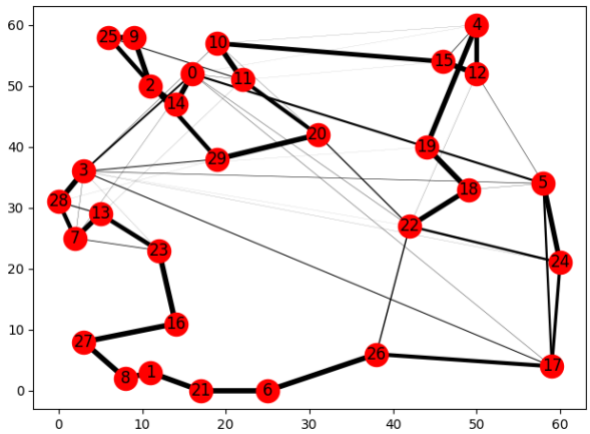
Ants: 60

Iterations: 6





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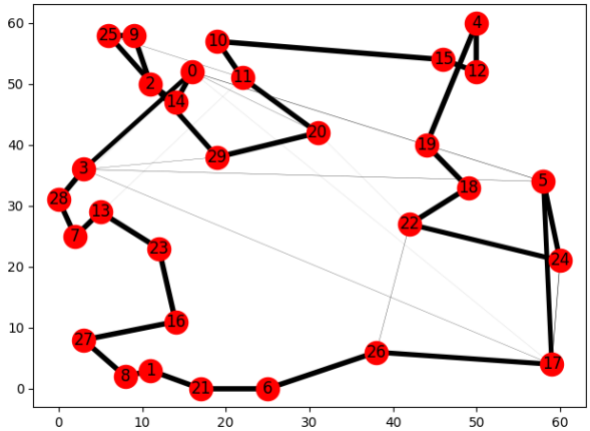
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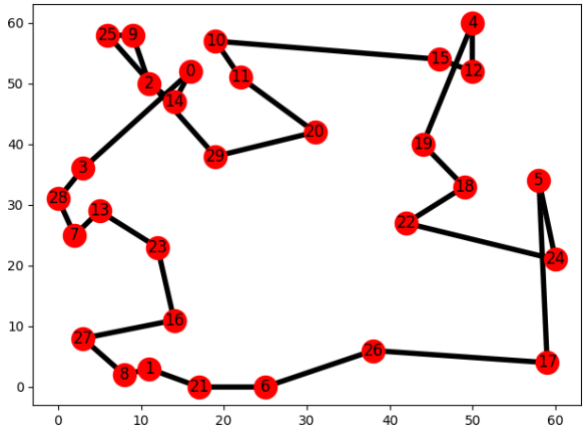
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