Home work 4 chap 15 Ant colony

**15.1**

This task is basically to code some of the functions that we can later use when doing the ant colony algorithm, I will here show the plots that are asked for :

Chart

Description automatically generatedChart

Description automatically generated

A picture containing text, crossword puzzle

Description automatically generatedChart, bar chart

Description automatically generated

**15.7**

**a)** is just implementation

**b)**

Not simplified paths for the ants that reached destination:

Chart, radar chart

Description automatically generatedChart, radar chart

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Chart, radar chart

Description automatically generatedChart, radar chart

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Chart, radar chart

Description automatically generatedChart, radar chart

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Chart, radar chart

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**Chart, radar chart

Description automatically generatedChart, radar chart

Description automatically generated**

simplified paths for the ants that reached destination:

Chart, radar chart

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Chart, radar chart

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**Chart, radar chart

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**Chart, radar chart

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**Chart, radar chart

Description automatically generatedChart, radar chart

Description automatically generated**

Shortest path:

**Chart, radar chart

Description automatically generated**

**d-g)**

**Chart

Description automatically generatedChart, radar chart

Description automatically generated**

**Chart, radar chart

Description automatically generatedChart, radar chart

Description automatically generated**

**Chart, radar chart

Description automatically generatedChart, histogram

Description automatically generated**

**15.8**

**a)**

**Chart, histogram

Description automatically generated**

**Chart

Description automatically generated**

**Chart

Description automatically generated**

The three above plots are for the distance=40 between the starting point and end point.

When you increase N there is a possibility to increase the distance between the starting point and end point. I did so for N=120, I set the distance between the starting and end point to 100 and got this:

Chart, histogram

Description automatically generated

It gets a little more chaotic but not much.

If we increase N and also the distance between starting point and ending point, the subsequent rounds after finding the shortest path is not hundred percent maintained.

**b)**

**This is for N=120 and the distance between starting and end point is 100:**

A picture containing diagram

Description automatically generatedChart

Description automatically generated

Chart

Description automatically generated

Chart

Description automatically generated

**This is for N=120 and the distance between starting and end point is 40:**

**A picture containing background pattern

Description automatically generatedChart

Description automatically generated**

**Chart

Description automatically generatedChart

Description automatically generatedChart

Description automatically generated**

**This is for N=60 and the distance between starting and end point is 40:**

**Chart, shape

Description automatically generatedChart, radar chart

Description automatically generated**

**Chart, radar chart

Description automatically generated**

**Chart, radar chart

Description automatically generated**

**This is for N=180 and the distance between starting and end point is 40:**

**A picture containing background pattern

Description automatically generated**

**Diagram

Description automatically generated**

**Chart

Description automatically generated**

**Chart

Description automatically generated**

**Chart

Description automatically generated**

**Question:** Do the ants explore the full graph, or is the search, in practice, restricted only to a

subset of the graph, especially after a few rounds? If the ants do not run over all the

possible paths, how can we be sure that we have effectively found the minimum?

**Answer:** From my plots I can see that the pheromones are kind of similar on all edges, like there is no cluster where there is particular more pheromones. That might have to do

With that there is much more nodes that each ant can choose between than before.

Since there is more spread in the pheromones after all rounds than before (for instance N=40) there could be that there is a shorter path that never get found since the choice

of node at each step is based on the pheromone matrix. if the Pheromone matrix after some rounds converge to the shortest path found, we probably have found the global optimum

Though I found that the above is based on a starting point and end point with a distance between them of around 100. When I run for the distance 40 between starting and end point

which is similar for the last run with N=40 where the distance where around 30. Well with N= 120 and a distance between starting and end point of 40 I get that it's found the

shortest path really fast. That might have to do with that the relative distance is shorter, I mean that there is less edges to choose from when the N is bigger with the same

distance configuration between the starting and the end point. With this configuration I believe that we can be sure that the shortest path has been found.

Comparing when I run for N=60 with the rest the same, I get comparing to N=120 and higher that it takes a little longer for it to find the shortest path.

**c)**

**for a lower alpha, alpha=0.5**

**Chart, histogram

Description automatically generated**

**Chart

Description automatically generated**

**Chart

Description automatically generated**

**Chart

Description automatically generated**

**For alpha=0.1**

**Chart, histogram

Description automatically generated**

**A picture containing text, outdoor object, pylon

Description automatically generated**

**Chart

Description automatically generated**

**Chart

Description automatically generated**

**Chart

Description automatically generated**

**Increasing alpha, alpha=0.9**

Chart, histogram

Description automatically generated

**Decreasing beta, beta=0.5**

**Graphical user interface

Description automatically generated with medium confidence**

**Decreasing beta and alpha to 0.5**

**Chart, histogram

Description automatically generated**

**Decreasing rho, rho=0.1**

**Chart, histogram

Description automatically generated**

**A picture containing text, outdoor object, pylon

Description automatically generated**

**Chart

Description automatically generated**

**Chart

Description automatically generated**

**Chart

Description automatically generated**

**Increasing rho, rho=0.9**

**Chart, histogram

Description automatically generated**

**Question** :

Do different choices give different shortest paths? Is some choice faster in finding the minimum?

**Answer:** One of the most interesting things or what make a significant difference was to decrease the rho. Since rho is a factor that decrease the pheromone level at every new

round, it makes the pheromones decrease less fast and the shortest path found is found after more rounds than before. In the pheromone matrix plot, we can see more of a path

of the pheromone level after a lot of rounds (150 rounds) which mirror the shortest path.

With a lower alpha we get a much noisier behavior of the shortest path length for every round. It shifts kind of chaotic.

There is not so much difference when tuning the beta as comparing with changing rho.

Change alpha makes also a kind of big different.

**d)**

**For the normal nr of ants which is 20 our results looks mostly like this:**

Chart, histogram

Description automatically generated

Chart, histogram

Description automatically generated

**For the less nr of ants, ants=10 our results looks mostly like this:**

**Chart, bar chart, histogram

Description automatically generated**

**Chart, bar chart, histogram

Description automatically generated**

**For the more nr of ants, ants = 0 our results looks mostly like this:**

**Chart, histogram

Description automatically generated**

**Chart, histogram

Description automatically generated**

**Ants=50:**

**Chart, histogram

Description automatically generated**

**Ants=70**

**Chart, histogram

Description automatically generated**

**Question:** Try the simulation using a different number of ants A walking through the graph.

Does this make a difference to the algorithm? Do more ants result in a more or

less accurate algorithm? What about computational efficiency?

**Answer:** I would say that less ants gives more chaotic behavior when looking at plot of the length of the shortest path for every round. It also do not probably find the shortest

path since for the same configuration and a lot of different runs I get that the shortest path distance is higher for less ants(10 ants instead of 20 or 30)!

I also found that increasing the ants leads a little more to less fast find the shortest path. So I would say is less effective since it takes little longer for it to find

the shortest path. Maybe more ants would lead to a more accurate algorithm since there is more exploration, I mean there is more ants that explore trying to find the shortest path.