UNIVERSIDAD DISTRITAL
FRANCISCO JOSÉ DE CALDAS

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Facultad de Ingeniería

System Analysis

Student:

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Group:

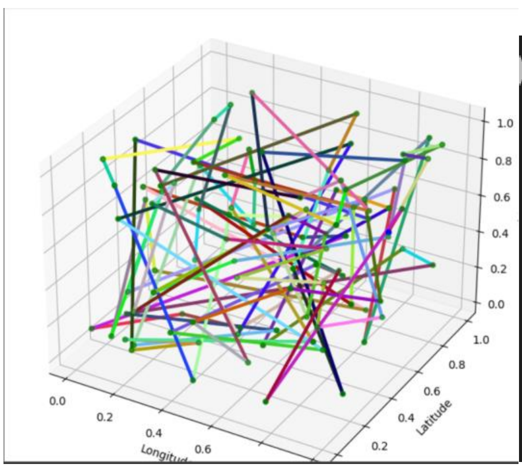
020-84

Workshop_2

The traveler problem, also known as the traveling salesman problem (TSP), is a classic challenge in the field of combinatorial optimization. It consists of finding the shortest route that visits all cities exactly once and returns to the starting point. Despite its apparent simplicity, the TSP is NP-hard, which implies that finding the optimal solution for a large number of cities is computationally expensive.

Our approach starts by generating random cities on a three-dimensional plane. Each city has unique coordinates and the distance between them is calculated to build a distance matrix. The ants, simulated as virtual agents, move randomly between cities using a probability that depends on several factors: Pheromones, distance, control parameters.

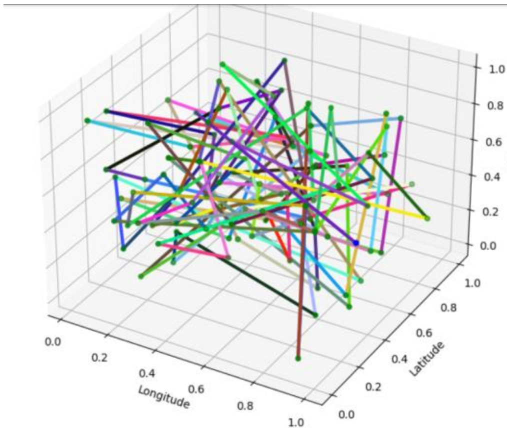
Basic graphics




```
# model parameters
number_cities = 100
number_ants = 100
number_iterations = 100
alpha = 1
beta = 1
evaporation_rate = 0.5
Q = 1
```

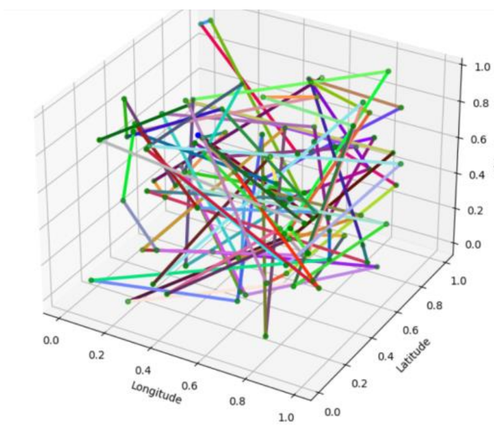
Conclusions:

1. What happens if we reduce the number of ants?
   You can see a greater condensation of paths, this is because having half the number of ants will make it more difficult to follow the trail of pheromones, causing this condensation.



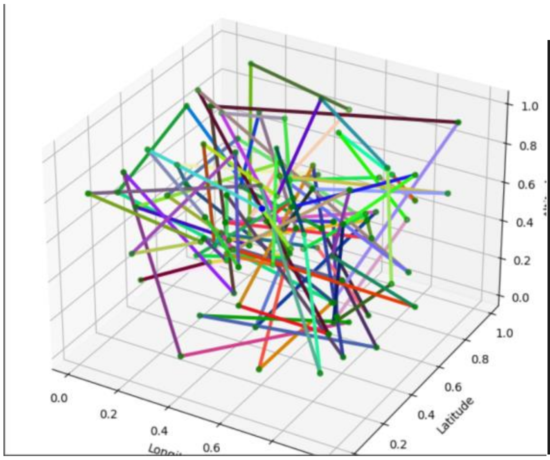

```
# model parameters
number_cities = 100
number_ants = 50
number_iterations = 100
alpha = 1
beta = 1
evaporation_rate = 0.5
Q = 1
```

2. What happens if the influence of the pheromone trail decreases?
   You can see how there are longer paths, with which you can conclude that since there is not so much influence from the trail of the other ants, they prefer to follow their own path, regardless of whether the distance is further away.



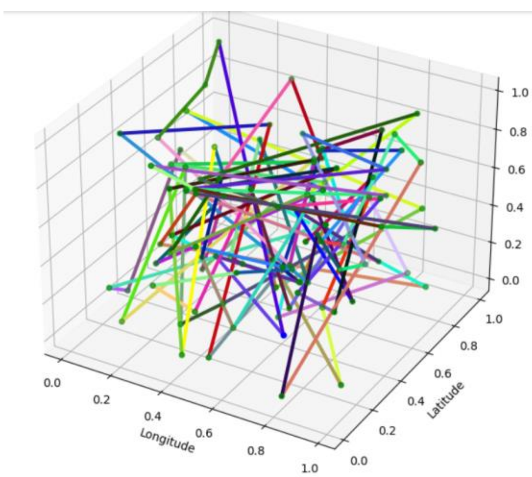

```
# model parameters
number_cities = 100
number_ants = 100
number_iterations = 100
alpha = 0.1
beta = 1
evaporation_rate = 0.5
Q = 1
```

3. What happens if the evaporation rate increases?
   It can be denoted that when they are close to the beginning they begin to follow the paths of the others, making the femorone persist, but as some ants begin to take more distant paths, we can see how the other ants begin to find it difficult to follow the trail of the other ants that have already moved too far away, this due to the evaporation of the pheromone trail.




```
# model parameters
number_cities = 100
number_ants = 100
number_iterations = 100
alpha = 1
beta = 1
evaporation_rate = 1
Q = 1
```

4. What happens if the influence of distance is decreased?
   You can see how the paths become a lot more random, most of them become shorter compared to the others, as they go from one city to another they end up changing towards another totally different city.




```
# model parameters
number_cities = 100
number_ants = 100
number_iterations = 100
alpha = 1
beta = 0.1
evaporation_rate = 1
Q = 1
```