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Analysis of ACO Algorithm

Results

Run 1

Trial 1:	Blue Mountains -> Grey Havens -> Sarn Ford -> Isengard -> Rivendell -> Moria -> Gladden Fields -> Esgaroth -> Iron Hills
Trial 2:	Blue Mountains -> Michel Delving -> Lake Evendim -> Fornost -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Esgaroth -> Iron Hills
Trial 3:	No Optimal Solution Found
Trial 4:	Blue Mountains -> Michel Delving -> Lake Evendim -> Fornost -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Erebor -> Iron Hills
Trial 5:	Blue Mountains -> Grey Havens -> Sarn Ford -> Isengard -> Dol Guldur -> Carrock -> Erebor -> Iron Hills

Run 2

Trial 1:	Blue Mountains -> Grey Havens -> Sarn Ford -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Esgaroth -> Iron Hills
Trial 2:	Blue Mountains -> Michel Delving -> Lake Evendim -> Fornost -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Erebor -> Iron Hills
Trial 3:	Blue Mountains -> Michel Delving -> Lake Evendim -> Fornost -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Esgaroth -> Iron Hills
Trial 4:	Blue Mountains -> Michel Delving -> Lake Evendim -> Fornost -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Esgaroth -> Iron Hills
Trial 5:	Blue Mountains -> Grey Havens -> Sarn Ford -> Isengard -> Dol Guldur -> Carrock -> Erebor -> Iron Hills

Run 3

Trial 1:	No Optimal Solution Found
Trial 2:	Blue Mountains -> Michel Delving -> Lake Evendim -> Fornost -> Rivendell -> Isengard -> Lothlorien -> Caradhras -> Gladden Fields -> Esgaroth -> Iron Hills
Trial 3:	Blue Mountains -> Lake Evendim -> Fornost -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Esgaroth -> Iron Hills
Trial 4:	Blue Mountains -> Michel Delving -> Lake Evendim -> Fornost -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Esgaroth -> Iron Hills
Trial 5:	Blue Mountains -> Grey Havens -> Sarn Ford -> Isengard -> Dol Guldur -> Carrock -> Erebor -> Iron Hills

Run 4

Trial 1:	No Optimal Solution Found
Trial 2:	Blue Mountains -> Lake Evendim -> Fornost -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Esgaroth -> Iron Hills
Trial 3:	Blue Mountains -> Grey Havens -> Sarn Ford -> Isengard -> Dol Guldur -> Carrock -> Esgaroth -> Iron Hills
Trial 4:	Blue Mountains -> Michel Delving -> Lake Evendim -> Fornost -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Erebor -> Iron Hills
Trial 5:	Blue Mountains -> Michel Delving -> Lake Evendim -> Fornost -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Esgaroth -> Iron Hills

Run 5

Trial 1:	Blue Mountains -> Grey Havens -> Sarn Ford -> Isengard -> Dol Guldur -> Carrock -> Esgaroth -> Iron Hills
Trial 2:	Blue Mountains -> Michel Delving -> Lake Evendim -> Fornost -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Erebor -> Iron Hills
Trial 3:	No Optimal Solution Find
Trial 4:	Blue Mountains -> Lake Evendim -> Fornost -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Erebor -> Iron Hills
Trial 5:	Blue Mountains -> Lake Evendim -> Michel Delving -> Brandy Hall -> Hobbiton -> Bree -> Fornost -> Rivendell -> Isengard -> Dol Guldur -> Carrock -> Esgaroth -> Iron Hills

1. Overall, the algorithm functioned fairly poorly. There exists a lot of variation, even within runs. Some runs did not even fully converge. For run 1, as the heuristic cost (higher beta) was prioritized, the ants tended towards roads that were of shorter distance. Hence, many short roads were taken. As the pheromone amount (higher alpha) was prioritized in run 2, the opposite effect was reached, where ants tended towards longer roads that brought it closer to the goal through slightly less nodes. This is even more true for run 3, as the heuristic cost was ignored all together. Finally, run 4 seemed the most consistent, as both parameters are equally prioritized, and weak pheromone evaporates quickly. Run 5 led to a lot of variation, but the results seemed to be consistent and converge fairly quickly.
2. A* was much better fitted for this map, as we have an extremely small map that is not fully connected. A* gives a definitive, consistent answer, as there is no randomness involved whatsoever. ACO relies greatly on randomness, so variation can exists. It is for this reason that I attribute the variation in our ACO answers to a misapplication of the algorithm. ACO is also much less efficient, so there needs to be an incentive (such as tackling a problem that A* cannot solve) to use it.

3. As aforementioned, ACO would be much more applicable to a complex problem on a more connected graph, such as the TSP problem. A* is very much better for simple problems, especially when all map nodes is known. ACO functions well in an environment where all nodes of the graph are not known, so larger environments are more suited for ACO.