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CSCI 3104, Algorithms **Profs. Grochow & Layer**
Explain-It-Back 10 **Spring 2019, CU-Boulder**

One of your colleagues studies the foraging patterns in ants and wants to better characterize the movements of a particular colony. Her graduate students have already performed aerial surveys of the routes these ants use, and she wants to know how many sensors she needs to best capture the ebb and flow of the colony. While many ants go in and out from the various tunnel entrances, they are most interested in tracking those ants that venture all the way to end of the surveyed routes. Explain to your colleague how this problem can be modeled as a flow network and how algorithms on these networks could help inform where to place the sensors.

Dear illustrious Colleague,

I read about your fascinating research in the esteemed journal *Nature* and it got me thinking about how your research group might apply some choice methodologies that are used within the field of computational sciences. I understand one of your challenges is in ideally placing sensors for monitoring the routes of ants within the colony. As I'm sure you don't have an abundance of sensors, I'd like to propose a potential solution that will help you reduce the use of sensors while increasing your data collection capabilities.

The solution that I'm proposing involves, in the most basic sense, determining those areas where pathways cross such that sensors are placed at these crossroads that account for all pathways going in and out of an area. Put another way, if we imagine that the complicated pathways of the ant colony are like a water pipe system, then we will want to put sensors at every location where water is both flowing in and out. By doing this, we can effectively meter/monitor the traffic, since any ant going to the end of a route MUST go through one of these cross sections of inflow and outflow. By determining which cross sections have the most in and out flow from a beginning location and an ending location (i.e. the end of the surveyed route) we can get a better idea of where it might be most effective to place our limited number of sensors. There are various other methodologies we could use to determine locations for sensors depending on various factors and variables you want to study.

Please let me know if you have any questions about my explanation and or analogy. I'm happy to discuss this with you further and hope it helps in your research! If you'd like to learn more about this, I've provided a couple links below that expand on my explanation that you might find helpful.

All the best,
Trevor Stanley

https://www.researchgate.net/publication/261288555_A_New_Ant_Colony_Optimization_Algorithm_Applied_to_Optimizing_Centralized_Wireless_Access_Network

https://www.hackerearth.com/practice/algorithms/graphs/maximum-flow/tutorial/

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