

Name: Trevor Stanley

ID: 103389068

CSCI 3104, Algorithms
Explain-It-Back 11

Profs. Grochow & Layer
Spring 2019, CU-Boulder

A startup has hired you as the chief technology officer (i.e., the only one who knows how to program). After the founders (all MBAs) finish explaining their vision for changing the world, you realize that what they describe can be reduced to the traveling salesman problem. No worries, you develop a solution that is a 1.5 approximation. The founders are devastated that they cannot use the word “optimal” in their next VC pitch, and wonder out loud if they need to get a new CTO who can do better. Convince them that an efficient optimal solution is unlikely (i.e., P probably does not equal NP) and that your solution is quite good.

Dear cofounders,

I was very interested in your business plan and think I can offer some insight into the scheme. After thinking a bit about it, I realized that the scheme you all discussed is analogous to the Traveling Salesman Problem. If you are unfamiliar with this problem, it is essentially the task of finding the most efficient pathway to and from a list of cities, given that you know the distances between all of them, and returning to the starting city/location. I've developed a solution to this problem that is a 1.5 approximation. While I understand that you all want to sell this as an “optimal” solution, I regret to inform you that developing a perfectly optimal solution is incredibly unlikely.

Because we want as optimal a solution as possible, the goal is to visit each city without ever having to visit the same one twice. This means that this problem belongs to a class of problems that is NP complete. Briefly, an analogy to NP complete problems is if someone asked you whether you love your brother or sister better. You would need to clone yourself in order to solve the dilemma of not loving one or the other more or less. This is contrast to P problems which you know you can solve easily and quickly (e.g. do you like red or blue better). In certain situations, NP complete problems can be reduced to P problems. Using our analogy, you can more quickly answer yes/no questions about certain things like color, preferences, desired attributes (like sharing), etc. that could possibly allow you to more quickly answer the harder question of do you love your brother or sister more. This would allow one to verify the correctness of the solution, even though we are just looking at one case at a time.

It is well established in the literature that if there is an optimal solution to the traveling salesman problem that the solution will be NP complete. However, unless $P = NP$, there cannot be a way to develop an optimal solution. If you still don't believe me, then please feel free to review the literature (cited below) on this topic or to bring in a consultant.

Thank you,
Trevor Stanley

https://en.wikipedia.org/wiki/Travelling_salesman_problem

Name:

ID:

CSCI 3104, Algorithms
Explain-It-Back 11

Profs. Grochow & Layer
Spring 2019, CU-Boulder
