AI Project Proposal

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When looking at the serious challenges facing humanity in the modern world, one of the most pressing issues for many communities is the lack of access to a clean and safe source of water. In many situations, if a country does have some form of water infrastructure, the water is improperly treated, sourced, or transported, so that by the time it reaches its destination, it is often contaminated. In the even worse case that no infrastructure exists, hours of time are spent gathering just enough water for drinking and basic hygiene, from a water source of often dubious sanitary value. Since in countries where such conditions are present there is increased gender disparity, the role of gathering the water is a burden of the women of the household, which further exacerbates issues of women lacking the opportunity to pursue their own educational and economic pursuits. As such, our goal is to create a program which can design efficient and convenient networks for distributing water to combat the problem of water scarcity and insecurity.

Everyone in the world deserves access to clean water. With the high need for water infrastructure in developing countries, companies and governments in under-developed parts of the world would be able to use a program similar to ours in order to implement shortest paths for water networks. In addition to water networks, the algorithm can be used for other infrastructure such as designing road and transit networks as the costs and paths would be very similar. Our plan to create a program that automatically maps water networks would cut costs and planning time, leading to a higher chance of implementation and better public services for the local residents.

The problem is also very interesting because there are a variety of changing variables to account for when creating the best path. Such variables include lay of the land and existing infrastructures which may affect the cost of putting a water path in a certain position. The program must account for these variables and decide where to create the water paths based on lowest costing paths. Planning out these variables will require much foresight and use of several search algorithms which will be both displayed and explained in our final project.

In some ways, this project is similar to the Pacman projects we have been working on in class, in that it revolves around finding the optimal path to reach a certain goal by minimizing some cost incurred. However, this problem is novel in that for Pacman, if he retraced his steps by passing over a position he already reached, the cost of that step would be added again to the total cost. On the other hand, once a pipe has been placed at a certain position, it stays there. As a result, the water can pass both ways through the pipe, but the only cost incurred is the single cost associated with placing the pipe at that point on the grid. Such graphical networks were also utilized when we looked at shortest path algorithms, but this situation is different in that it is focused on connecting multiple points in the most efficient way, rather than getting from one point to another. As such, this problem will provide a unique and novel challenge to tackle with our program.

We plan to break our project down into a few main tasks. We will first work on defining our state space and other problem variables. We plan to represent our problem as a grid with villages and a water source. These variables can be represented in a very similar format as the Pacman problem, using a grid class. In the early stages of the project, we will likely work on a simplified version of the problem with only one water source and a few villages. Using this simplified problem, we can test various search algorithms in order to determine which one is the optimal strategy to use. Once we have a simple framework, we will then account for other variables, for example, multiple water sources, varying elevations (where water must flow to strictly decreasing elevations), and/or weighted costs for certain locations. Weighted costs can account for real-world variations in the environment or terrain in which pipes need to be placed. For example, costs would increase if there is a mountain we would have to build through, private property we have to go around, or if we run into an old pipeline that we need to remove.

Since we have broken up our plan in this way, we will always have a product ready to release. Even if we are unable to complete all features in time, we will at least have a working project for a slightly simpler problem. We plan to use github to collaborate on code. Since we are increasing the variables involved in steps (one new cost factor at a time), we are going to have to coordinate a lot.

References:

https://www.un.org/en/sections/issues-depth/water/index.html

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