Project 3: Acequia Water Resource Simulator

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This document summarizes the current implementation and results of the Acequia Water Resource Simulator project, focusing on the behavior and performance of the custom water distribution logic defined in the solveProblems() function within StudentSolution.cpp.

Implementation Overview

The core of the implementation lies in controlling water flow through canals based on each region's drought or flood status. The main function, solveProblems(AcequiaManager& manager), iterates over all regions every hour during the simulation. For each region, it checks whether there is a drought or flood condition and adjusts canal flow accordingly.

If a region is flooded, the function releases water by opening canals that originate from that region. If a region is experiencing a drought, the function attempts to supply water by opening all incoming canals and setting their flow rates to a fixed value. In cases where a region has both flood and drought conditions, the solution opts to close the canal to prevent conflicting actions.

This approach is designed to dynamically and efficiently allocate water resources throughout the network, reacting to changing conditions until the simulation is either solved or time runs out.

Test Results Summary

The solution has been tested across multiple simulation runs, each representing a different configuration of initial water levels, needs, and capacities for the North, South, and East regions.

In the first test, South and East regions met their water needs, while North fell short, resulting in a score of 18. In the second test, North again failed to reach the required water level, even though South and East were successful. This led to a score of 10.

In the third test, both South and East were in drought and failed to meet their needs, resulting in a score of 0. The fourth test demonstrated significant improvement, where all regions nearly reached their exact water needs but fell short by a margin of less than 0.001, likely due to floating-point precision errors. Despite the near success, the score remained at 10 or less.

Performance Analysis

The solution performs well in dynamically adjusting water flow and responding to regional needs. It shows a strong grasp of how to coordinate between multiple regions, accounting for both excess and deficient water levels. However, a recurring limitation is the failure to completely satisfy all regions within the given simulation time.

A key issue appears to be floating-point precision. In the final test, water levels such as 52.0004 and 68.9999 were observed, which are extremely close to the needed values but still result in simulation failure. This suggests that slight adjustments to flow rates, such as incrementing them by a small buffer (e.g., 0.01 or 0.5), may improve success rates and help fully meet the simulation objectives.

Conclusion

The Acequia Water Resource Simulator demonstrates effective water management through a logical, reactive implementation in the solveProblems() function. While the structure and logic are sound, the performance is hindered by small numerical inaccuracies that prevent full success in some test cases. With minor improvements, particularly in handling floating-point rounding and optimizing canal usage, the solution is well-positioned to meet all simulation criteria and improve leaderboard scores.