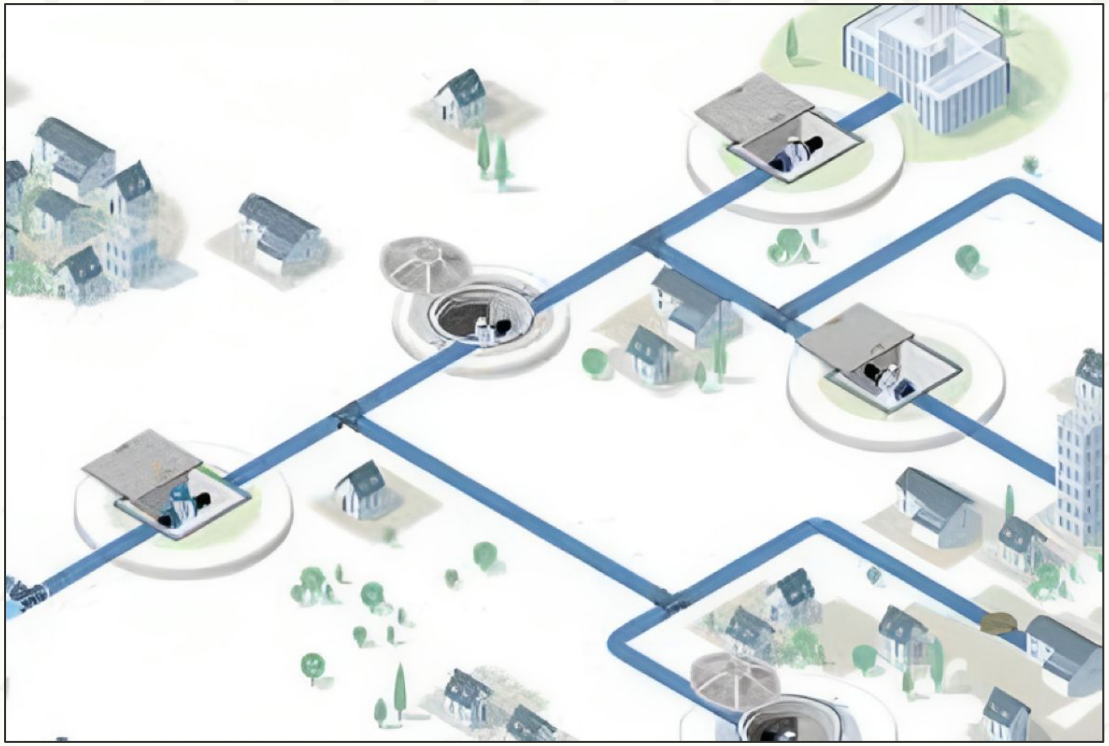

Problem Situation 2
WATERWORKS!

Analysis and Design of Advance Algorithms

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Translation of
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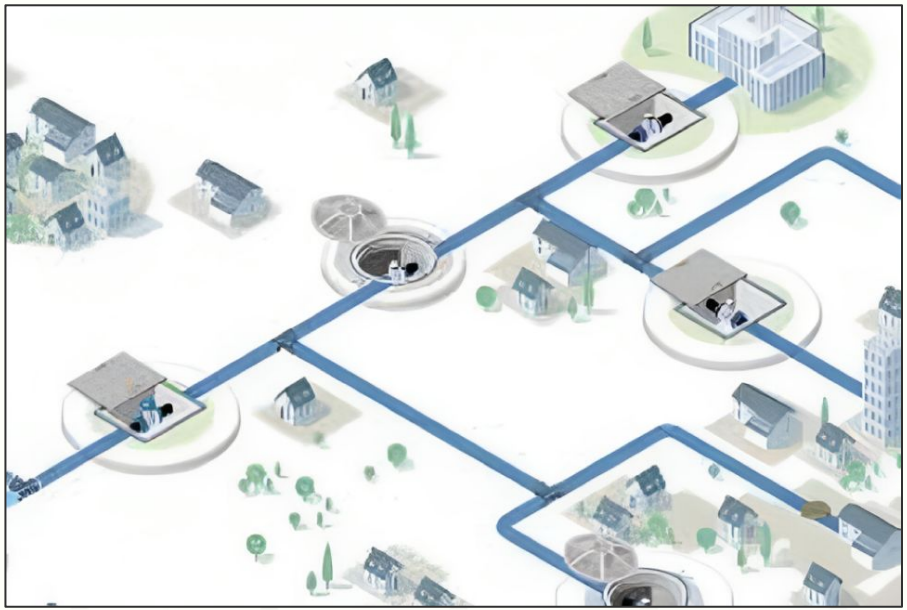
presentation

Water distribution networks

Water distribution is a complex and challenging problem

Since the water distribution infrastructure is a network of nodes, the concepts of graph theory and related algorithms are a valuable tool for optimizing the process.

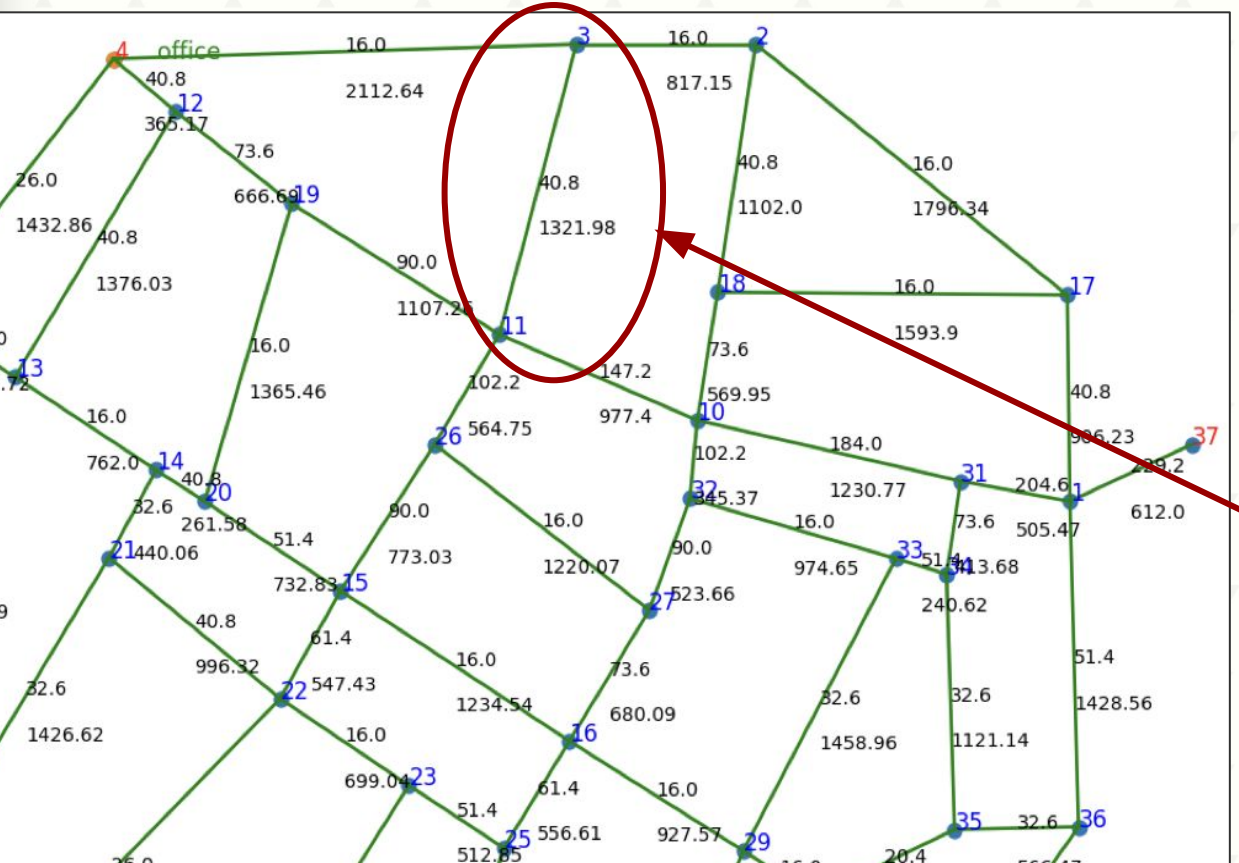
Water distribution networks



1. Instances
Nodes: the network has different types of nodes
Sources
Non-source nodes

Pipes (edges) with associated weights, symbolizing capacity

Water distribution networks

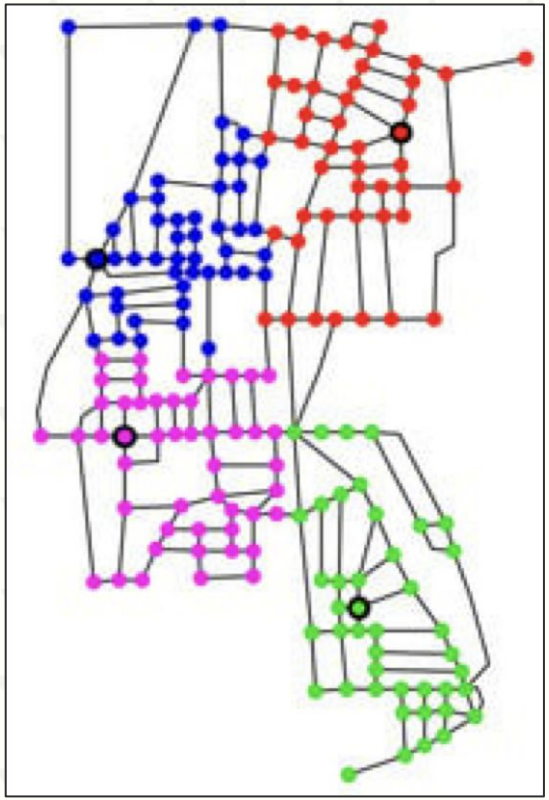


2. Pipe Lengths

Use the x, y coordinates of each node to determine the length of each pipe.

Create graphs like this one, showing the diameter and length of each pipe.

Water distribution networks



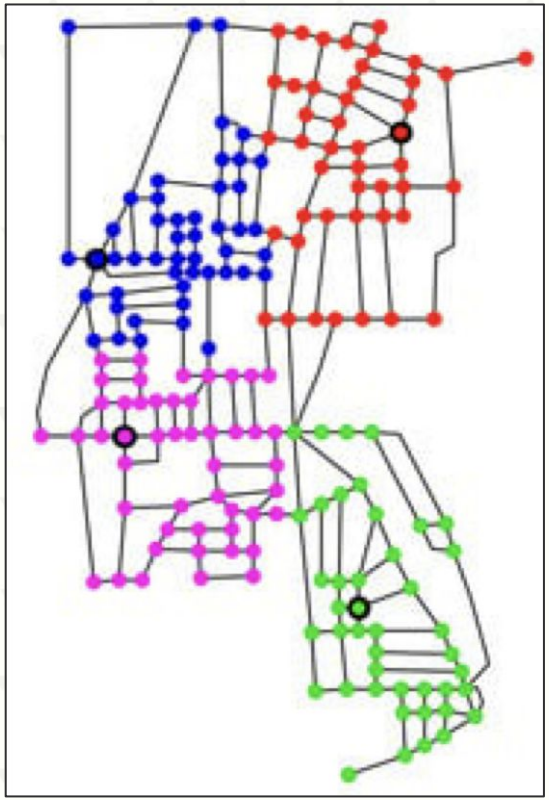
3. Sectorization:

This is the division of the network into sectors associated with a source.

Nodes must be supplied by the nearest source within the network. Separation between sectors is achieved by closing some pipes. Determine which ones.

You must report which nodes belong to the same sector, which pipes are closed, and show this visually (color-coded graphic, marking closed pipes, freestyle).

Water distribution networks

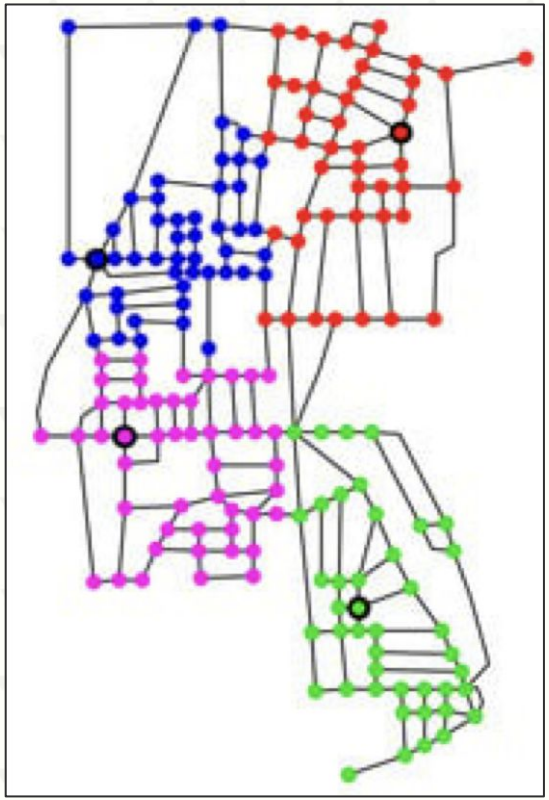


4. Water Freshness

One metric of water quality is the time it takes for water to travel from the source to a node. **This is proportional to the distance.**

Which node receives the water the slowest in each sector?

Water distribution networks



5. Maximum Flow Rate for Each Sector:

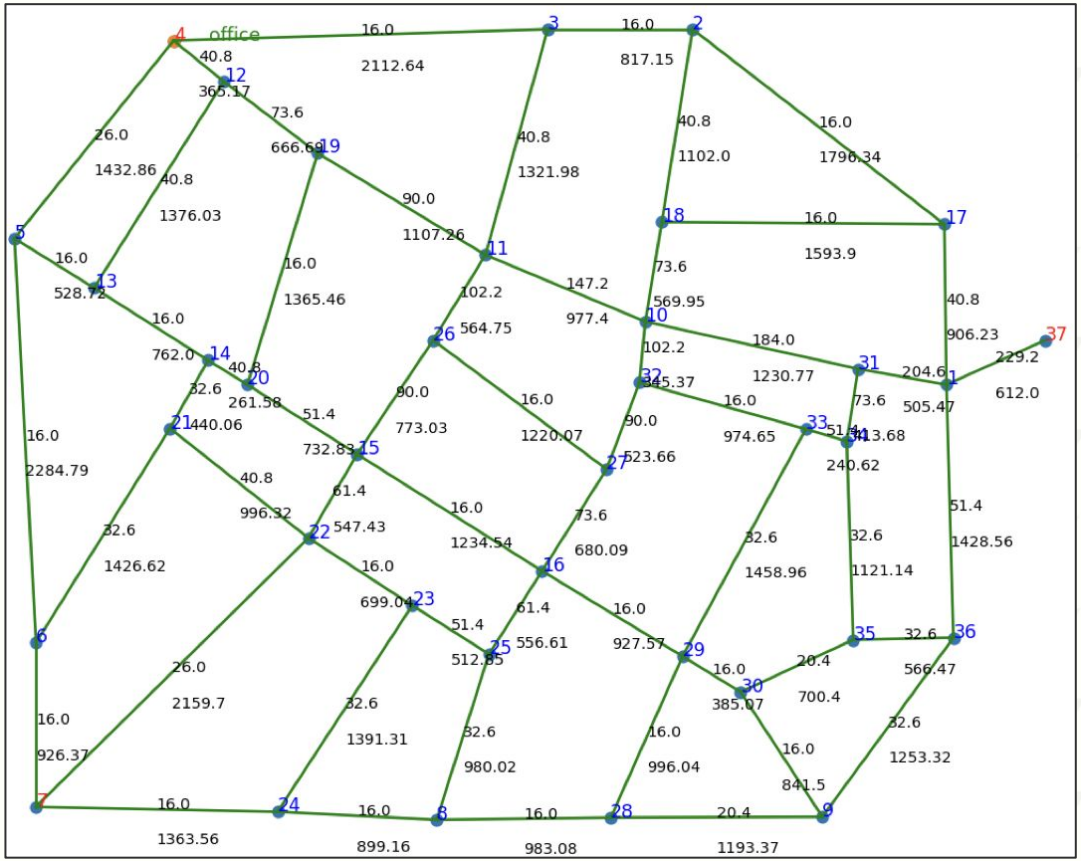
Use the capacity of the different pipes to determine the maximum flow rate for each sector.

Consider the following:

Origin: the source

Destination: the node farthest from the source

Water distribution networks

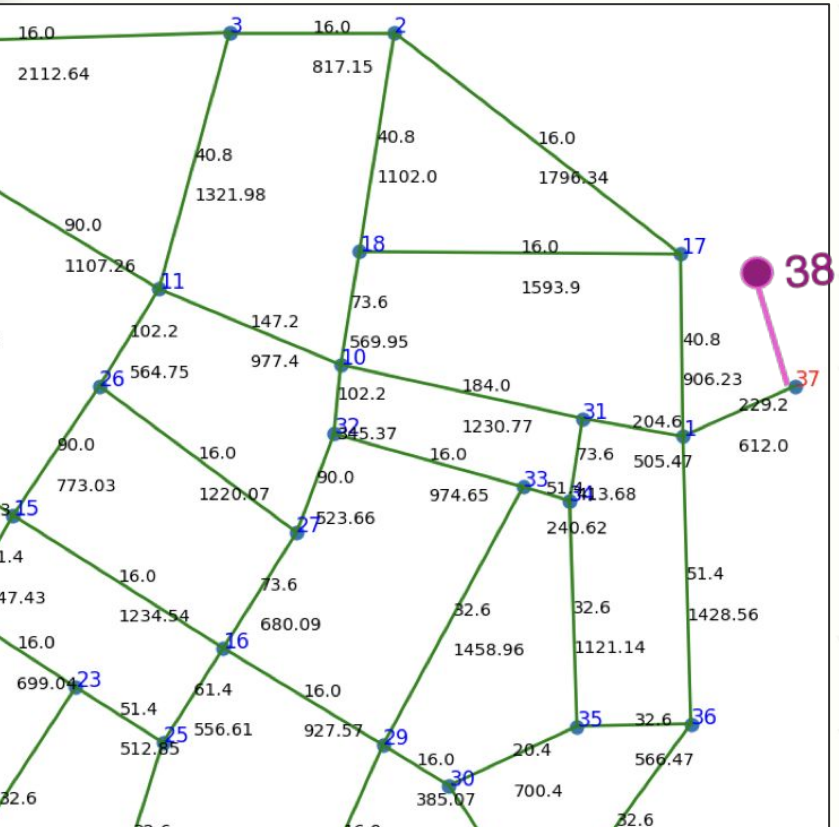


6. Water Quality Sampling

To analyze water quality, samples must be taken from each node.
Determine a minimum distance route for a person, located at the node marked “office,” to visit the entire network, collect samples, and return.

Assume this can be done in a single day, and that street patterns correspond to pipe layouts.

Water distribution networks



7. Network Expansion:

Assuming a new node is created at specific coordinates

How would you connect it to the network?
Link the new node to the nearest non-source node.

Then, **update the network accordingly.**

Only Problem 6 **may** require full recomputation.

All other structures must be updated in place and locally following the previously established rules, and must not be rebuilt from the beginning.

Water distribution networks

Test files will be in canvas

Waterworks!

Water distribution game by scriptwelder

This is a game that could use all the algorithms (low node count.) Gamification that benefits from understanding graphs and geometry. Although some simple solutions (BF) could and can be made for the SP2, for specific systems like this one, processing time is really important. More so if its web based too and if the map were to grow and grow to a huge city and it wasn't optimized a little bit. It would be laggy and the player would feel frustrated..