WATER SUPPLY MANAGEMENT SYSTEM

MADE BY: FILIPE GAIO, LEANRO MARTINS AND GONÇALO CONCEIÇÃO

CONTENT

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CLASSES

Our project is separated in 3 files that help in the use of our application.

This is the file that starts our program, it starts by creating a management system and then executing the read functions to import the data, then starts the menu

MAIN.CPP

This is the class of the menu, it's job its to interact with the user so they can call the functions they want to use and it prints the results of those functions

MENU.CPP

This class is the one that executes all the main functions that do some work, in our case, it executes edmond's Karp algorithm and other functions

MANAGEMENT SYSTEM.CPP

CSV'S READ AND WRITE

In our project we start by reading the given data and then we also write on some new csvs imporatnt data

SYSTEM.READ...()

VERTEXES

EDGES

NETWORK

GRAPH STRUCTURE

Graph holding every other class

GRAPH

Vertexes can be Cities or Pumping Stations or even Reservoirs

VERTEX

Edges connect vertexes and also have their own attributes

EDGE

GRAPH STRUCTURE

Vertex

- Vertex class has parameters that save the info of each site of the water management system.
- Each vertex is represented by a string that is the code of the specific site.
- Each vertex also has a type variable, that differentiates if it is a reservoir, city or pumping station.
- It also has 2 vectors for incoming and outgoing edges

- Each edge has a capacity and a flow.
- Each edge has a departing vertex and a destination vertex that can be either a reservoir, pumping station or a city.

Edge

INDIVIDUAL FUNCTIONS

readCities
readPipes
readReservoirs
readStations

CSV

edmondsKarp (uses
findAugmentingPath
and minResidualPath)
createSuperSource
createSuperSink

EDMONDSKARP

Filters()
we can filter as many things
as we want to

FILTER

EDMONDS KARP

This is the main function of the program, it runs Edmonds Karp Algorithm in the given graph and it calculates the max flow.

It has a complexity of $O(V E^2)$ where V is the amount of vertices and E is the amount of edges of the graph.

FILTERS

The filter functions adds the chosen site to the ignore vector, while also setting its vertex to be ignored, so when the edmonds Karp algorithm is ran, those get ignored.

The complexity to adding a site to the filter is O(V) for vertices and O(V E) for edges, where V is the amount of vertices and E is the amount of edges from the source vertex.

```
Filter of ignored/nonfunctional stops.
Reservoirs ignored:

Pumping Stations ignored:

Pipes ignored:

1) Add Reservoir/Station
2) Remove Reservoir/Station
3) Add Pipe
4) Remove pipe
5) Empty the filter
6) Check affected Cities
0) Return
```

MENU

1 - Max flow (4.1)

2 - Filter Menu (4.2)

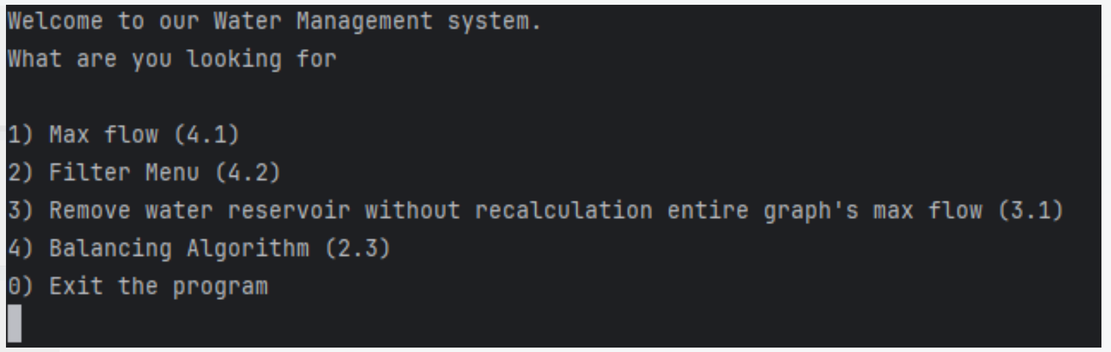
3 - Remove reservoir (3.1)

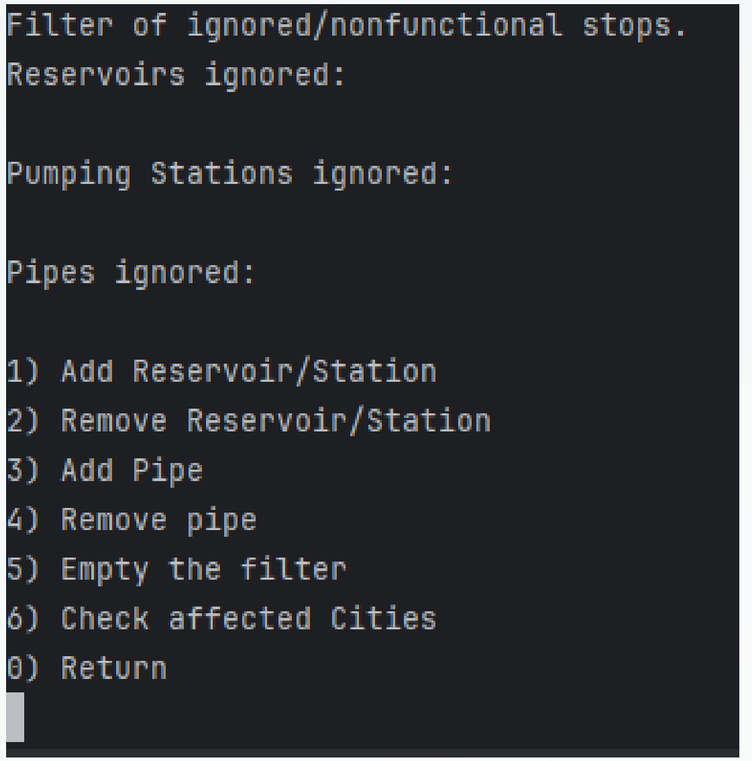
4 - Balancing pipe usage (2.3)

2.1 - Add or remove reservoirs, stations or pipes to the filter

2.5 - Clean filters

6 - Check how the filter affects the network

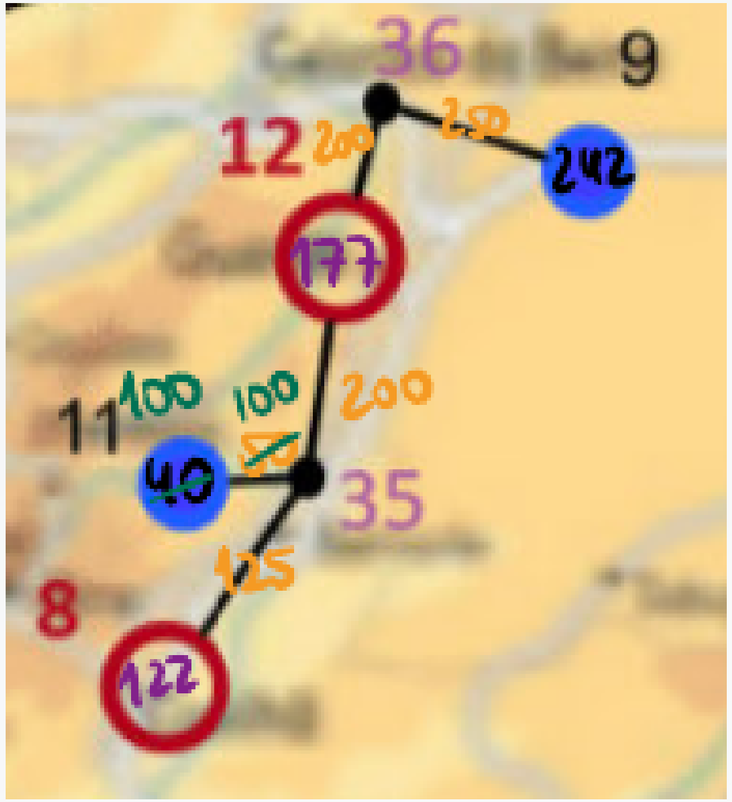




REMOVE WATER RESERVOIR WITHOUT RECALCULATION ENTIRE GRAPH'S MAX FLOW

Finds the cities that are affected and the reservoirs affecting those cities, then does an edmondsKarp but only checking these reservoirs

It has a complexity of $O(V E^2)$ where V is the amount of vertices and E is the amount of edges of the graph.



BALANCING NETWORK

How to balance

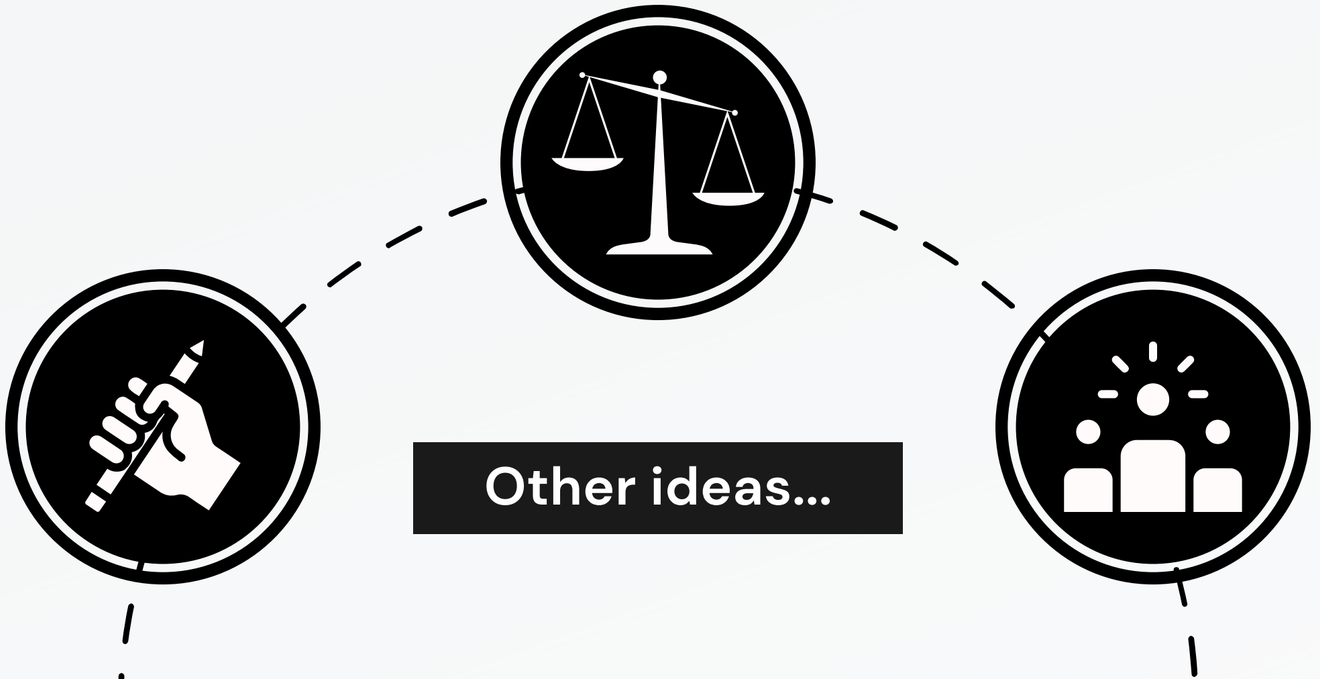
Limit pipe percentage of usage so that the flow has to go trough other pipes.

Implementation

Making an Edmonds Karp algorithm with the pipe flow limited

Checking results

The average of pipe percentage of usage dropped significantly and the discrepance also got smaller



Other ideas...

IMPORTANT ASPECTS

Almost everything goes by reference
Fast execution
Clean and well done menu

01

DIFFICULTIES

Implementing a good balancing algorithm, checking if the results are right.

02

LEANDRO

Implemented the colorful terminal, made functions print results into some csvs.

03

FILIPE

Reworked menu appearance for a cleaner look, main idea of the applied balancing algorithm.

04

GONÇALO

Added doxygen documentation and though of a different approach for removing Reservoir.

DA-PROJECT

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