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2L.EIC12

DA Project

Graph Creation

```
class Edge {
public:
    Edge(Vertex *orig, Vertex *dest, double w, const std::string &service, double cost);

    Vertex * getDest() const;
    double getWeight() const;
    double getCost() const;
    Vertex * getOrig() const;
    double getFlow() const;
    std::string getService() const;

    void setFlow(double flow);
    void setWeight(double weight);
protected:
    Vertex * dest;
    double weight;
    double cost;
    std::string service;
    Vertex *orig;
    double flow;
};
```

- Bidirectional and weighted graph.
- Our graph reuse the code from the practical classes.
Each station is represented by a vertex and each connection between stations is represented by an edge.

Data set Reading from data files

In order to store the data, a method was implemented for each file:

- readStations -> Reads the stations.csv file and stores each Station in a vector of Vertexs.
- readNetwork -> Reads the network.csv file and creates an Edge in the graph for each connection that is added to the respective station.

Creation of Municipalities and Districts vectors.

Issues with the given data.

User Interface

```
+-----+
|          Very welcome to          |
|      Railway Management application  |
|          I hope to be useful : )    |
+-----+

+-----+
|          RAILWAY MANAGEMENT         |
+-----+

| [1] - Complete Listings             |
| [2] - Basic Service Metrics         |
| [3] - Operation Cost Optimization   |
| [4] - Reduced Connectivity & Report |
| [R] - Reset Graph                  |
| [Q] - Exit the application          |
+-----+

Choose the option and press ENTER:|
```

- This project has an interactive, intuitive and friendly menu, with multiple options chained within each different functionality.
- All user inputs are validated, displaying clear and succinct error messages when incorrect.

```
Enter the name of the departure station:lisboa oriente

Enter the name of the arrival station:etnosda

+-----+
| At least one of the entered stations does not exist |
+-----+

Enter the name of the departure station:|
```

Menu

The menu is divided into 6 parts:

- Complete Listings
- Basic Service Metrics
- Operation Cost Optimization
- Reduced Connectivity & Report
- Reset Graph
- Exit the application

Complete Listings:

```
+-----+
|                                     |
|                               RAILWAY MANAGEMENT                               |
|                                     |
+-----+
| [1] - List Stations                |
| [2] - List Station Connections     |
| [B] - Go Back                     |
+-----+
```

Implemented Features and Algorithms

Basic Service Metrics:

1. Edmonds-Karp
2. Max-flow between all pairs of stations
3. Maximum internal flow
4. Max-flow of the entire Railway Grid

+-----+-----+	
	BASIC SERVICE METRICS
+-----+-----+	
	[1] - Max-Flow Between Two Stations
	[2] - Pair of Stations - Most Amount of Trains
	[3] - Purchasing & Maintenance - Budget
	[4] - Max Number of Trains - Entire Railway Grid
	[B] - Go Back
+-----+-----+	

Implemented Features and Algorithms

Operation Cost Optimization:

- Maximum cost of a line = capacity x service cost
- Dijkstra
- MutablePriorityQueue
- Max number of trains – Min capacity
- Calculate the path cost

```
Enter the name of the departure station:braga
Enter the name of the arrival station:espinho

The maximum number of trains from BRAGA to ESPINHO is 4

Path: BRAGA -> FAMALICAO -> TROFA -> PORTO CAMPANHA -> ESPINHO

The cost of the path is 56
```

Implemented Features and Algorithms

Reduced Connectivity & Report

- Break edge
- Decrease edge
- Max-flow of the entire Railway Grid
 - Before
 - After

```
Enter the name of the departure station:braga
+-----+
|               DESTINATIONS               |
+-----+
|      NAME      | SERVICE | CAP |
+-----+
|    FERREIROS    |  STANDARD  |  8  |
|    FAMALICAO    |  ALFA PENDULAR  |  4  |
+-----+

Enter the name of the arrival station:ferreiros

Capacity: 8 -- BRAGA -> FERREIROS

Do you want to break the edge or decrease the capacity? (B/D):b

Edge BRAGA - FERREIROS broken.

Do you want to add another edge? (Y/N):n

Do you want to see the report of affected stations? (Y/N):y

+-----+
|      MOST AFFECTED STATIONS      |
+-----+
|      NAME      | DIFFERENCE (-) |
+-----+
|    FERREIROS    |      4      |
|    RUILHE       |      2      |
|    AVELEDA      |      2      |
|    TADIM        |      2      |
|    TROFA        |      2      |
|    ARENTIM      |      2      |
|    PORTO CAMPANHA |      2      |
|    FAMALICAO    |      2      |
|    COUTO DE CAMBESES |      2      |
|    MAZAGAO      |      2      |
|    AVEIRO - VOUGA |      2      |
|    ESPINHO      |      2      |
|    BRAGA        |      2      |
+-----+
```


Implemented Features and Algorithms

Reset Graph

```
+-----+
|                                     |
|                               RAILWAY MANAGEMENT                               |
|-----+-----+
| [1] - Complete Listings           |
| [2] - Basic Service Metrics       |
| [3] - Operation Cost Optimization |
| [4] - Reduced Connectivity & Report |
| [R] - Reset Graph                 |
| [Q] - Exit the application        |
|-----+-----+

Choose the option and press ENTER:r

Graph reseted!
```