PROGRAMMING PROJECT I

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Railway Network Management

Choose database

- Equipped with the standard network, but capable of accepting any properly formatted one

- .csv files must be placed in the *cmake-build-debug* folder

```
Digite:
1- Para usar a rede ferroviária padrão
2- Para usar uma rede ferroviária fornecida
2
Digite o nome do ficheiro de estações que deseja utilizar
demo_stations.csv
Digite o nome do ficheiro de conexões que deseja utilizar
demo_network.csv
```

User interface

- Consists of main menu that calls submenus for each function
- Upon completion of function, returns to main menu

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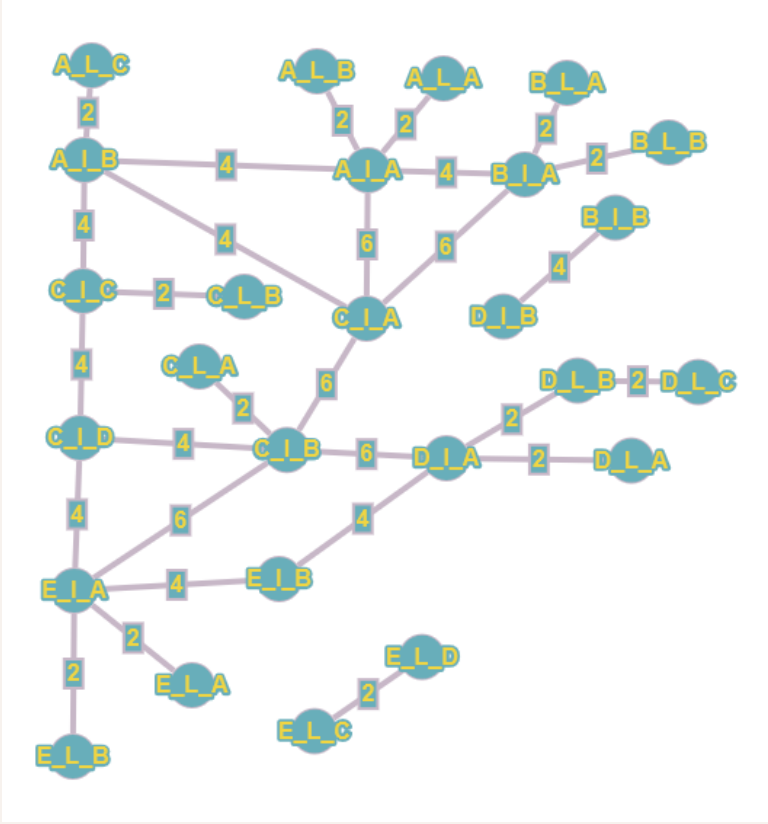
================================================================================================================
                                                    MENU
================================================================================================================

Selecione uma das seguintes opções (0-6):
1- Número máximo de trens que podem viajar simultaneamente entre duas estações específicas
2- Pares de estações que requerem a maior quantidade de trens
3- Top-k municípios e distritos com mais necessidade de transportes
4- Número máximo de trens que podem chegar simultaneamente numa estação específica
5- Número máximo de trens que podem viajar simultaneamente entre duas estações com custo mínimo
6- Número máximo de trens que podem viajar simultaneamente entre duas estações com conexão reduzida
7- Top-k estações mais afetadas por cada falha num segmento
0- Sair
```

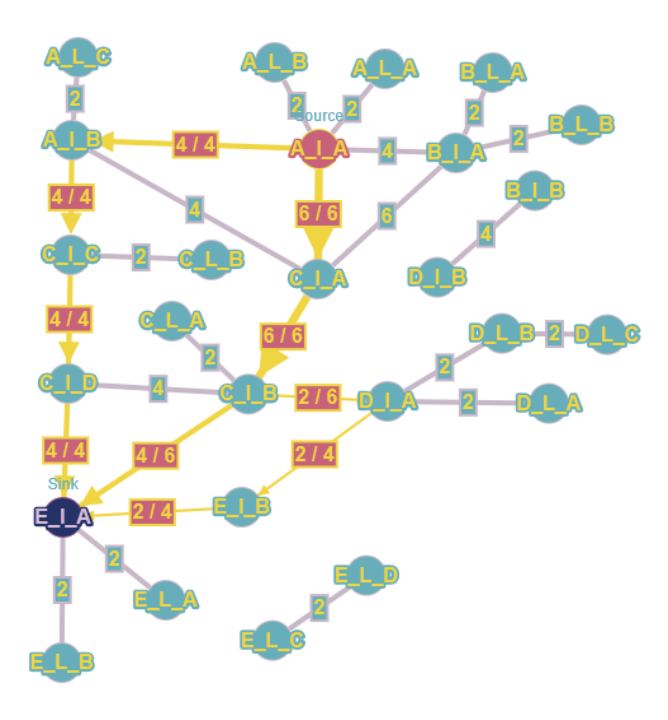
Demo network

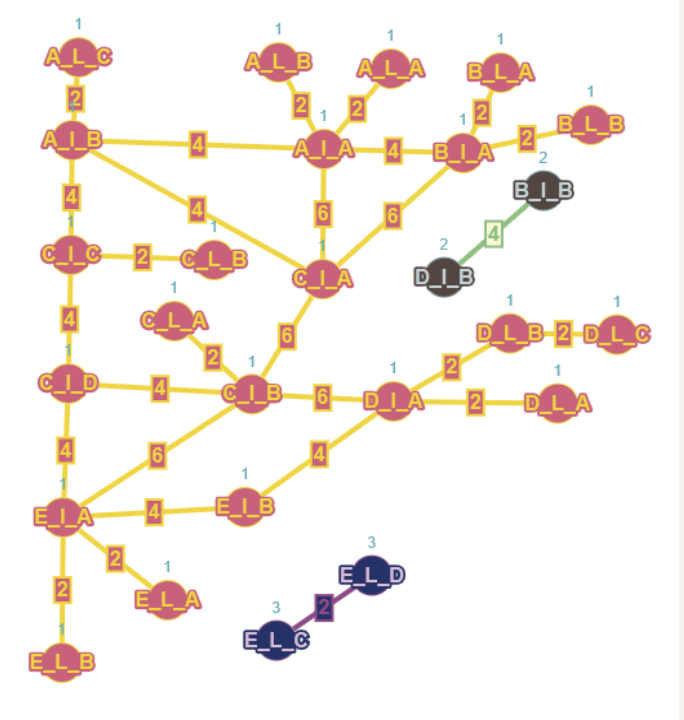


1- Basic Service Metrics

1.1 Most trains between two stations

- Maximum flow
- A_I_A / E_I_A expectation: 10
- A_I_A/B_I_B expectation: 0

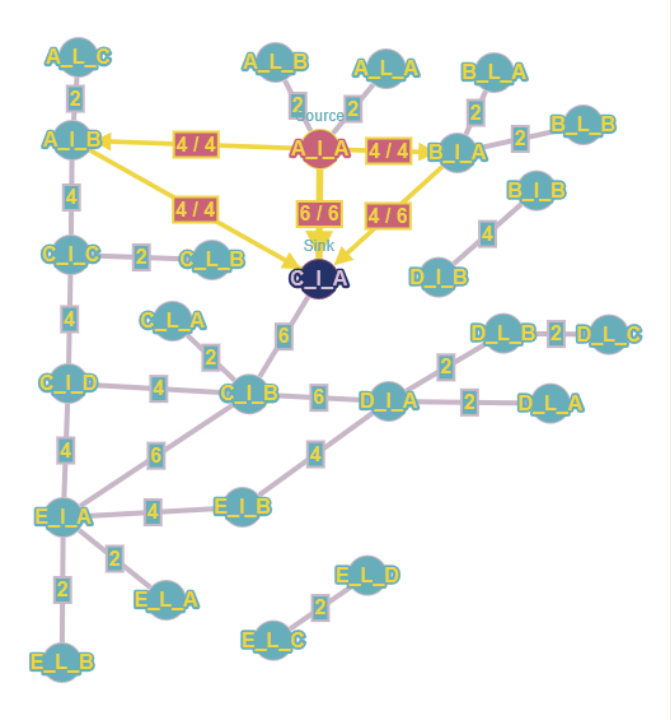


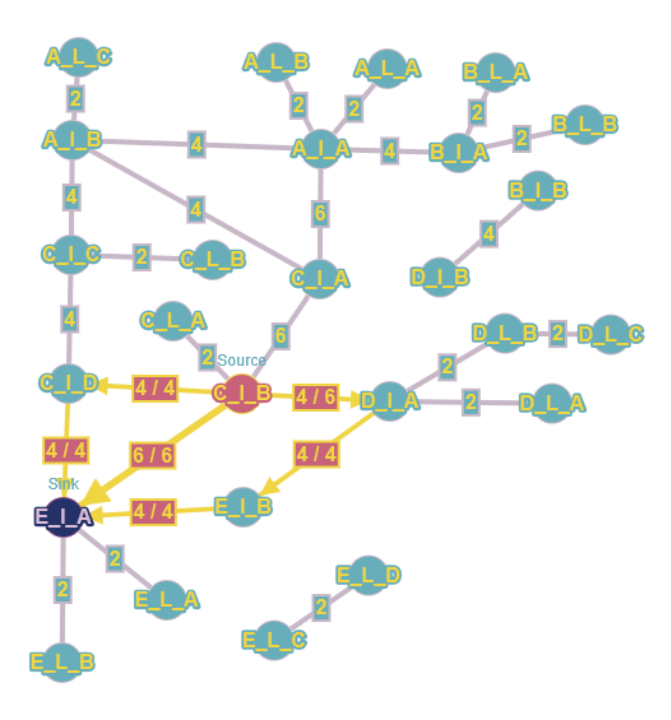


1.2 – Pairs of stations that require the most trains

- Checks all combinations of sinks and sources to find greatest max flow

- Expected result: A_I_A/C_I_A and C_I_B/E_I_A

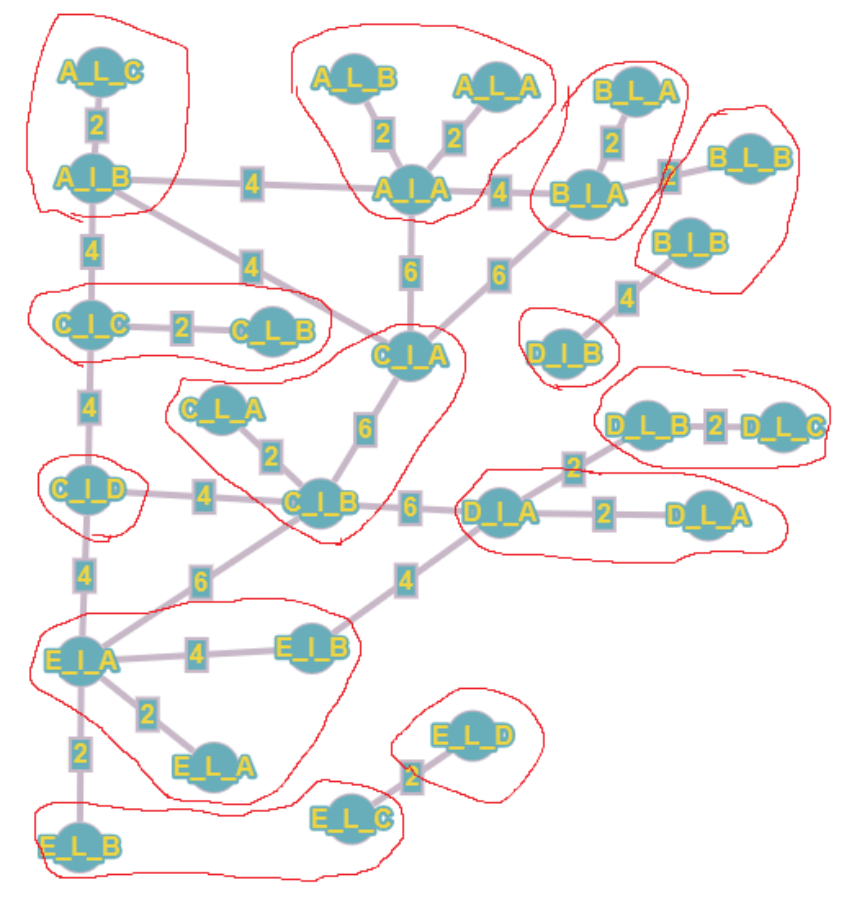




1.3 – District and municipalities that require the most budget

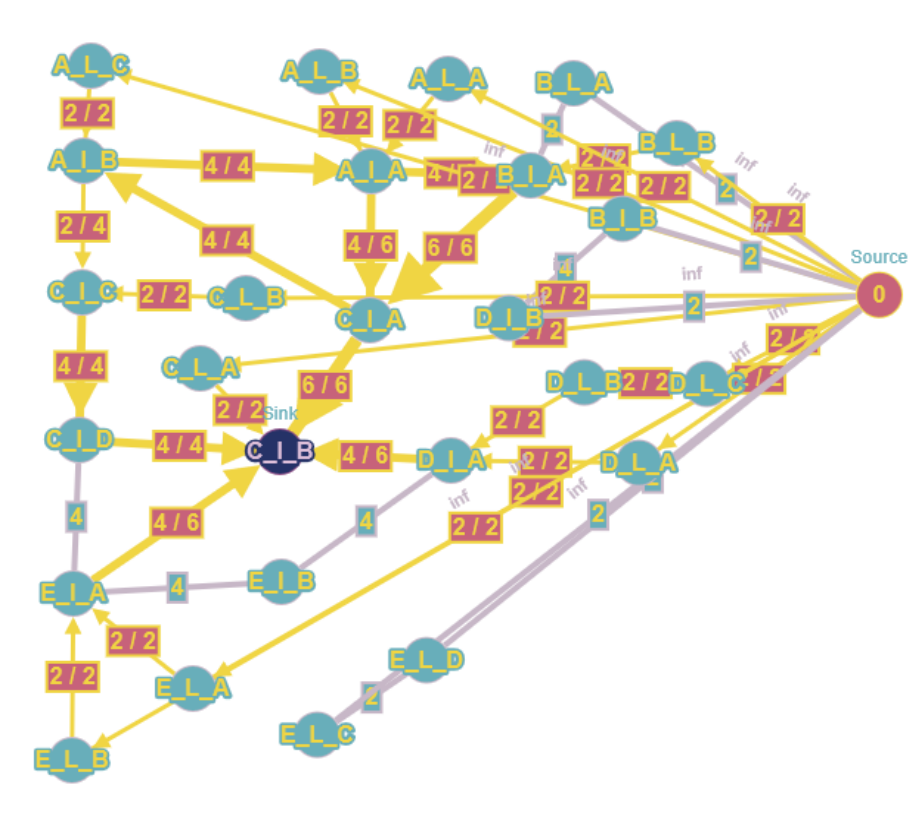
- Determines the k mun/dist with the highest flow sum from its stations

- Expected District order: C, A, E, D, B
- Expected Municipality order: C-A, A-A, E-A, ,



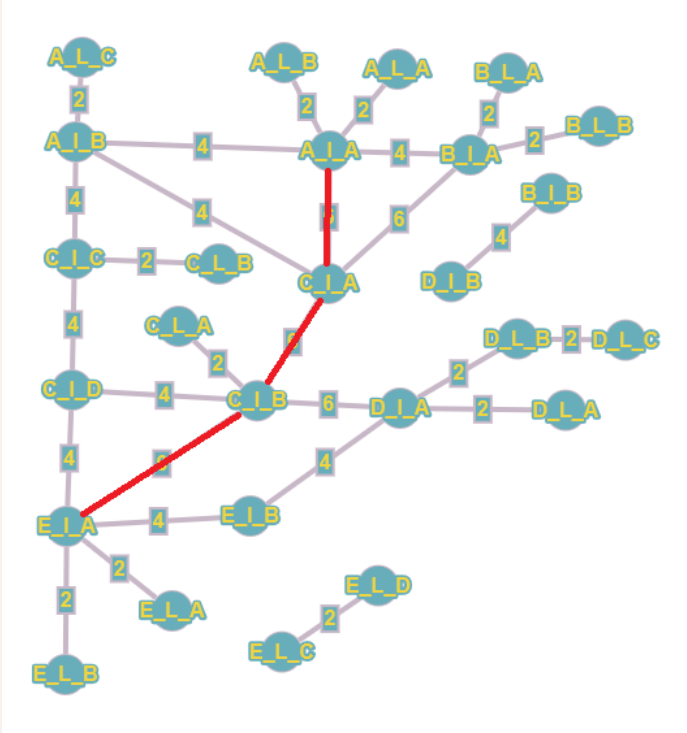
1.4 – Most incoming trains into a single station

- Checks the maximum incoming flow to a given station
- C_I_B expectation: 20
- E_L_C expectation: 2



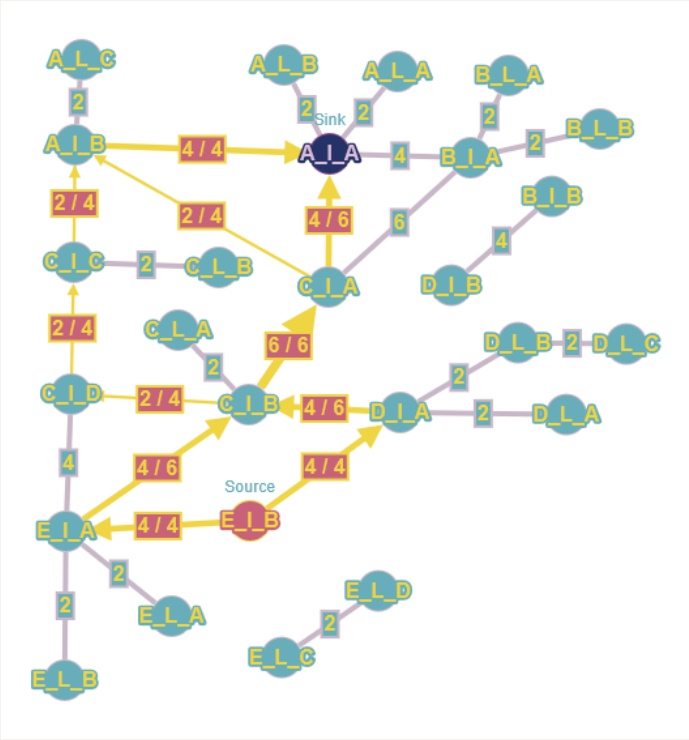
2 - Operation Cost Minimization

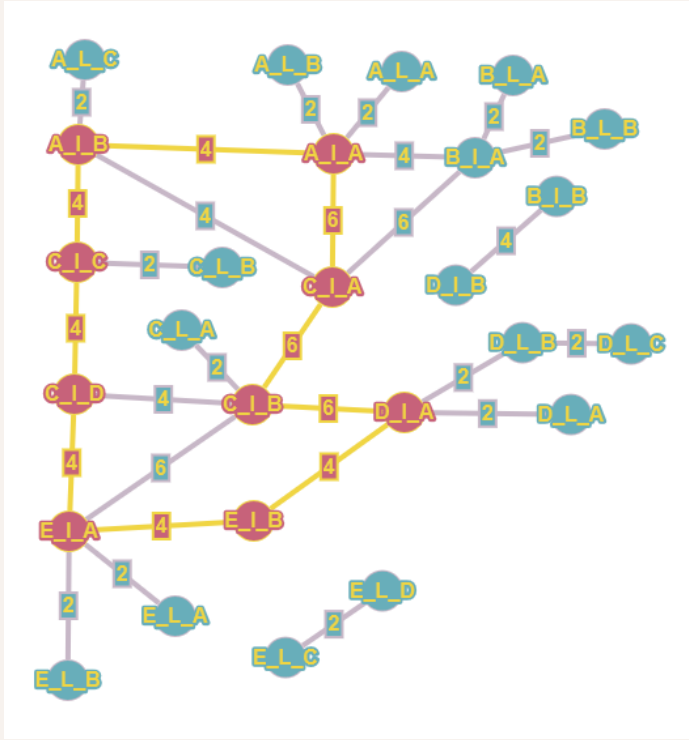
AP Line


A_L_C
A_L_B
A_L_A
B_L_A
B_L_B
A_I_B
A_I_A
B_I_A
B_I_B
C_I_C
C_L_B
C_I_A
D_I_B
C_L_A
D_L_B
D_L_C
C_I_D
C_I_B
D_I_A
D_L_A
E_I_A
E_I_B
E_L_D
E_L_A
E_L_C
E_L_B

2.1 – Max trains, minimum cost

- Adds the lowest available price path until it reaches maximum flow
- Max trains expected: 8
- Min cost expected: 88

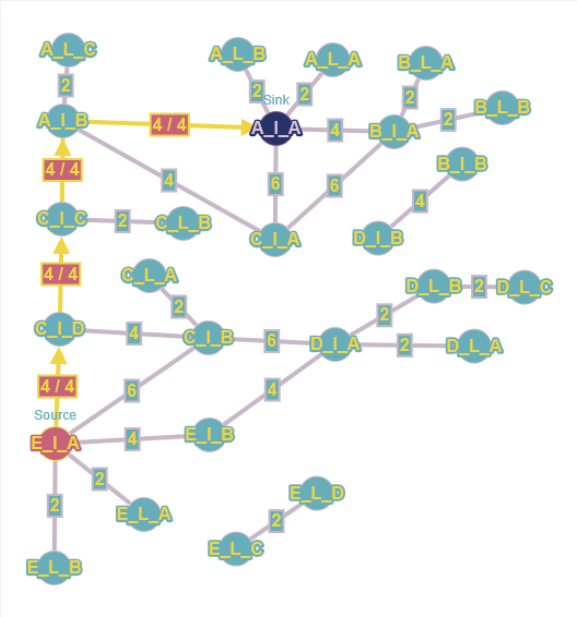


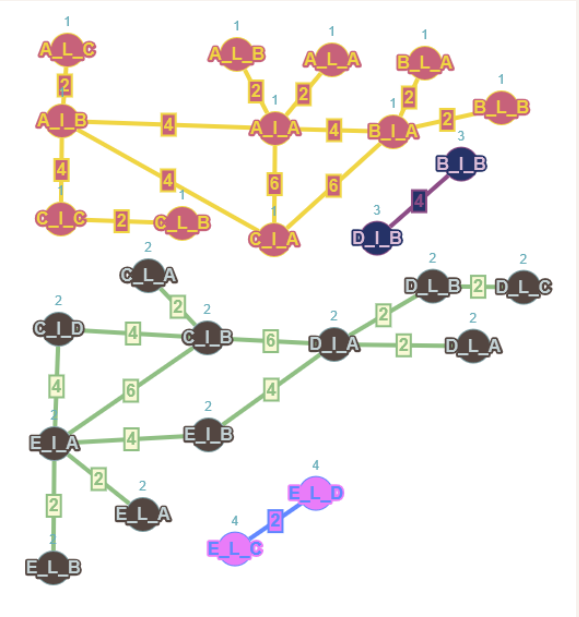


3 - Reliability and Sensitivity to Line Failures

3.1 – Most trains between 2 stations/reduced connection

- Temporarily set capacity of chosen lines to 0 then find max flow
- A_I_A/E_I_A (left) expectation: 4
- A_I_A/E_I_A (right) expectation: 0





3.2 – Most affected stations by a segment failure

- Compares the max flow to each station before and after then failure, then returns the k most affected ones

- C_I_A/C_I_B failure expectation for k = 5: C_I_A, C_I_B, E_I_A, A_I_A

- E_L_C/E_L_D failure expectation for k = 5: E_L_D, E_L_C