Lunch break

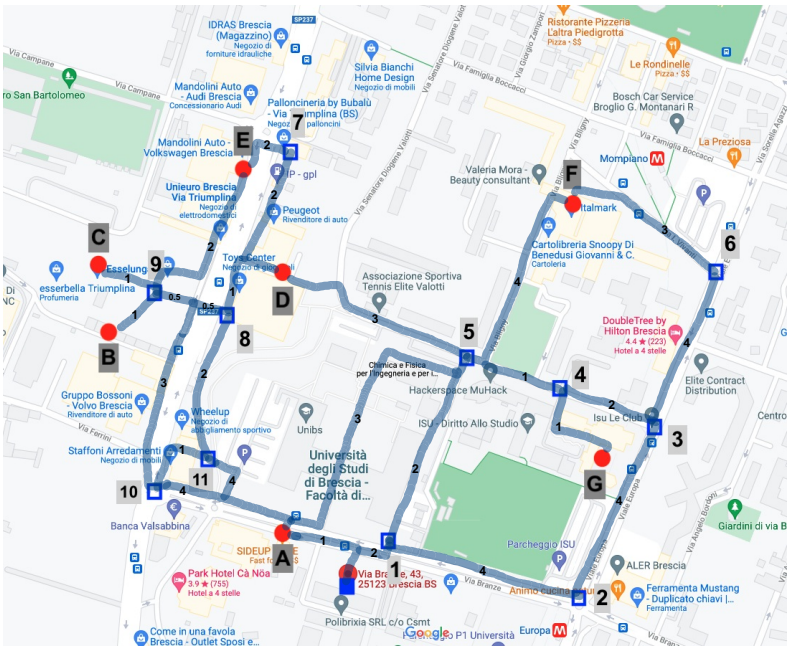
Difficulty level: intermediate

Keywords

- Graph theory
- Directed graphs
- Dijkstra's algorithm
- Heuristic algorithms

Problem description

The map below represents the area of Brescia where the several Engineering departments are located. The map indicates the main refreshment stands frequented by university students during their lunch break, also shown in the table with the legend.



In particular, the Engineering Department where we are right now is represented by the filled-blue square. On the roads highlighted in blue, the values

Map point	Refreshment stands
A	SideUp Pokè
B	Birra & Brace Restaurant
C	Atlantic Bar
D	Gusto e Sapore Bar
E	Piadineria
F	Supermarket
G	University canteen

indicate the estimated travel times (in minutes) to move from one point to another on the map. Soon we will have to go and have our lunch break. We will have an hour to move, eat something, and return here.

Tasks

1. By applying Dijkstra's algorithm and showing each step of the procedure, determine the closest and the farthest refreshment stands from our starting point.

2. In which places is it not convenient to go because we risk not being back in time by 13:30?

3. If all the shortest paths to reach all the refreshment stands are highlighted on the map, what can you notice?

4. Consider the following variant of the problem, where each student in the class indicated the three places they would prefer to have lunch. Also consider the fact that the refreshment stands have a limited number of places, given the rush hour of 12:30. Given all the shortest paths to reach the refreshment stands (computed for the basic version of the problem), decide where each of the 22 students will go for lunch, by trying to please everyone as much as possible and by staying as close as possible to the Engineering department where we currently are. Describe a heuristic algorithm that solves this seat allocation problem.

Student #	Place #1	Place #2	Place #3
1	E	B	A
2	E	B	D
3	A	E	D
4	E	C	A
5	A	E	B
6	A	E	B
7	A	E	D
8	E	A	B
9	E	A	B
10	E	B	A
11	E	A	D
12	G	D	B
13	B	D	E
14	A	E	B
15	A	E	D
16	E	D	C
17	B	A	E
18	E	A	B
19	E	A	B
20	A	E	D
21	E	F	A
22	A	E	D

Map point	Refreshment stand	Available seats
A	SideUp Pokè	6
B	Birra & Brace Restaurant	10
C	Atlantic Bar	5
D	Gusto e Sapore Bar	5
E	Piadineria	7
F	Supermarket	20
G	University canteen	10