Prevention of Street Harassment Through Constrained Shortest Path Algorithms

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Team Presentation

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Report and algorithms

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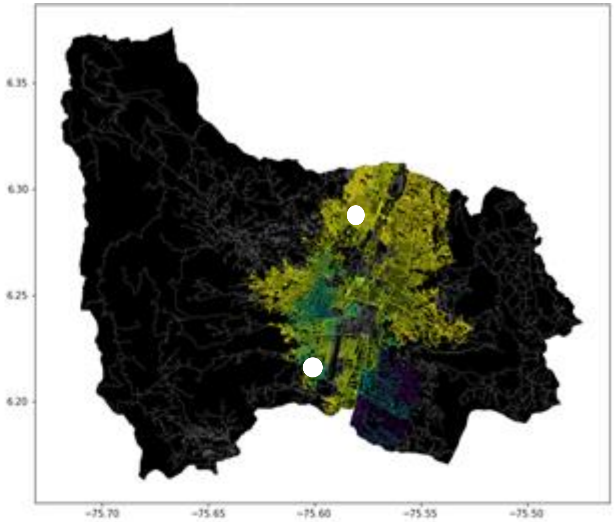
Literature review

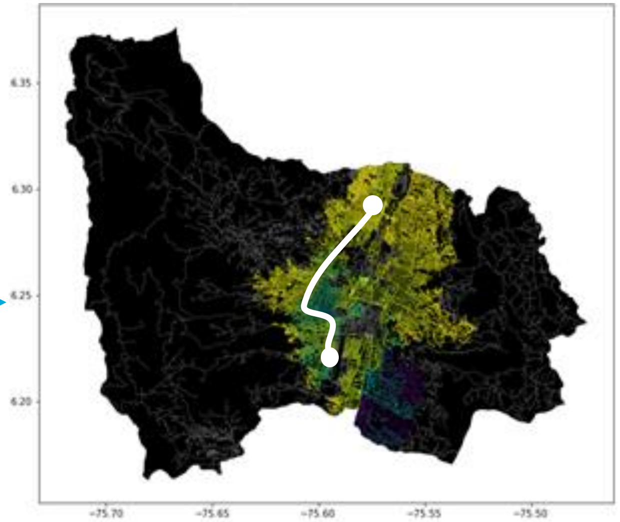
Mauricio Toro
Data preparation

Problem Statement



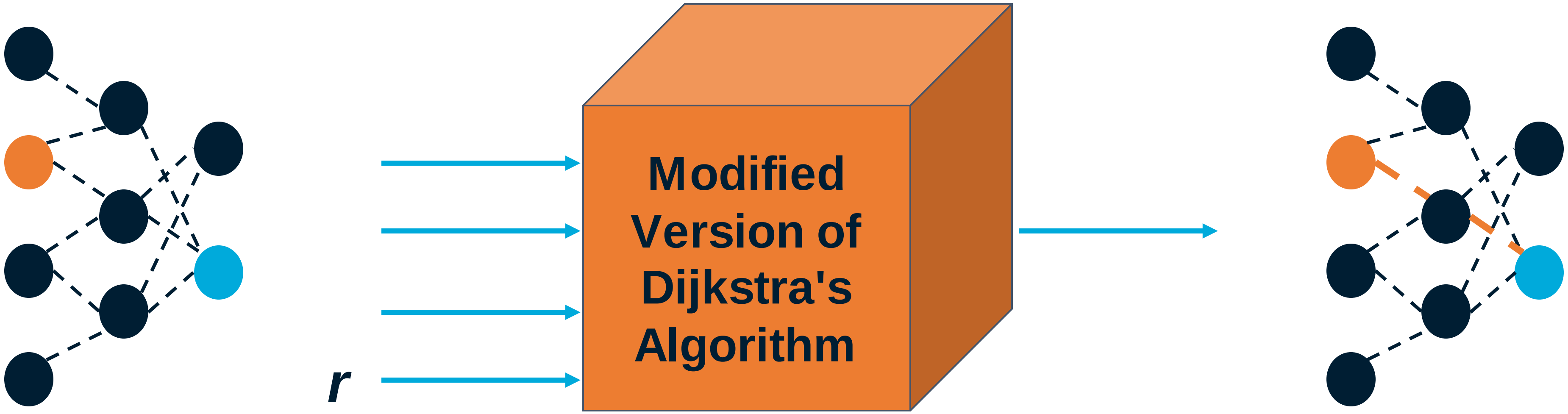
Streets of Medellín: Origin and Destination

Constrained Shortest Path Algorithm



Constrained Shortest Paths

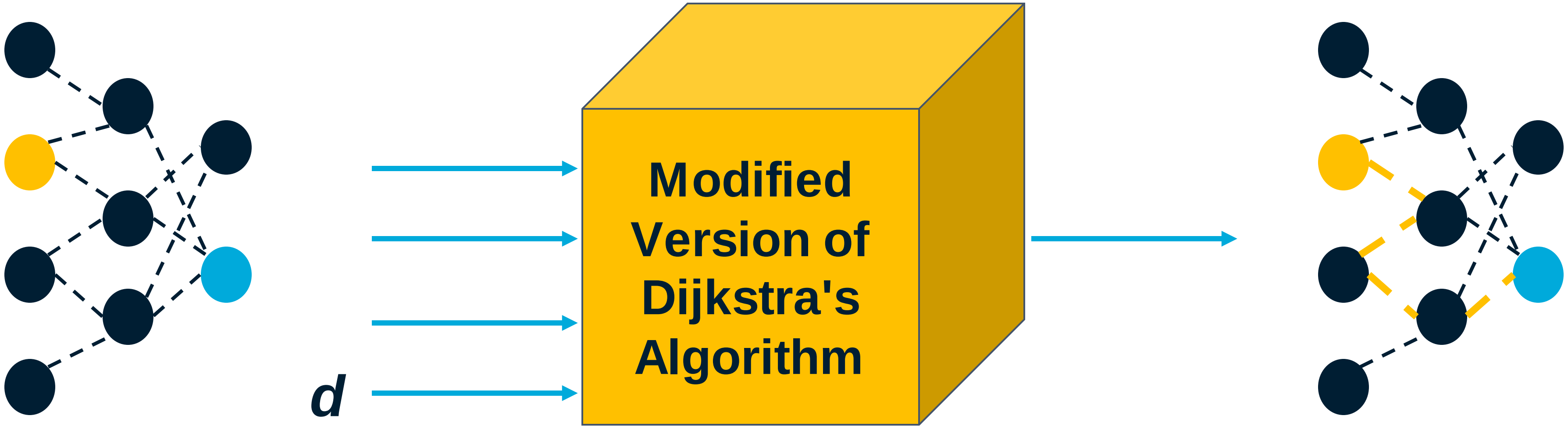
First Algorithm



Streets of Medellín, Origin and Destination

Shortest path without exceeding a weighted-average risk of harassment *r*

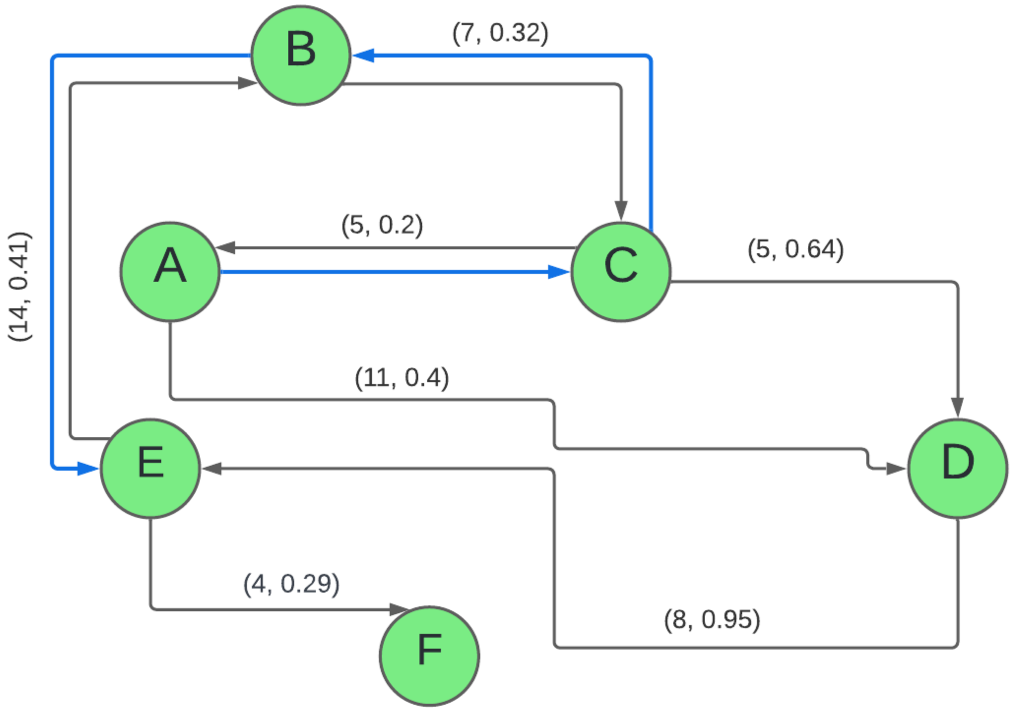
Second Algorithm



Streets of Medellín, Origin and Destination

Path with the lowest weighted-average risk of harassment without exceeding a distance *d*

Algorithm Explanation



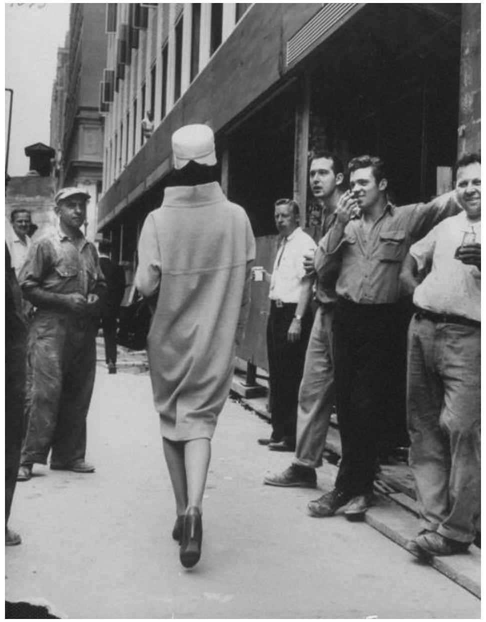
Example Execution:

Source = A
Destination = E
Max Risk = 0.5

Shortest path from A to E without exceding av. risk of 0.5
A -> C -> B -> E

Vertex	Shortest Distance from A	Prev. Vertex	Average Weighted Risk
A	0	-1	0
B	~~∞,~~ 12	C	0.27
C	~~∞,~~ 5	A	0.2
D	~~∞,~~ ~~11,~~ 10	~~A,~~ C	~~0.4,~~ 0.42
E	~~∞,~~ 26	B	0.34
F	∞		

Queue: {~~A,~~ ~~C,~~ ~~D,~~ ~~B,~~ E}



Modified Dijkstra's Algorithm for the Constrained Shortest Path Problem

https://github.com/isabelmorar/ST0245-001

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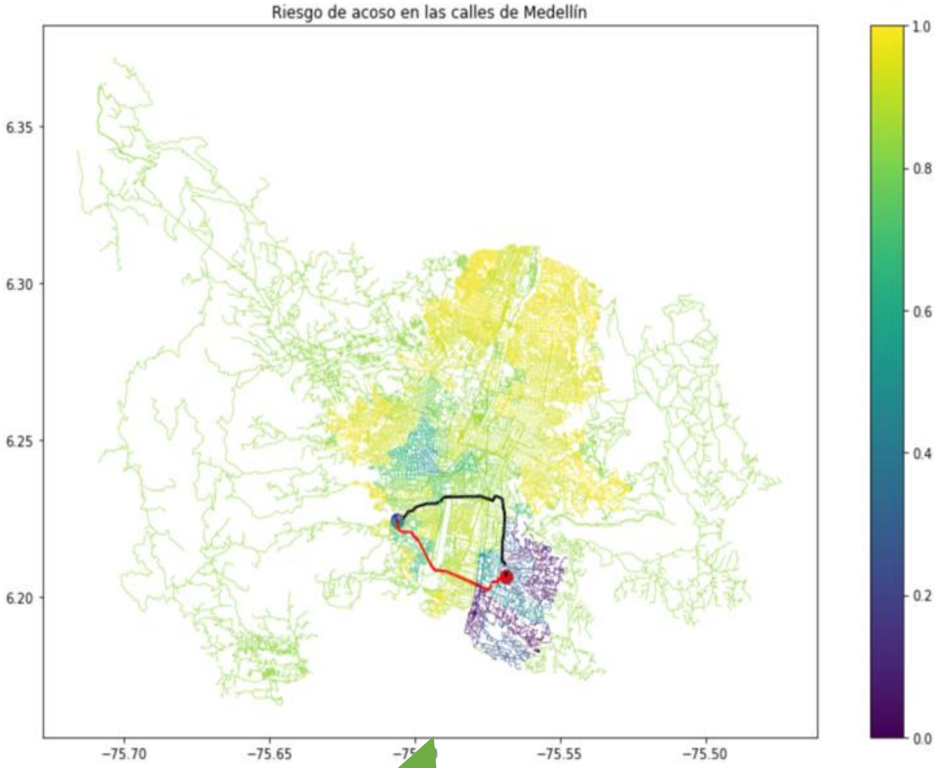
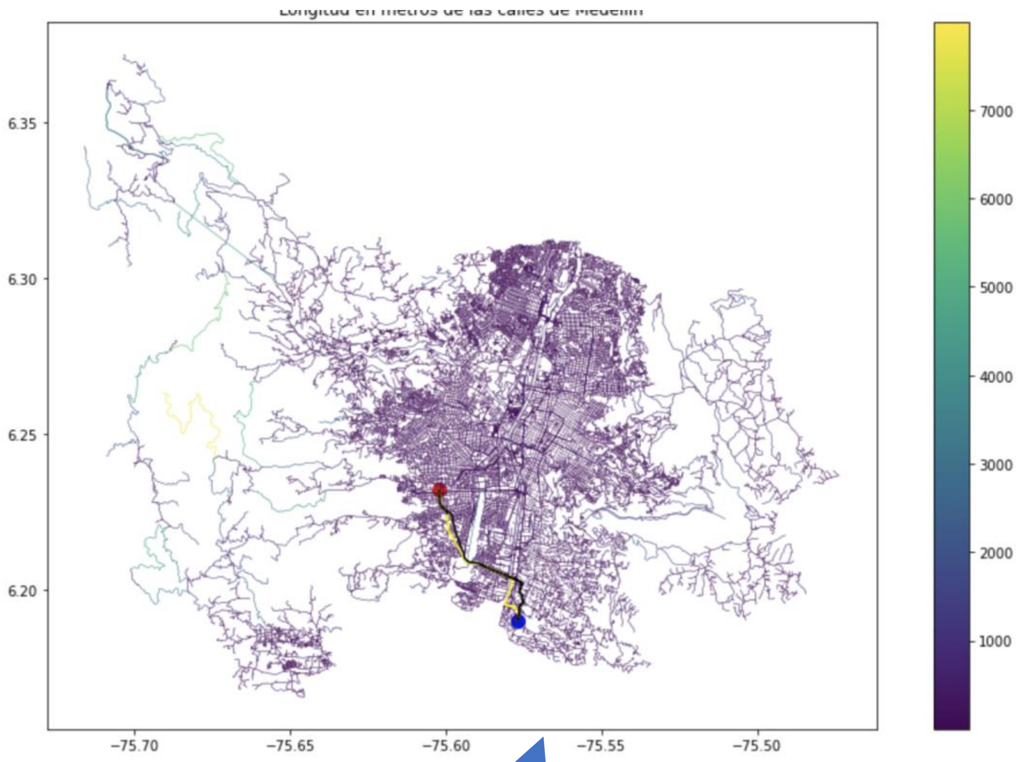
Example Output

```
Shortest path (red) -
Total Distance: 5903.91 meters
Average Risk: 0.688

Shortest path without exceeding risk of 0.65 (black) -
Total Distance: 7644.081 meters
Average Risk: 0.647
```



Carrera 39 to Carrera 83

```
Path with lowest risk (yellow) -
Total Distance: 4302.909 meters
Average Risk: 0.727

Path with lowest risk without excedding distance of 4100 meters (black) -
Total Distance: 4056.151 meters
Average Risk: 0.823
```



Calle 30A to Calle 16A

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	Time Complexity	Memory Complexity
Modified Dijkstra’s with Adjacency List	O((V + E) logV)	O(V + E)

Time and memory complexity of the modified version of Dijkstra’s algorithm, where V is the number of nodes and E is the number of edges in the graph. Specifically, V represents the intersections and E represents the streets in Medellin’s map.

Shortest Path Results

Origin	Destination	Path	Maximum weighted-average risk of harassment
Universidad EAFIT	Universidad de Medellín	d = 6142.57 m r = 0.758	0.84
Universidad de Antioquia	Universidad Nacional	d = 860.19 m r = 0.845	0.85
Universidad Nacional	Universidad Luis Amigó	d = 1910.13 m r = 0.842	0.845

Path with shortest distance without exceeding a weighted average risk of harassment *r*.

Lowest Risk Results

Origin	Destination	Path	Maximum distance (meters)
Universidad EAFIT	Universidad de Medellín	r = 0.719 d = 6183.71 m	7000
Universidad de Antioquia	Universidad Nacional	r = 0.865 d = 815.44 m	820
Universidad Nacional	Universidad Luis Amigó	r = 0.849 d = 1472.52	1500

Path with lowest weighted-average risk of harassment without exceeding a distance *d*.

Algorithm Execution Times

Origin	Destination	Execution Time
UNIVERSIDAD EAFIT	Universidad de Medellín Ciencia y Libertad	11.787 seconds
UNIVERSIDAD DE ANTIOQUIA	UNIVERSIDAD NACIONAL DE COLOMBIA	8.095 seconds
UNIVERSIDAD NACIONAL DE COLOMBIA	UNIVERSIDAD CATÓLICA LUIS AMIGÓ	8.292 seconds

Future Work Directions

Web Development

- Graphical display of calculated paths
- Interactive user interface

Statistics

- Improve the numerical representation of sexual harassment risk
- Consider user demographics

Optimization

- Bi-objective optimization
- Calculate optimal path based on risk and distance simultaneously.

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- Traffic Estimation
- Predict ideal paths through simulations of different scenarios

Report Accepted on OSF.IO

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