



# **Prevention of Street Harassment Through Constrained Shortest Path Algorithms**

# Team Presentation



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Report and  
algorithms



**Andrea  
Serna**  
Literature review



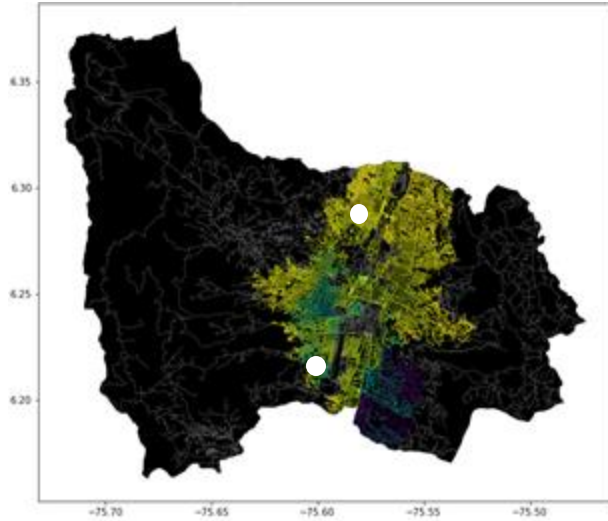
**Mauricio  
Toro**  
Data preparation



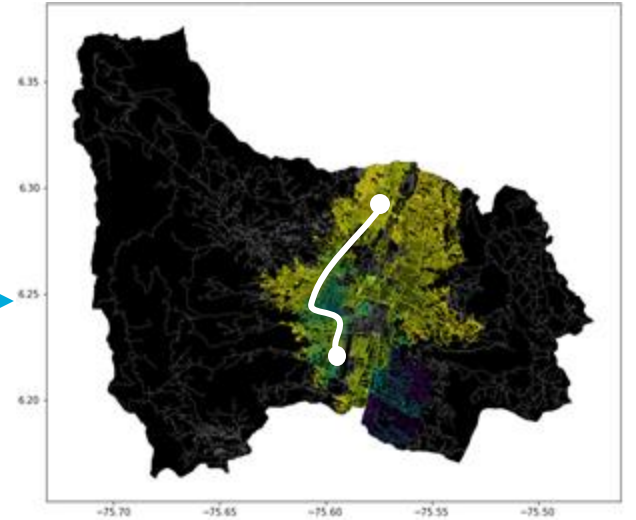
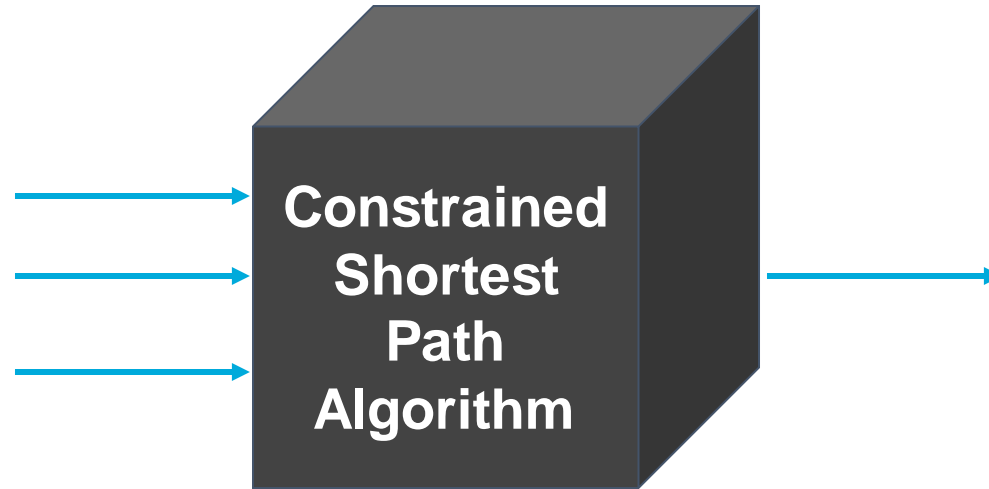
<https://github.com/isabelmorar/ST0245-001>



# Problem Statement

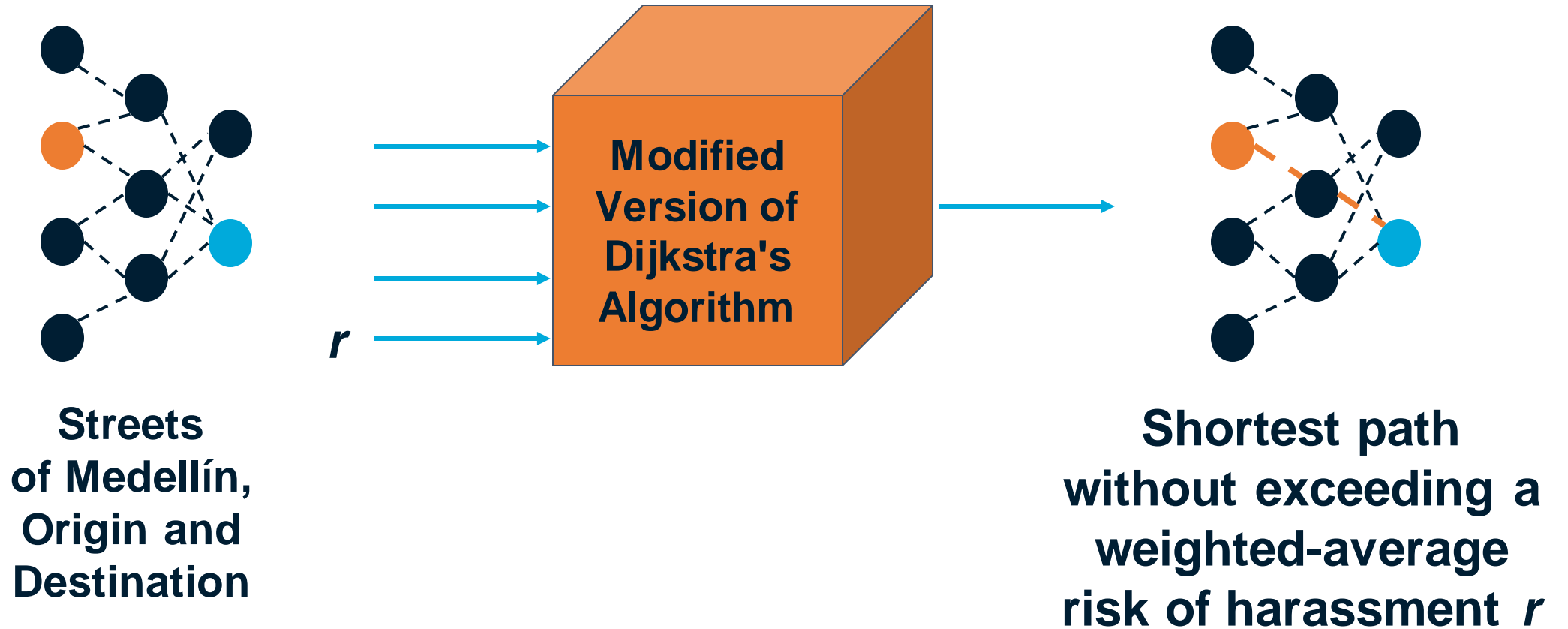


**Streets of Medellín:  
Origin and  
Destination**

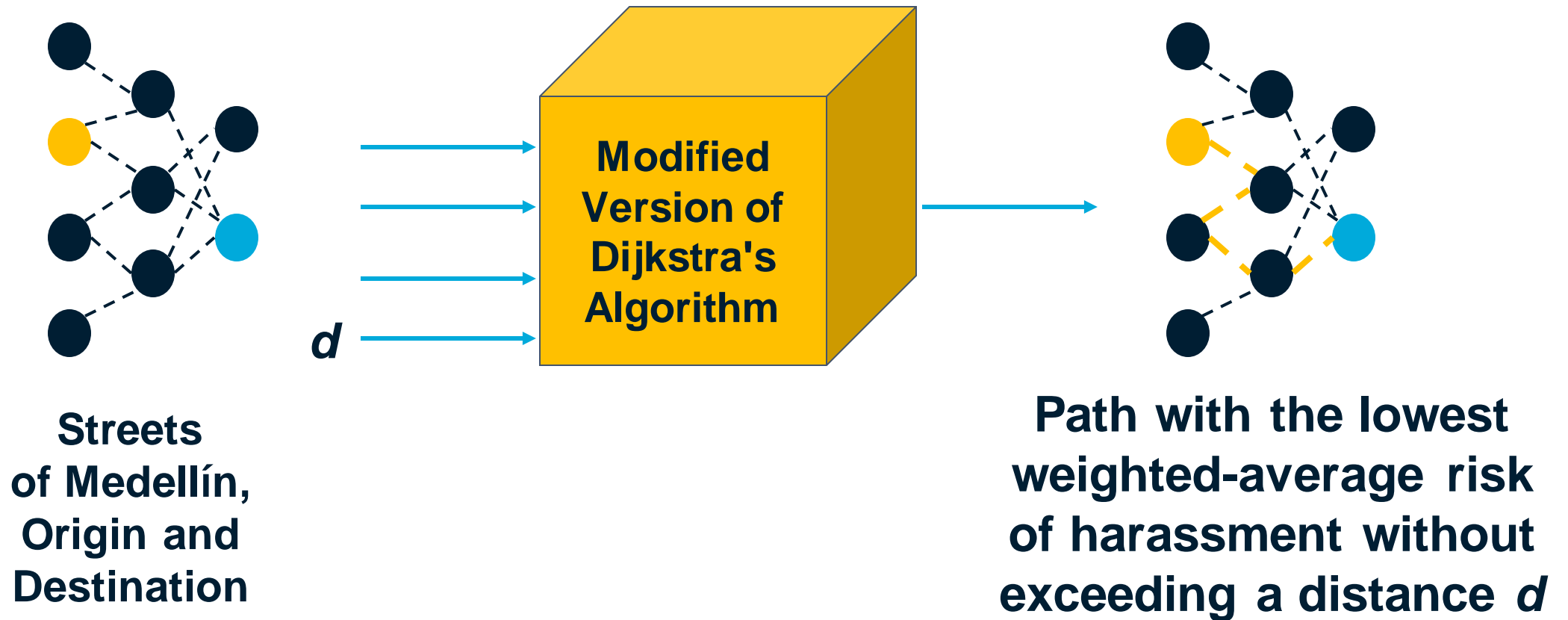


**Constrained  
Shortest  
Paths**

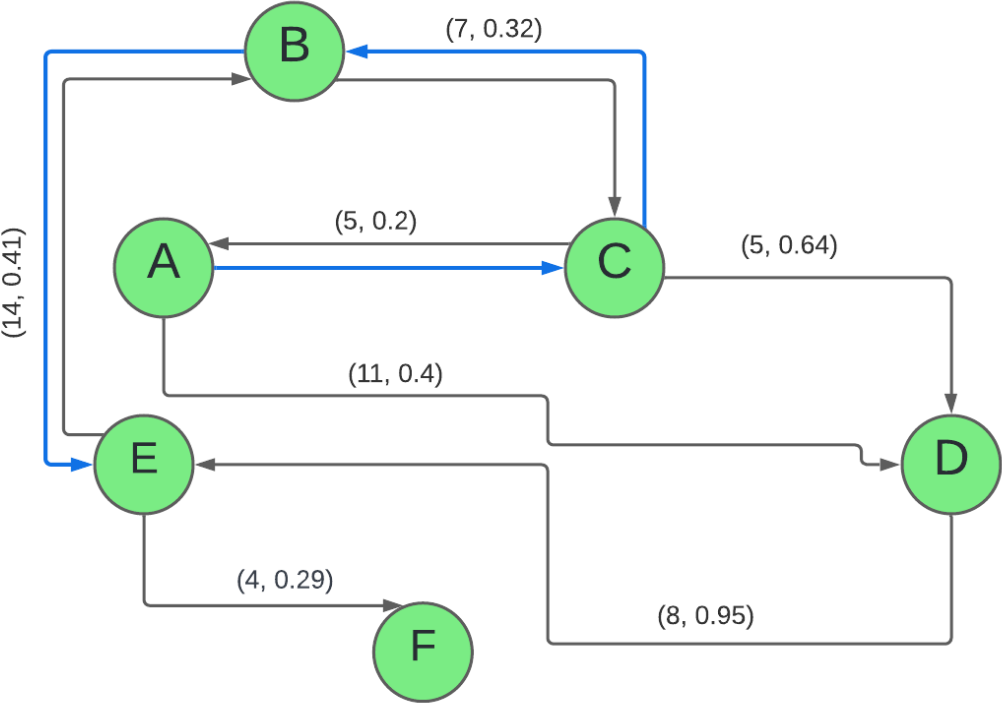
# First Algorithm



## Second Algorithm



# Algorithm Explanation



## Example Execution:

Source = A  
Destination = E  
Max Risk = 0.5

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

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

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



Modified Dijkstra's Algorithm for the  
Constrained Shortest Path Problem



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



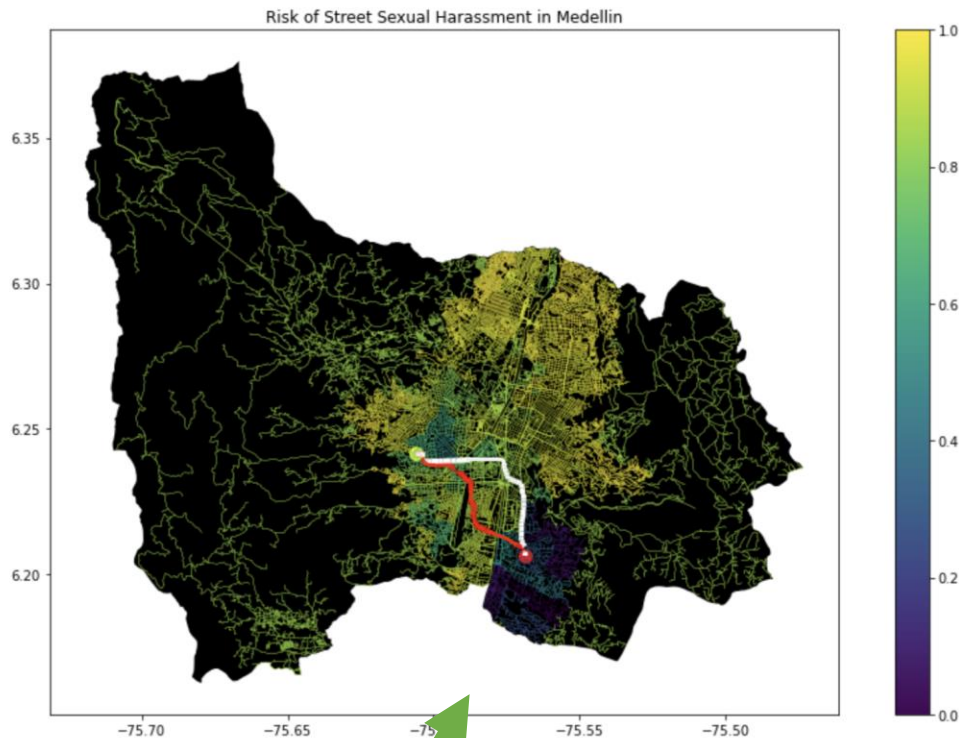


# Example Output



Shortest path (red) –  
Total Distance: 7323.31 meters  
Average Risk: 0.741

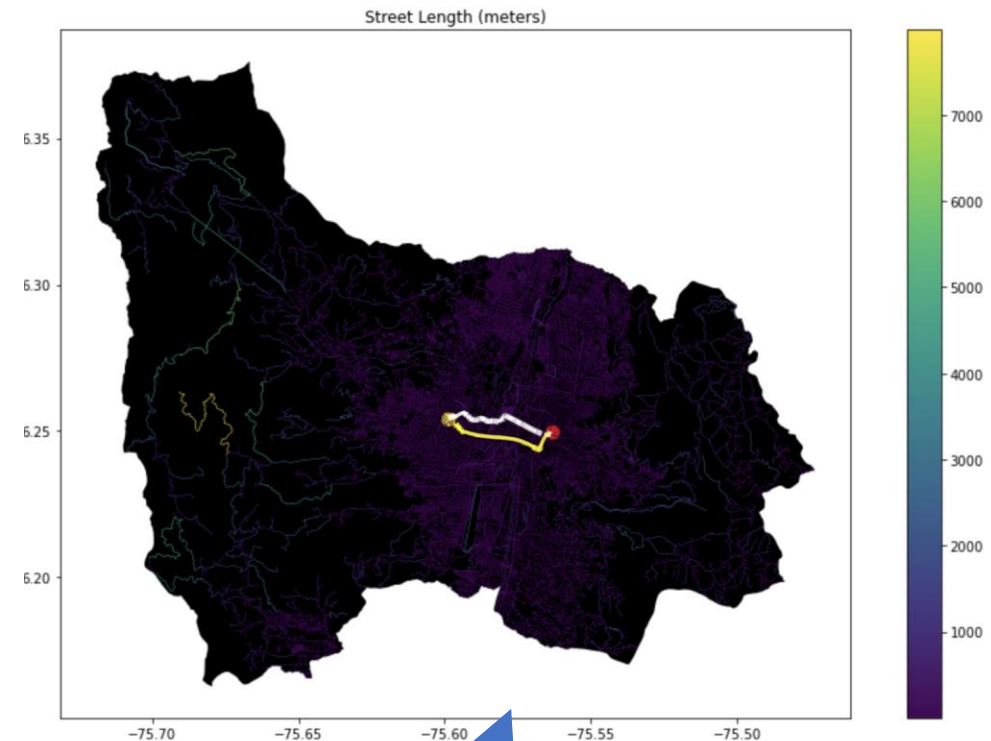
Shortest path without exceeding risk of 0.65 (white) –  
Total Distance: 7913.826 meters  
Average Risk: 0.6



Carrera 39 to Carrera 83

Path with lowest risk (yellow) –  
Total Distance: 4933.763 meters  
Average Risk: 0.814

Path with lowest risk without exceeding distance of 4700 meters (white) –  
Total Distance: 4631.827 meters  
Average Risk: 0.855



Calle 30A to Calle 16A

	Time Complexity	Memory Complexity
Modified Dijkstra's with Adjacency List	$O((V + E) \log V)$	$O(V + E)$ $O(V * 5) = O(V)$

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	$d = 6142.57 \text{ m}$ $r = 0.758$	0.77
Universidad de Antioquia	Universidad Nacional	$d = 860.19 \text{ m}$ $r = 0.845$	0.85
Universidad Nacional	Universidad Luis Amigó	$d = 1910.13 \text{ m}$ $r = 0.842$	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	$r = 0.719$ $d = 6183.71 \text{ m}$	7000
Universidad de Antioquia	Universidad Nacional	$r = 0.865$ $d = 815.44 \text{ m}$	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®**



**11.787 seconds**



**UNIVERSIDAD  
DE ANTIOQUIA**



**UNIVERSIDAD  
NACIONAL  
DE COLOMBIA**



**8.095 seconds**



**UNIVERSIDAD  
NACIONAL  
DE COLOMBIA**



**8.292 seconds**



## 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.

## S & M 4

- • • • •

Traffic Estimation

- • • • •

Predict ideal paths through simulations of different scenarios



Mora, I., Serna, A., & Toro, M.  
(2022, May 18). Prevention of  
Street Harassment Through  
Constrained Shortest Path  
Algorithms. Universidad EAFIT.  
<https://doi.org/10.31219/osf.io/9fr32>

The screenshot shows the OSF Preprints interface. At the top, there's a navigation bar with the OSF Preprints logo, a dropdown menu, and links for 'My Preprints', 'Add a Preprint', 'Search', 'Support', 'Donate', and a user profile for 'Isabel Mora'. The main title of the preprint is 'Prevention of Street Harassment Through Constrained Shortest Path Algorithms'. Below the title, it lists the authors: 'Isabel Mora, Andrea Serna, Mauricio Toro'. There are also sections for 'AUTHOR ASSERTIONS' showing 'Conflict of Interest: No', 'Public Data: Available', and 'Preregistration: No'. On the right, there's a green 'Edit preprint' button. Below the title section, there's a 'Download' button and a 'Views | Downloads' section. The abstract is visible, starting with 'Street sexual harassment is an issue impacting the safety and well-being of citizens. Such a problem is prominent in Medellin, where women repeatedly say they feel unsafe while walking. Despite the negative side effects of street harassment, the lack of algorithms that warn citizens of areas where harassment is likely to occur perpetuates people's exposure to these situations.' The abstract is followed by a 'See more' link. The bottom of the screenshot shows the 'UNIVERSIDAD EAFIT' logo.



# THANK YOU!

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