Prevention of Street Harassment Through Constrained Shortest Path Algorithms

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Team Presentation

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Report and algorithms

Andrea Serna
Literature review

Mauricio Toro
Data preparation

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

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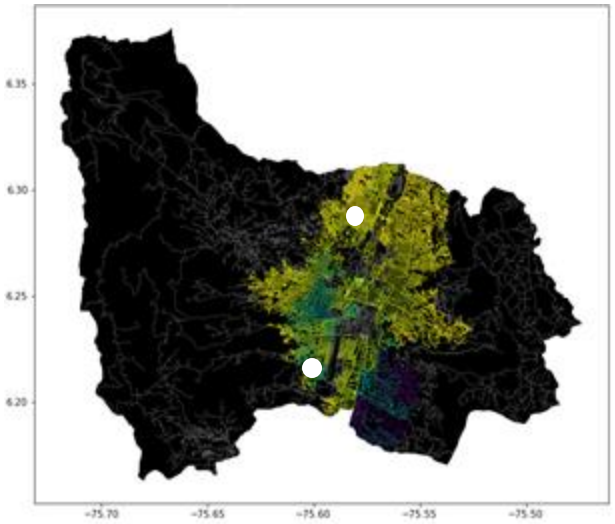
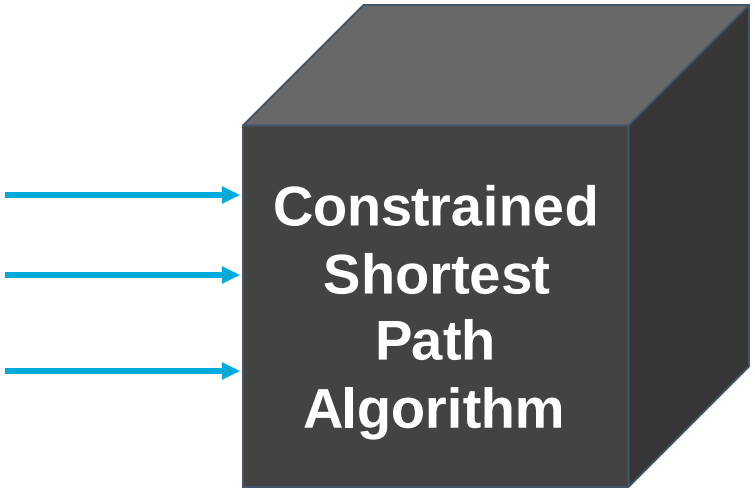
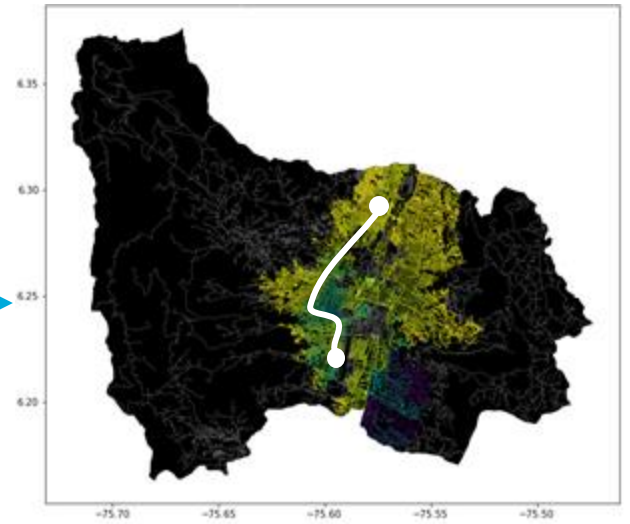
Problem Statement



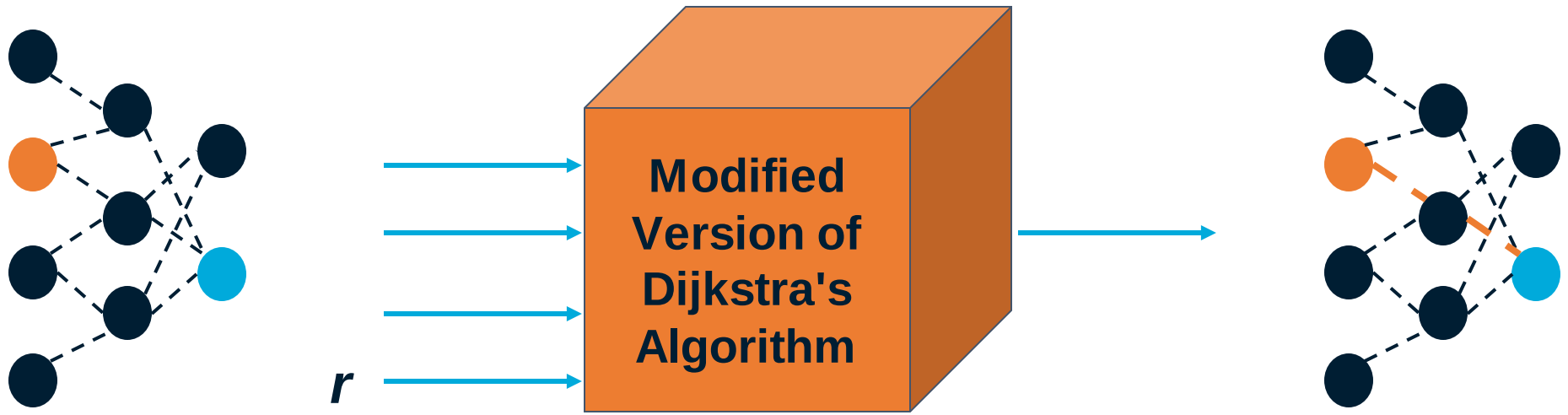
Streets of Medellín: Origin and Destination





Constrained Shortest Paths

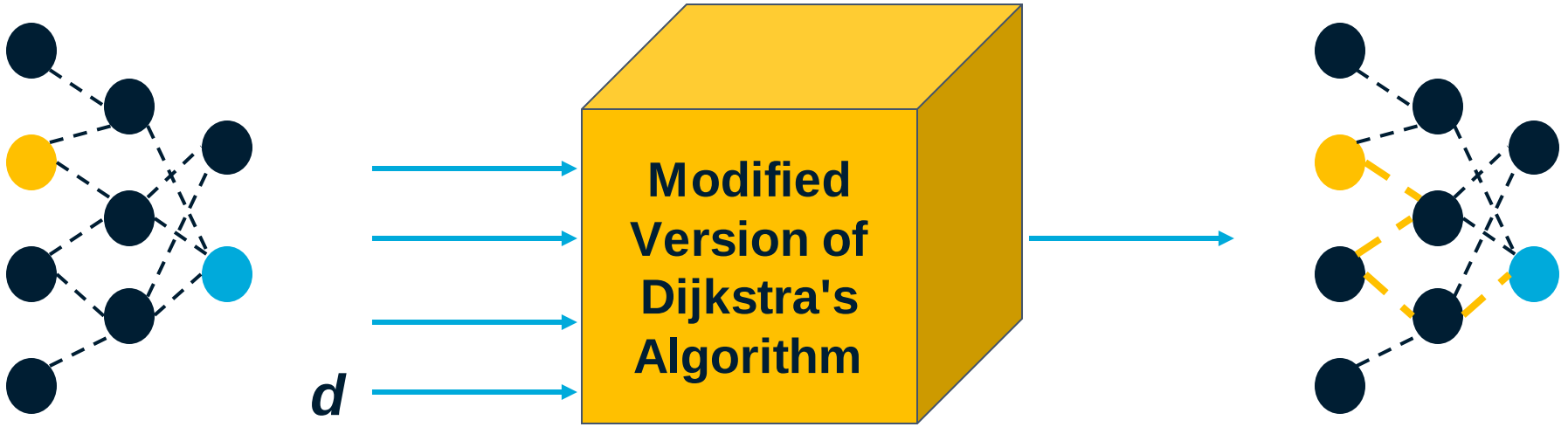
First Algorithm



Streets of Medellín, Origin and Destination

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

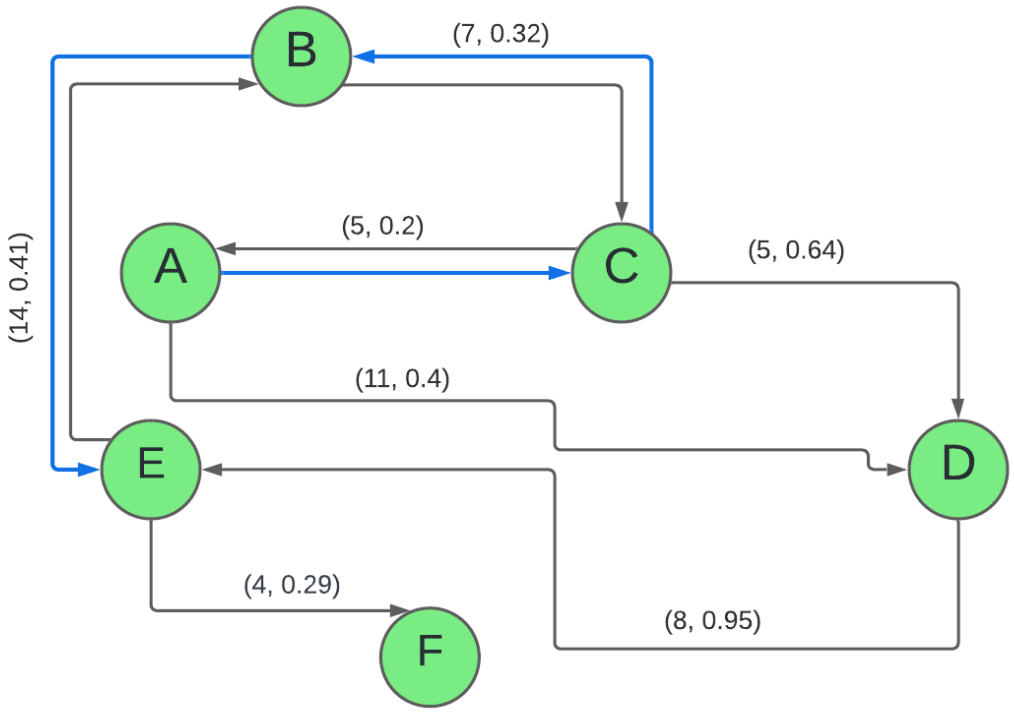
Second Algorithm



Streets of Medellín, Origin and Destination

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

Algorithm Explanation

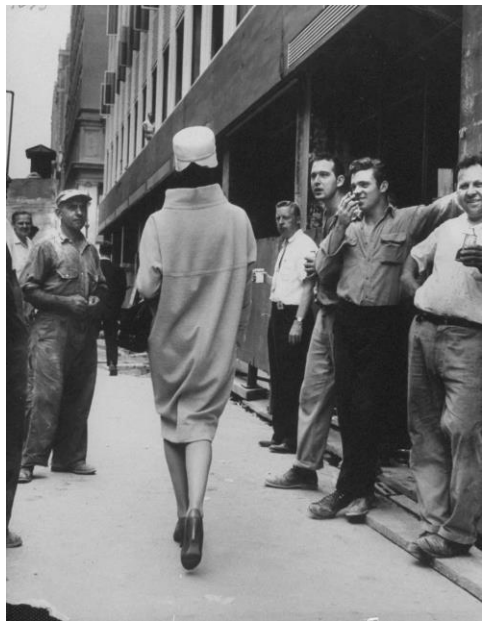


Example Execution:

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}

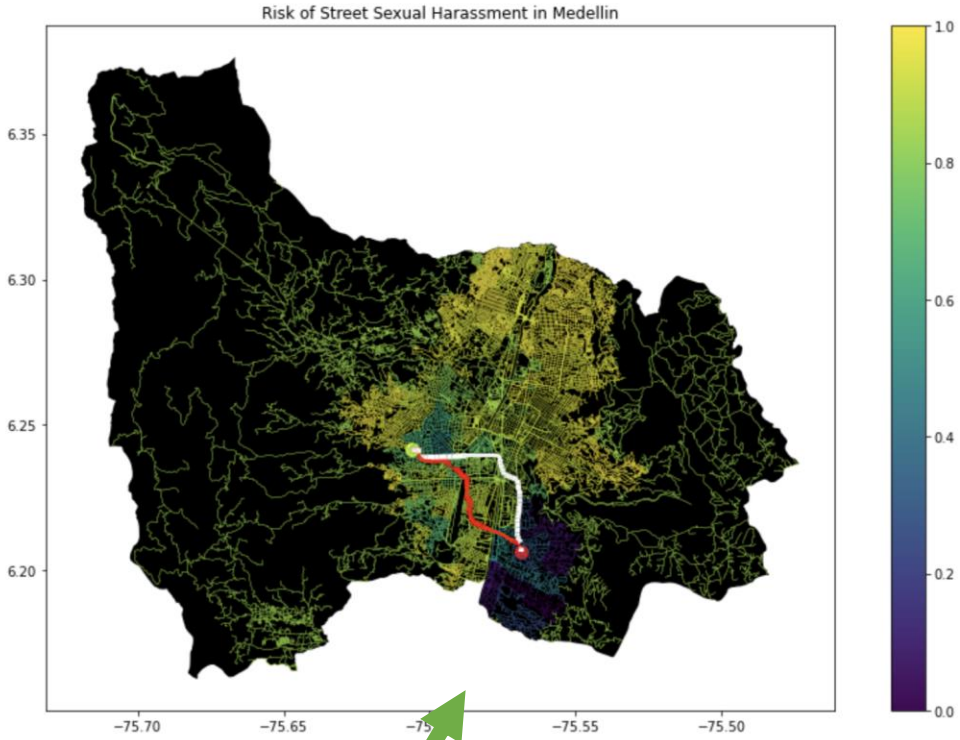


Modified Dijkstra's Algorithm for the Constrained Shortest Path Problem

Example Output

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

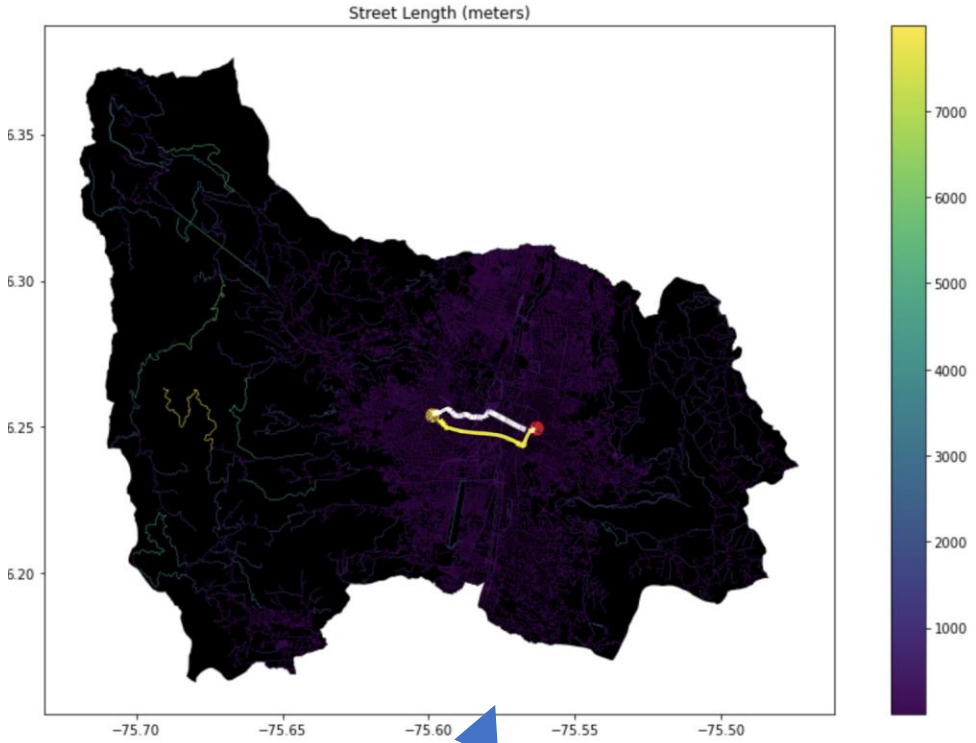
Shortest path without exceeding risk of 0.65 (white) –
Total Distance: 7913.826 meters
Average Risk: 0.6



Carrera 39 to Carrera 83

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

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



Calle 30A to Calle 16A

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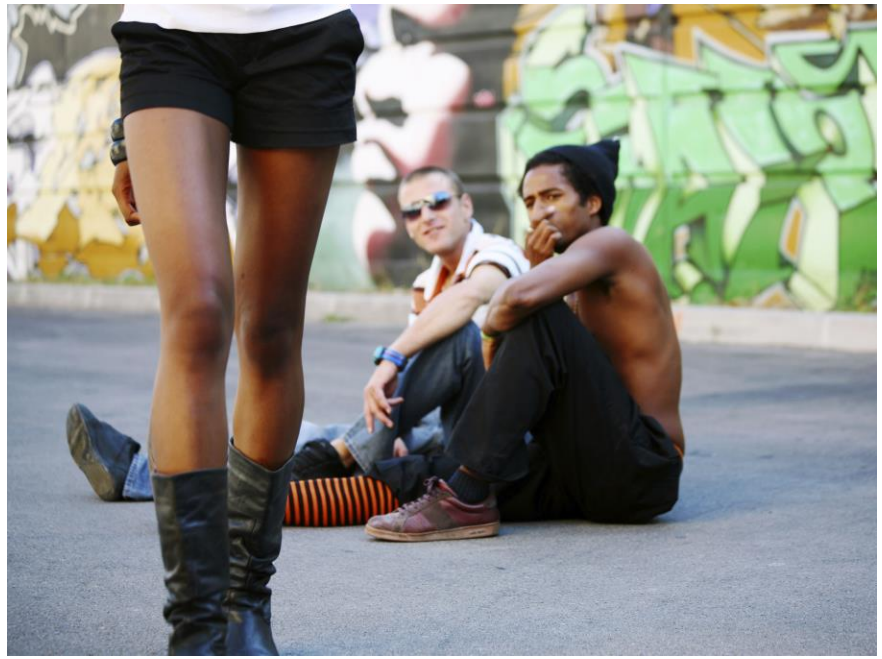
Algorithm Complexity

	Time Complexity	Memory Complexity
Modified Dijkstra's with Adjacency List	O((V + E) logV)	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 m r = 0.758	0.77
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	11.787 seconds
Universidad de Antioquia	Universidad Nacional de Colombia	8.095 seconds
Universidad Nacional de Colombia	Universidad Católica Luis Amigo	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.

S & M 4

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

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Report Accepted on OSF.IO

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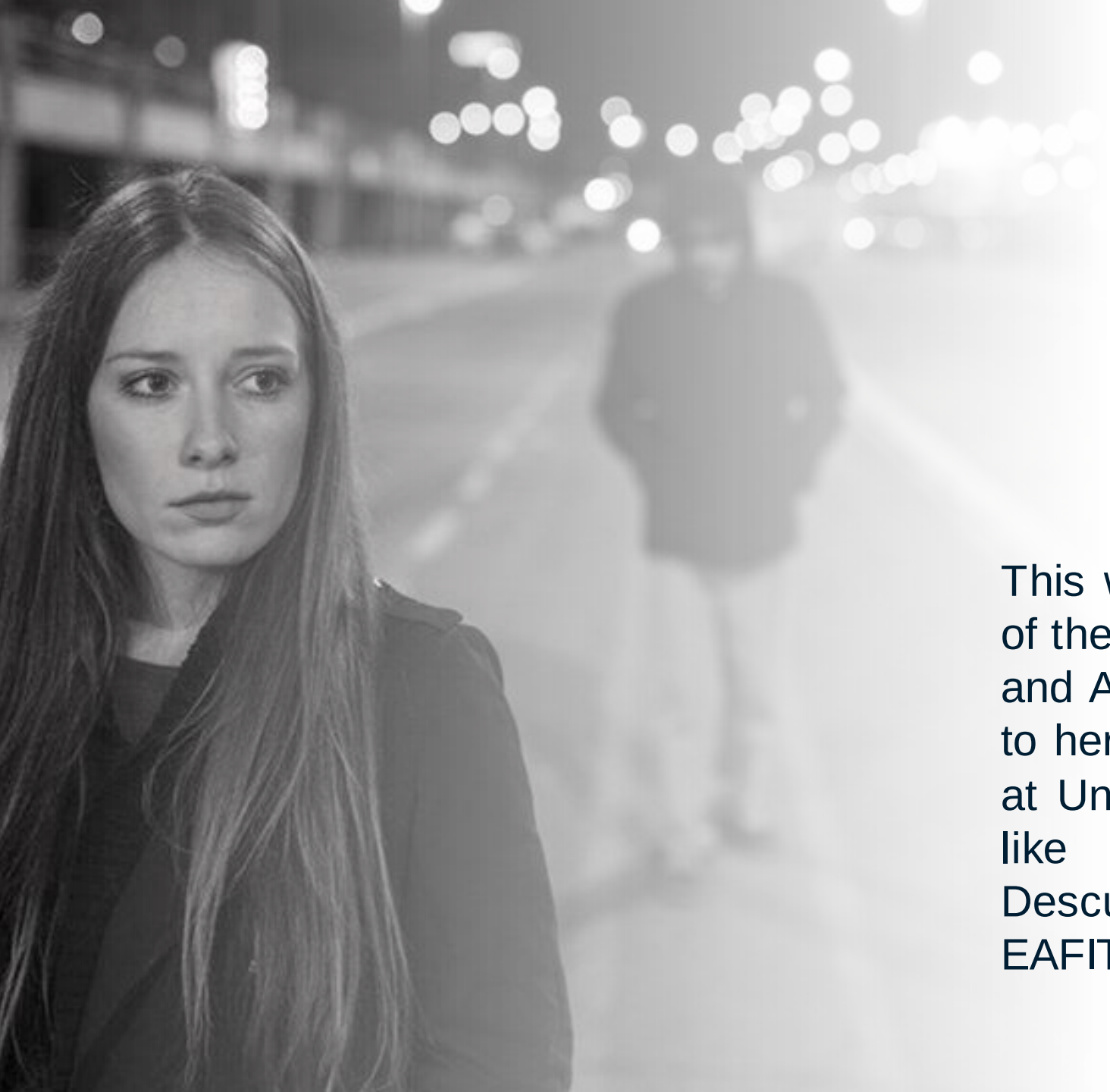

THANK YOU!

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