PATHFINDING ALGORITHM FOR SEXUAL HARASSMENT PREVENTION, APPLIED TO MEDELLÍN-COLOMBIA

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Presentation of the team

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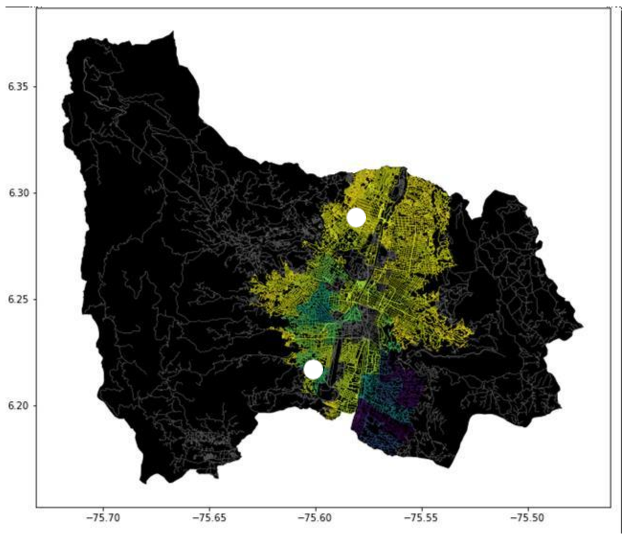
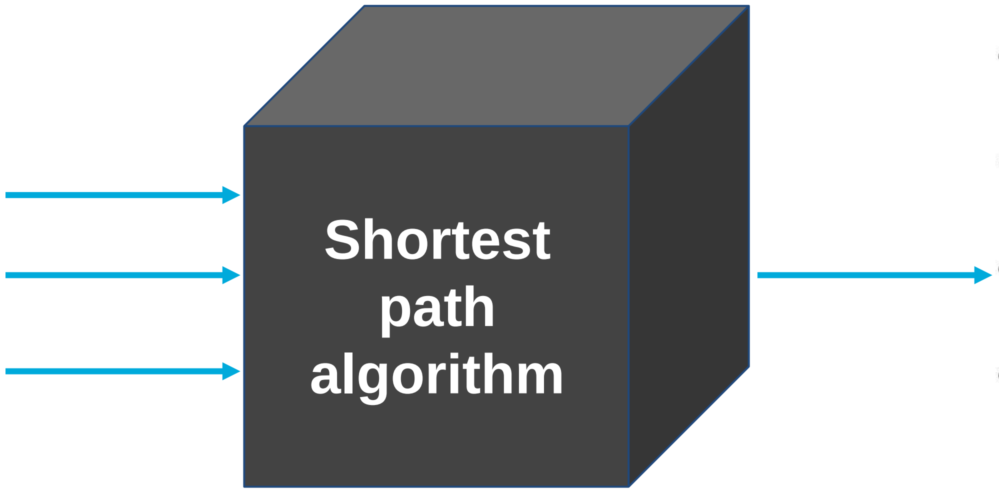
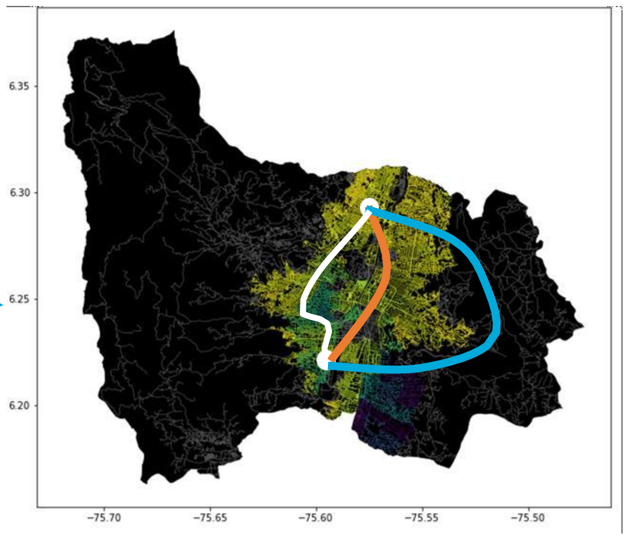
Data preparation

Problem Statement



Streets
of Medellín,
Origin and
Destination





Three paths that reduce both the risk of harassment and distance

https://github.com/RafaelUrbina/st245-002

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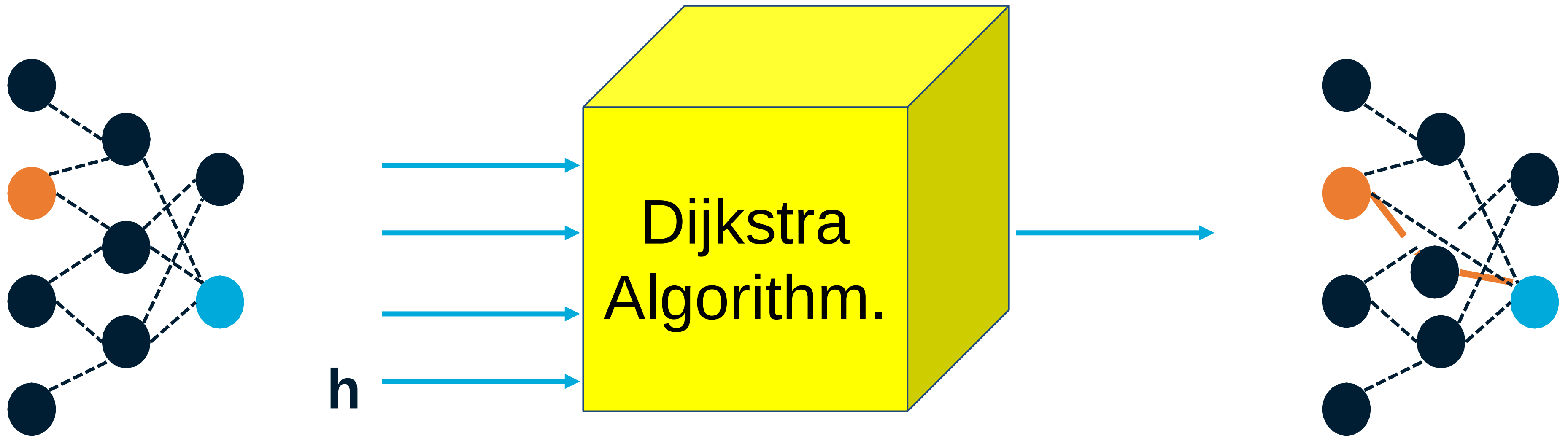
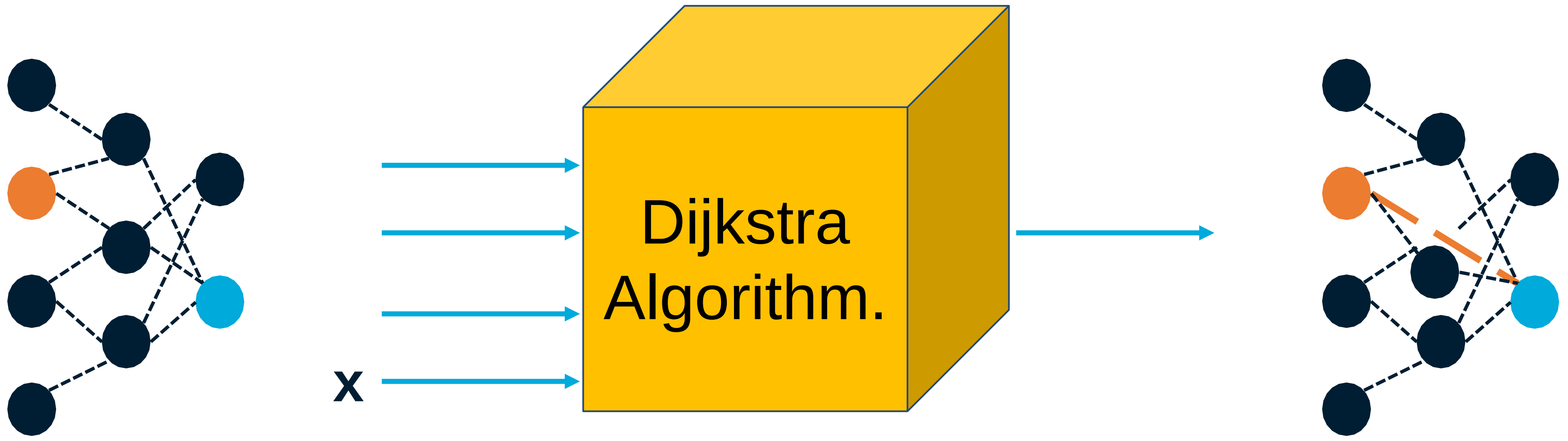
Solution Algorithm



Streets of Medellín, Origin and Destination

A path that reduces both distance and harassment

Solution Algorithm



Streets of Medellín, Origin and Destination

a path that further reduces only the distance

https://github.com/RafaelUrbina/st245-002

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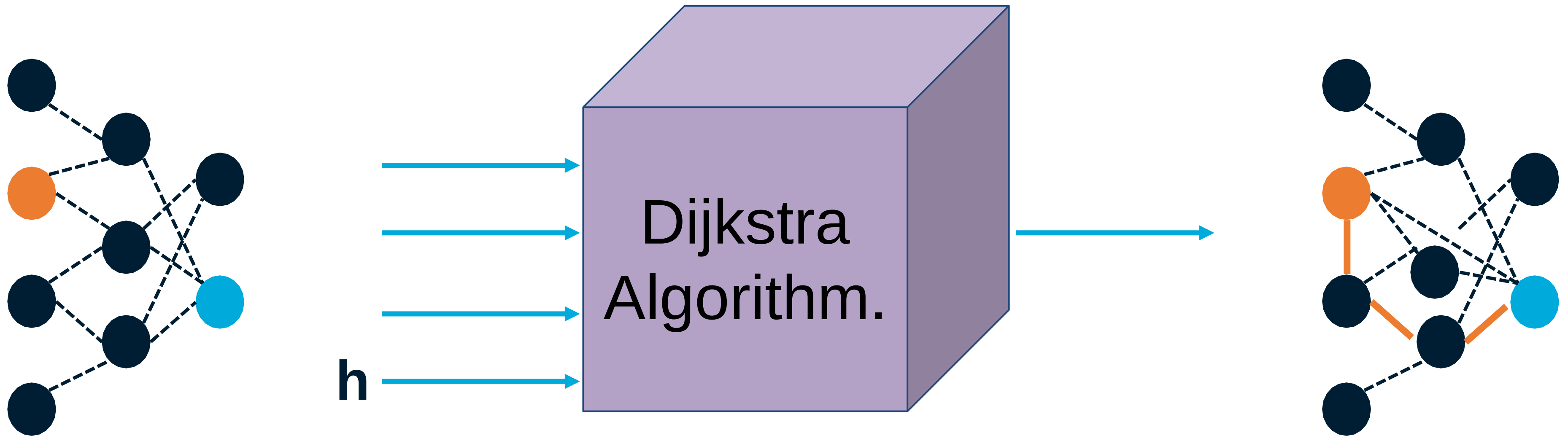
Solution Algorithm

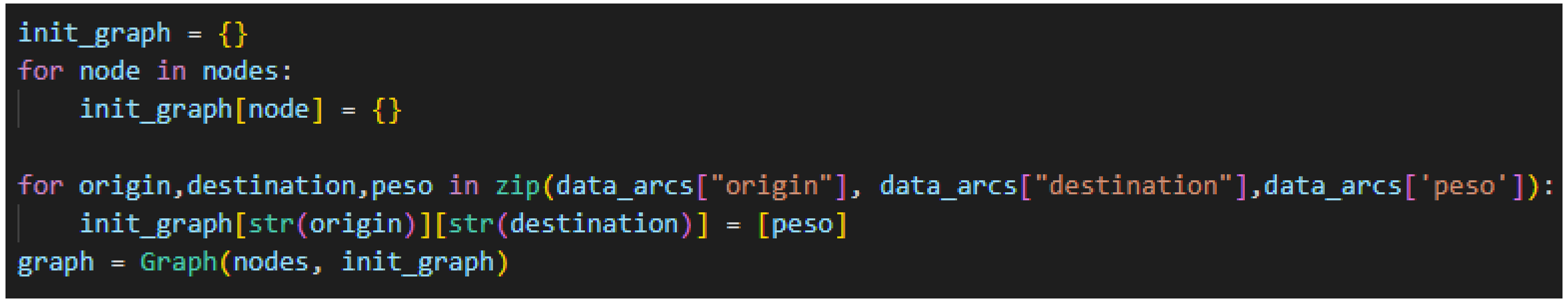


Streets of Medellín, Origin and Destination

a path that reduces risk regardless of distance

The graph implementation

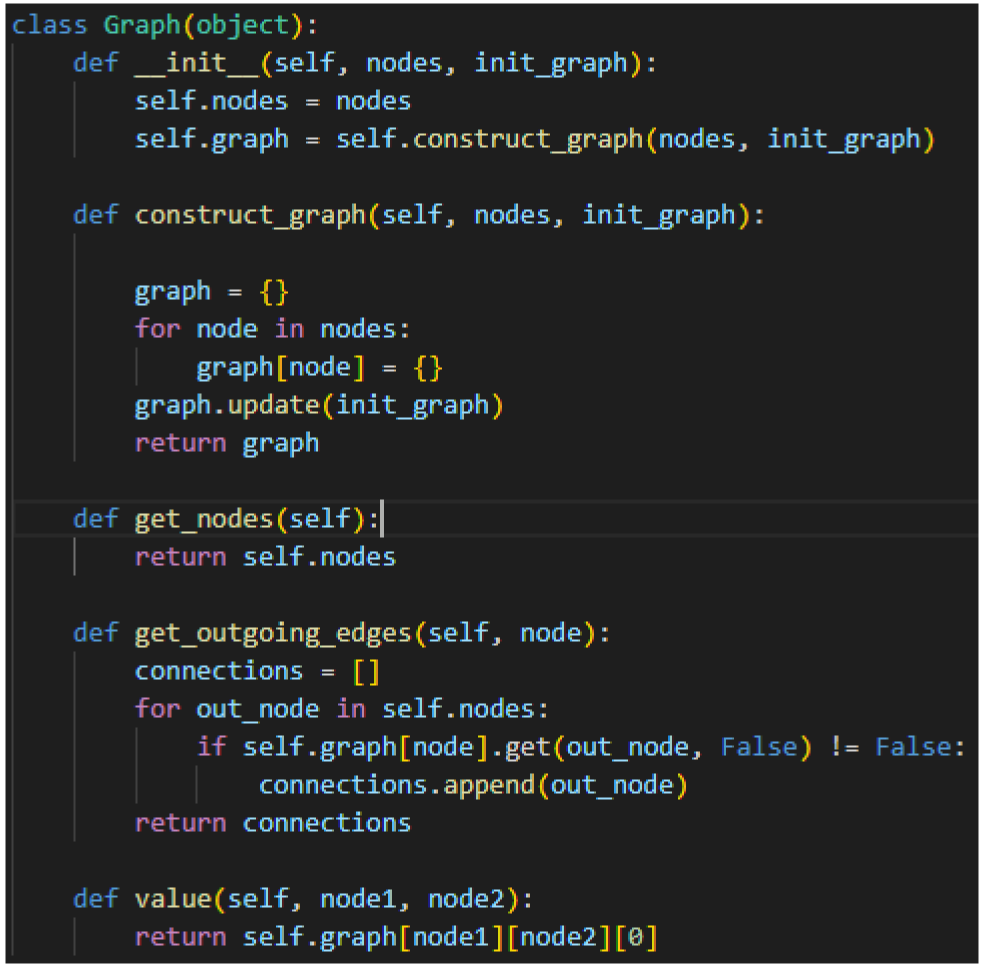
Our data structure is based on an Adjacency list implemented with dictionaries.



```
init_graph = {}
for node in nodes:
    init_graph[node] = {}

for origin,destination,peso in zip(data_arcs["origin"], data_arcs["destination"],data_arcs['peso']):
    init_graph[str(origin)][str(destination)] = [peso]
graph = Graph(nodes, init_graph)
```

The graph implementation

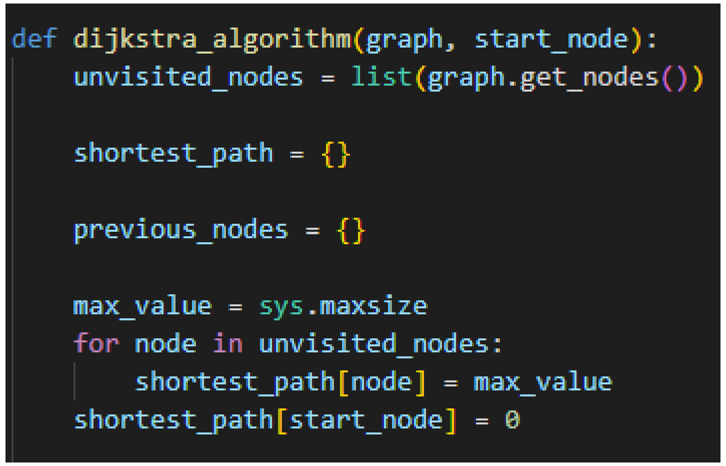
A class Graph is used since this allow us to implement the creation of the graph easily if we want to use it on another script



```python
class Graph(object):
    def __init__(self, nodes, init_graph):
        self.nodes = nodes
        self.graph = self.construct_graph(nodes, init_graph)

    def construct_graph(self, nodes, init_graph):

        graph = {}
        for node in nodes:
            graph[node] = {}
        graph.update(init_graph)
        return graph

    def get_nodes(self):
        return self.nodes

    def get_outgoing_edges(self, node):
        connections = []
        for out_node in self.nodes:
            if self.graph[node].get(out_node, False) != False:
                connections.append(out_node)
        return connections

    def value(self, node1, node2):
        return self.graph[node1][node2][0]
```

The algorithm (Dijkstra)

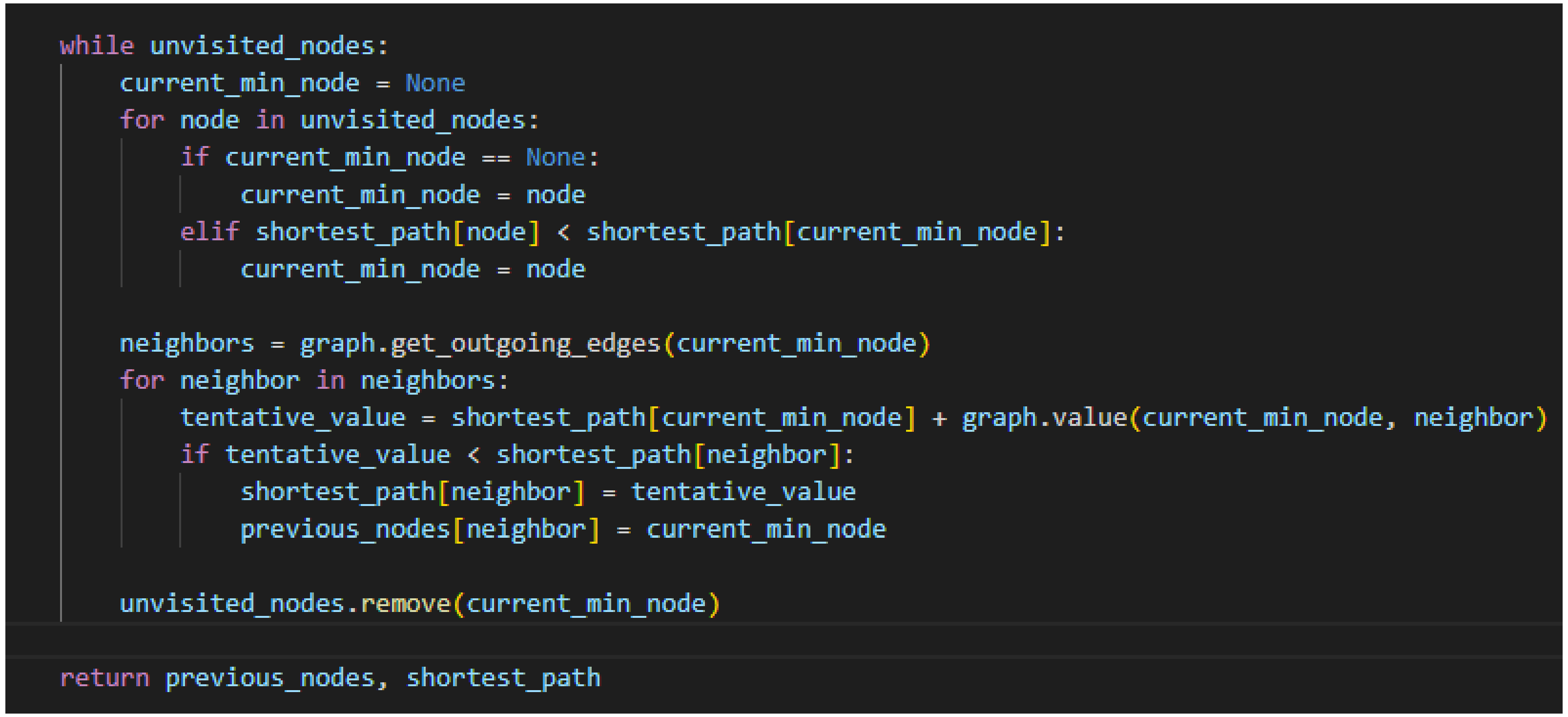
Dijkstra setting all nodes value close to infinity



```python
def dijkstra_algorithm(graph, start_node):
    unvisited_nodes = list(graph.get_nodes())

    shortest_path = {}

    previous_nodes = {}

    max_value = sys.maxsize
    for node in unvisited_nodes:
        shortest_path[node] = max_value
    shortest_path[start_node] = 0
```

The algorithm (Dijkstra)

Dijkstra finding the shortest path



```
while unvisited_nodes:
    current_min_node = None
    for node in unvisited_nodes:
        if current_min_node == None:
            current_min_node = node
        elif shortest_path[node] < shortest_path[current_min_node]:
            current_min_node = node

    neighbors = graph.get_outgoing_edges(current_min_node)
    for neighbor in neighbors:
        tentative_value = shortest_path[current_min_node] + graph.value(current_min_node, neighbor)
        if tentative_value < shortest_path[neighbor]:
            shortest_path[neighbor] = tentative_value
            previous_nodes[neighbor] = current_min_node

    unvisited_nodes.remove(current_min_node)

return previous_nodes, shortest_path
```

Explanation of the algorithm

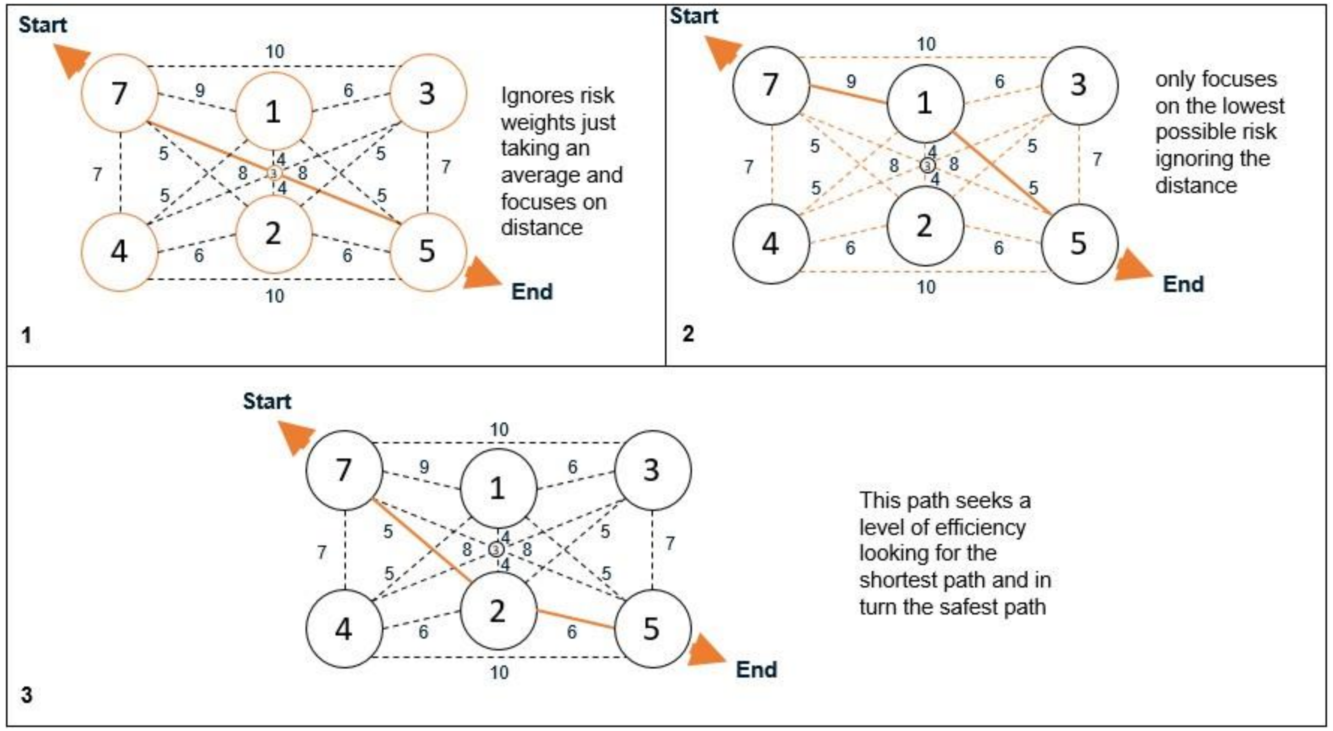

Start
10
9
6
7
1
3
5
4
8
2
End
Ignores risk weights just taking an average and focuses on distance
only focuses on the lowest possible risk ignoring the distance
This path seeks a level of efficiency looking for the shortest path and in turn the safest path

Figure 1: https://www.proclamadelcauca.com/dejame-caminar-por-la-calle-tranquila/

Dijkstra algorithm by three paths, One that takes both distance and risk[1], one that further reduces distance[2], one that gives the safest path[3].

Complexity of the algorithm

	Time complexity	Complexity of memory
Dijkstra Algorithm	$O(V^2)$ $O((V+E)\log V)$	O(V)

Time and memory complexity of the Dijkstra. where V is the number of vertices or nodes and E is the number of edges in the graph.

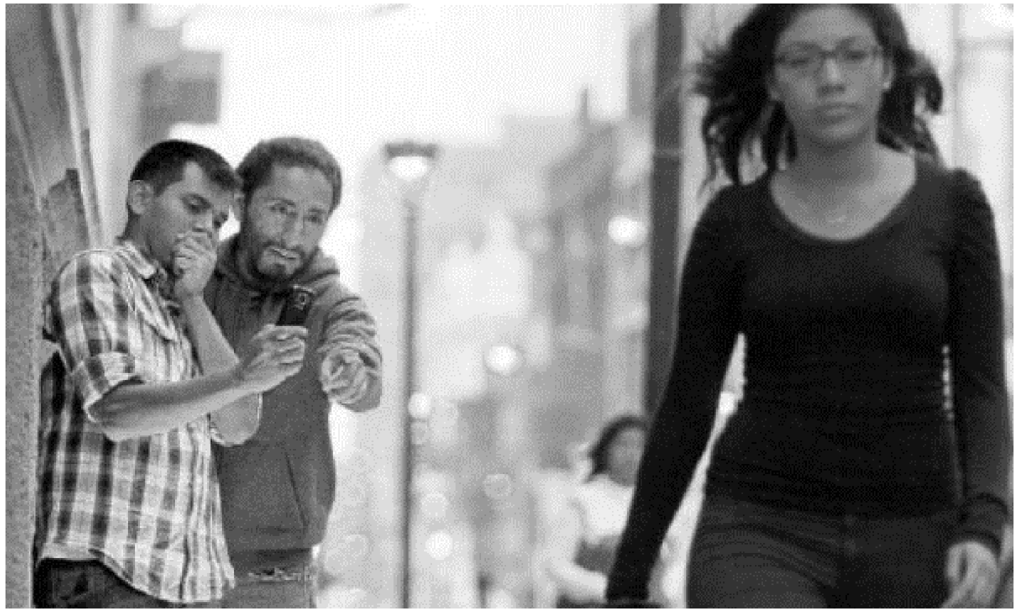


Figure 2: http://www.mujereslibresdeviolencia.usmp.edu.pe/6-cosas-que-debes-hacer-si-eres-victima-de-acoso-sexual-callejero/

First path minimizing d = Length

Origin	Destination	Distance (meters)	Risk of harassment (between 0 and 1)
EAFIT University	National University	7966.87	60.14

Distance and risk of harassment for the path that minimizes d = Length Execution time of 163.56 seconds.

Second path minimizing d = Both

Origin	Destination	Distance (meters)	Risk of harassment (between 0 and 1)
EAFIT University	National University	9671.59	35.10

Distance and risk of harassment for the path that minimizes d = Both Execution time of 164.24 seconds.

Third path minimizing d = Risk

Origin	Destination	Distance (meters)	Risk of harassment (between 0 and 1)
EAFIT University	National University	9680.52	35.10

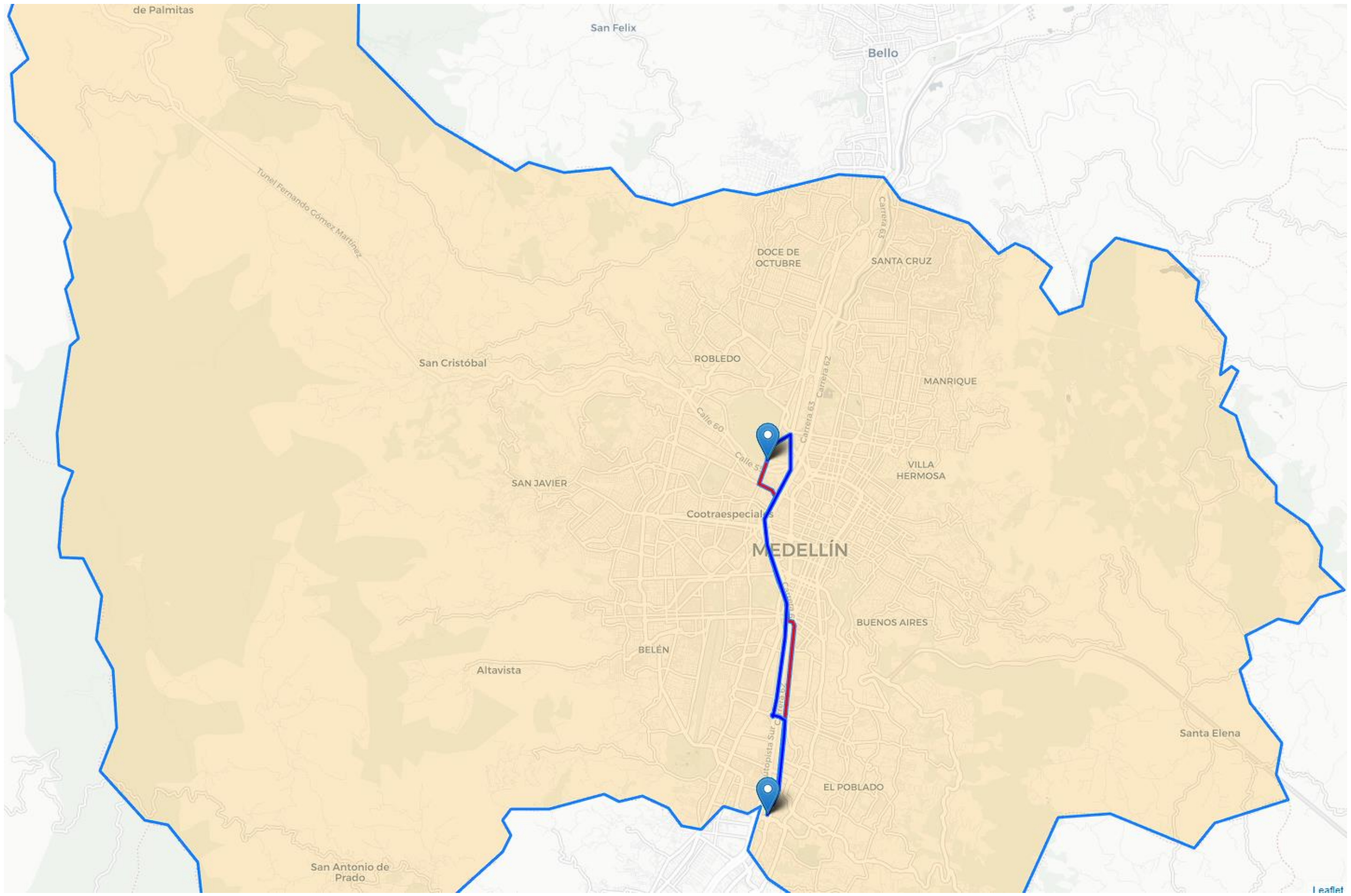
Distance and risk of harassment for the path that minimizes d = Risk Execution time of 166.48 seconds.

Other route d = all

Origin	Destination	Distance (meters)	Risk of harassment (between 0 and 1)
Las Palmas	La America	5603.60	67.66
Las Palmas	La America	6309.87	61.29
Las Palmas	La America	6365.76	61.28

Distance and risk of harassment for the path that minimizes d = all Execution time of 162 seconds.

Visual comparison of the three paths (Eafit- Unal)



🟥 Shortest 🟦 Safest 🟨 Combination

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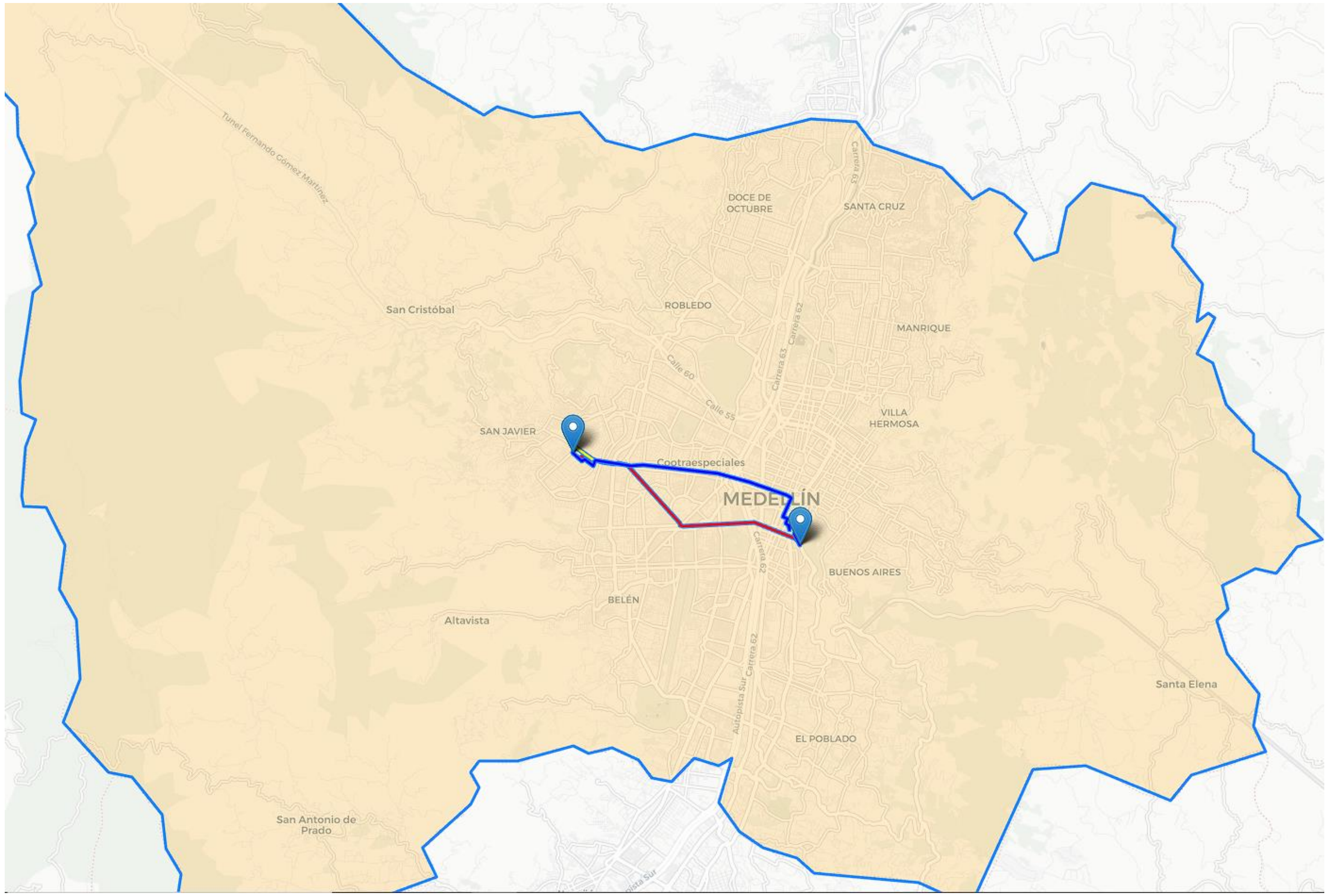
Visual comparison of the three paths (Las Palmas – La America)



🟥 Shortest 🟦 Safest 🟨 Combination

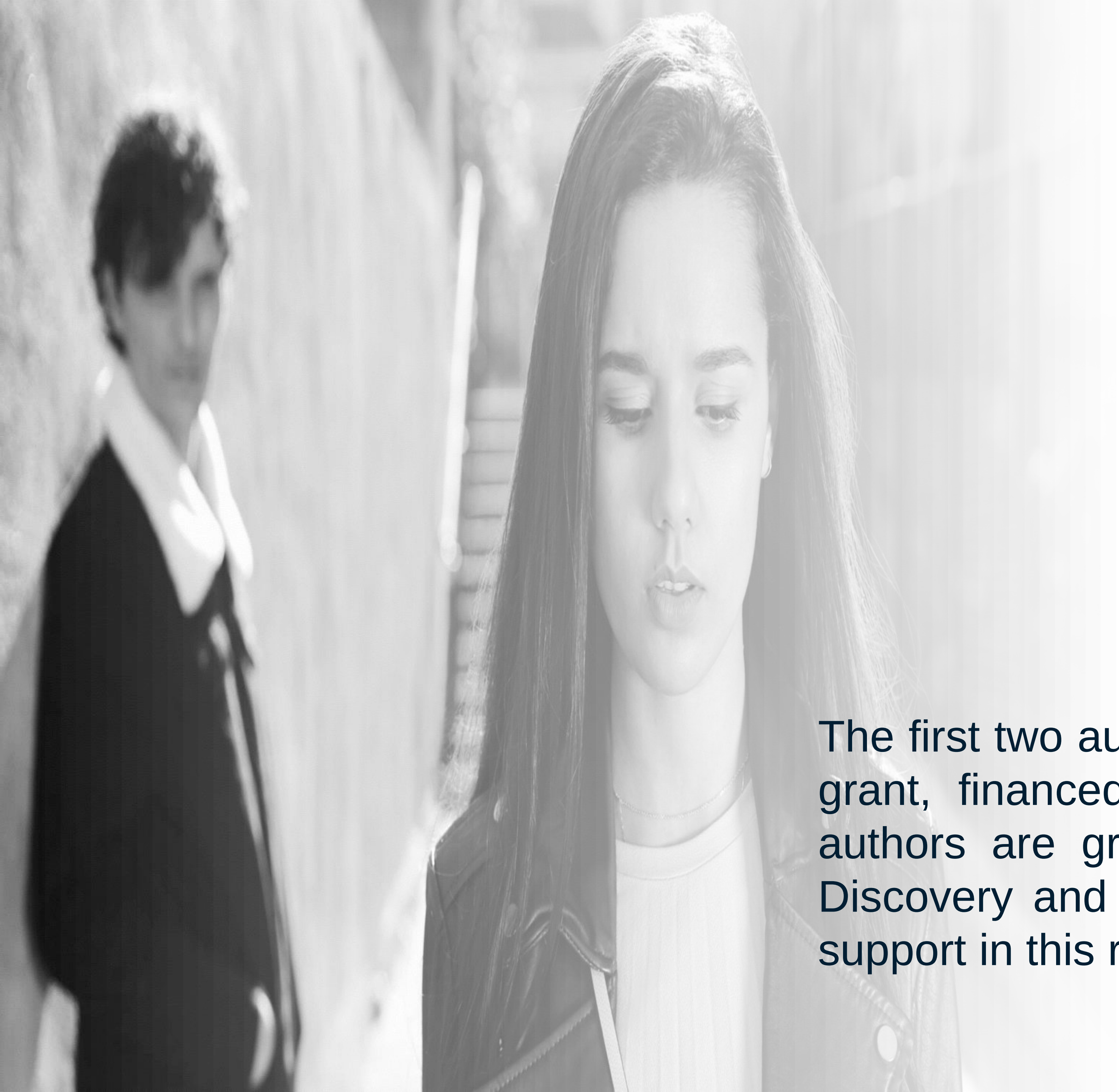
Future work directions

Databases
- Other variables
- Other algorithms

Project 1
- Web application

Software Engineering
- Mobile application

Project 2
- Include ML or VR



THANK YOU!

With the support of

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