Faster Shortest Path Computation for Traffic Assignment

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Traffic Assignment

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- transportation network with supply and demand nodes

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- minimise travel times

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- arcs have non-linear travel times for capturing congestion effects

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Initialise: load all traffic on shortest path with free flow travel times

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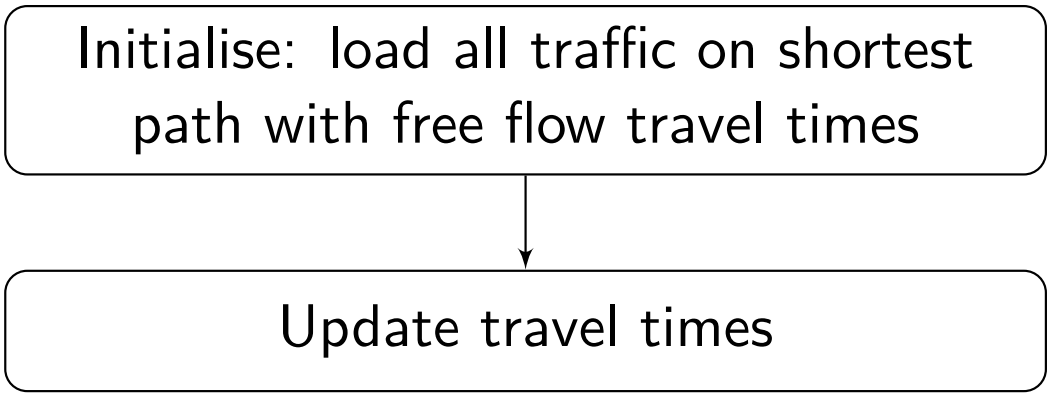

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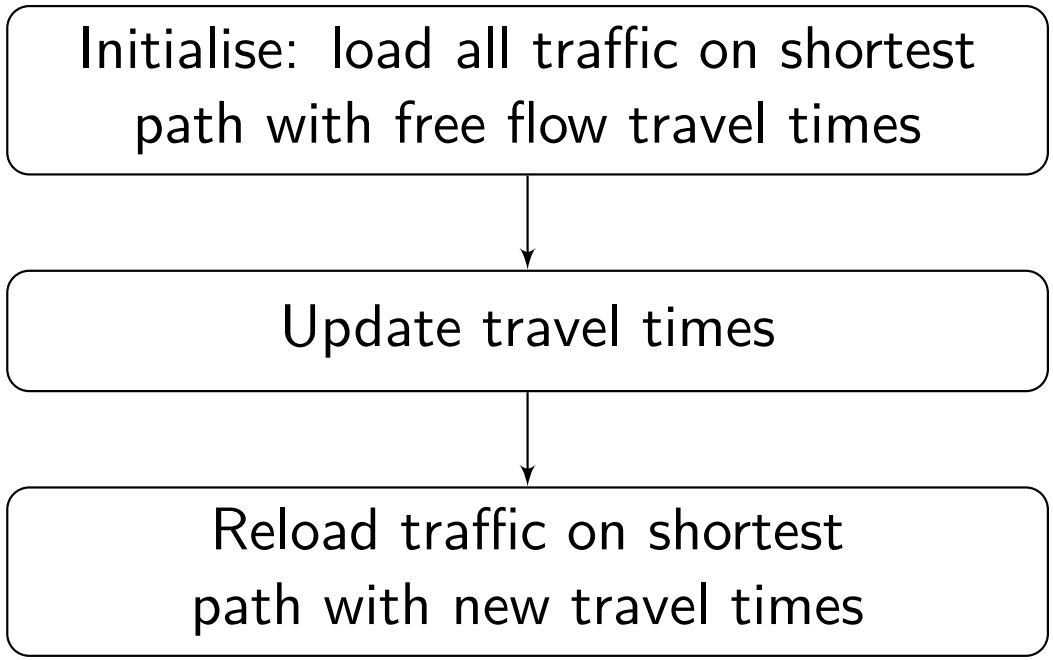

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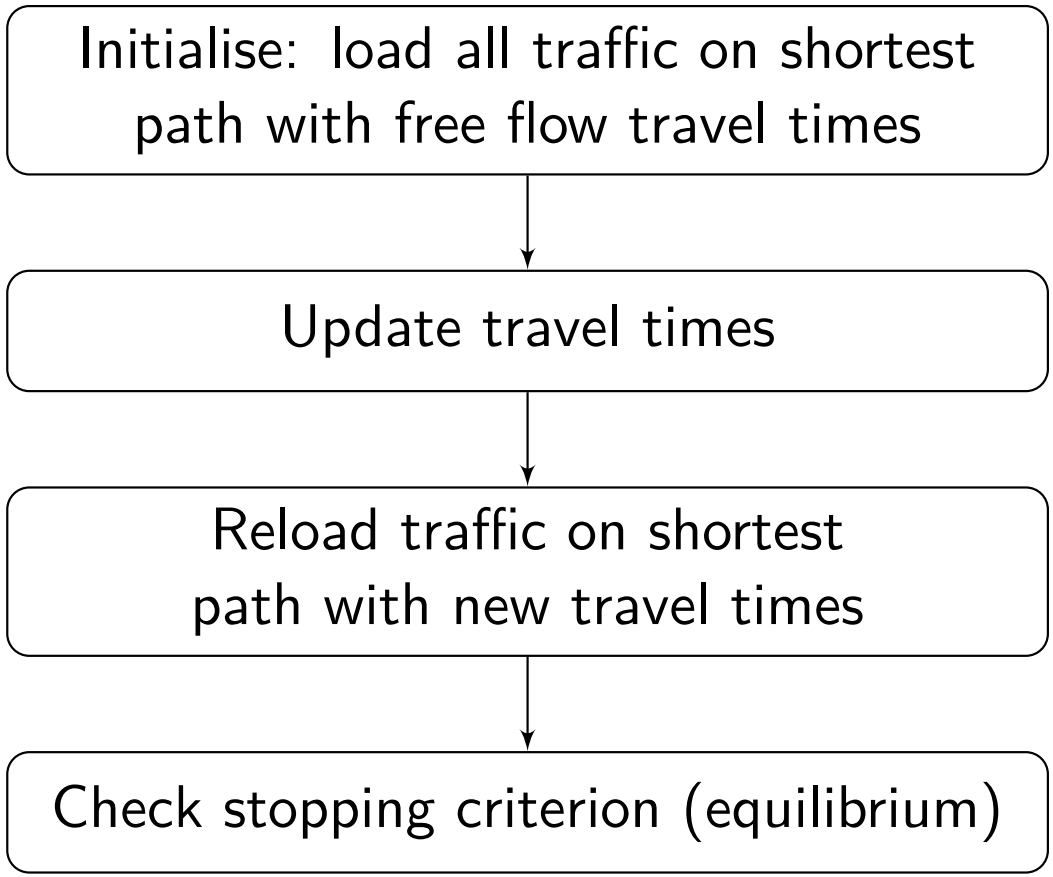

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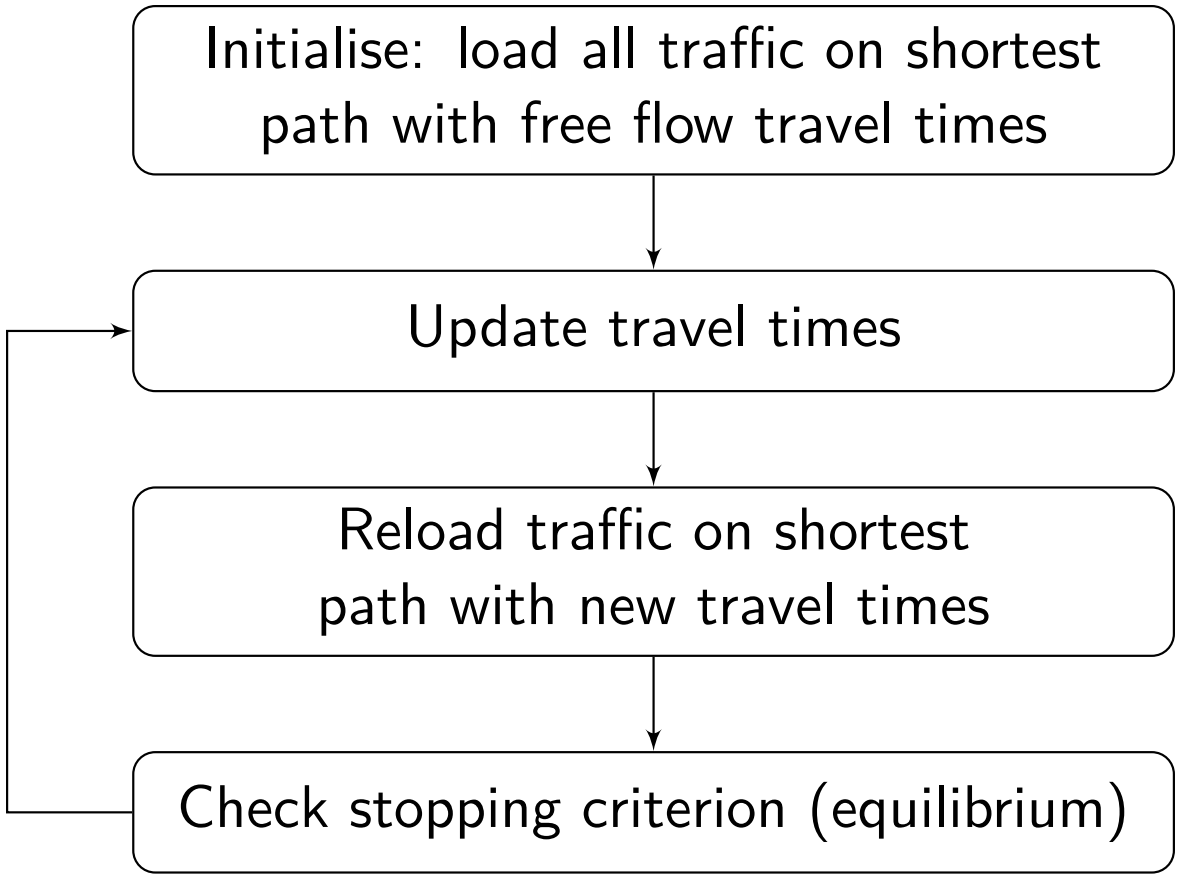
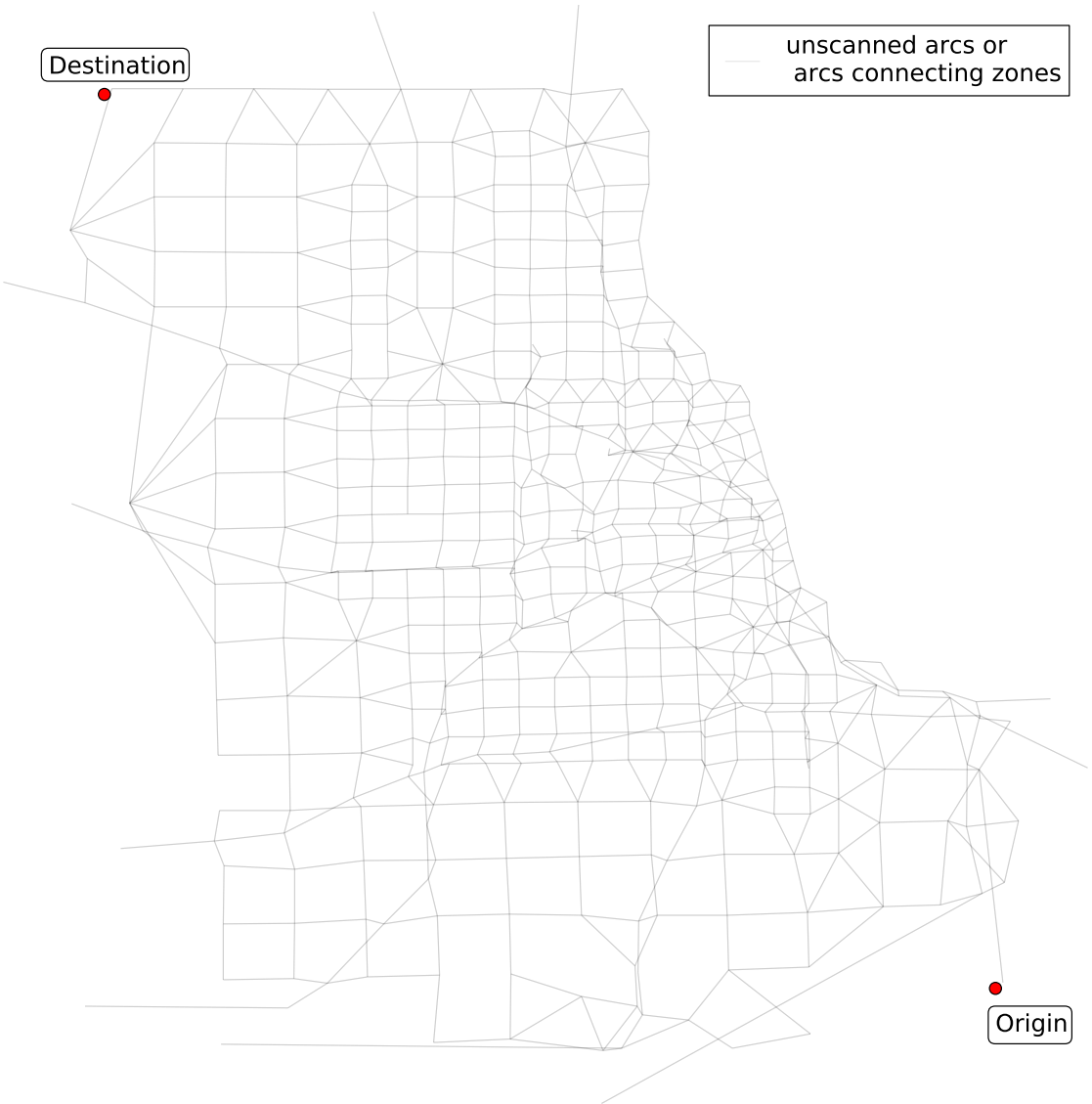
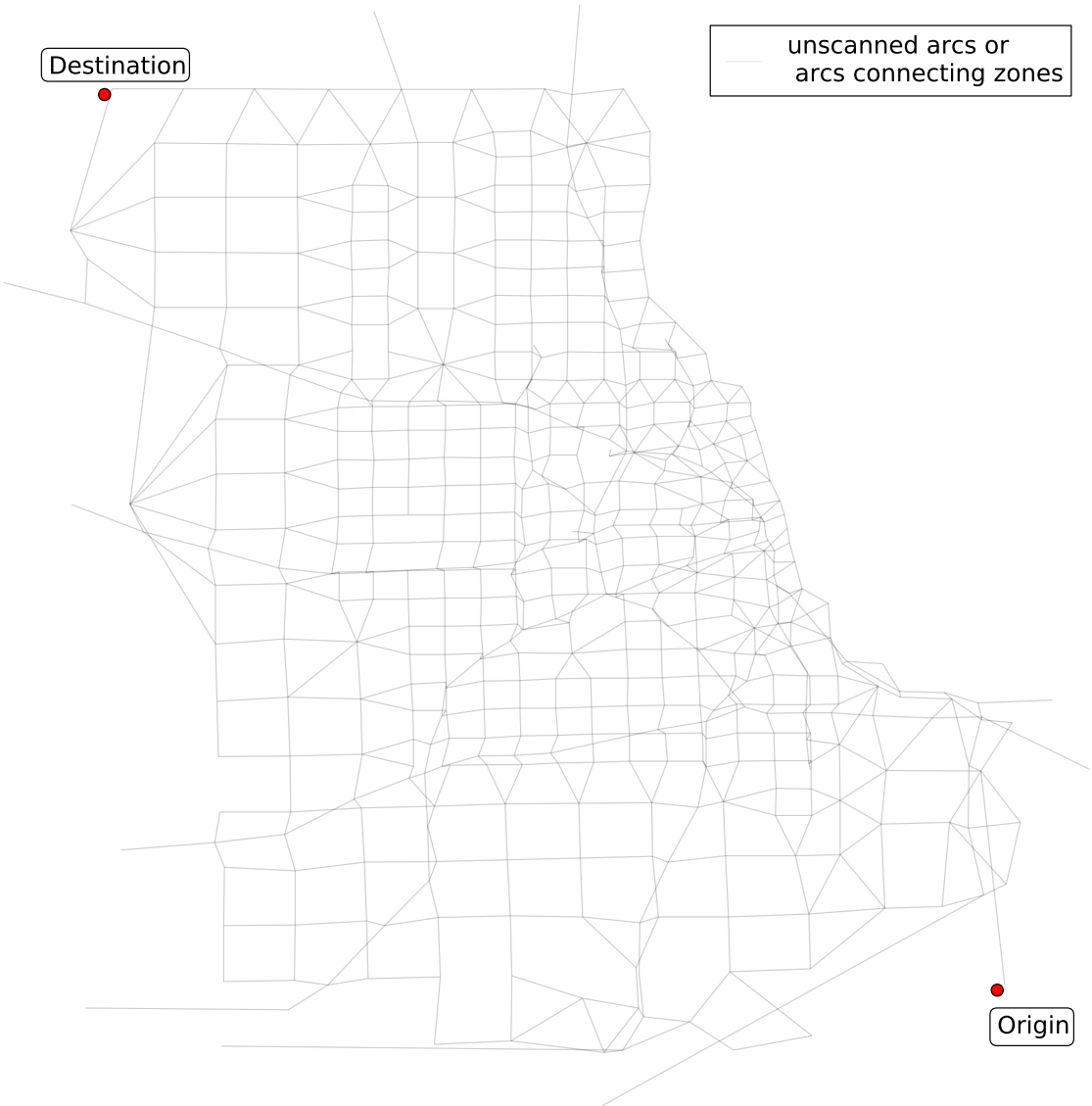


The Graph - 93,135 Origin-Destination Pairs



Dijkstra's Algorithm



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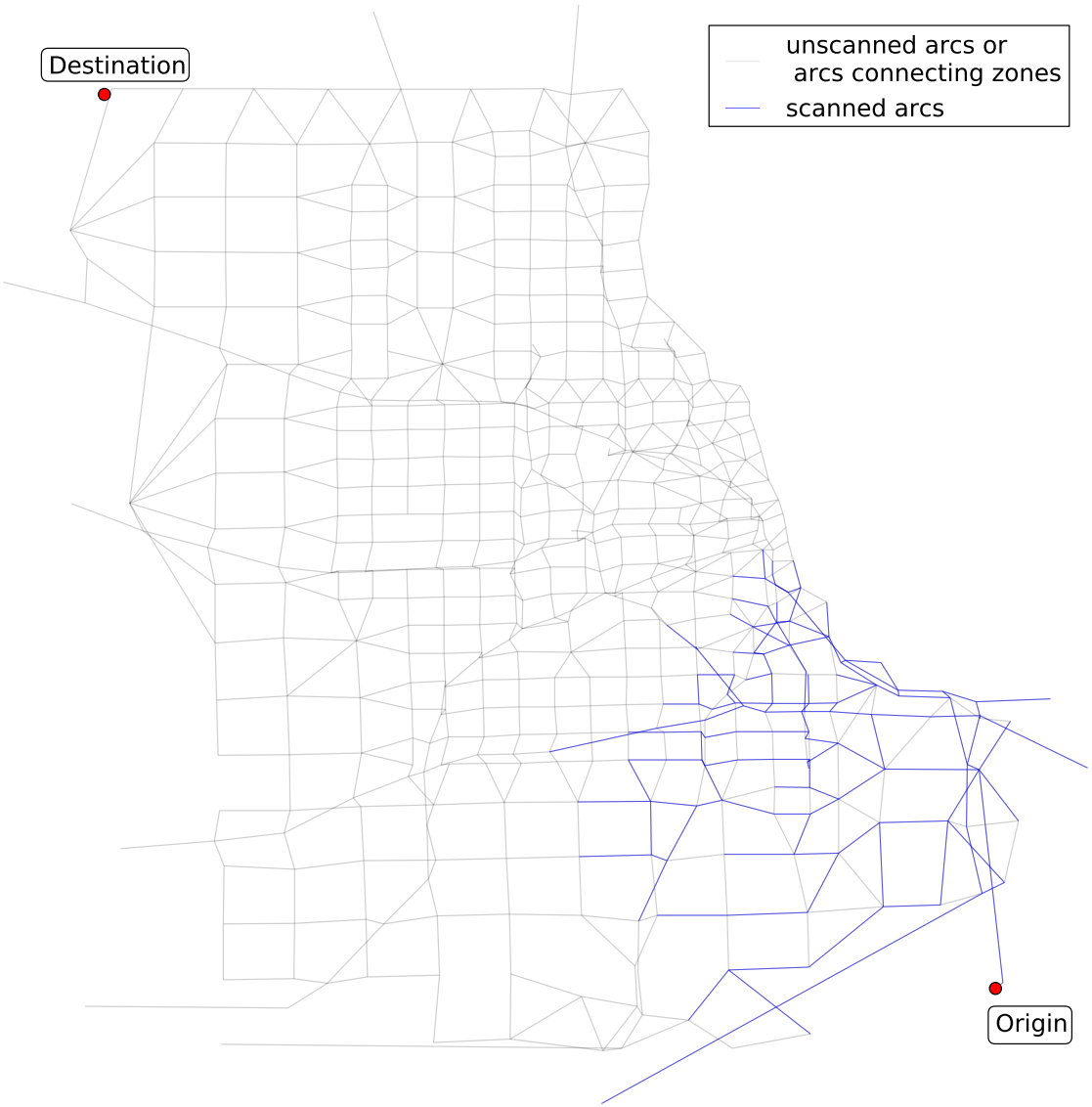

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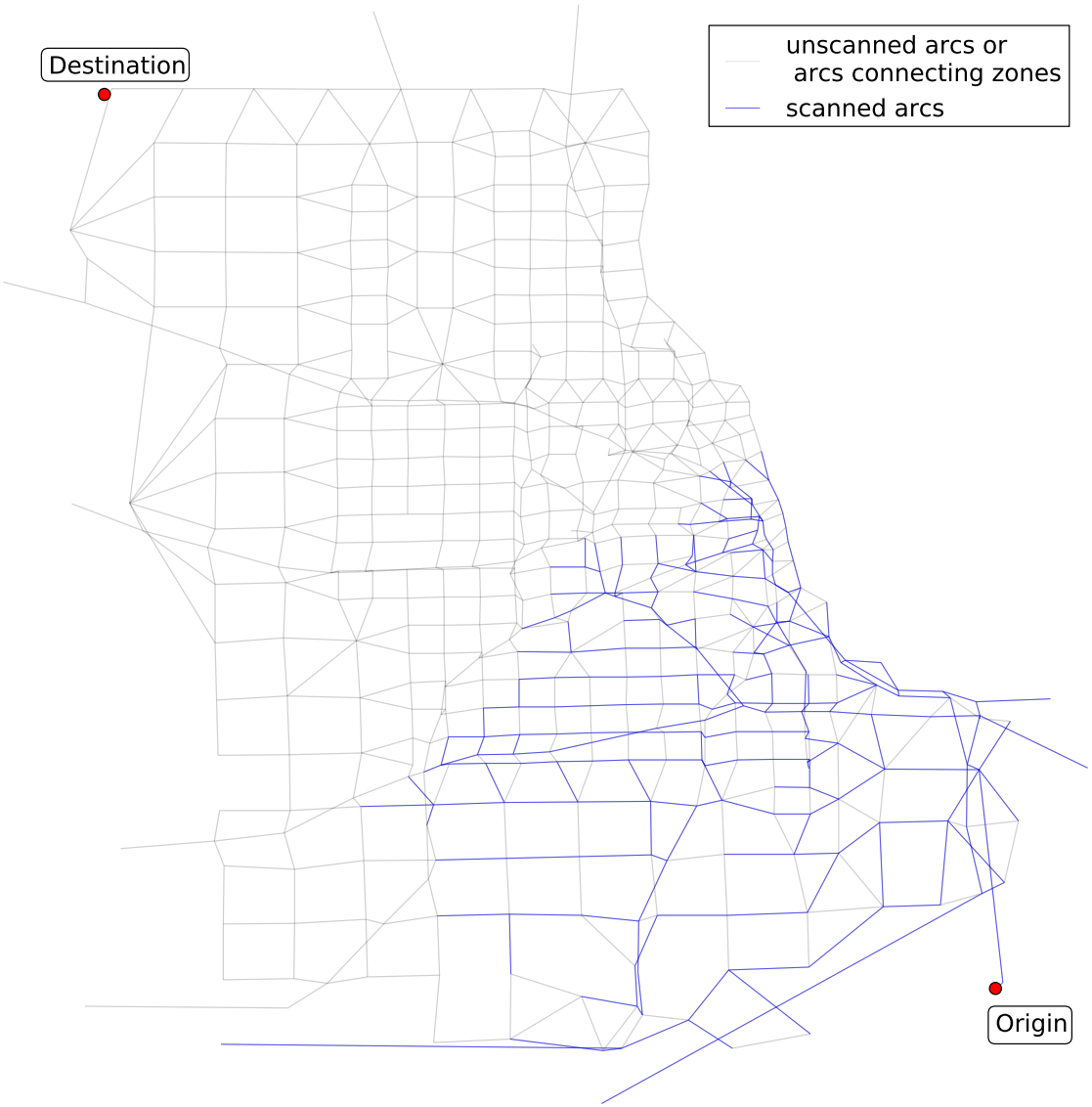

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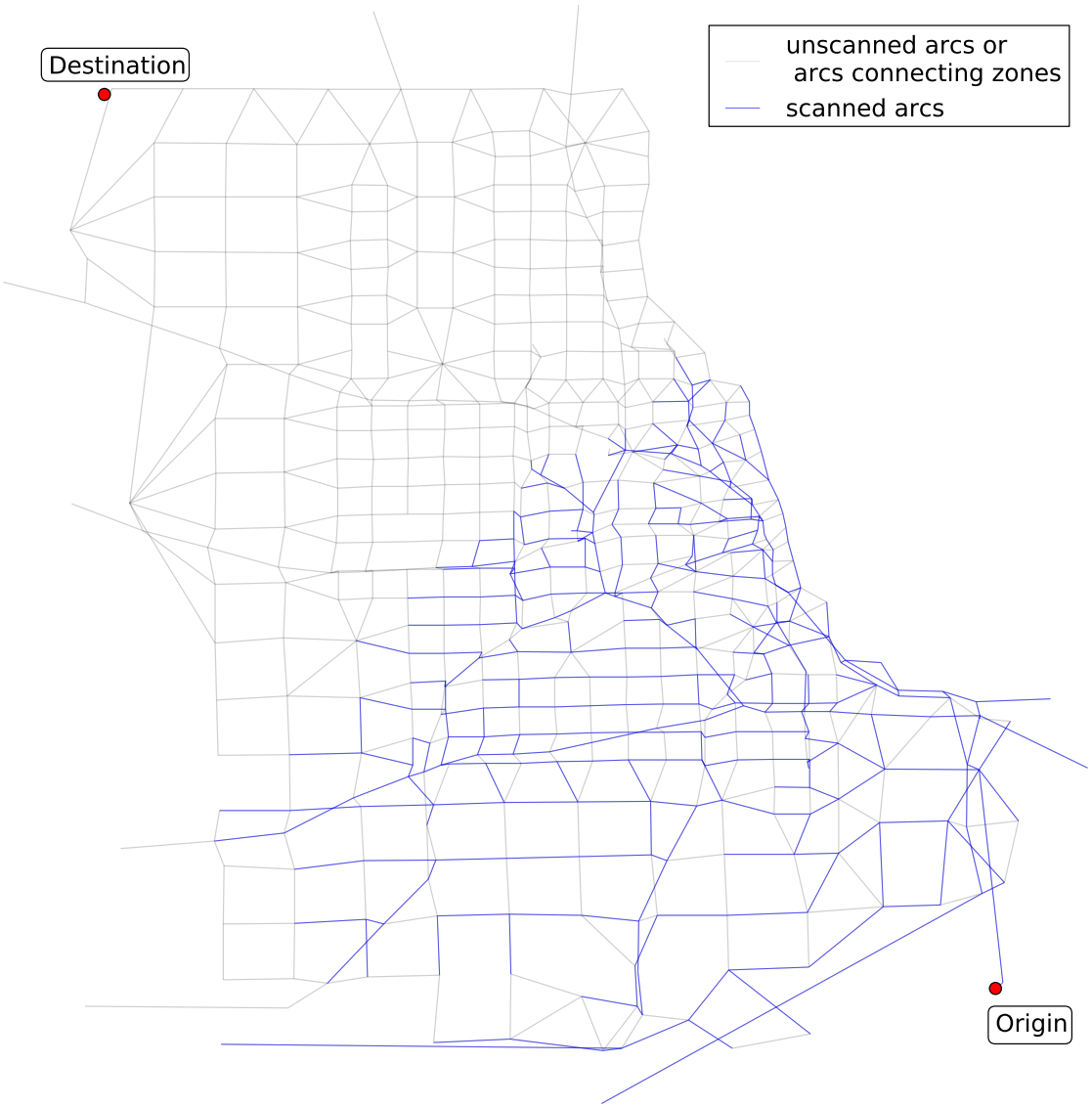

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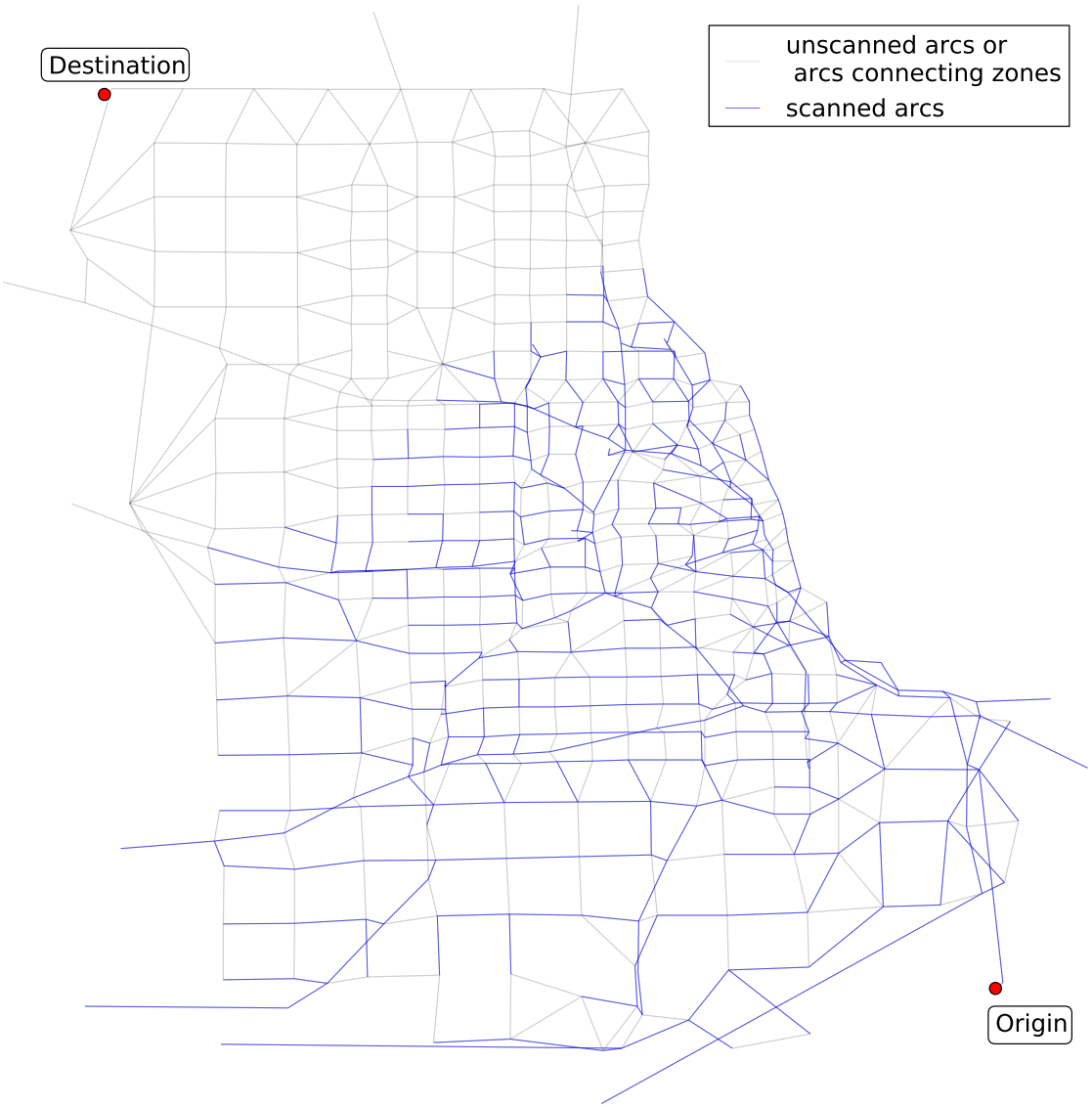

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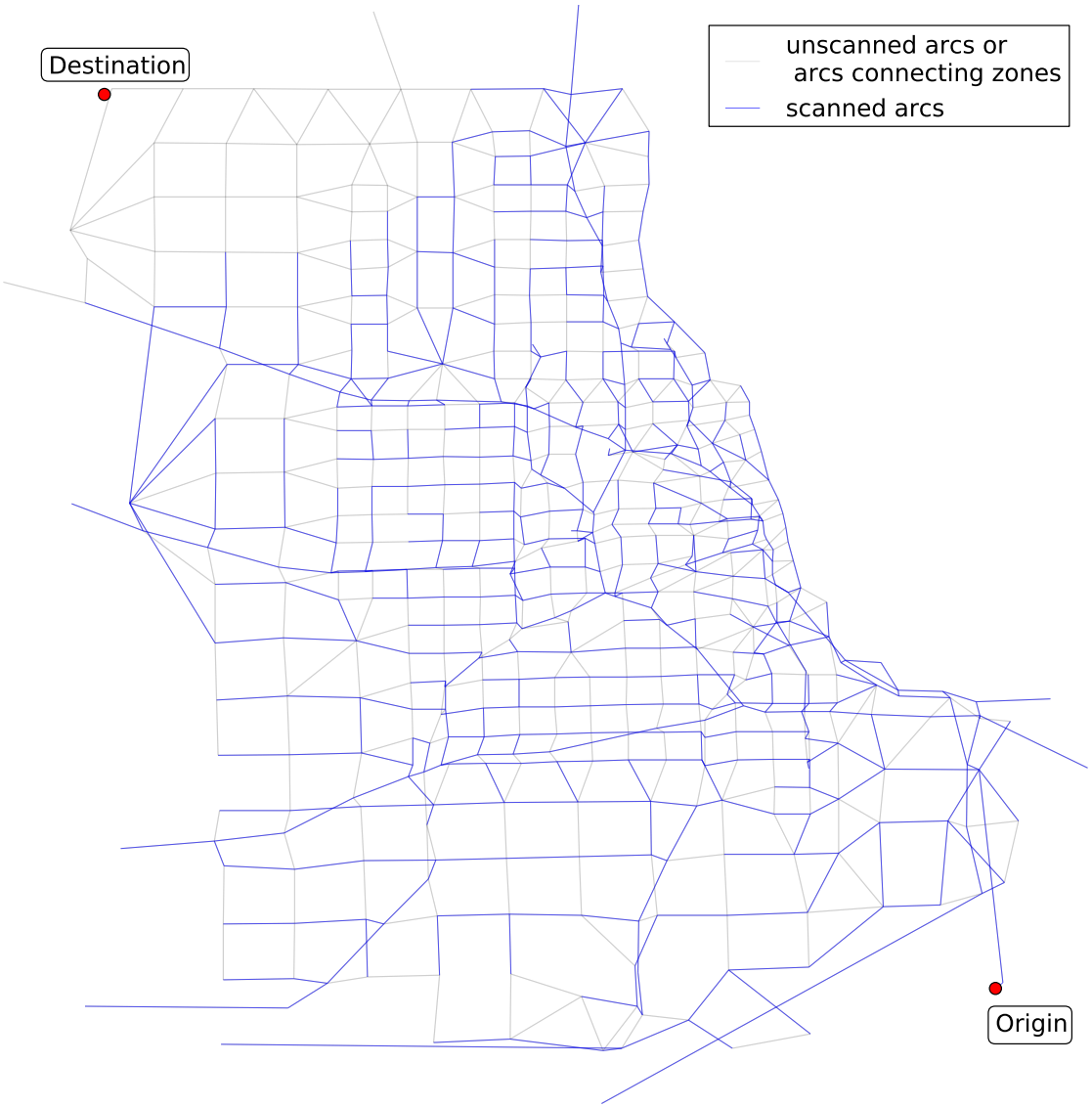
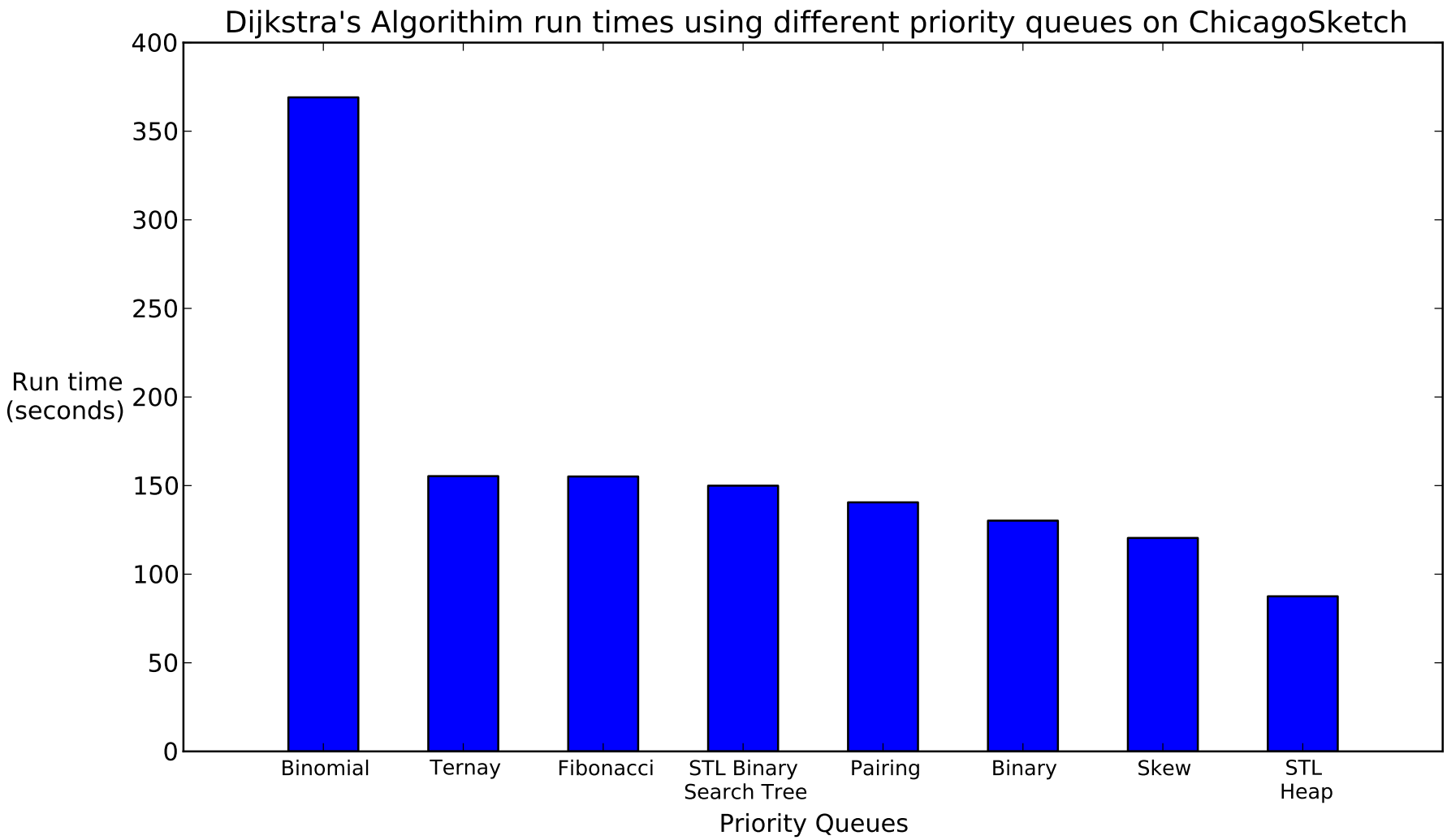


Dijkstra's Algorithm

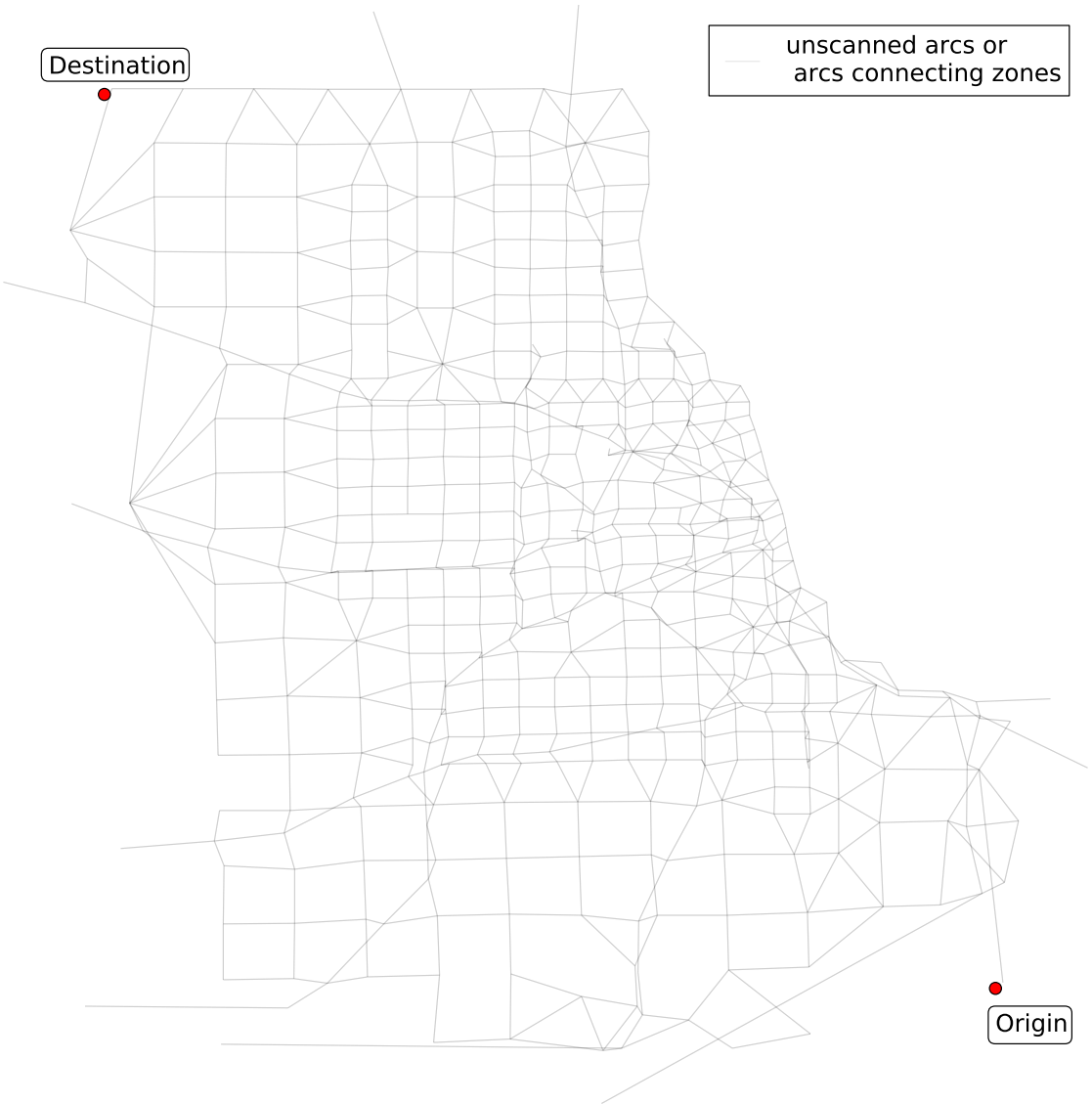
Dijkstra's Algorithm - Priority Queue

- pointer based Heap (C++ boost library)
  - Binomial
  - Pairing
  - Binary
  - Ternary
  - Skew
  - Fibonacci
- (red-black) binary search tree (C++ STL <set>)
- array based Heap (C++ STL <priority_queue>)

Dijkstra's Algorithm - Priority Queue



Bidirectional Dijkstra's Algorithm



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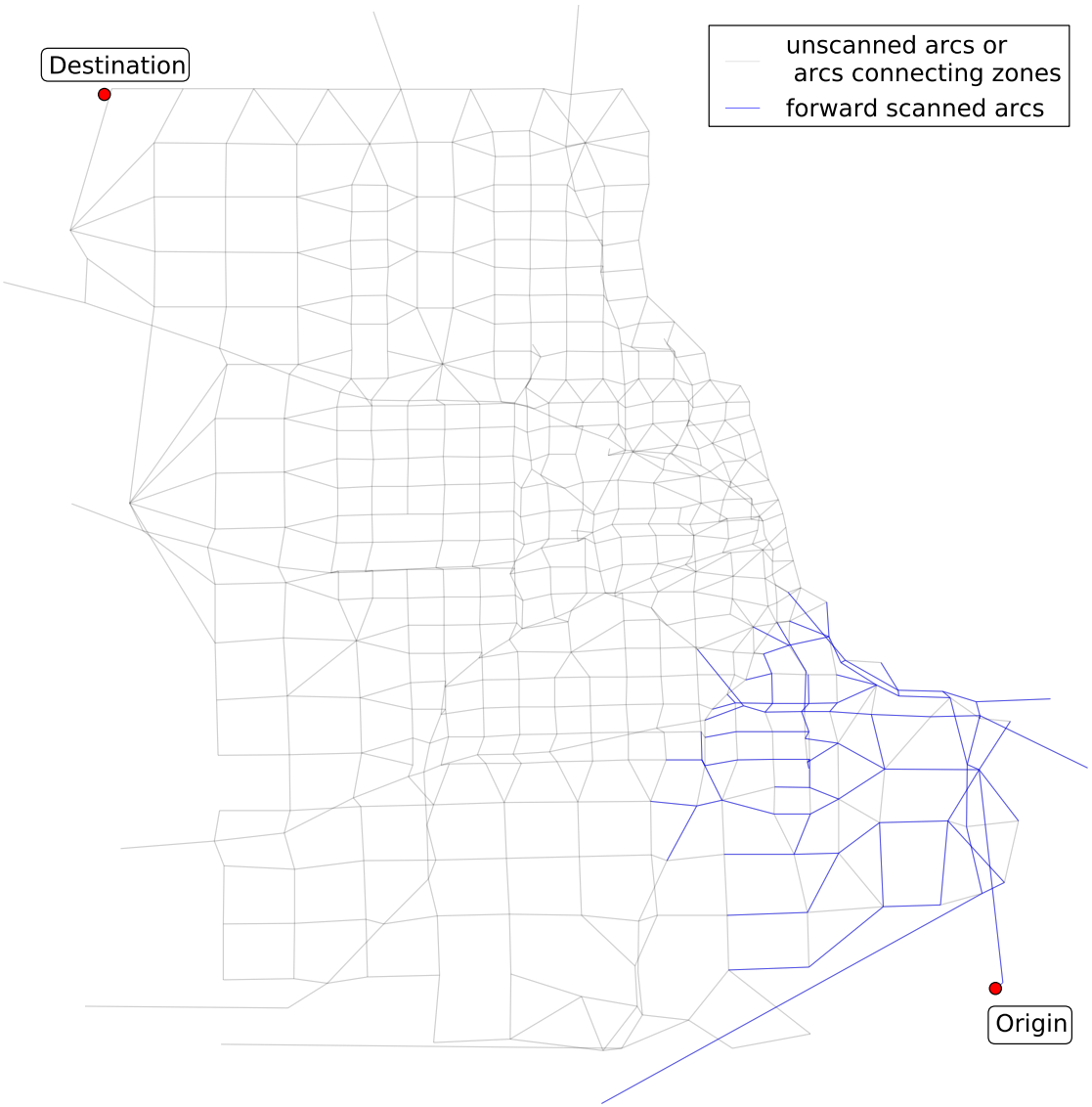

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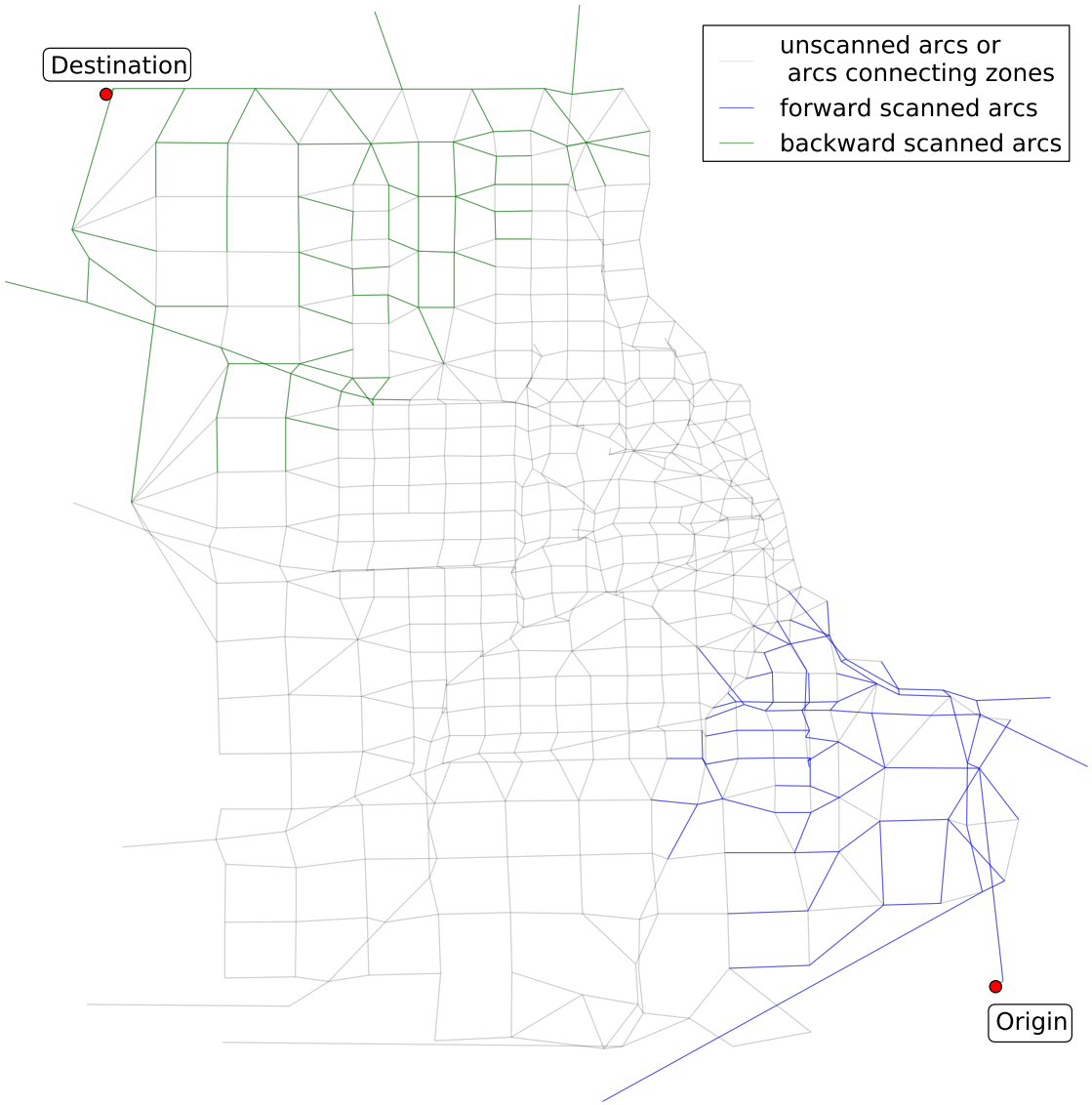

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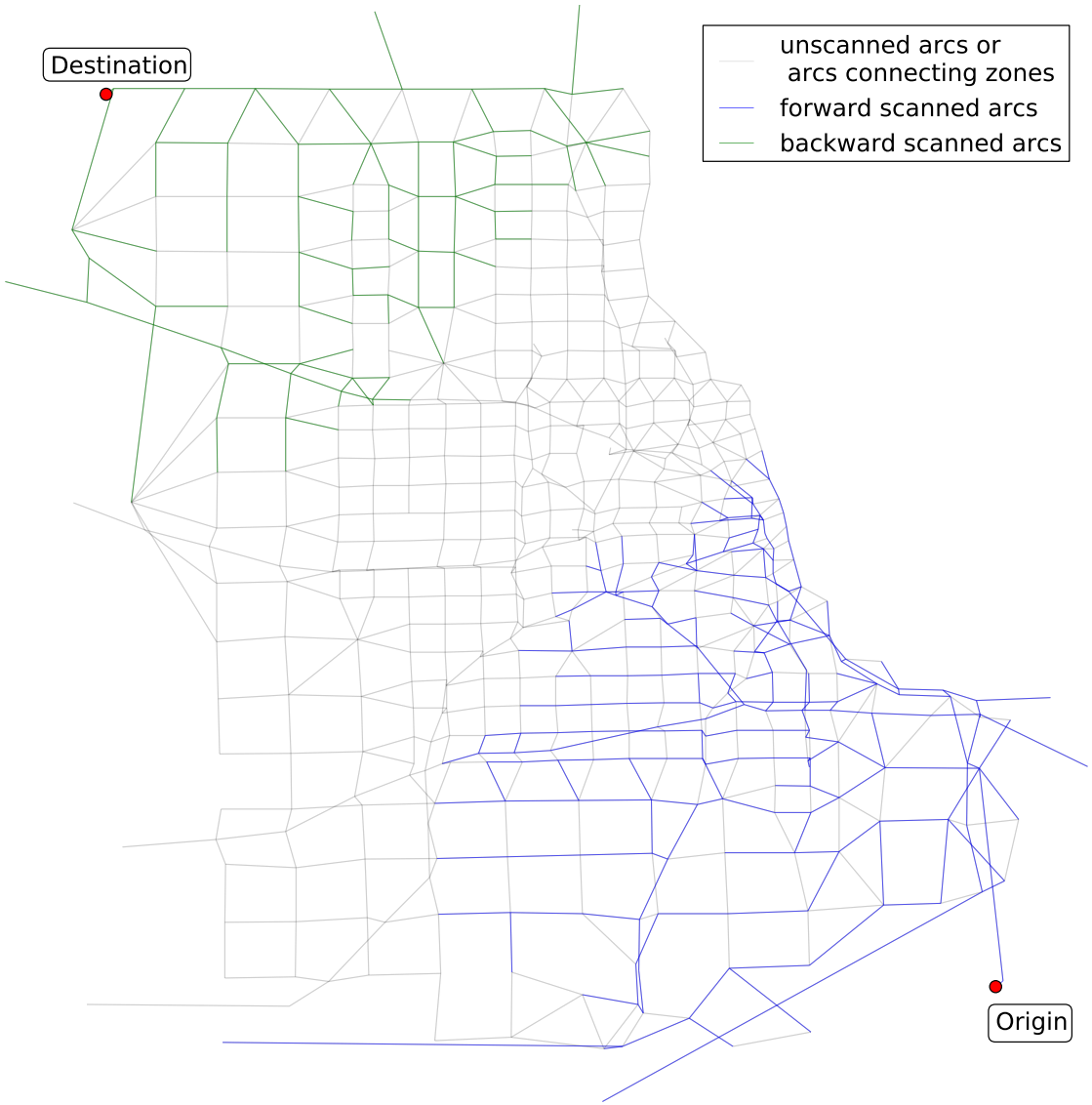

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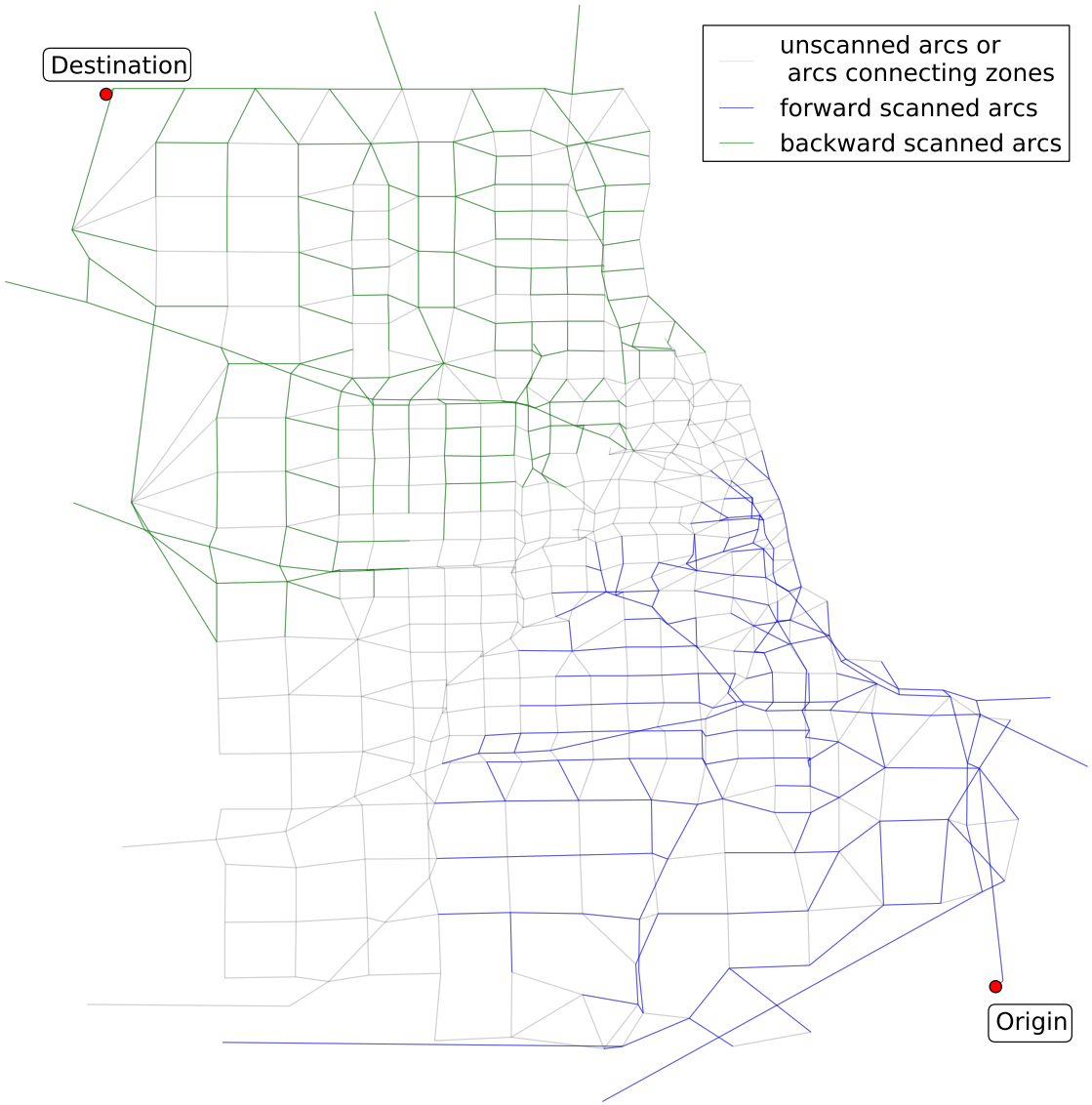

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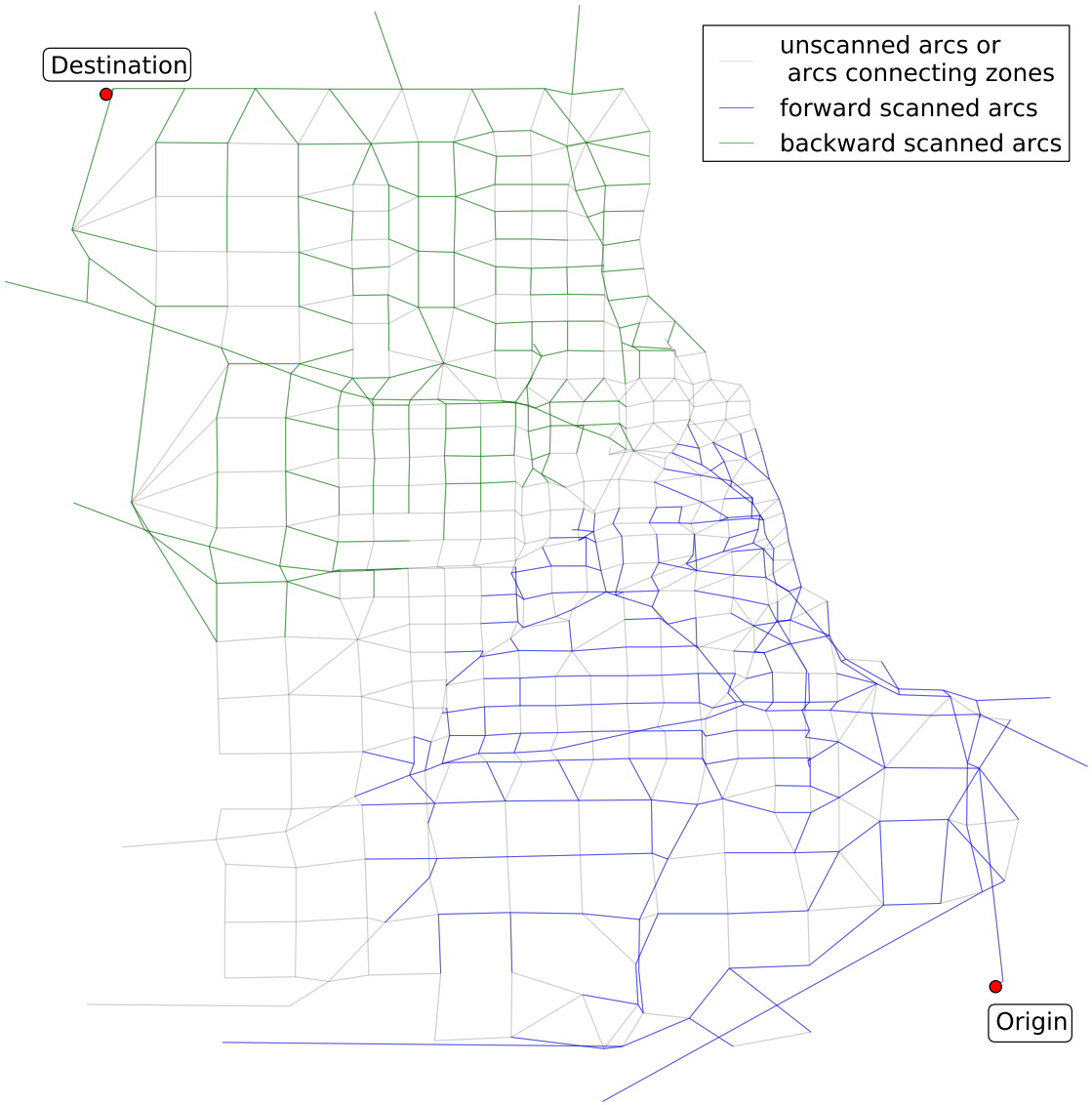

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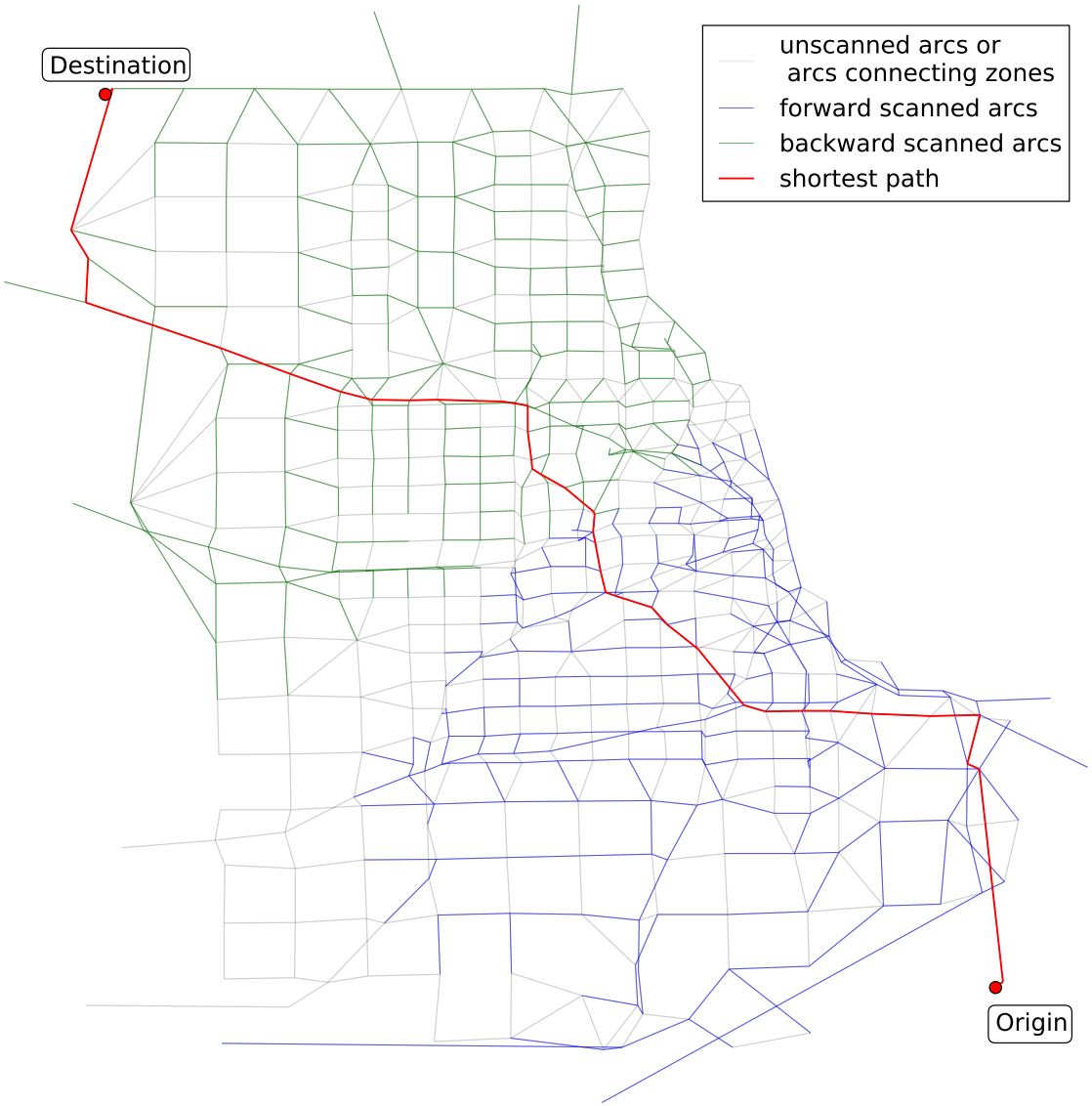
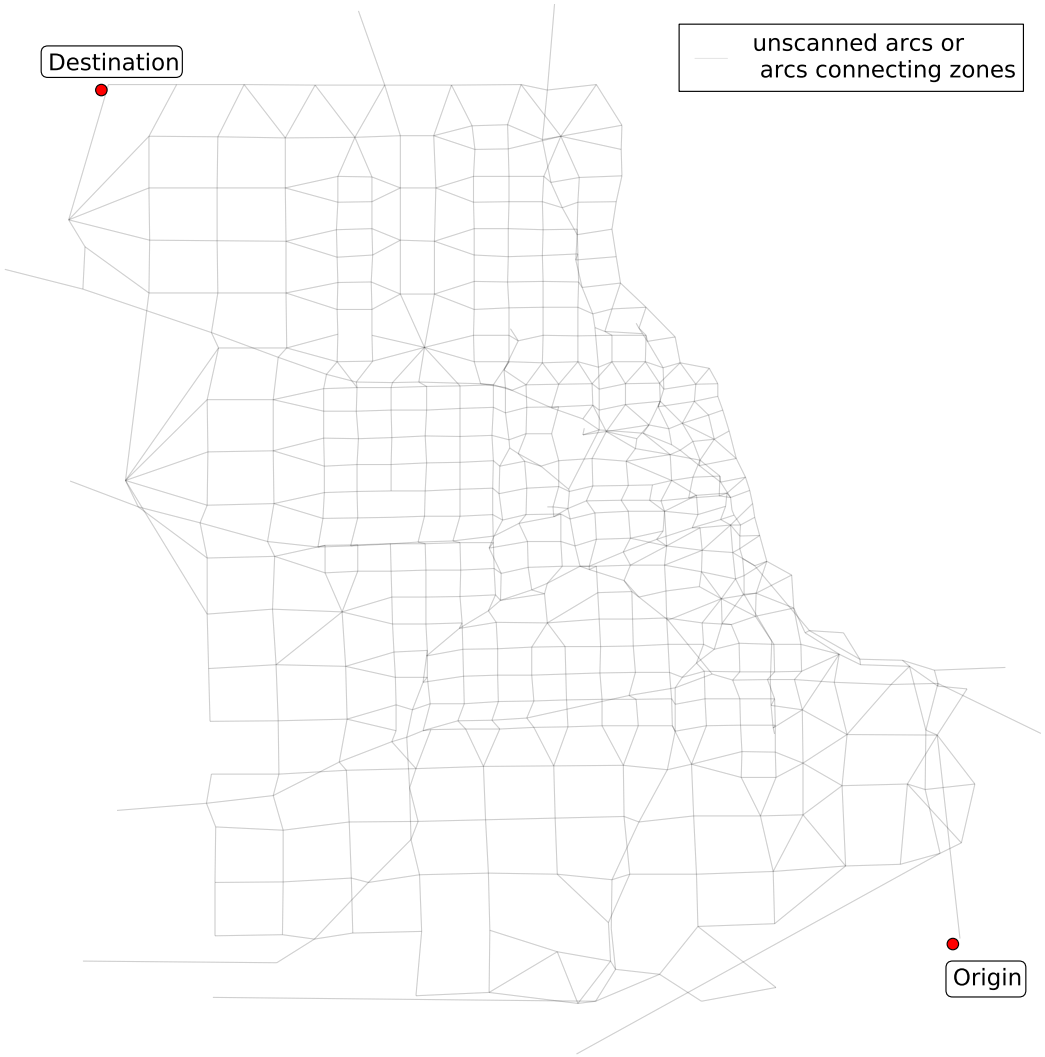


A* Search (Best-First Search)

- Visit the next node that is on the expected shortest path.



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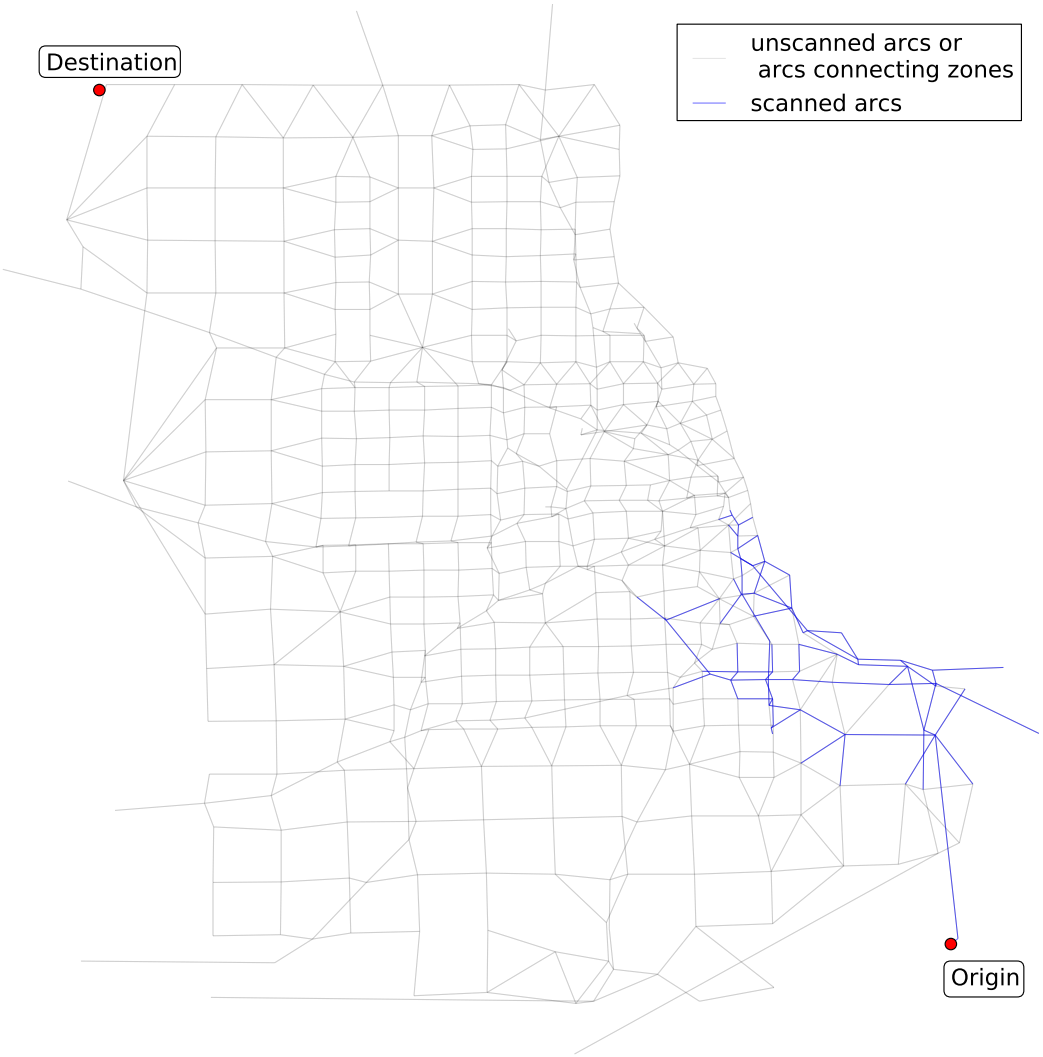

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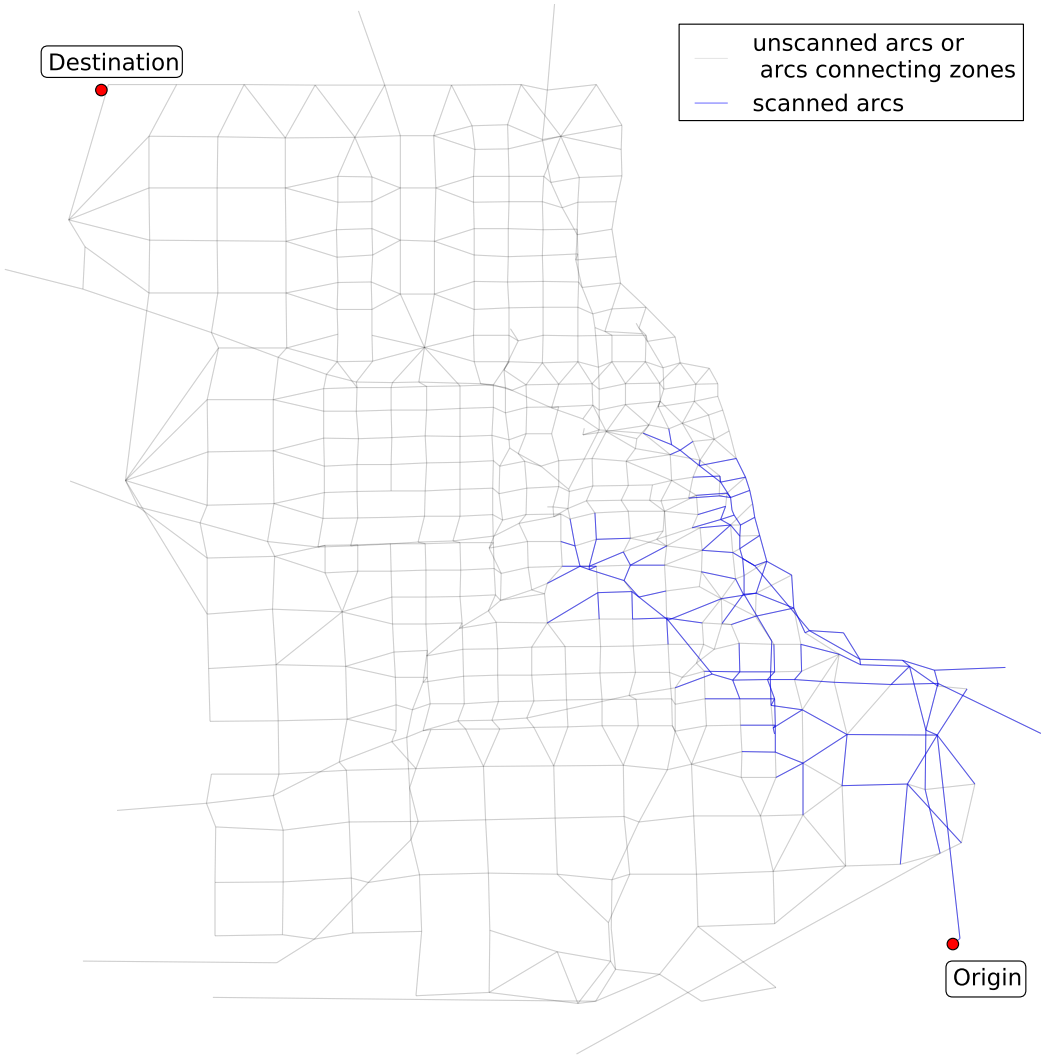

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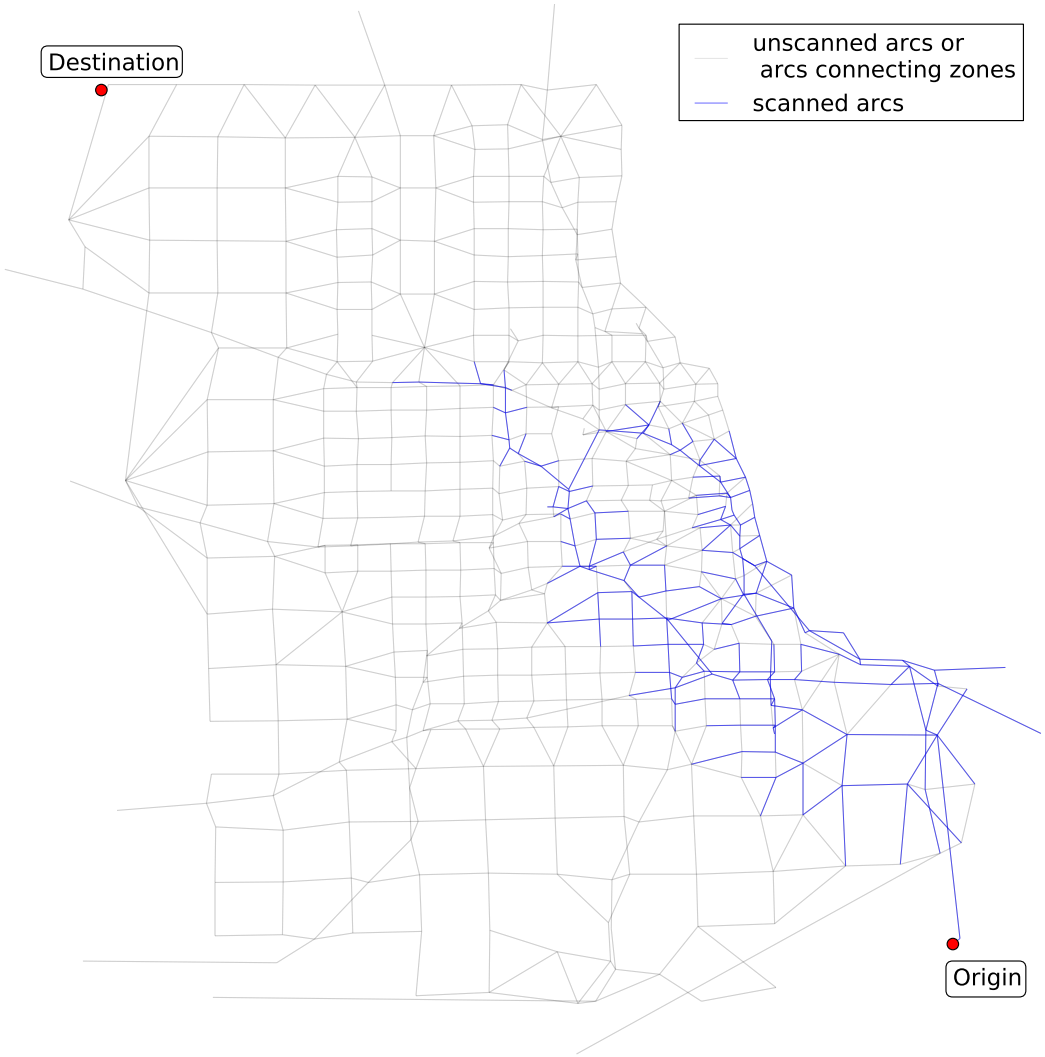

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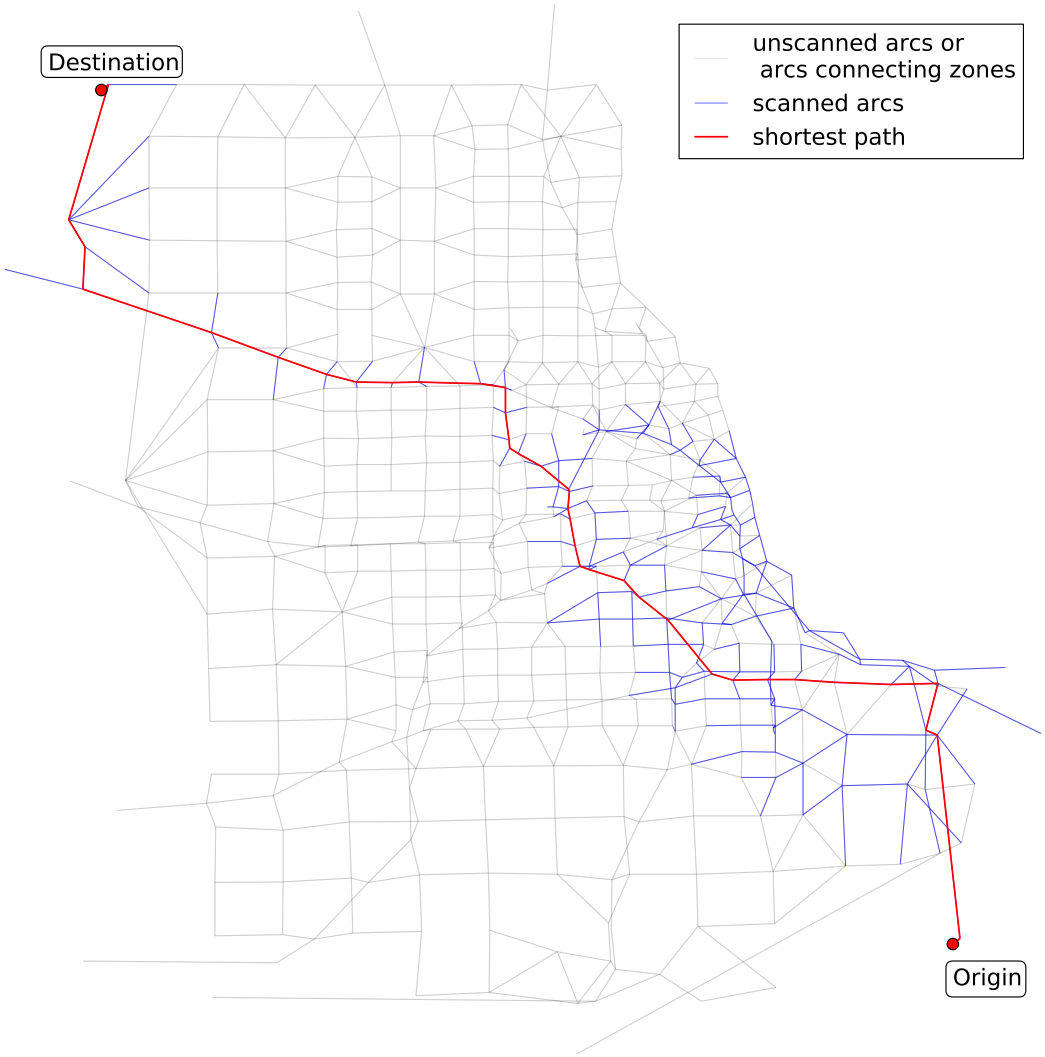
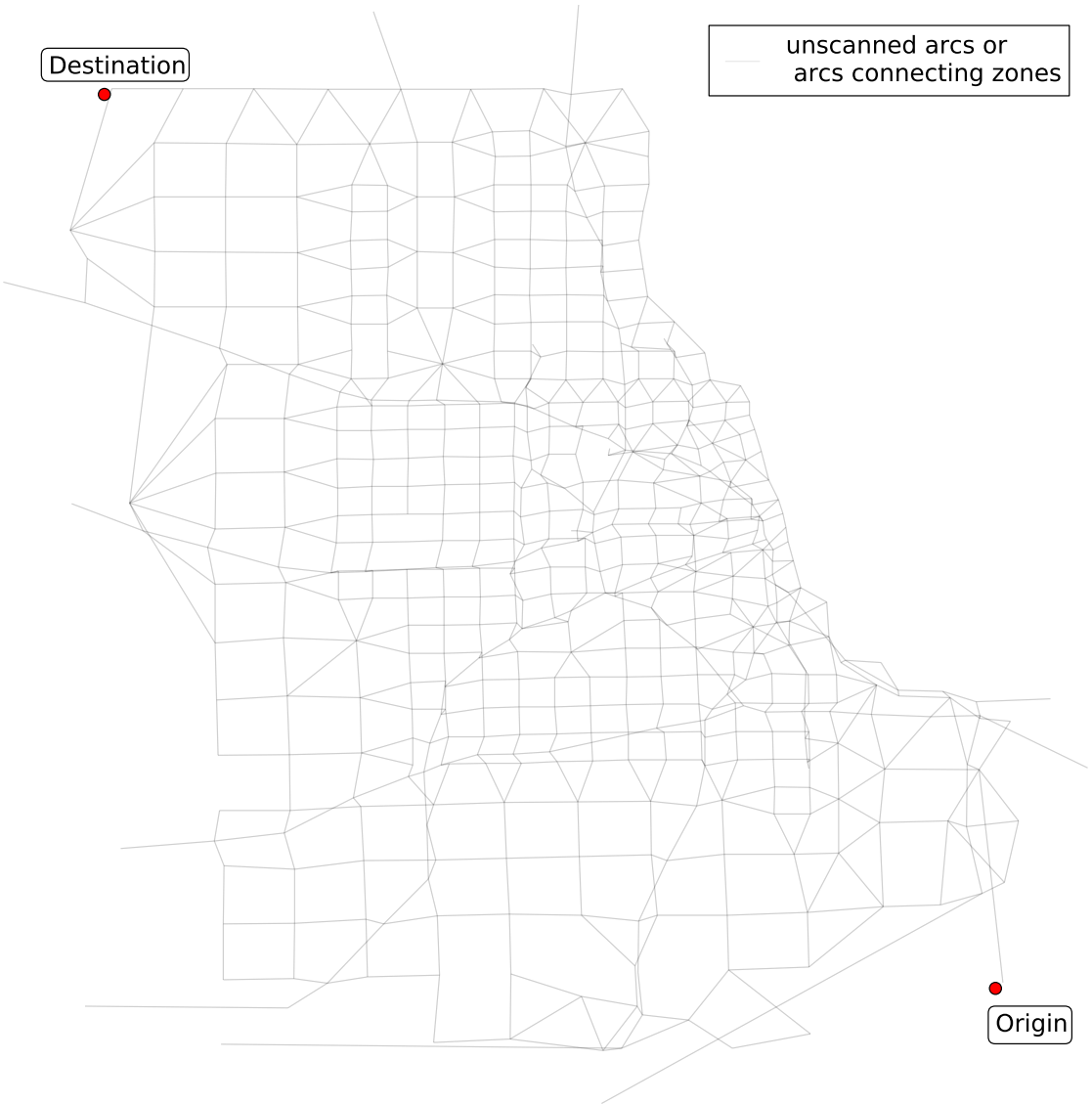


Bidirectional A* search



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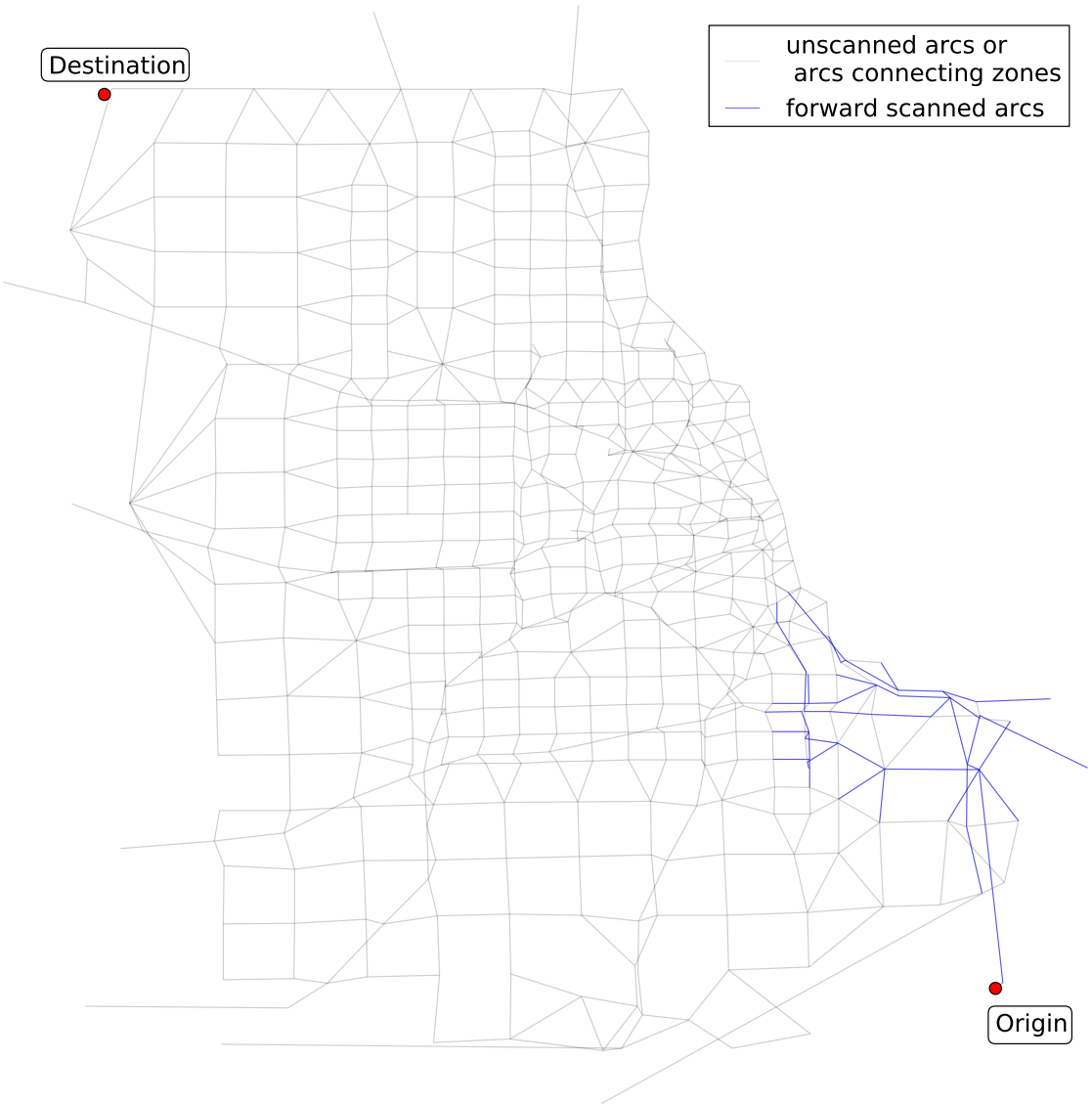

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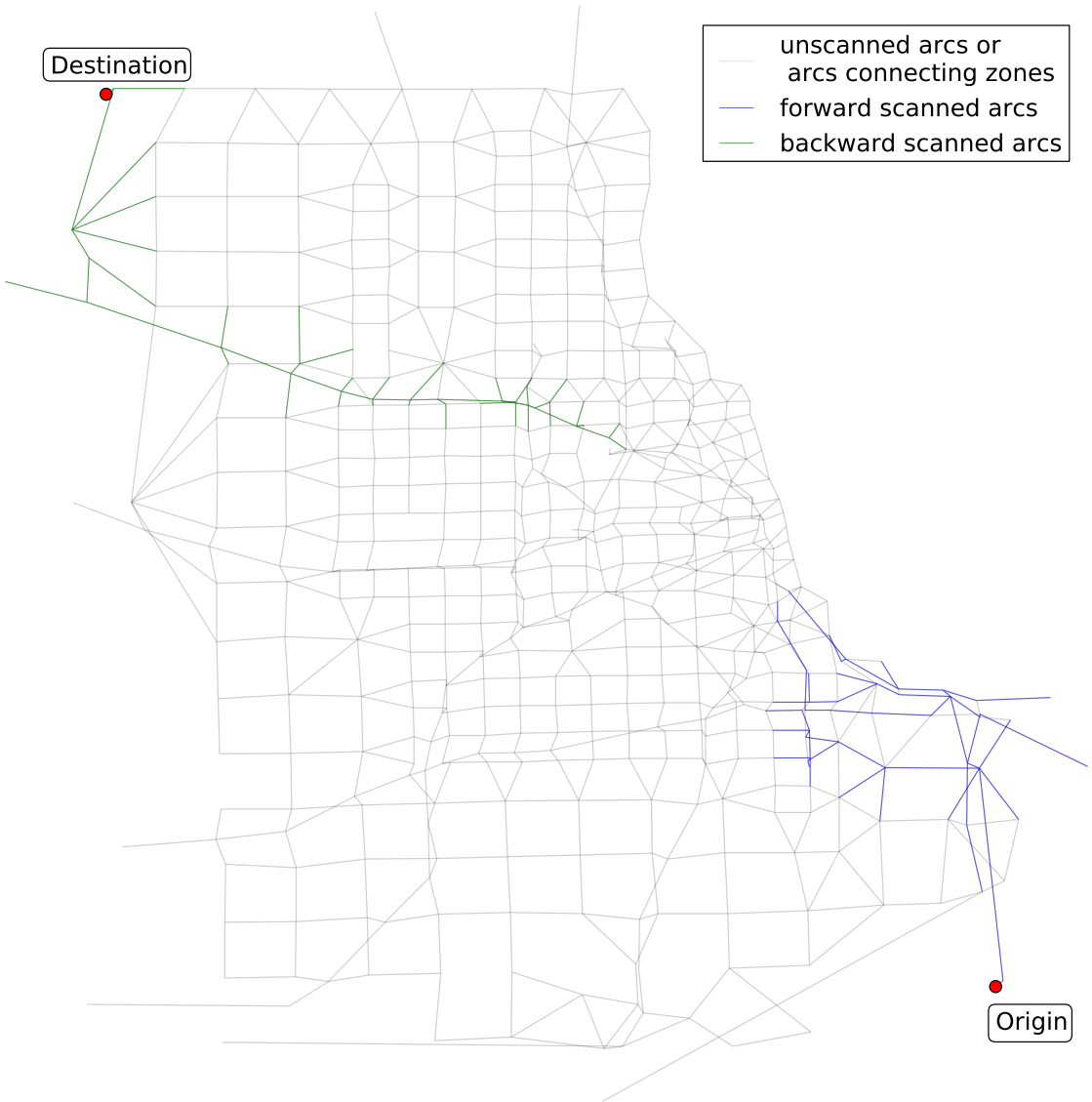

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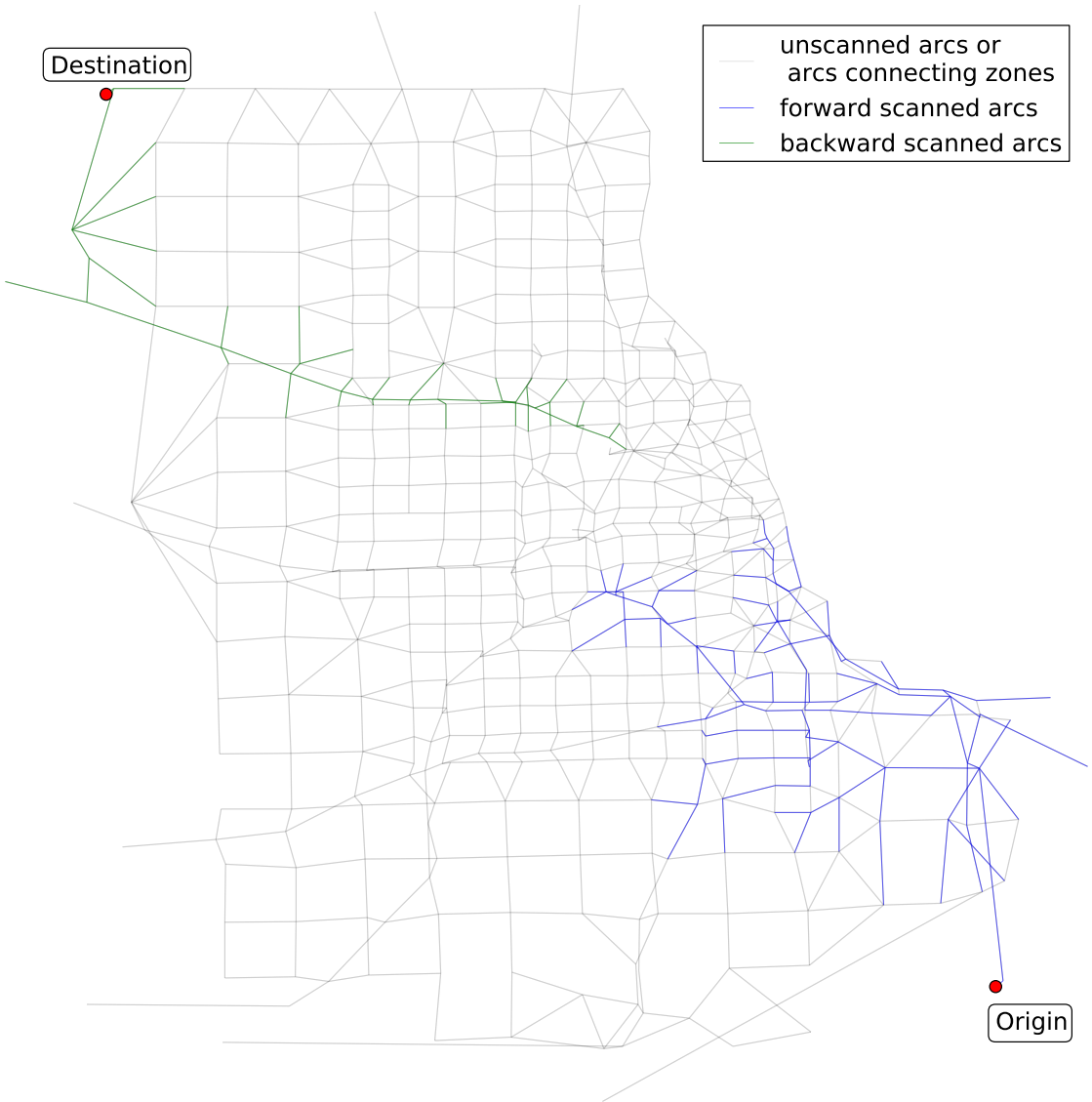

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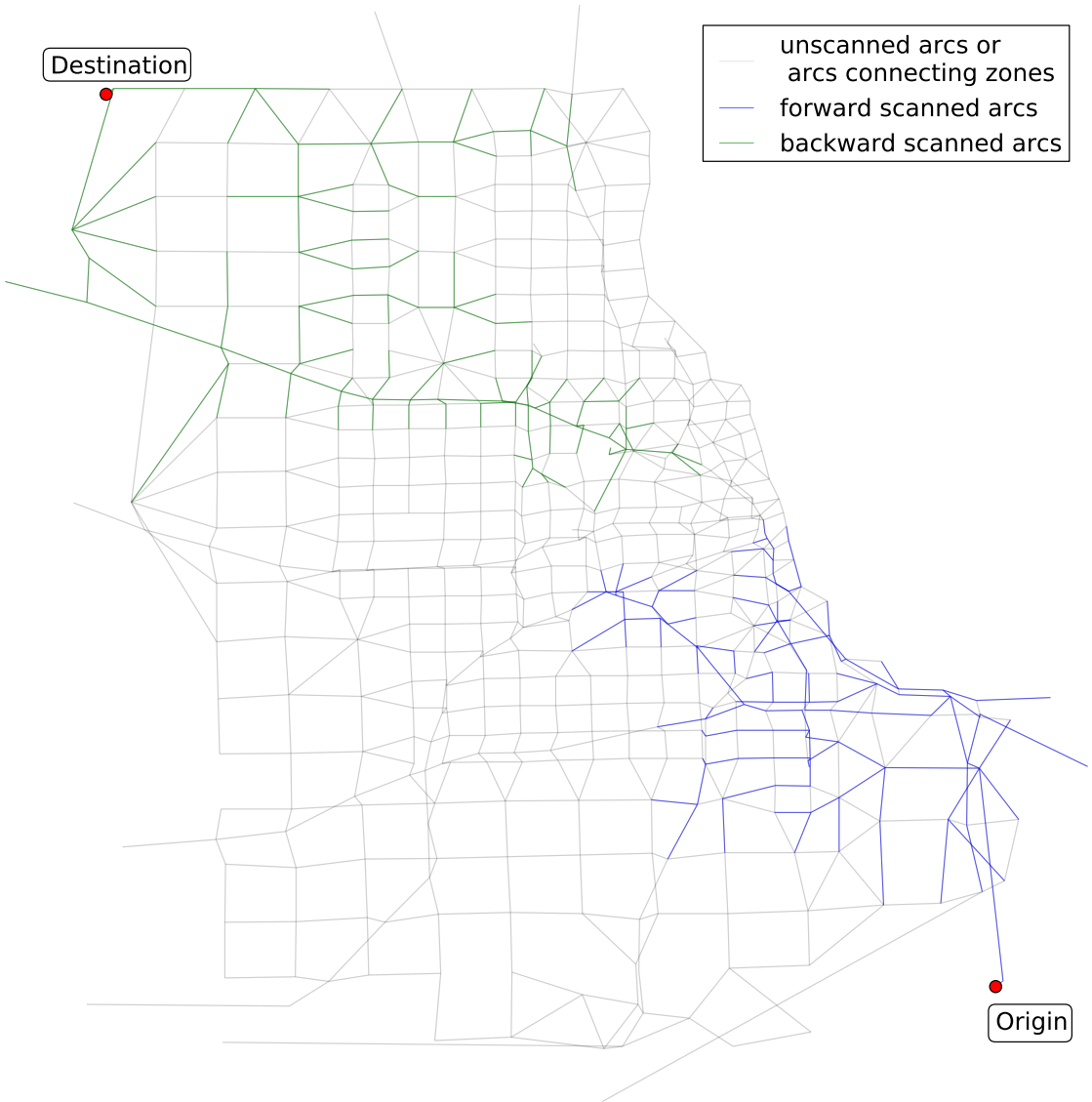

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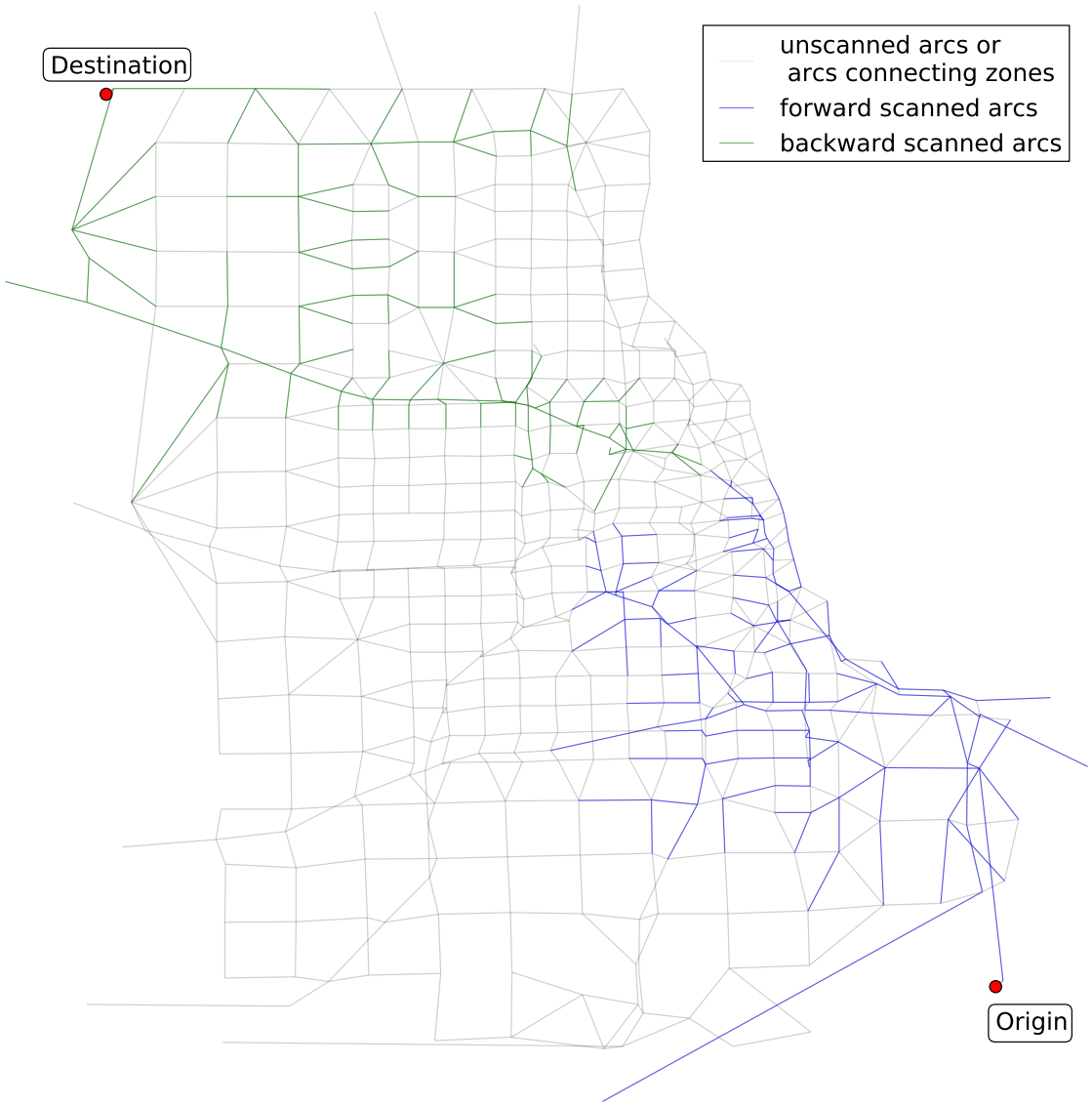

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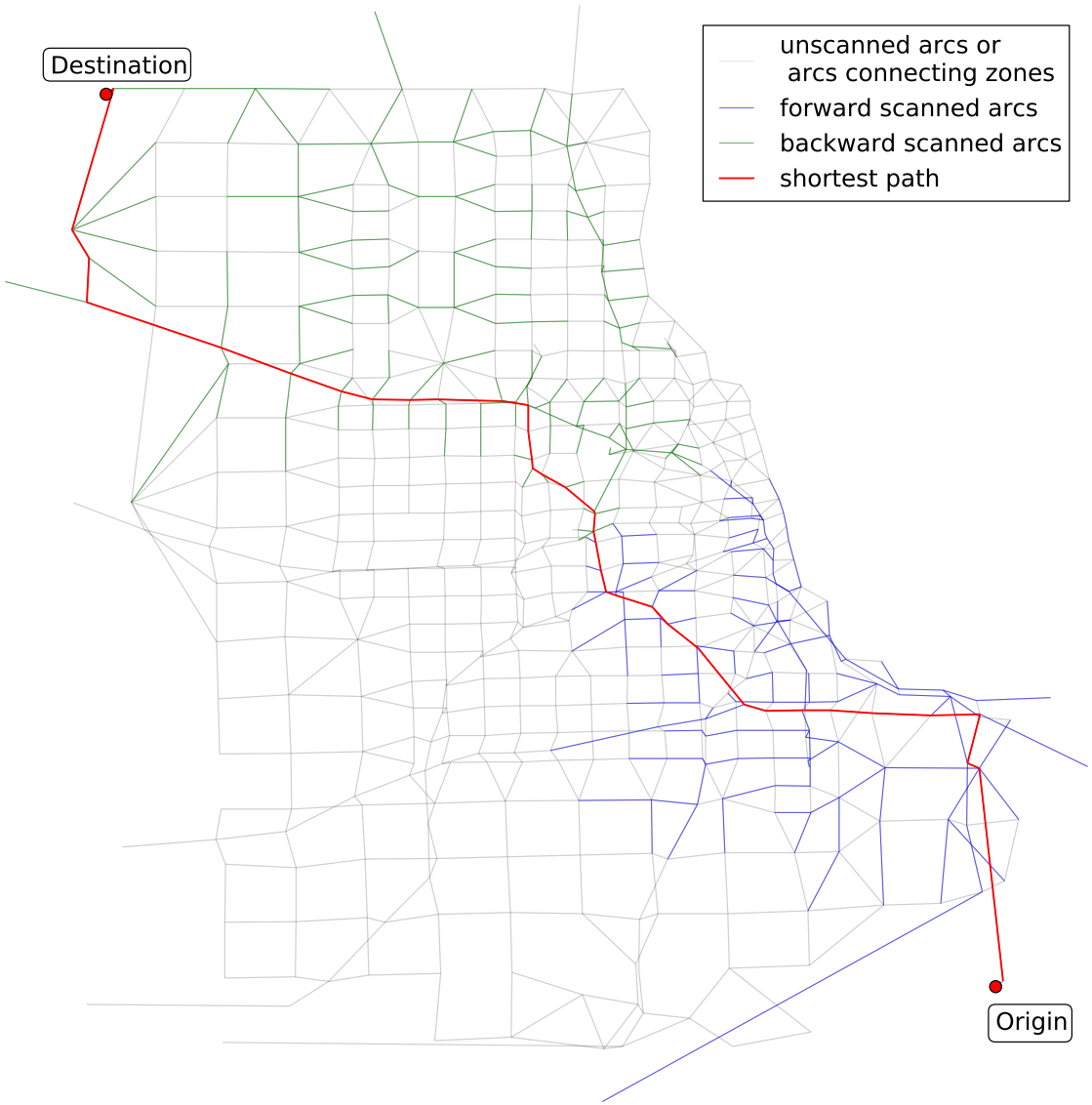

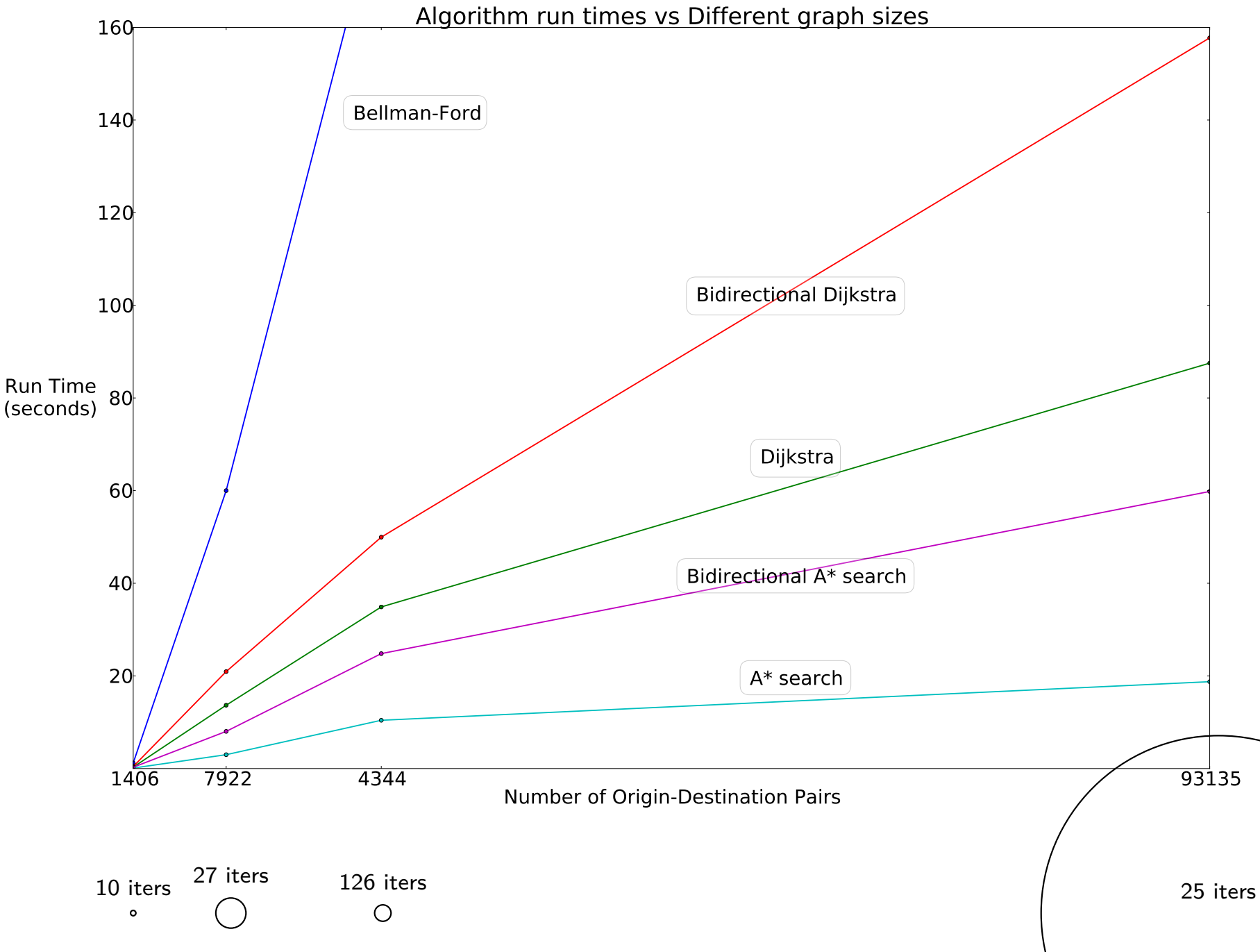
Algorithm run times vs Different graph sizes
Run Time (seconds)
160
140
120
100
80
60
40
20
Bellman-Ford
Bidirectional Dijkstra
Dijkstra
Bidirectional A* search
A* search
1406
7922
4344
93135
Number of Origin-Destination Pairs
10 iters
27 iters
126 iters
25 iters

Future Work

- preprocessing

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- preprocessing
  - A* search combined with landmark distances

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- use information from previous iteration

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- use information from previous iteration
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- avoid shortest path calculations if possible
  - most of the shortest paths do not change after the first few iterations