Efficient Traffic Routing with Progress Guarantees

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ETH Zurich – Distributed Computing – www.disco.ethz.ch


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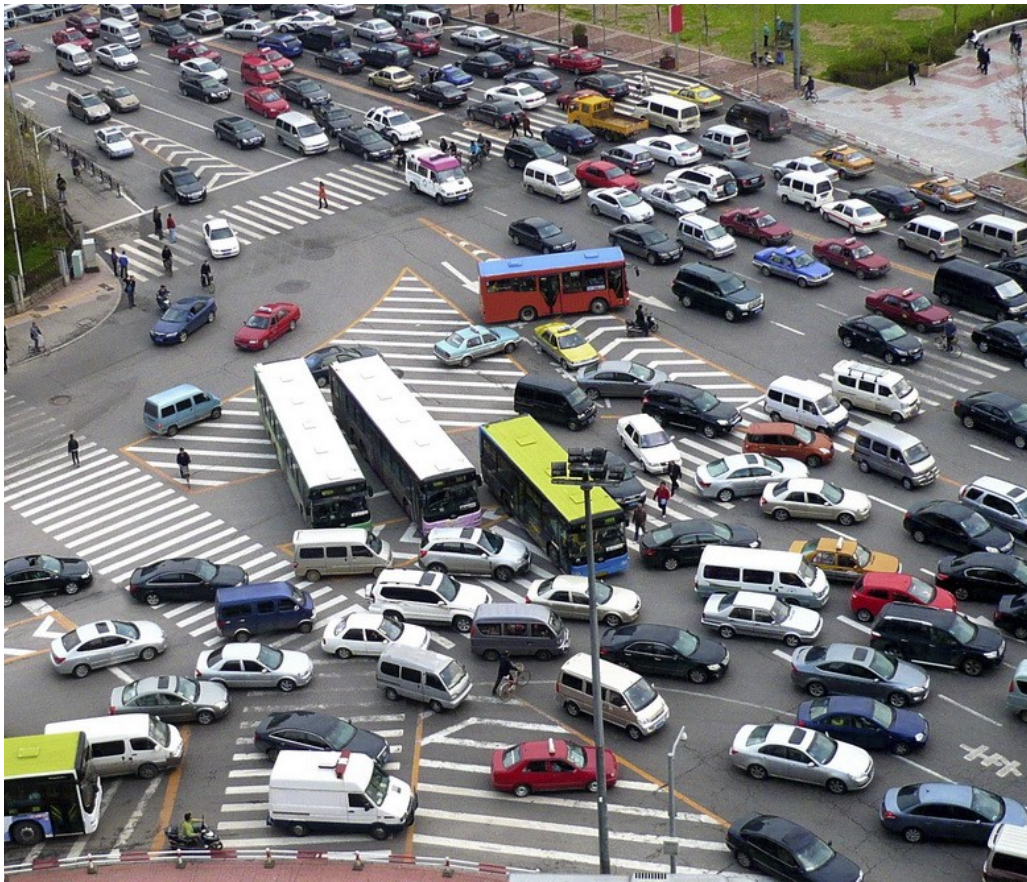
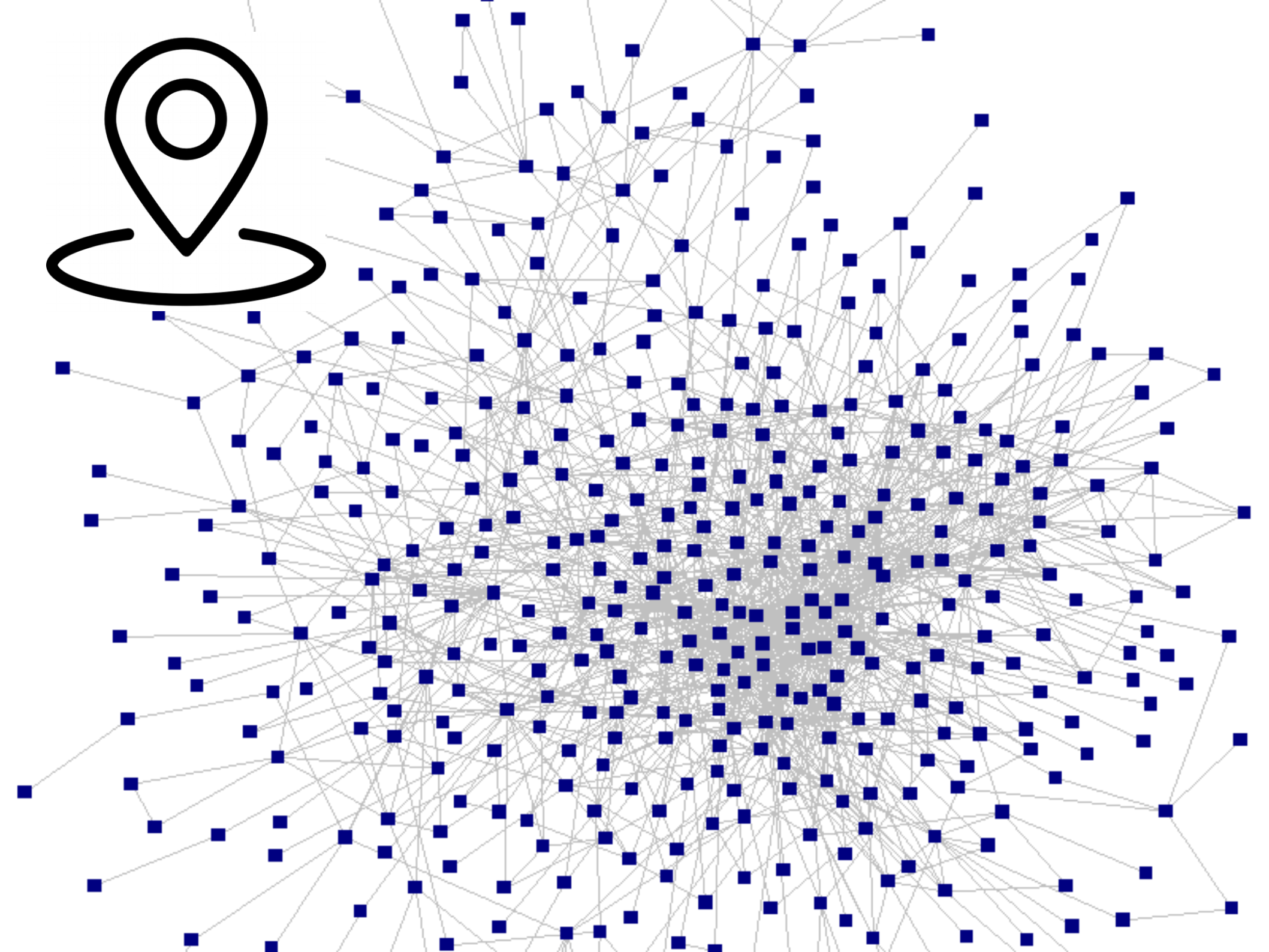
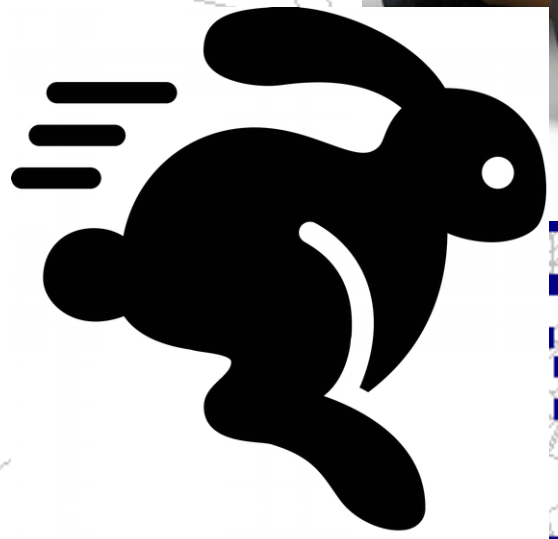
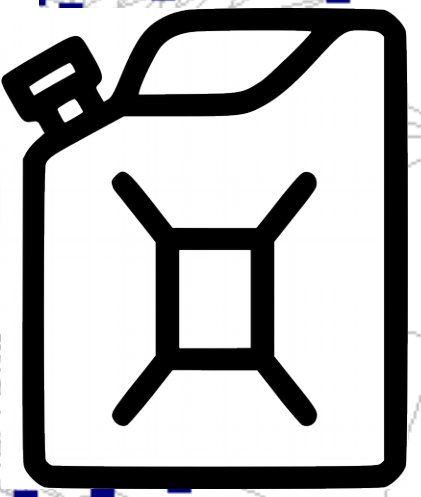
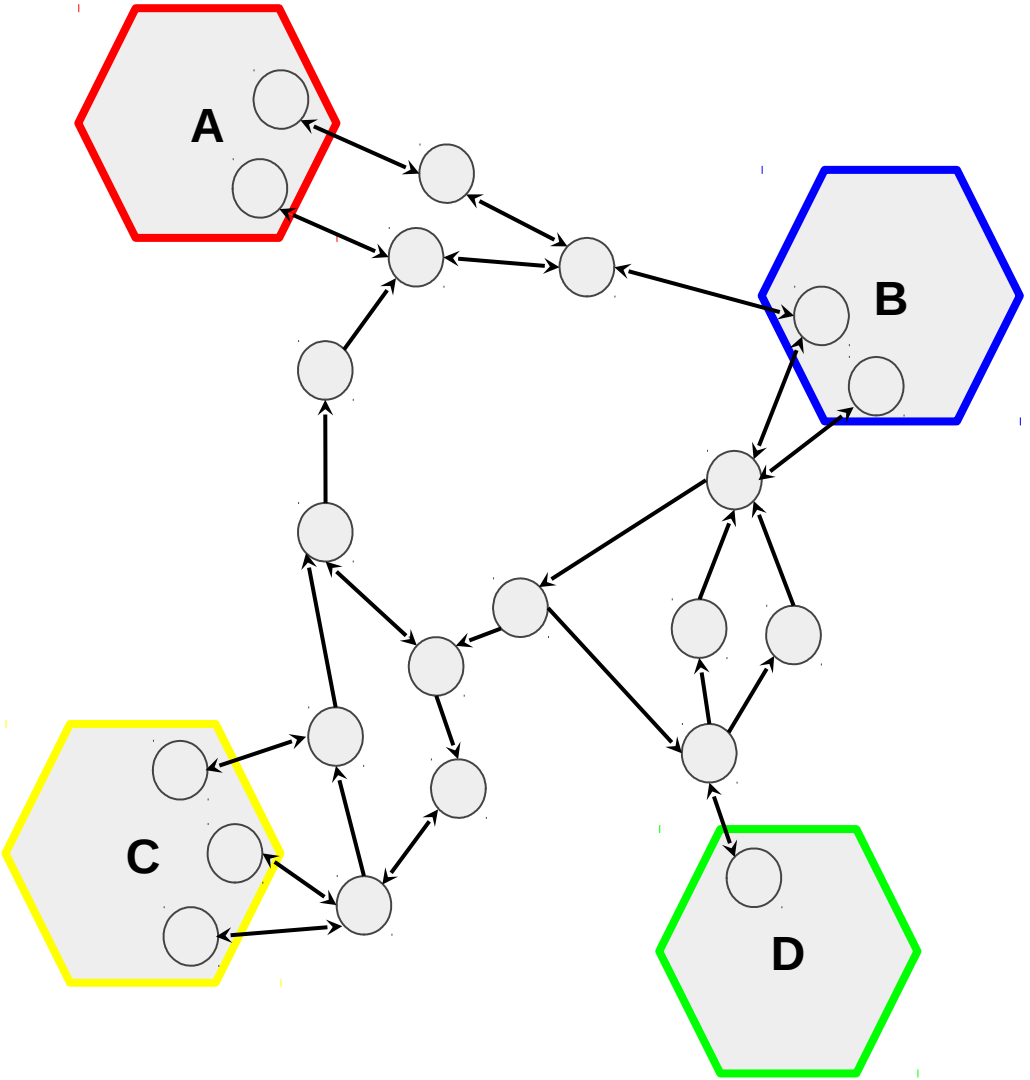




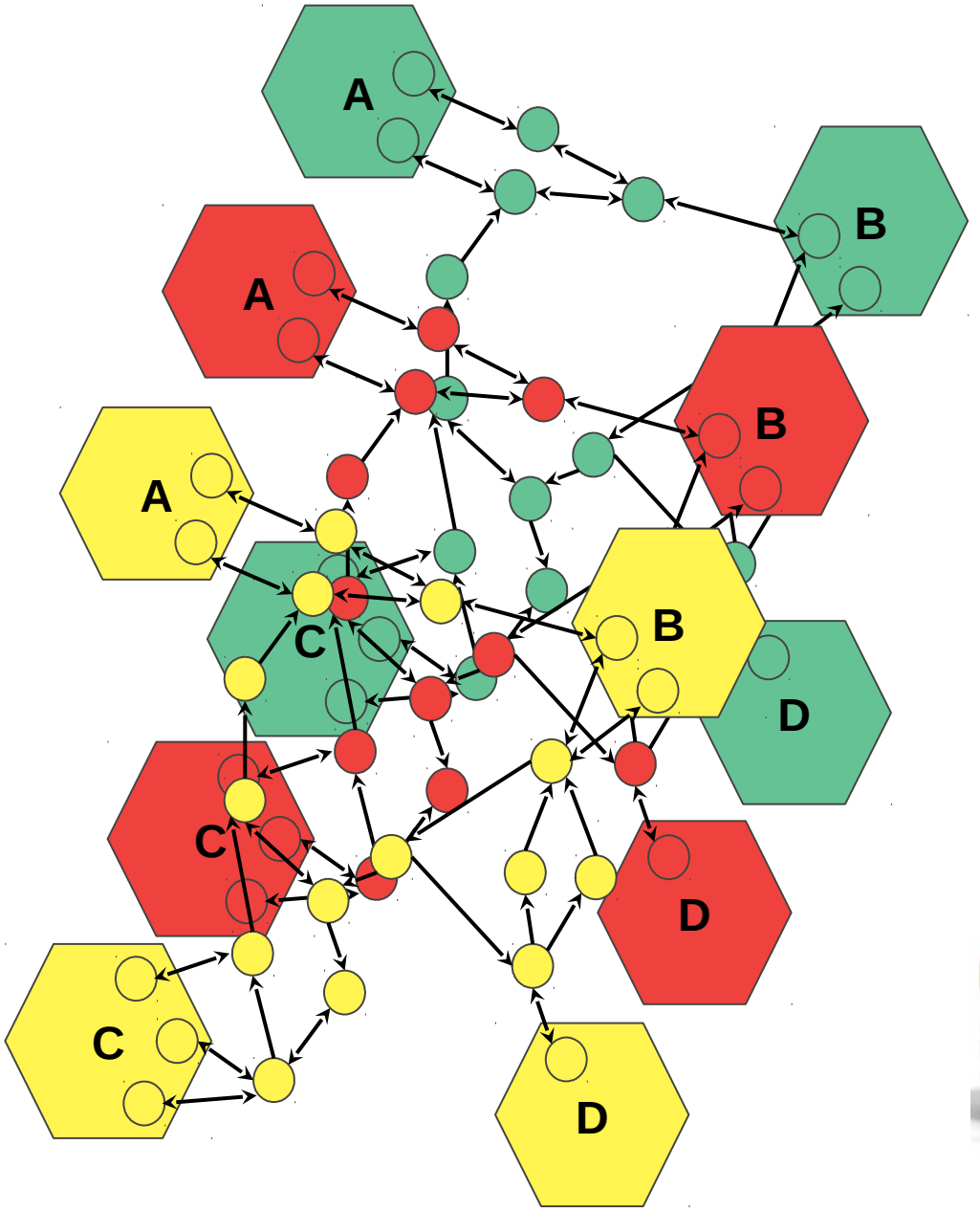


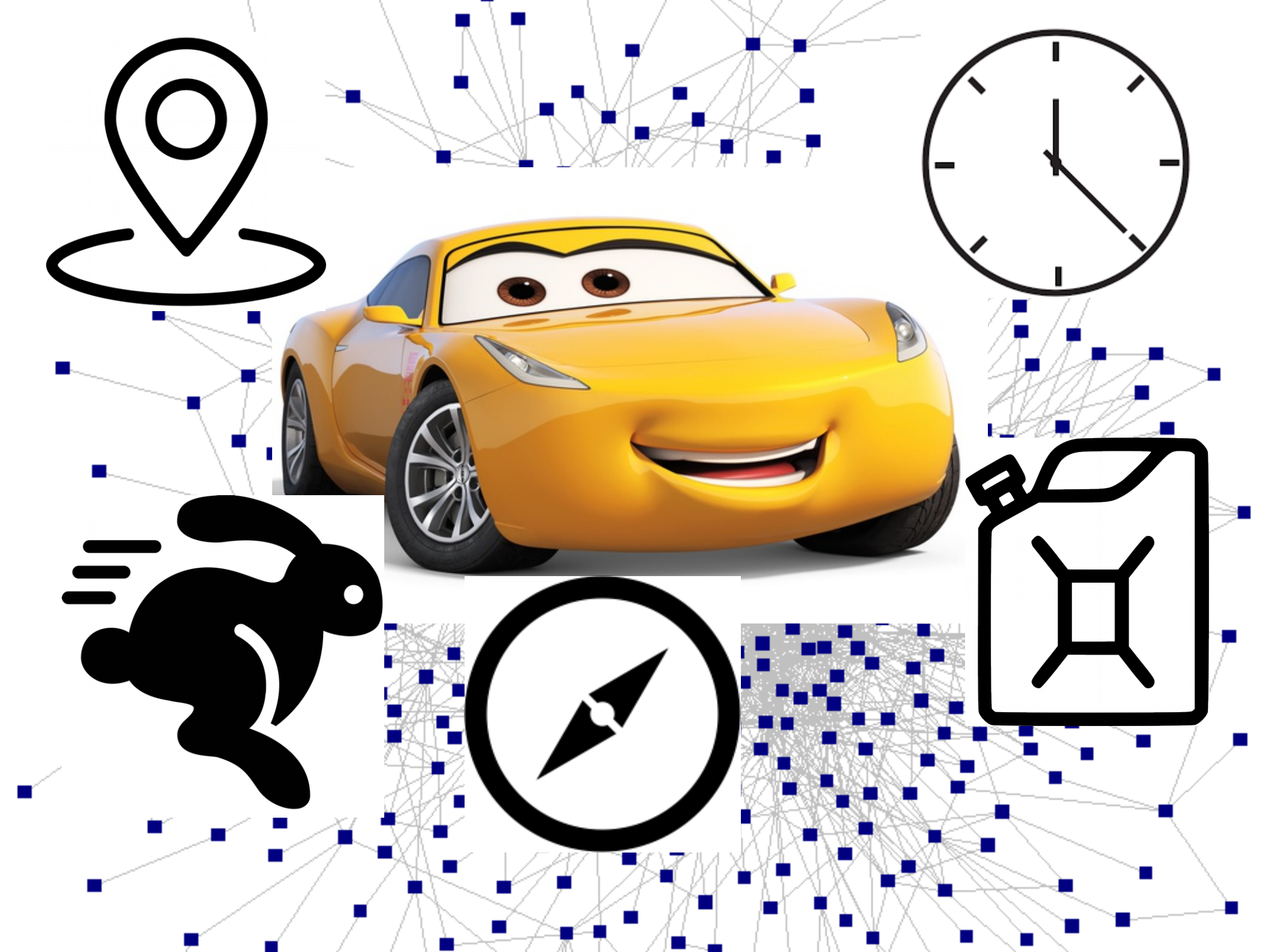


Stations



Movement Graph





Routing

	Single Agent	
A → B	Dijkstra, A*	

Infinite paths

- Infinite routing impossible
  - Except for periodic routes

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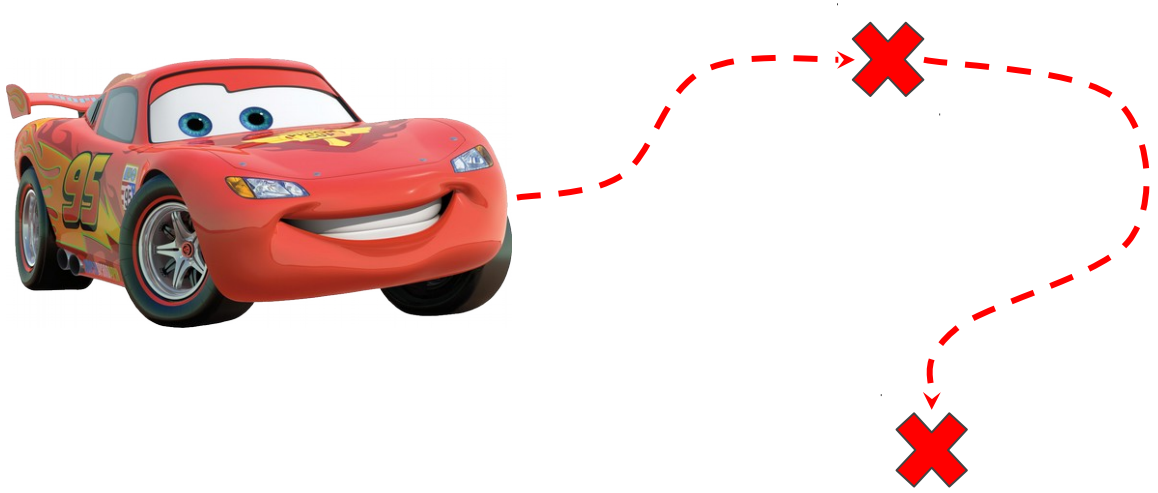

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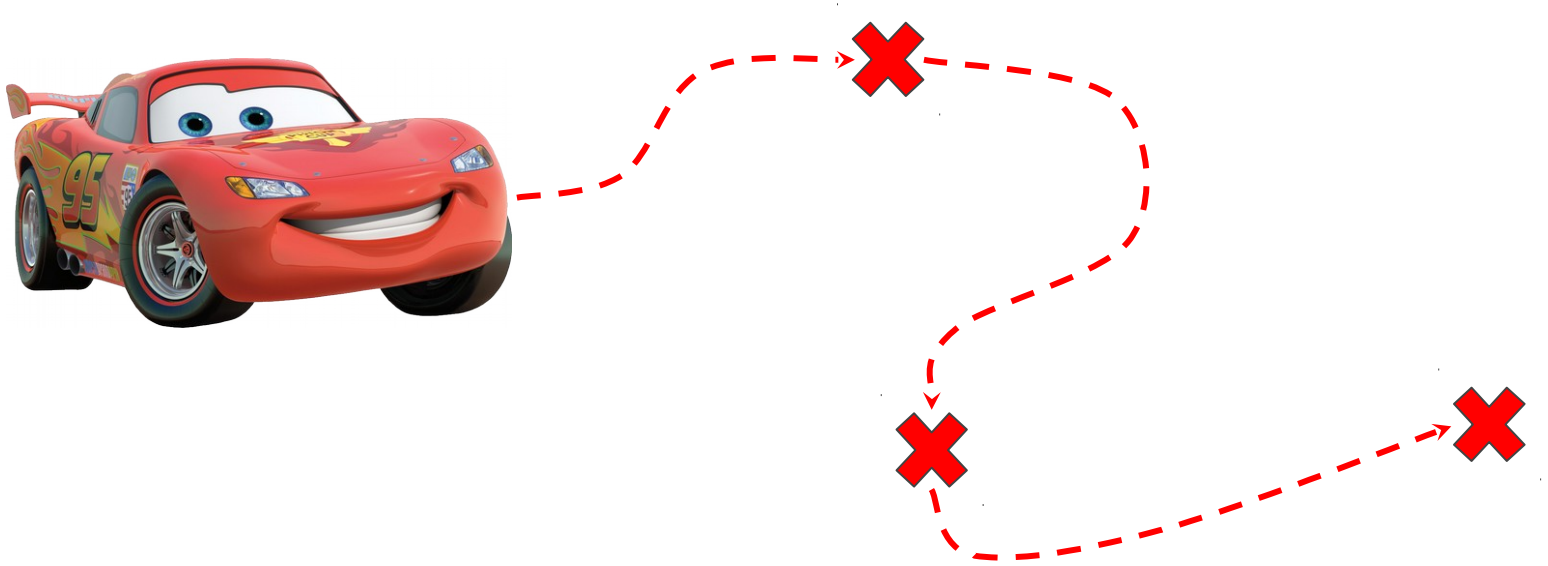

Routing

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A → B	Dijkstra, A*	
Infinite Path	A → B, B → C, ...	

Routing

	Single Agent	**Multiple Agents**
A → B	Dijkstra, A*	route sequentially
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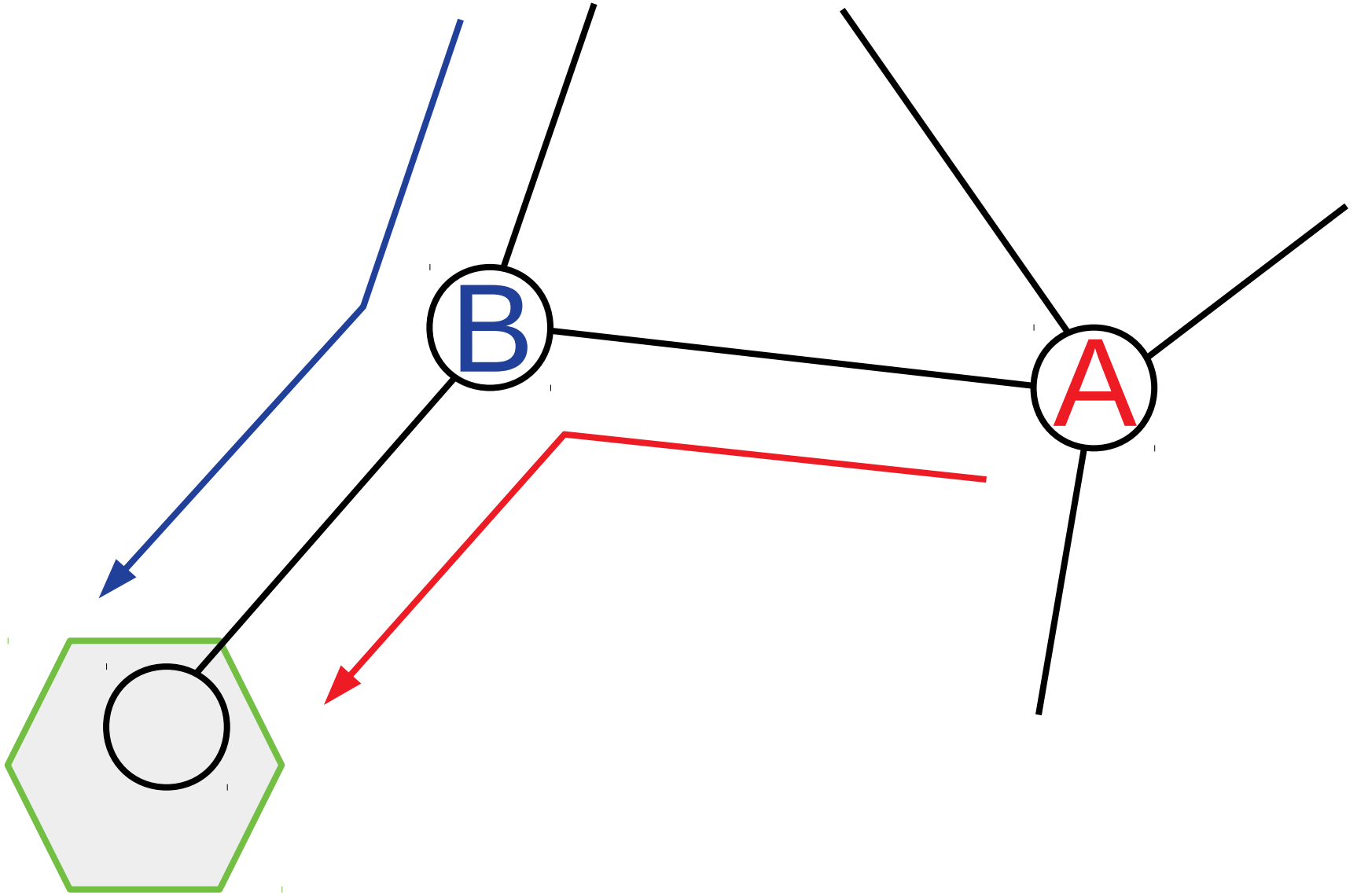
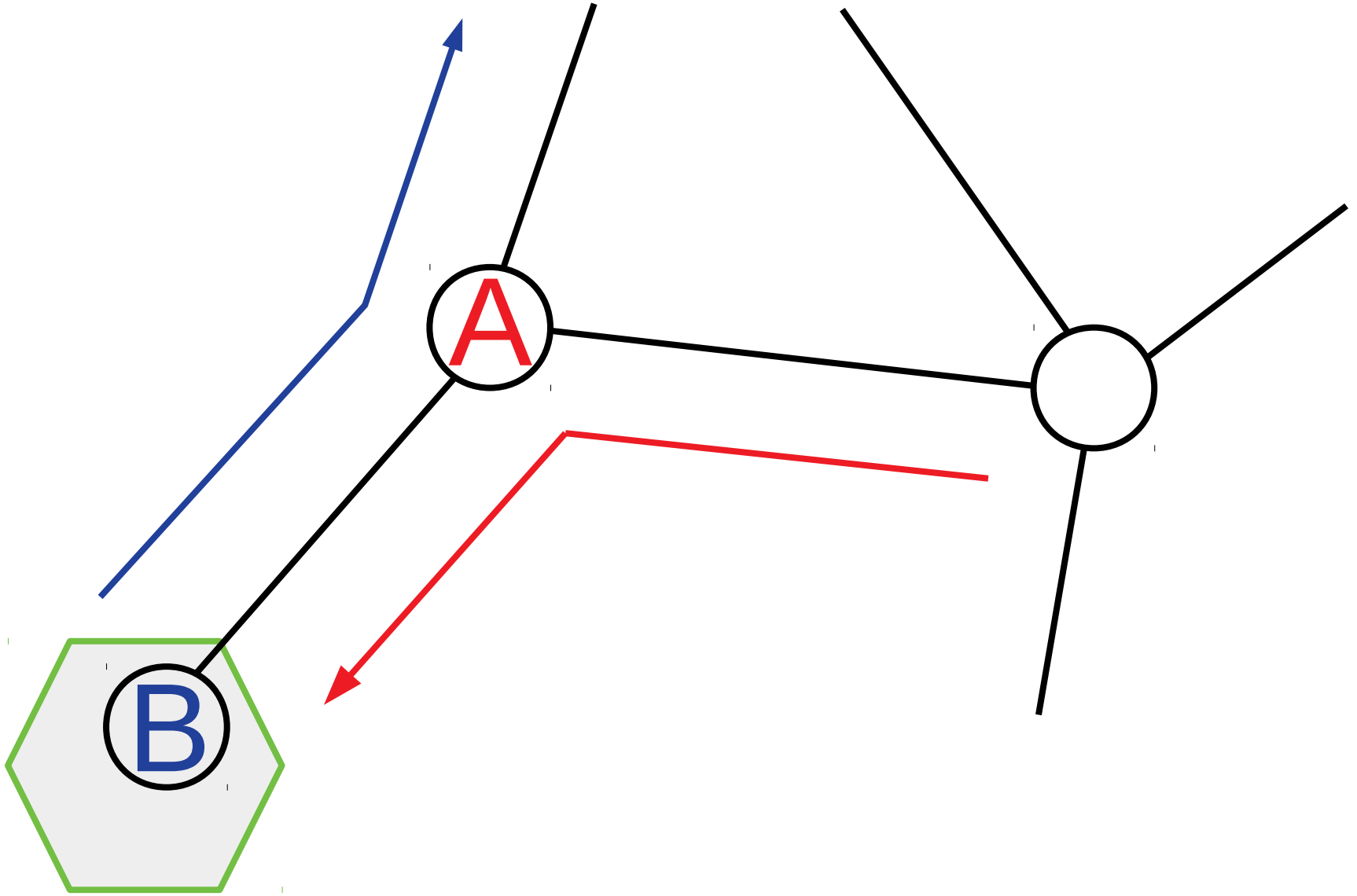
Routing

	Single Agent	**Multiple Agents**
A → B	Dijkstra, A*	route sequentially
Infinite Path	A → B, B → C, ...	?

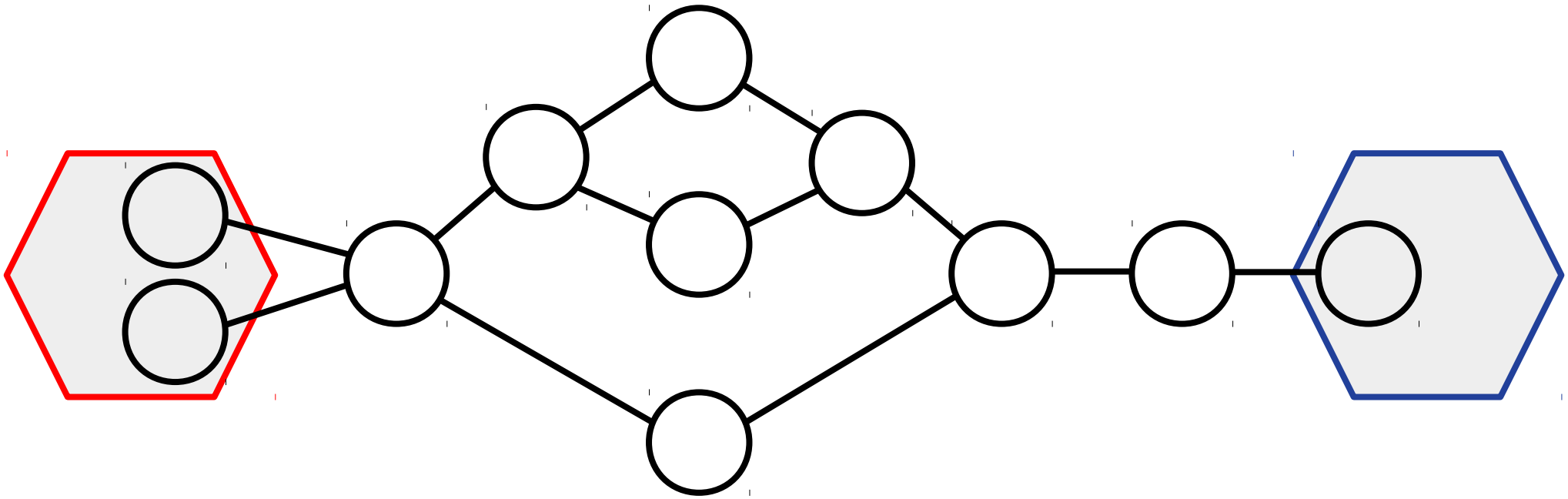
Destination to Destination



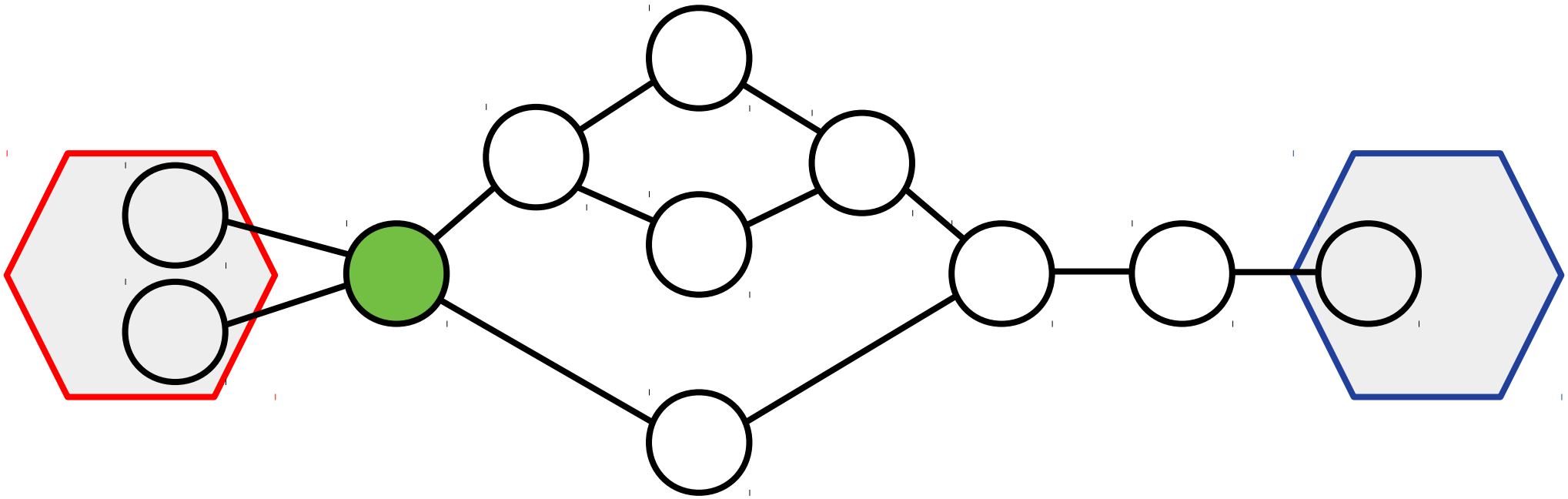
Deadlock



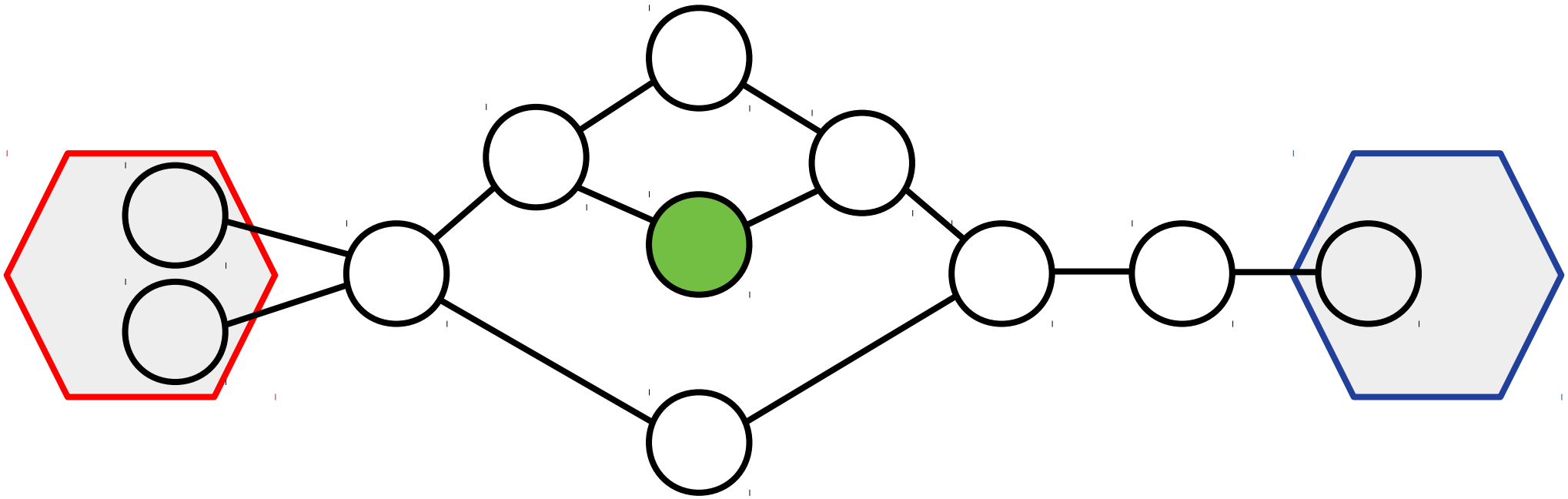
Safe Spots



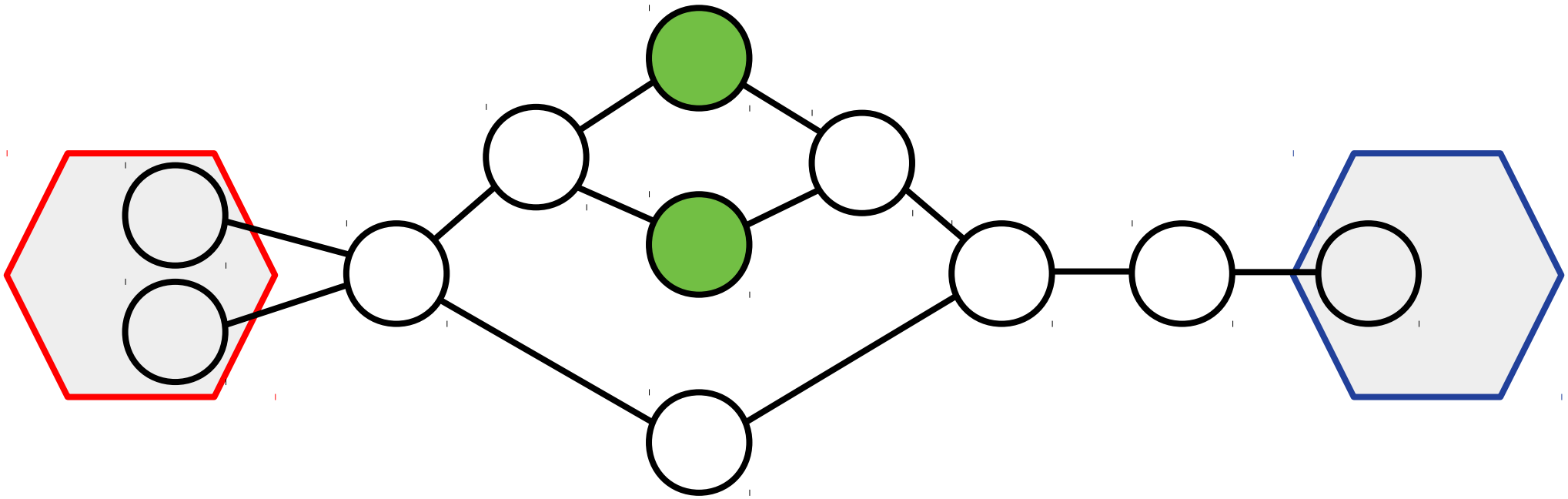
Safe Spots



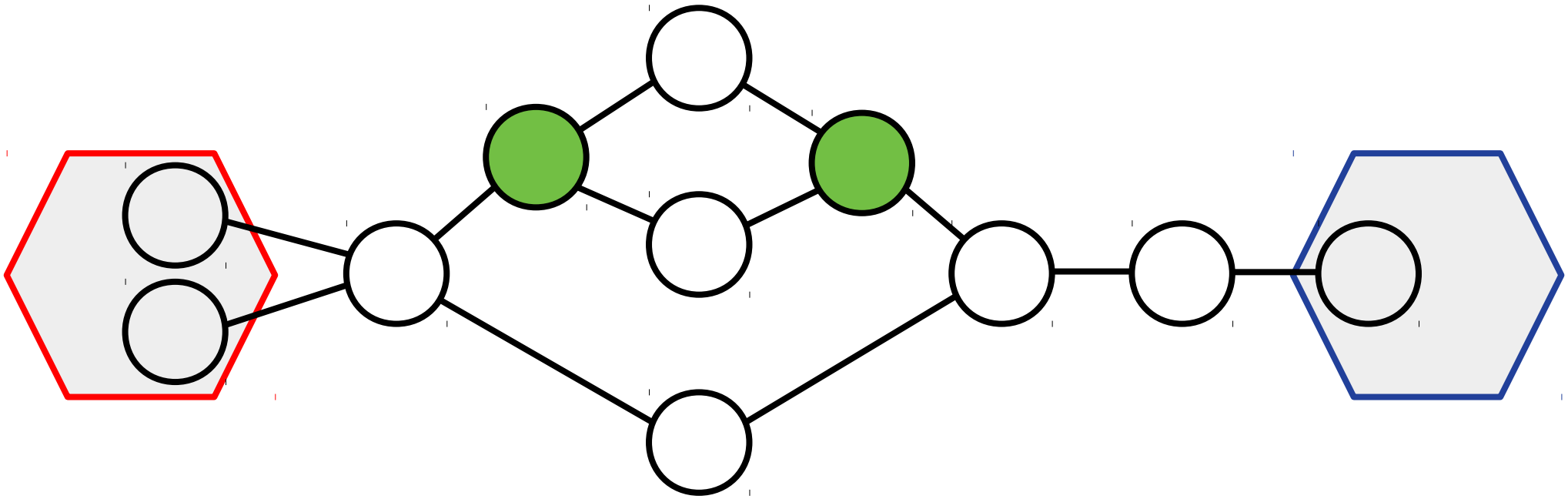
Safe Spots



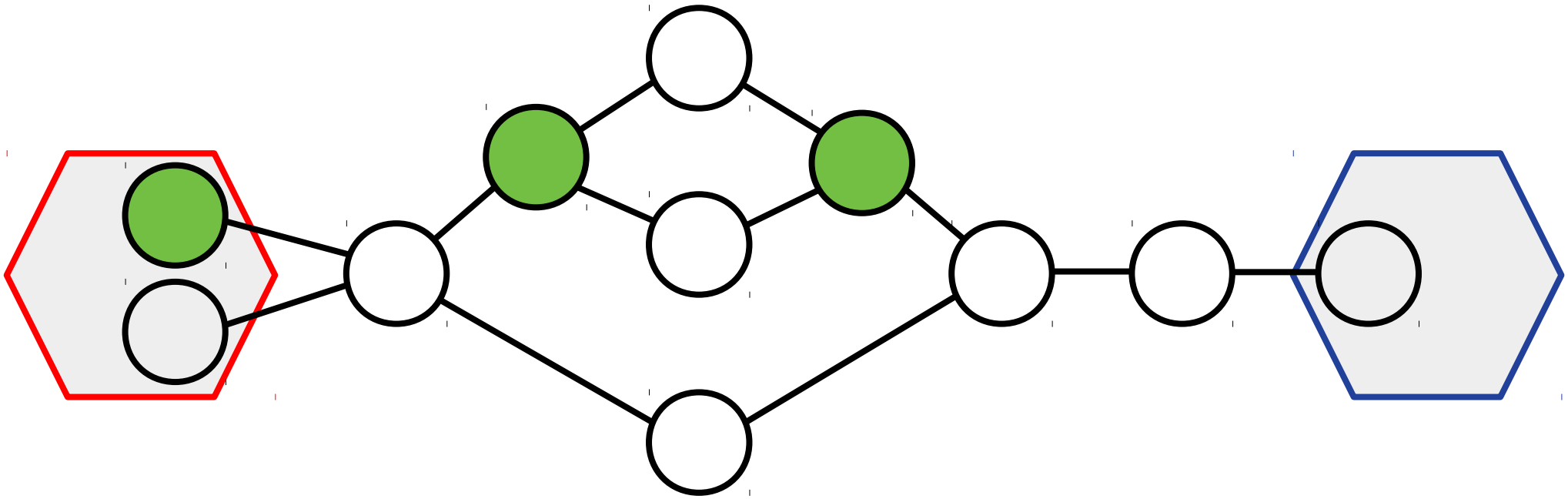
Safe Spots



Safe Spots



Safe Spots

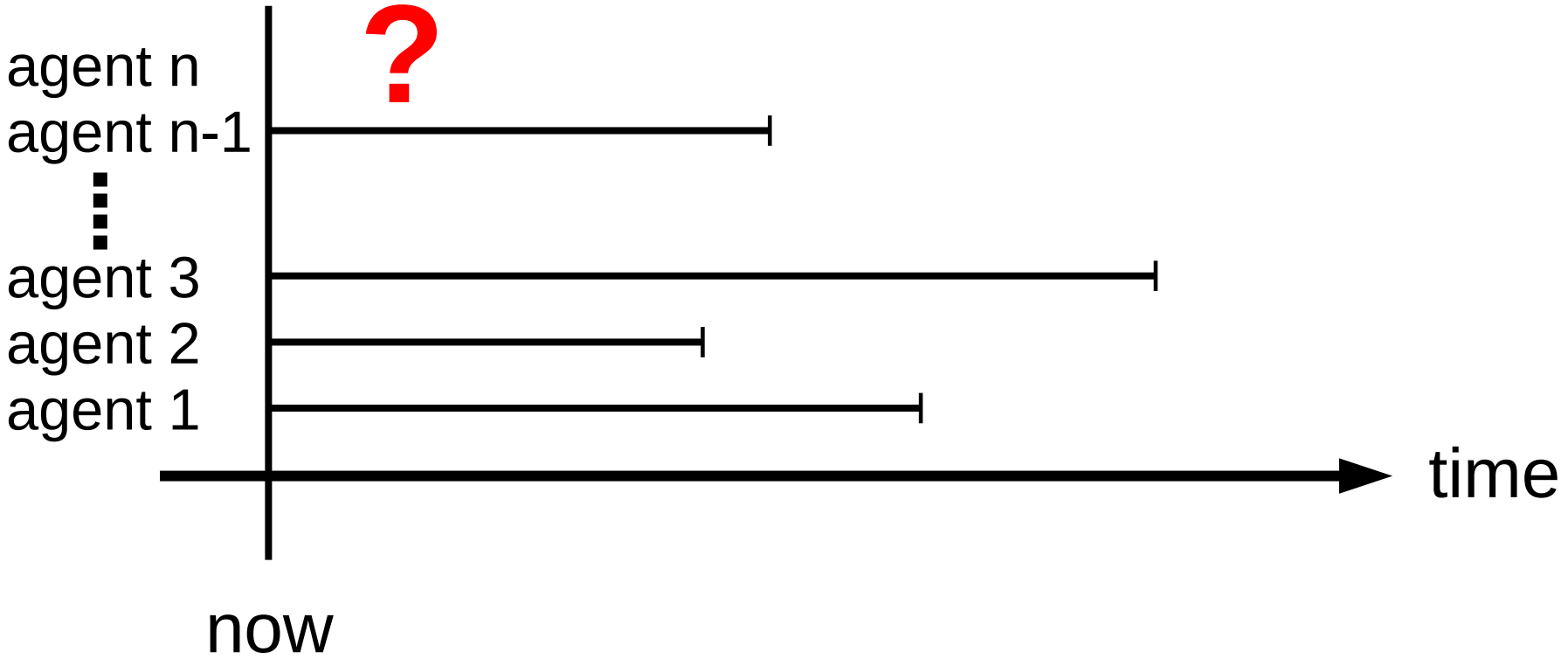


Deadlock-Freedom

- Agent in safe spot does not block anyone
- Moving agent cannot be blocked

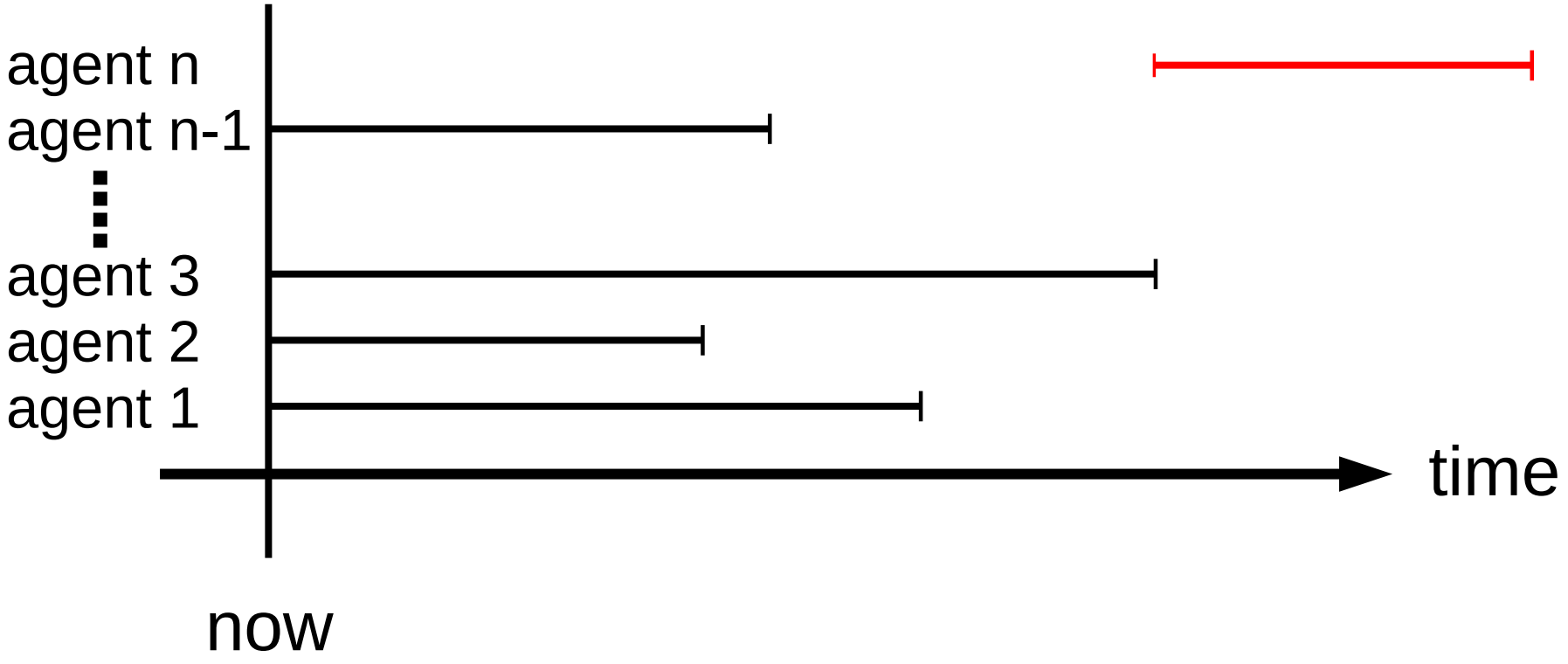
No Deadlock

Progress

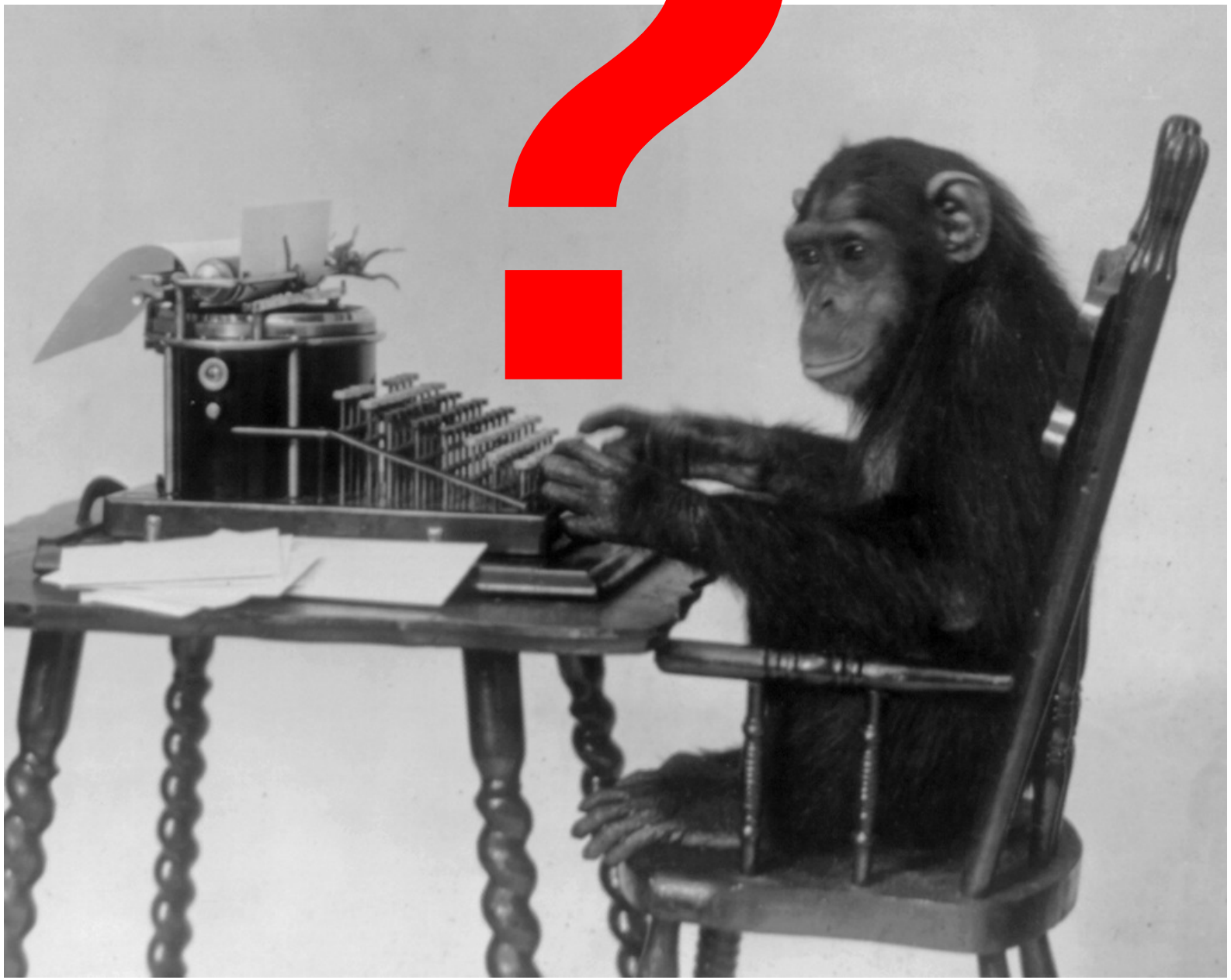


Progress

No Starvation



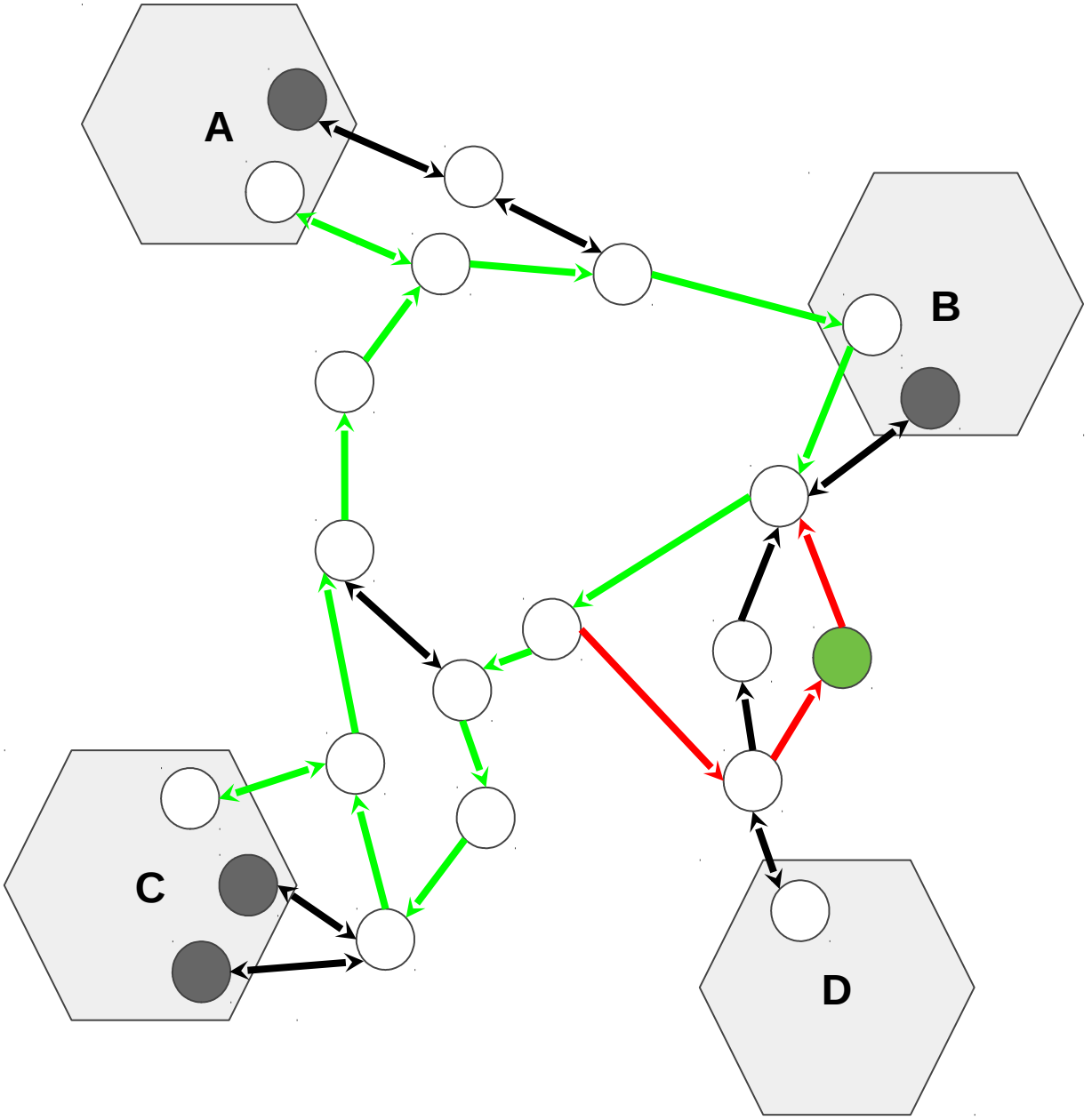
Practice



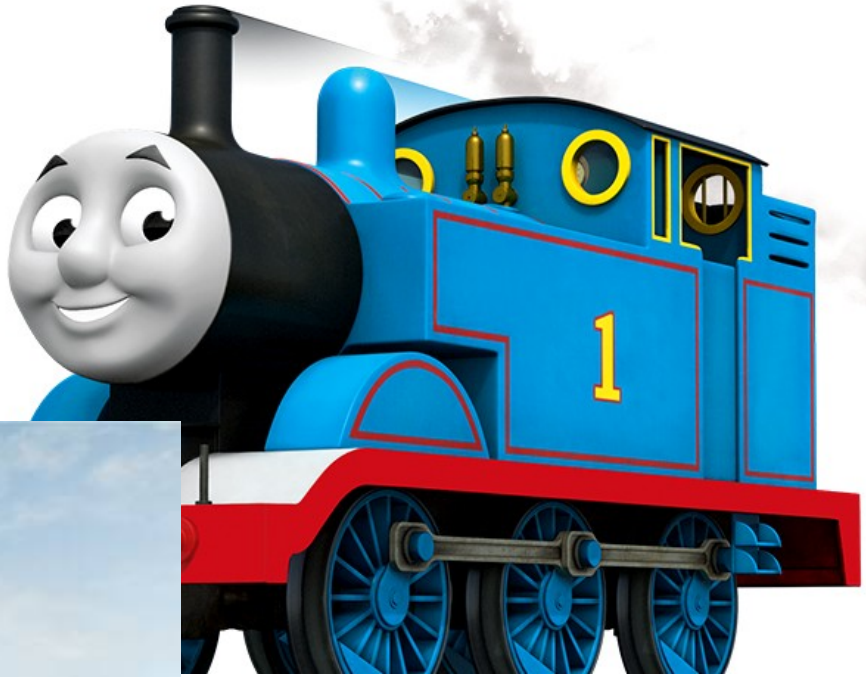
*Hierarchical A**

- Distance heuristic: Distance in graph x 1.7
- 158x speed up
- No nodes revisited: Agents cannot stop

Shortcuts



Traffic Types



Results

512 x 512

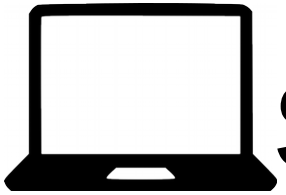
32

7

< 60 M states / time step

Results

10s of seconds long

0.1  s /  / segment

< 60 M states / time step

Applications

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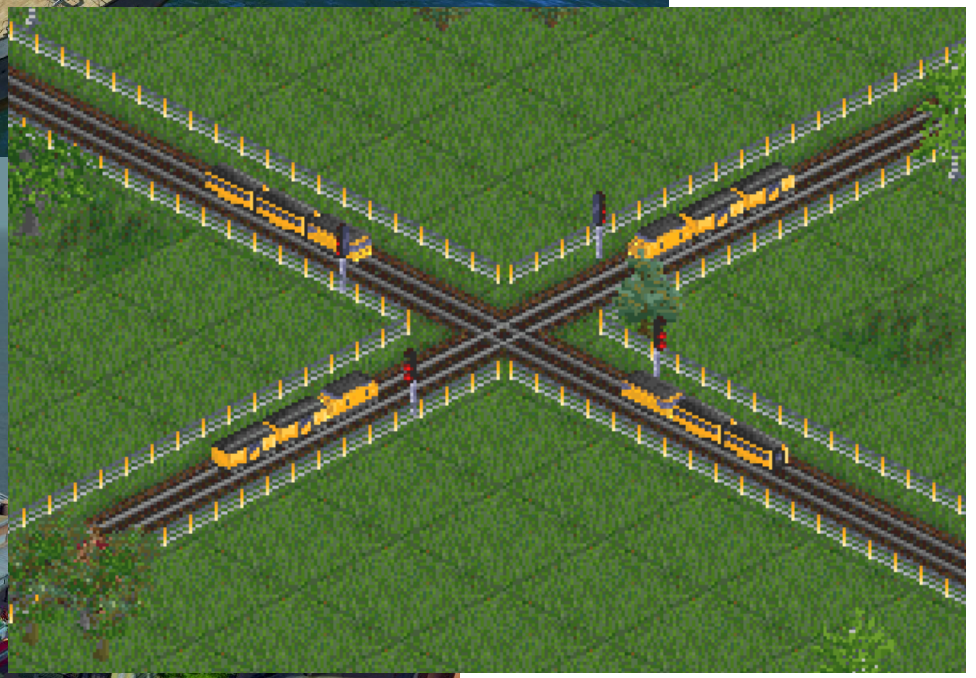

Conclusion

- Routing between safe spots
- Deadlock-free
- Starvation-free
- Real-time (re)scheduling
- Separation between network operators

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