Algorithmic approaches for optimal ship route planning

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Livorno, October 23, 2013

Background: academic

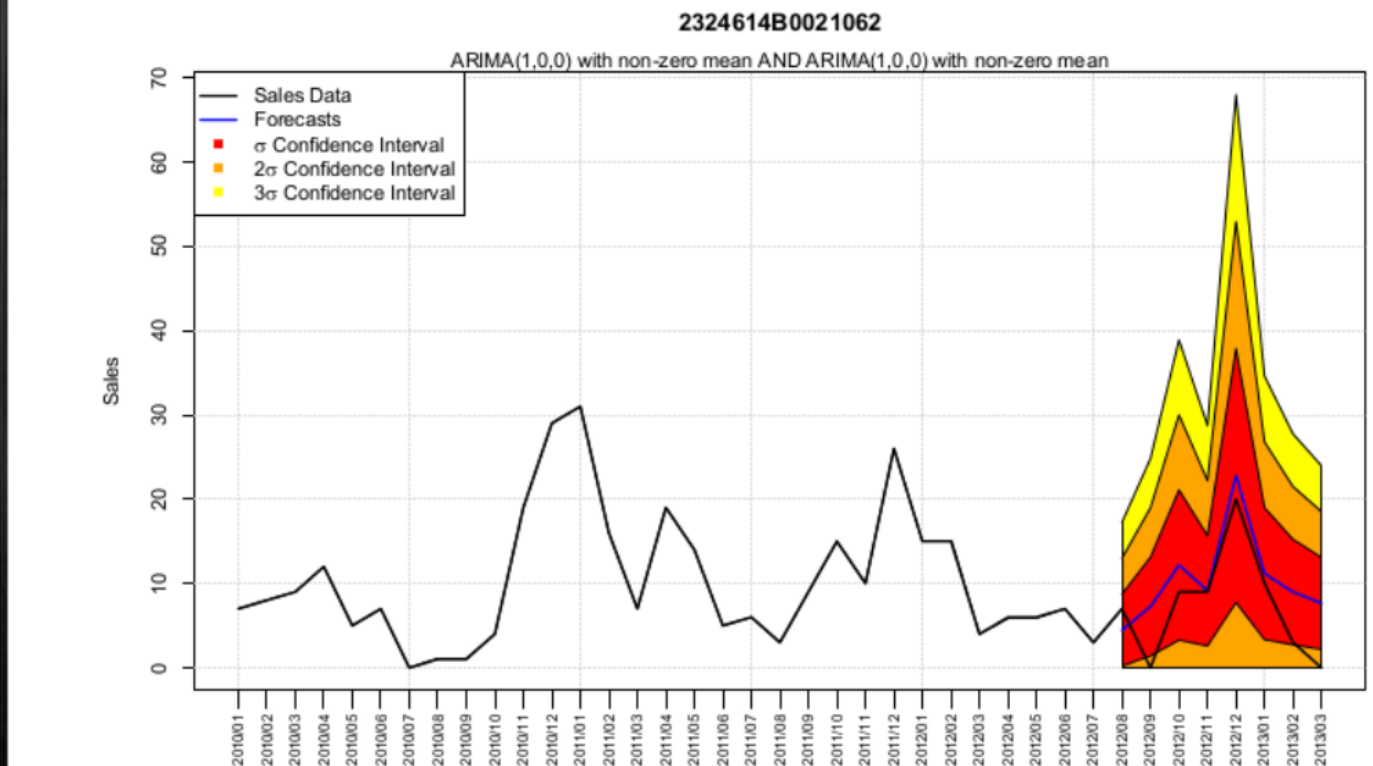
Operations Research group - University of Florence

- Global Optimization
- Traffic equilibrium
- Shortest paths
- Data Mining

Background: KKT srl (spinoff)

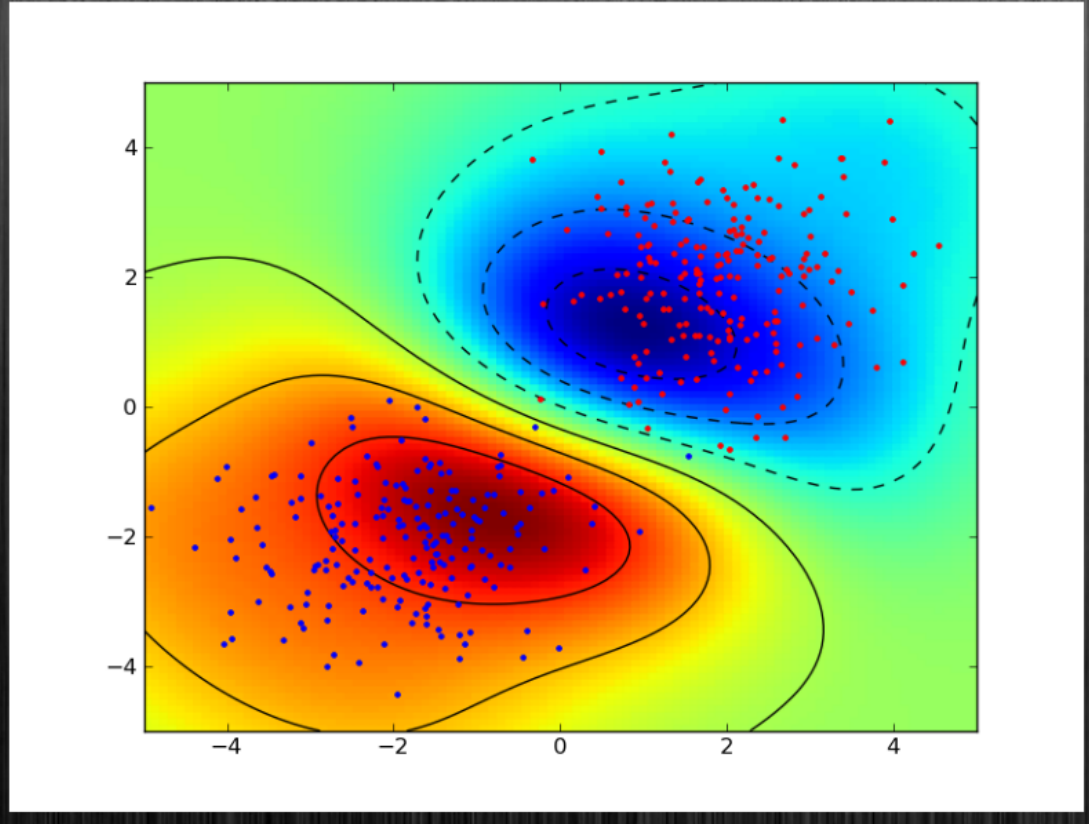
Forecasting tools

sales forecasting - short/medium/long range for fashion, retail, production



Background: KKT srl (spinoff)

Data mining and machine learning



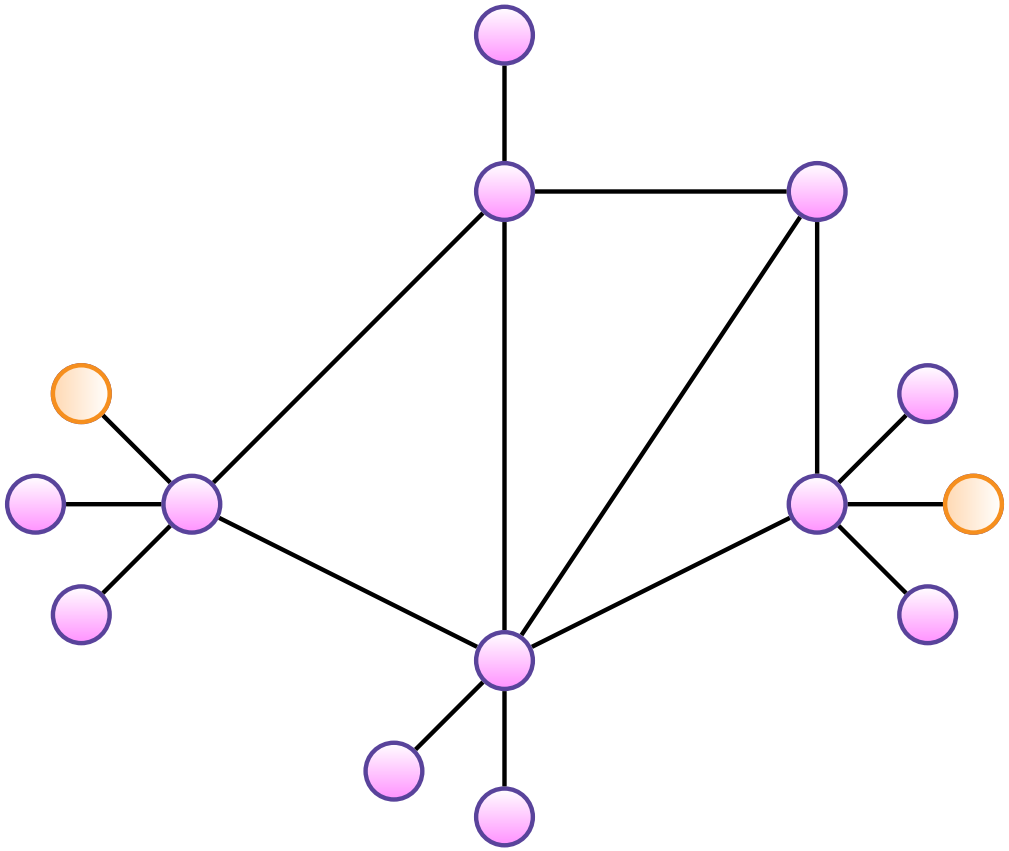
Background: KKT srl (spinoff)

Vehicle routing / technician routing

www.routist.com

From shortest paths to ship route planning

Shortest/least cost path planning (navigators):
Given a graph, with costs on the edges (time, €, reliability, . . .),
find a path which minimizes total cost.



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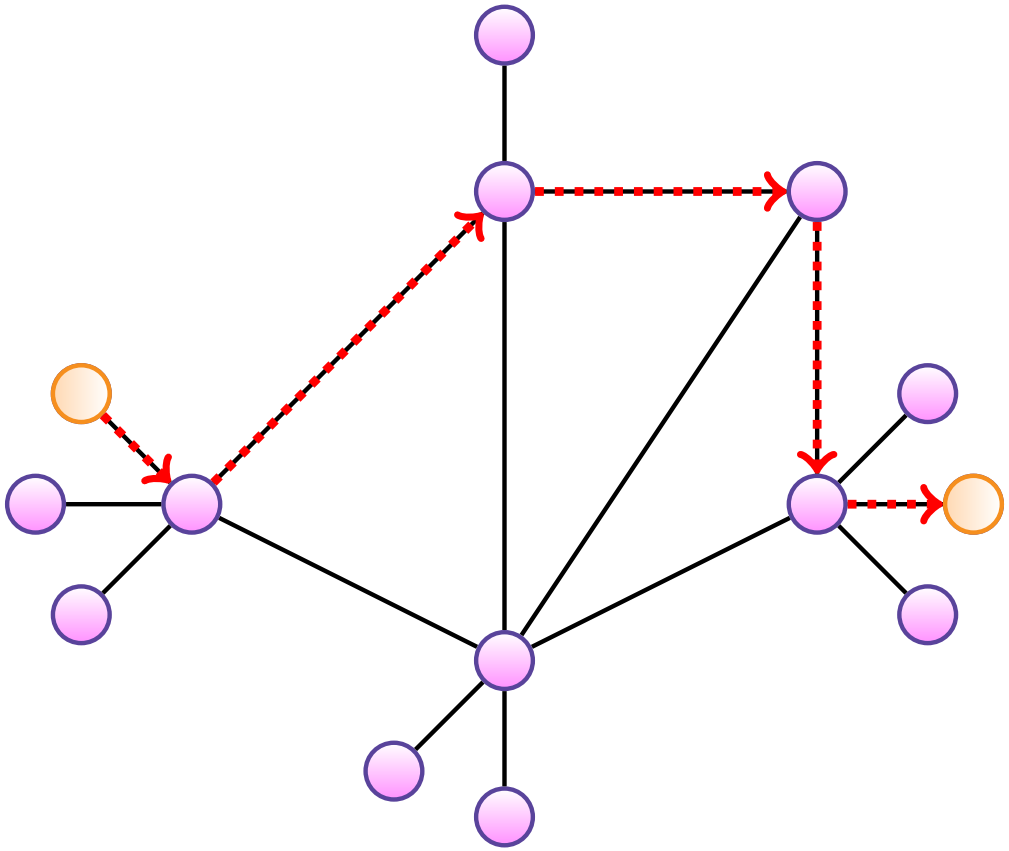

Sea $\neq$ land

Approach: discretize the sea (e.g., in squares of 0.25 miles per edge)

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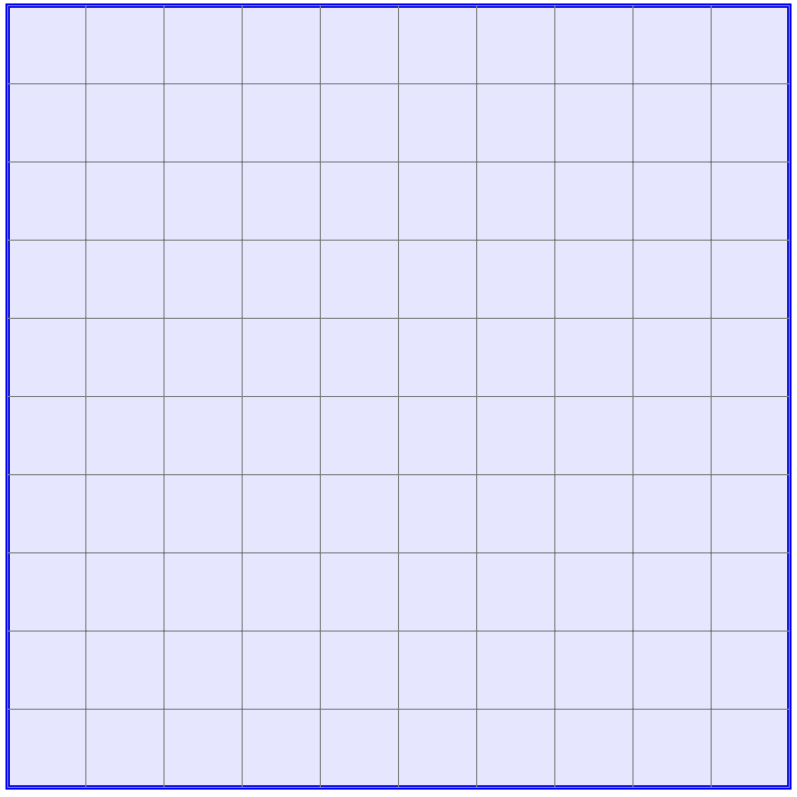

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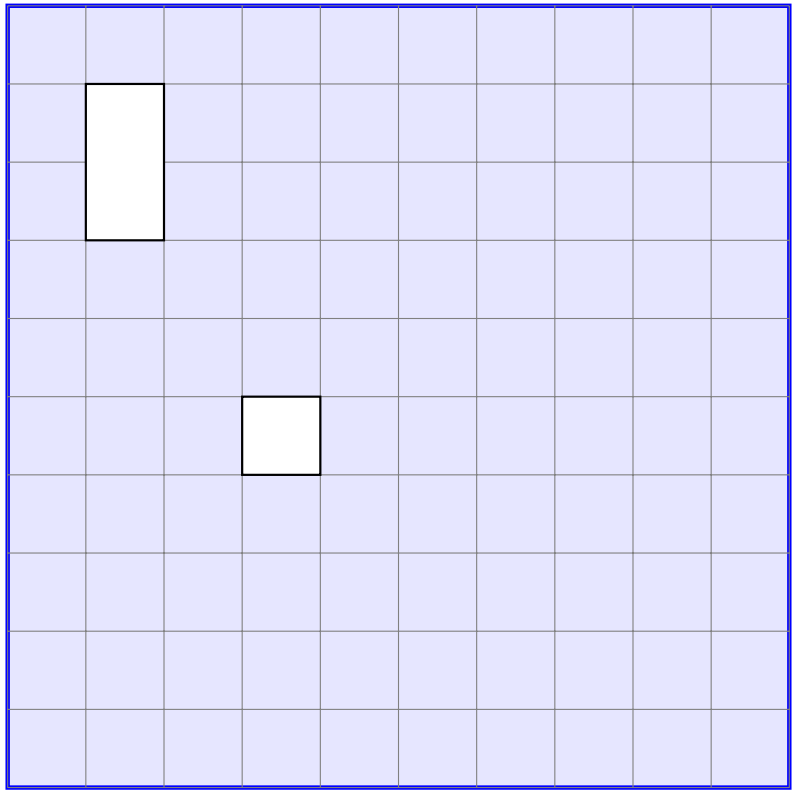

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Build a graph

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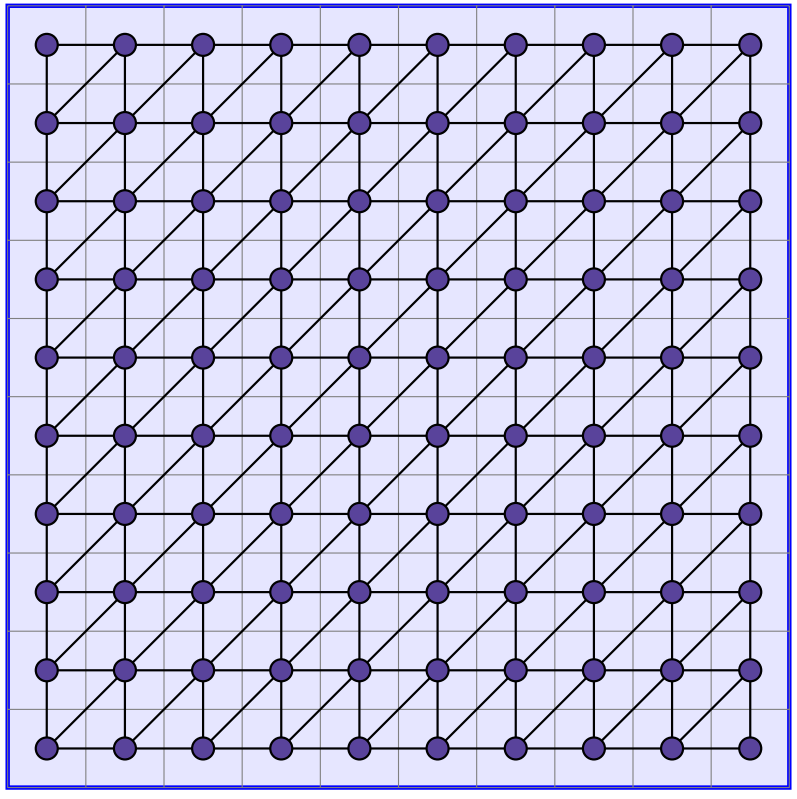

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Of course no!
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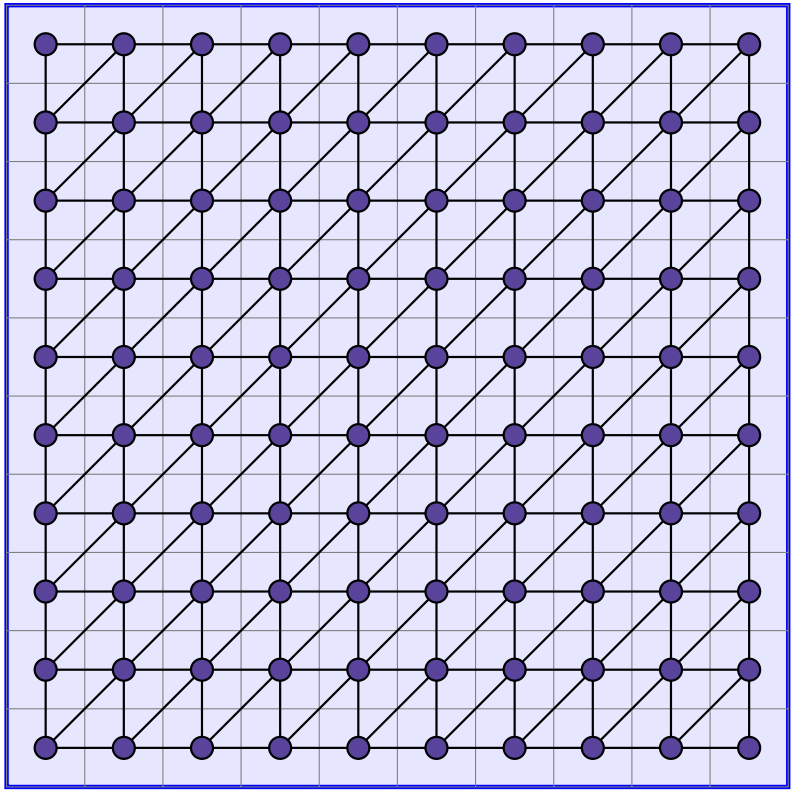
The problem becomes *dynamic* and *stochastic*

How to deal with the dynamics?

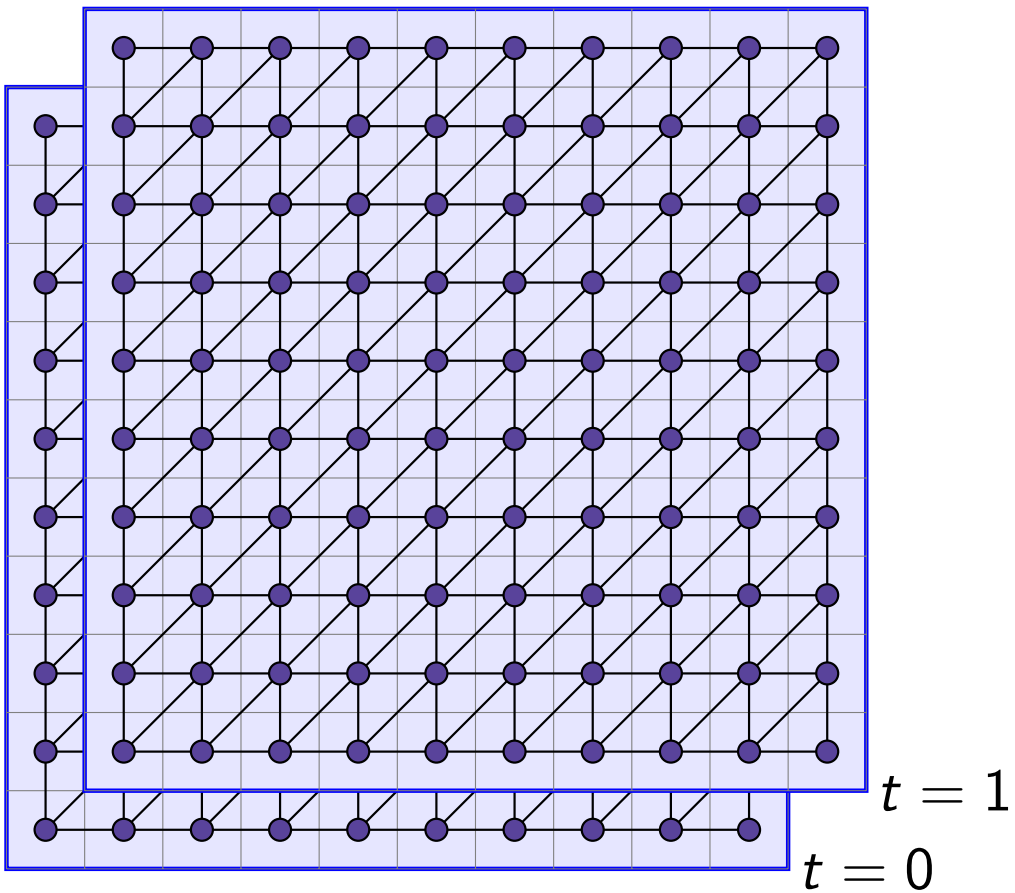
One possibility: dynamic graphs:

How to deal with the dynamics?



$t = 0$

How to deal with the dynamics?



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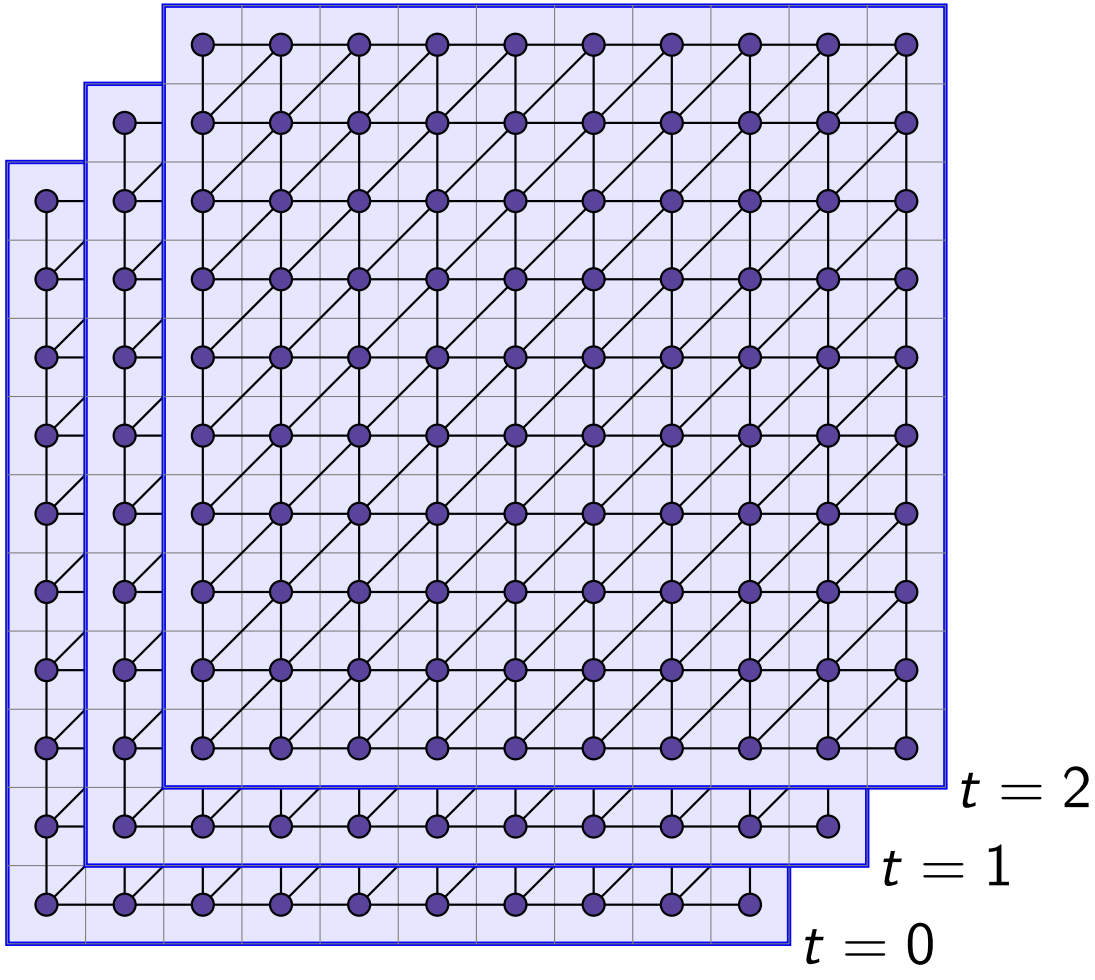

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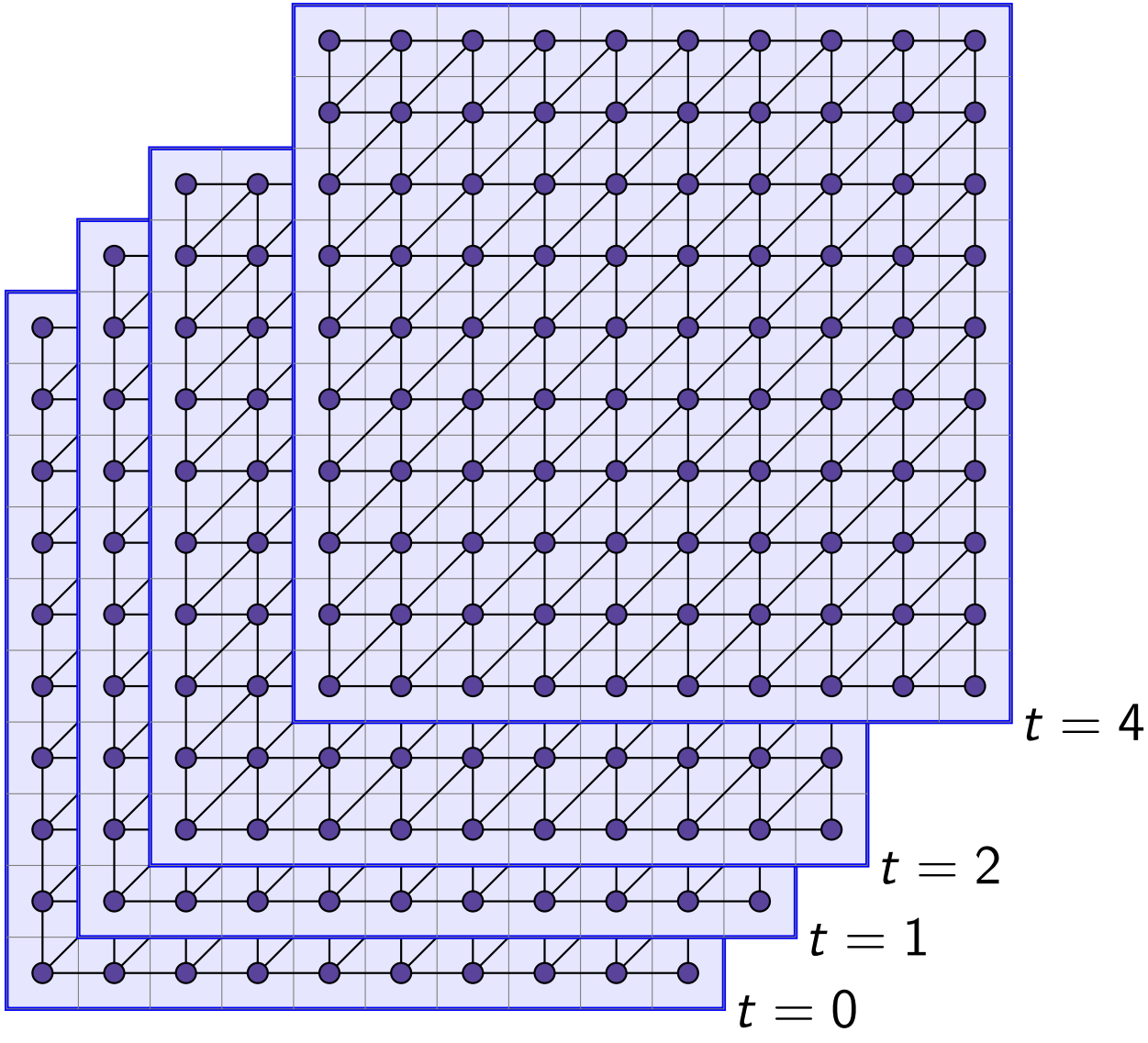

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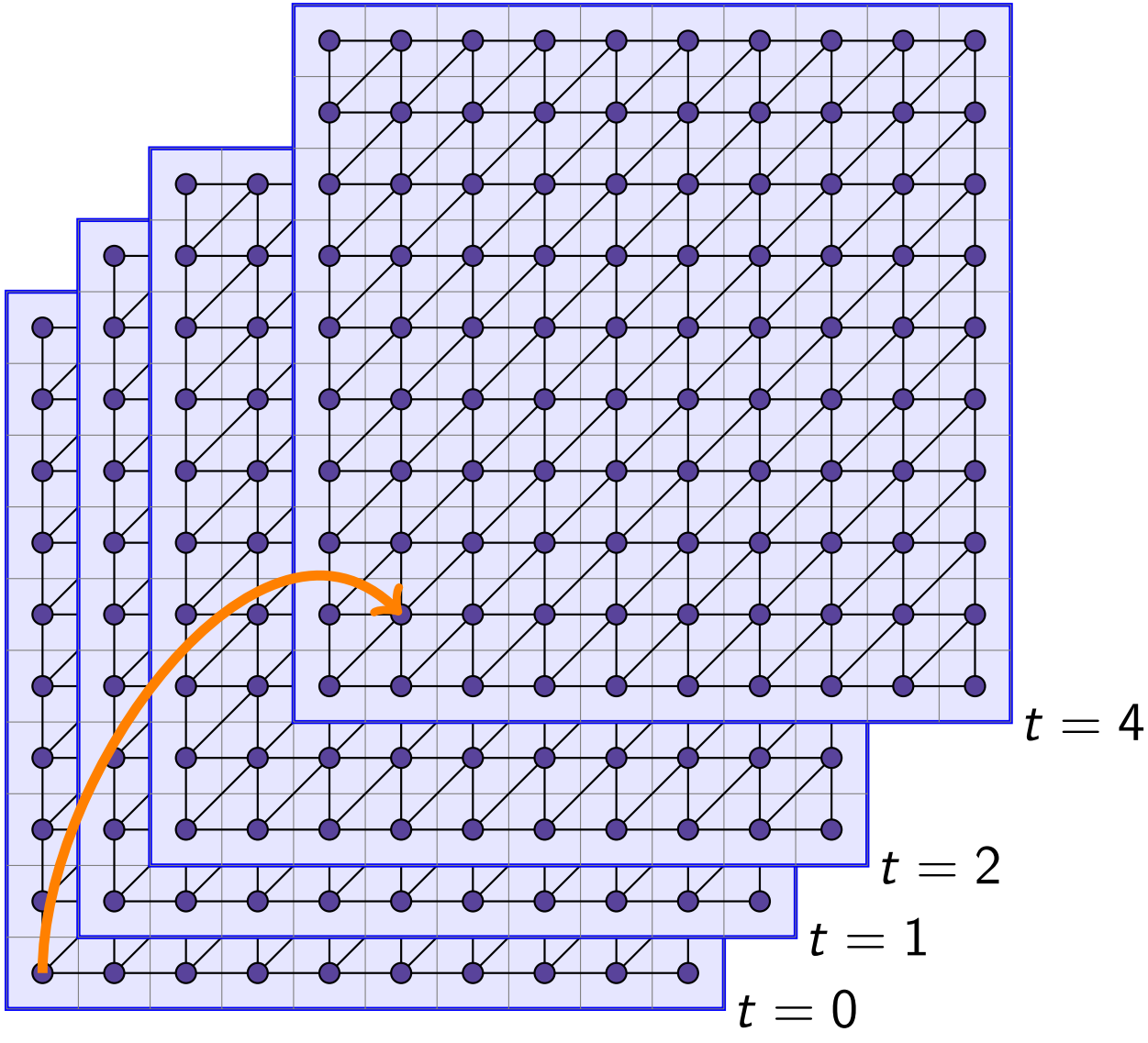

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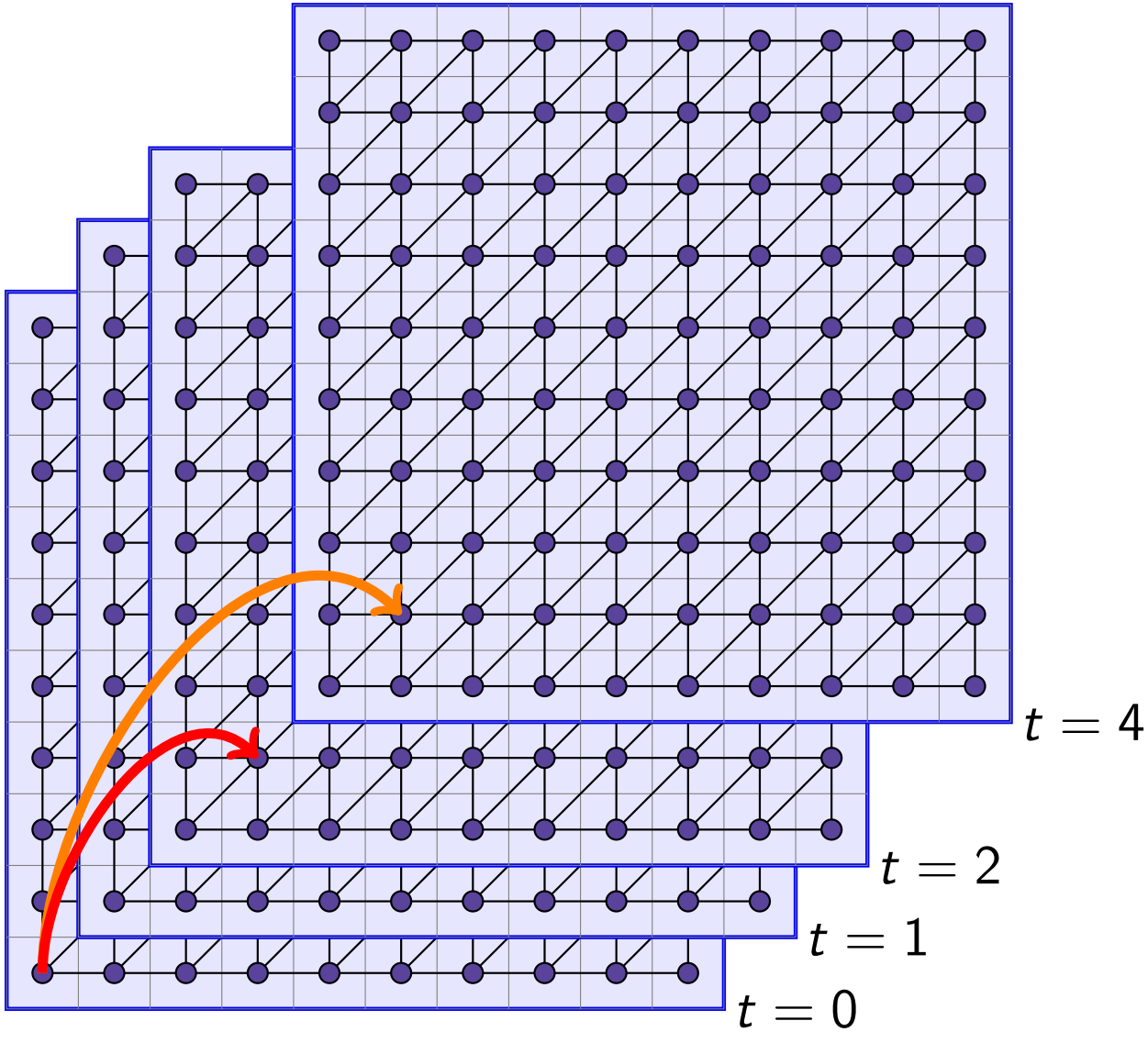

Costs

The cost on each arc depends:

- on the distance traveled
- on the speed (time distance between nodes)
- on weather forecast at origin and destination nodes of the arc

A (very big) graph can be built based on a discretization of times and speed and with weather–dependent costs. An efficient shortest path algorithm can be used to find the best point-to-point route

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