TEMPORAL GRAPH ANALYSIS FOR OUTBREAK PATTERN DETECTION IN COVID-19 CONTACT TRACING NETWORKS

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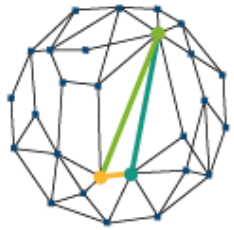

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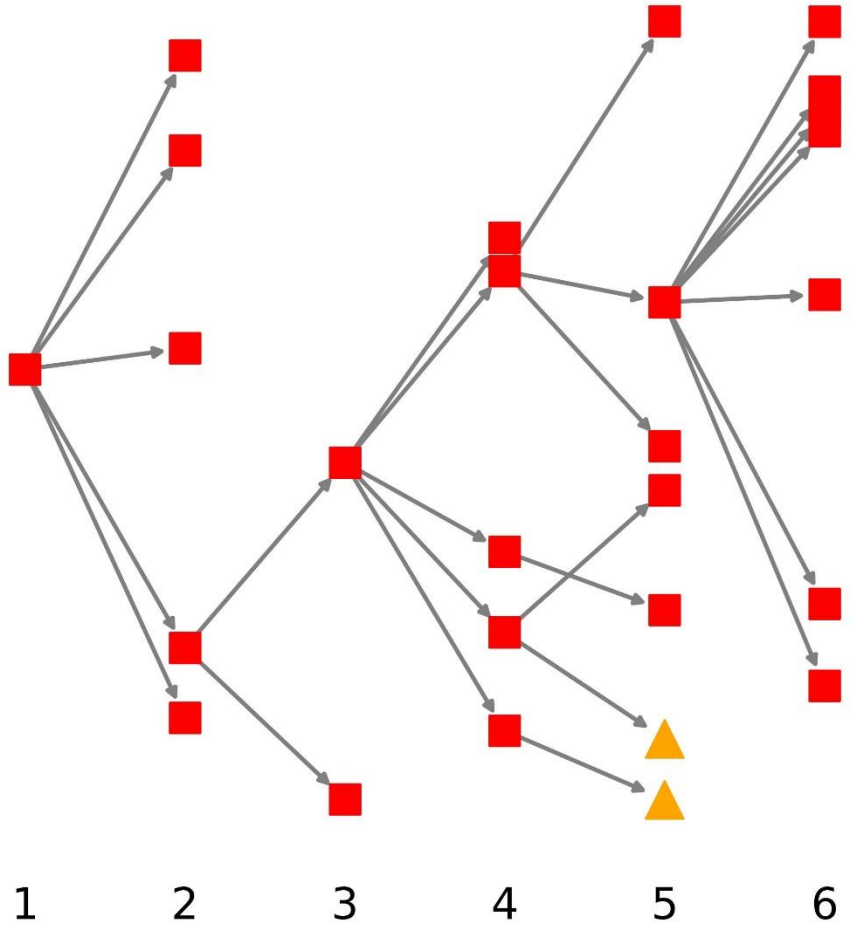
Why analyze contact tracing data?

Data from German health authority

- COVID-19 is a highly **dynamic pandemic**
  - Challenge for local health authorities: Improve decisions on social restrictions and quarantines
  - Goal: Break infection chains via contact tracing and selective testing/quarantining
- Contact tracing data can be represented as a **temporal graph**
  - **Nodes** are persons (either infected or contacts)
  - **Edges** are (assumed) spreading of infection from one person to another
  - Attributes on nodes and edges store additional data



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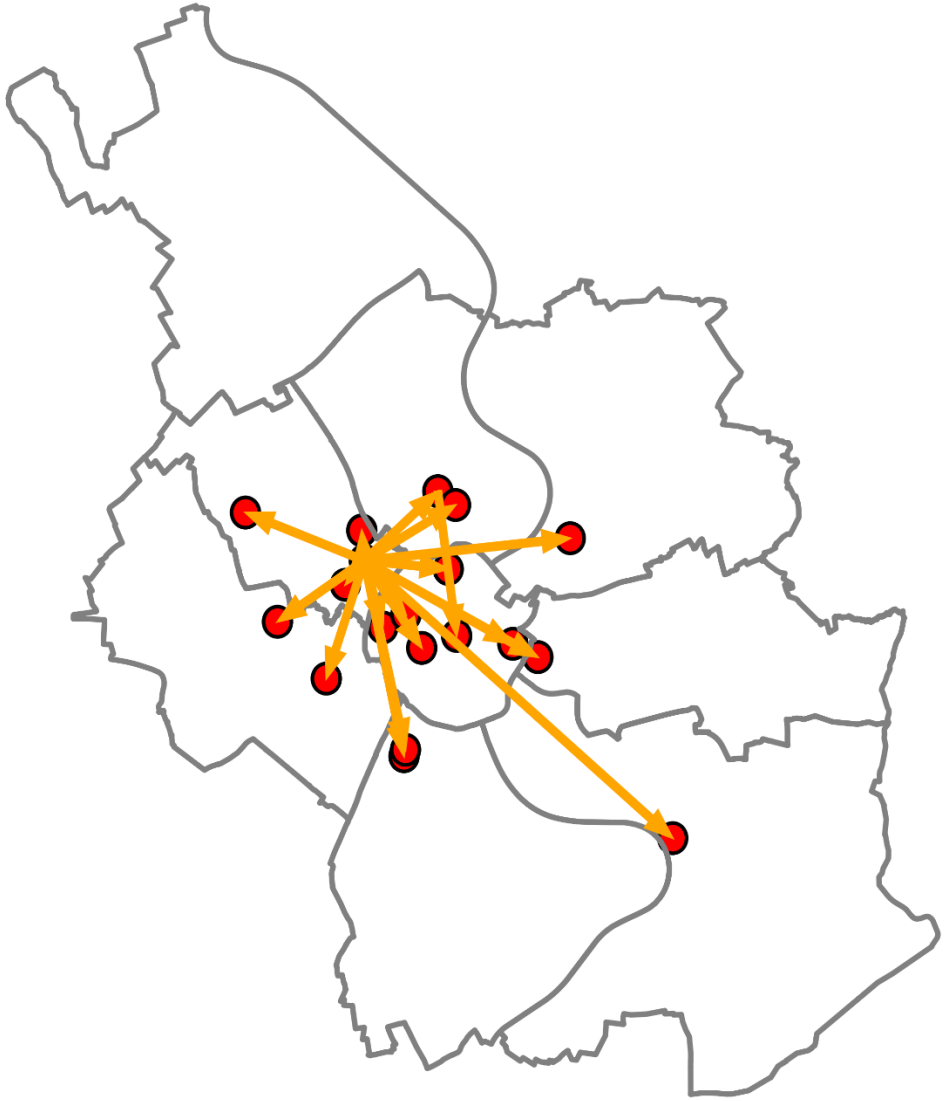
Why analyze contact tracing data?

Data from German health authority

- **Dataset**
  - 10.200 infections and more than 40.000 contacts between February and October 2020
  - Spatial, temporal, demographical and epidemiological information for each case

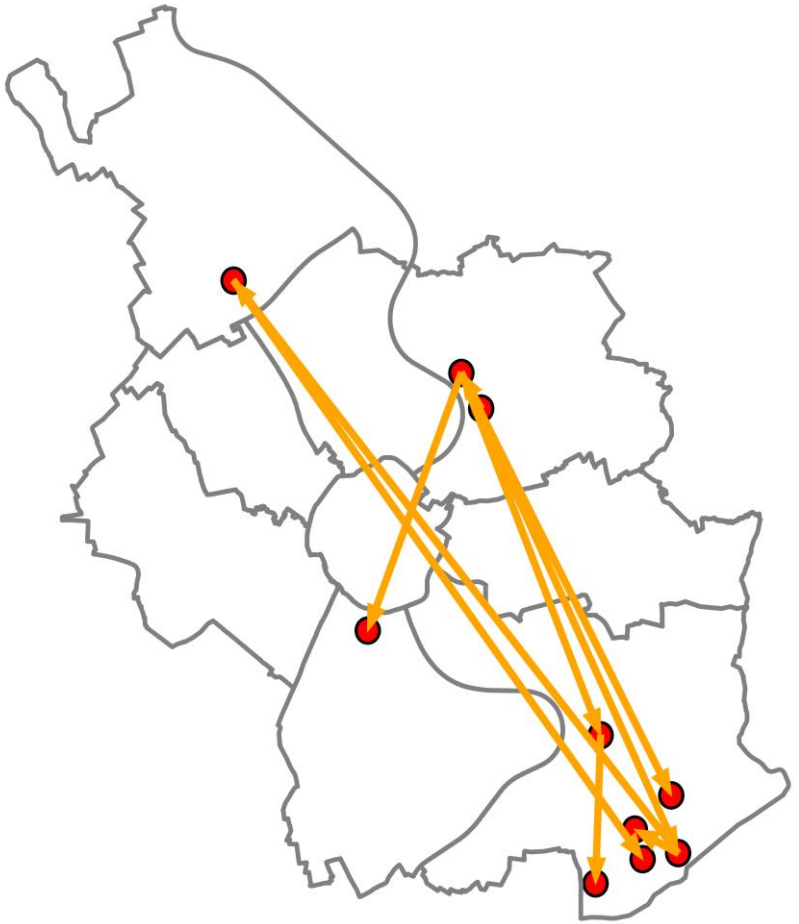
- **Research questions identified with subject matter experts**:
  - Can we identify recurring patterns in the developing network?
  - Can we predict ‘missing links’ between infections?
  - How can we assess the current risk of uncontrollable spreading?



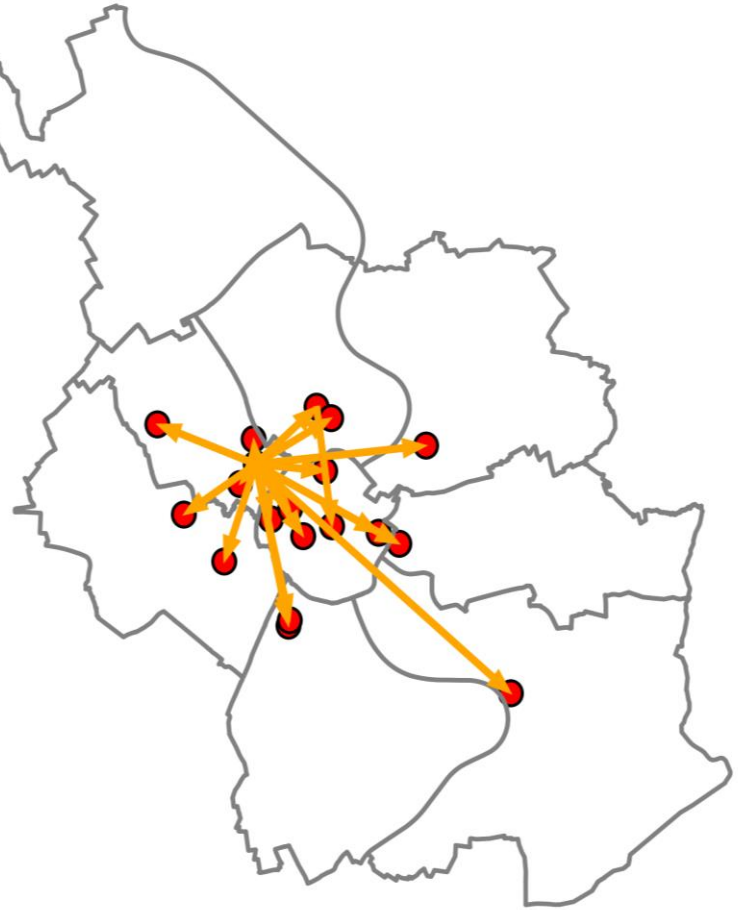
How can we analyze contact tracing data?

Qualitative results

- **Understanding of infection spreading**
- **Example**: Differentiate multiple types of spatio-temporal clusters



Type A

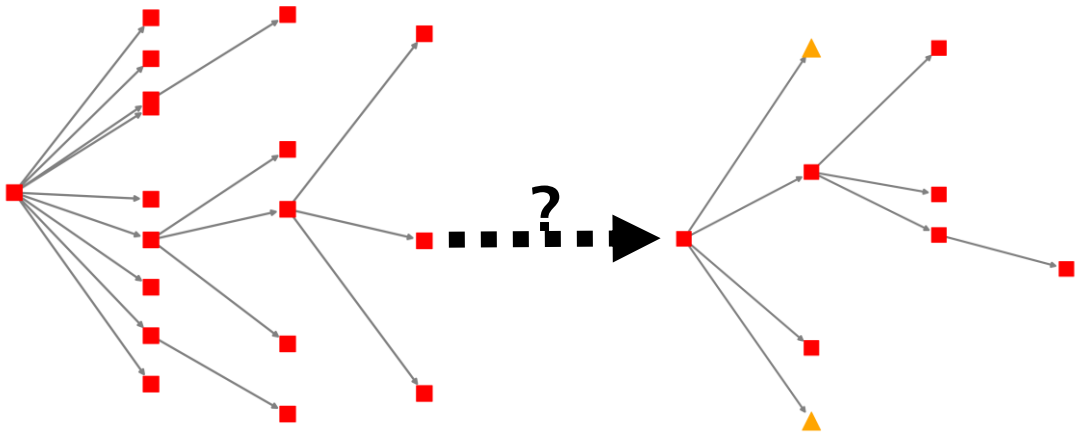


Type B

How can we analyze contact tracing data?

Proposed Model

- **Interactive temporal graph analysis framework**
  - User can select interesting components
  - Similar components are detected and visualized automatically
- **Metrics describing connected components**
  - E.g. Component risk factor $r(C) = \frac{a_{med}}{s_{med}}$
    - a_{med}: median number of infections
    - s_{med}: median serial interval between subsequent infections
- **Predicting missing links**
  - Large portion of infection links go unreported
  - Approach: Predict missing connections based on spatiotemporal fit
- **Evaluation** against related methods for persistence mining [4], motif mining [5] and frequent subgraph mining [6].



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We would like to thank Gesundheitsamt Köln for the collaboration.

Thank you for listening!

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