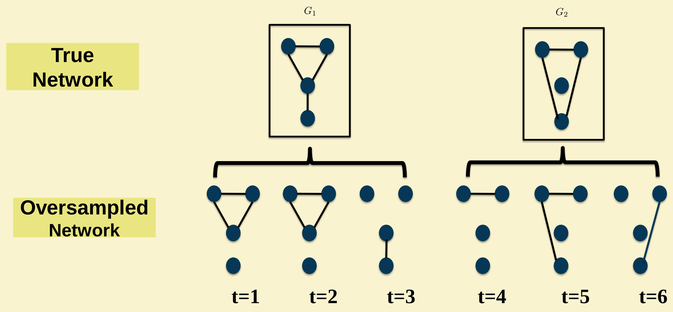
Prediction Based Scale Identification of Temporal Graphs

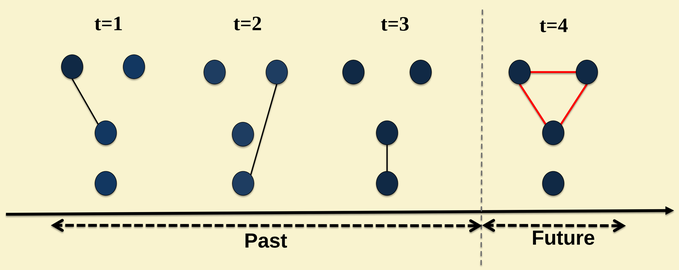
Problem

- Data representing temporal networks are often collected at a much higher rate than what is appropriate for analysis
- Oversampling in temporal networks greatly affects inference tasks

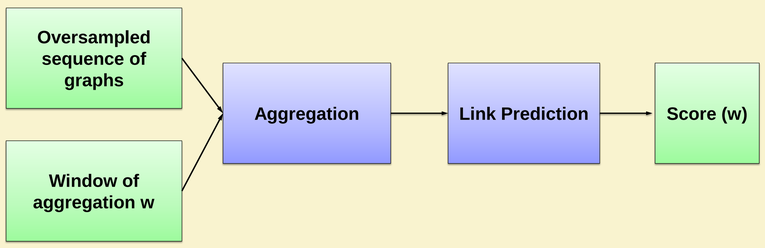


Our Approach

- A useful temporal network representation is one that allows us to predict evolving structure well



- We use the performance of a Link Prediction algorithm to capture the temporal scale at which network topology becomes predictive

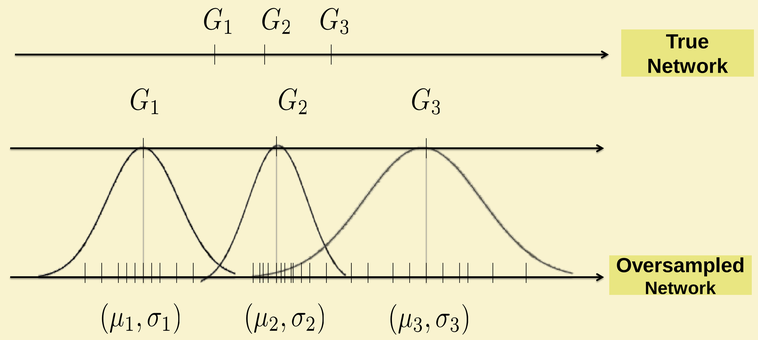


Empirical Setup/Results

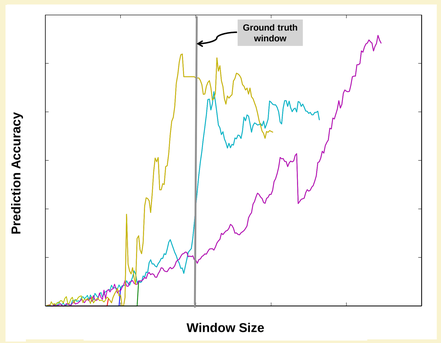
Generative Model for Ground Truth Temporal Networks

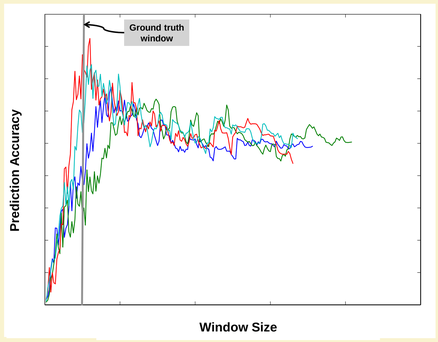
- Start with an initial graph G with arbitrary topology
- Rank non-edges based on a given similarity function
- Add top ranked new edges in the subsequent graph

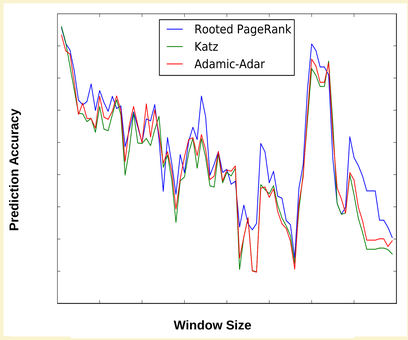
Generative Model for Oversampled Temporal Networks



- Link prediction drives the graph aggregation algorithm to natural temporal scales
- Consistency of results across different link prediction algorithms







Our Contributions

- We define a general model of oversampling in temporal networks that allows for rigourous analysis of temporal noise effects
- We present a novel, task-driven algorithm for denoising oversampled temporal networks
- We demonstrate that link prediction can serve as a good quality score for identifying the appropriate window of aggregation

Future Work

- Rigourously identify outlying windows in terms of link prediction quality
- Extend existing framework to handle non-uniform partitions of a temporal netwrok
- Investigate how the choice of inference task affects the choice of window of aggregation
- Address issues of algorithmic scalability

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