

# Studying propagation dynamics in networks through rule-based modeling

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## 1 Main Idea and Objectives

- Network propagation covers a large spectrum of phenomenon (social rumors, epidemics...)
- Rule-based modeling: common language/formalism to express propagation models
- Study/Compare models by visual manipulation of rule sets and simulations steering

## 2 Tested Models

### Independent Cascade Model

- Each node  $v$  attempts to activate its neighbours  $w$  only once and succeeds with probability  $p_{v,w}$ .

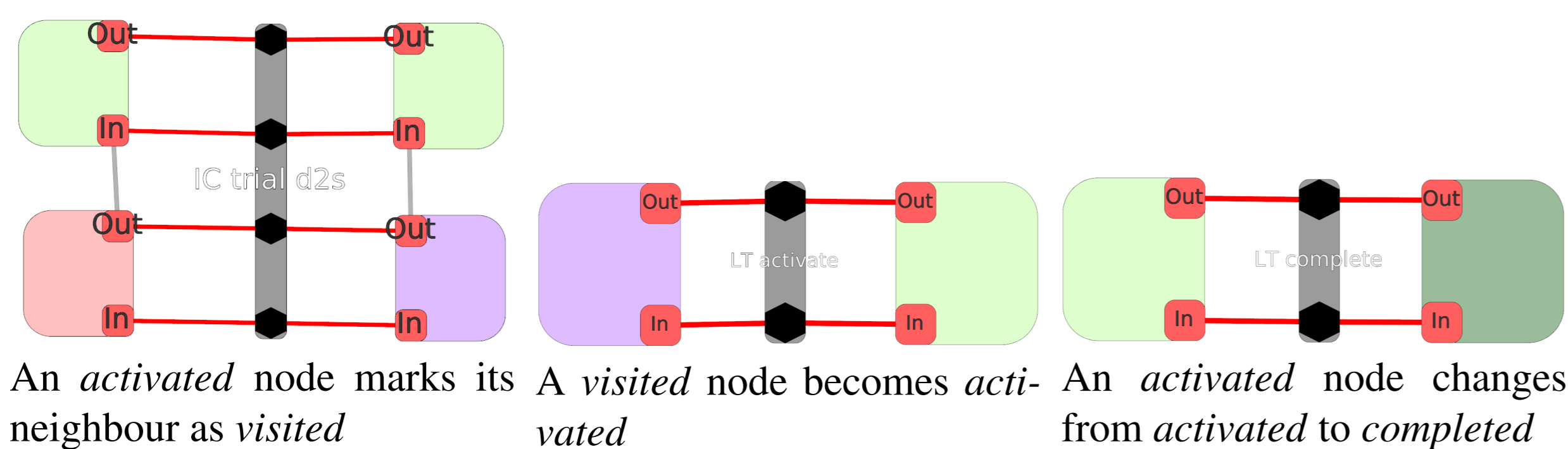
### Linear Threshold Model

- The probability  $p_v$  of a node  $v$  becoming activated increases as neighbours try to influence it. The node activates when  $p_v$  is large enough.

## 3 Graph Rewriting and Model Translation

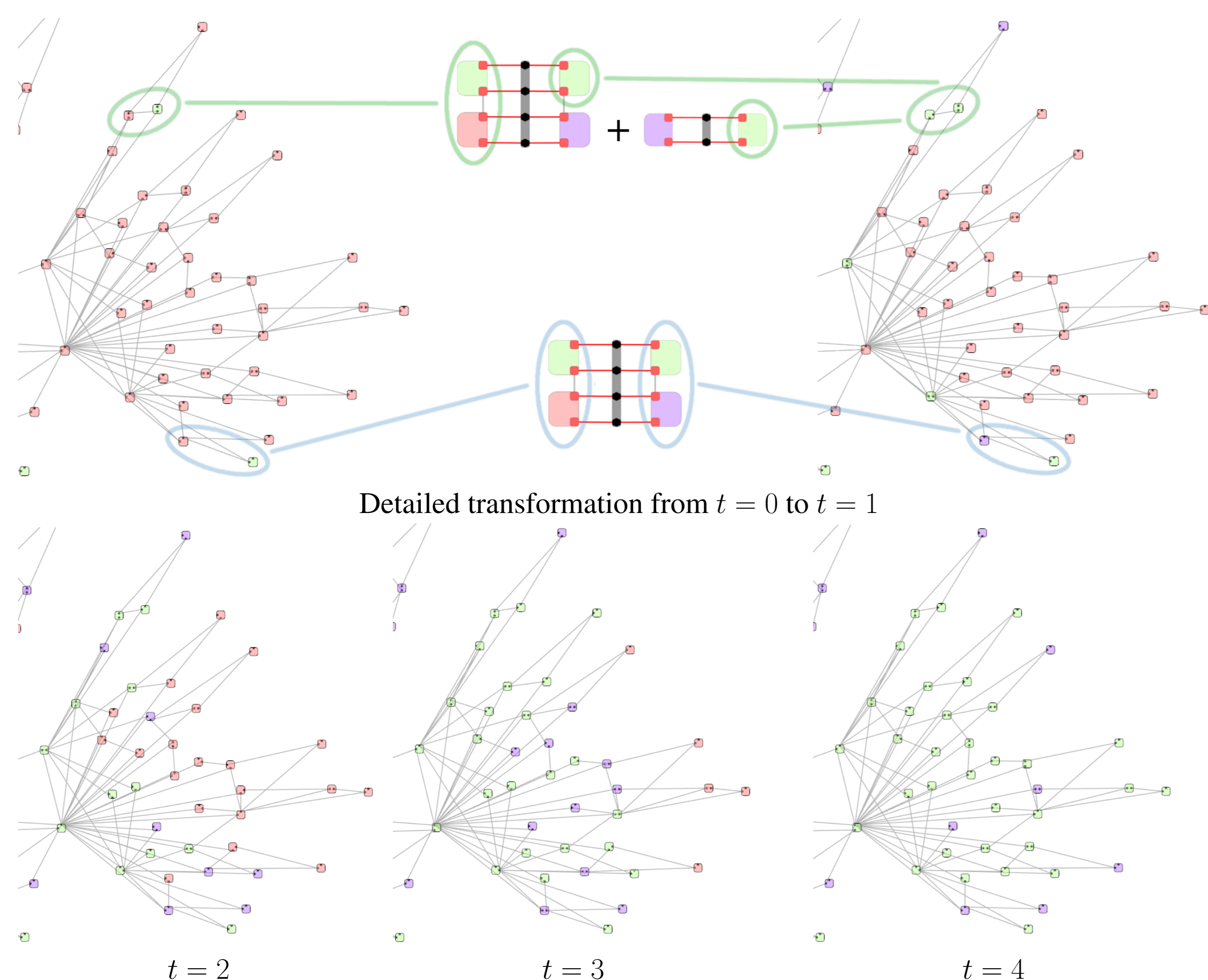
### Rules

Models can be described as a sequence of simple local transformations, called *rules*, performed on the graph.



### Strategy

Rule combinations and conditional application of rules are specified through a *strategy*.



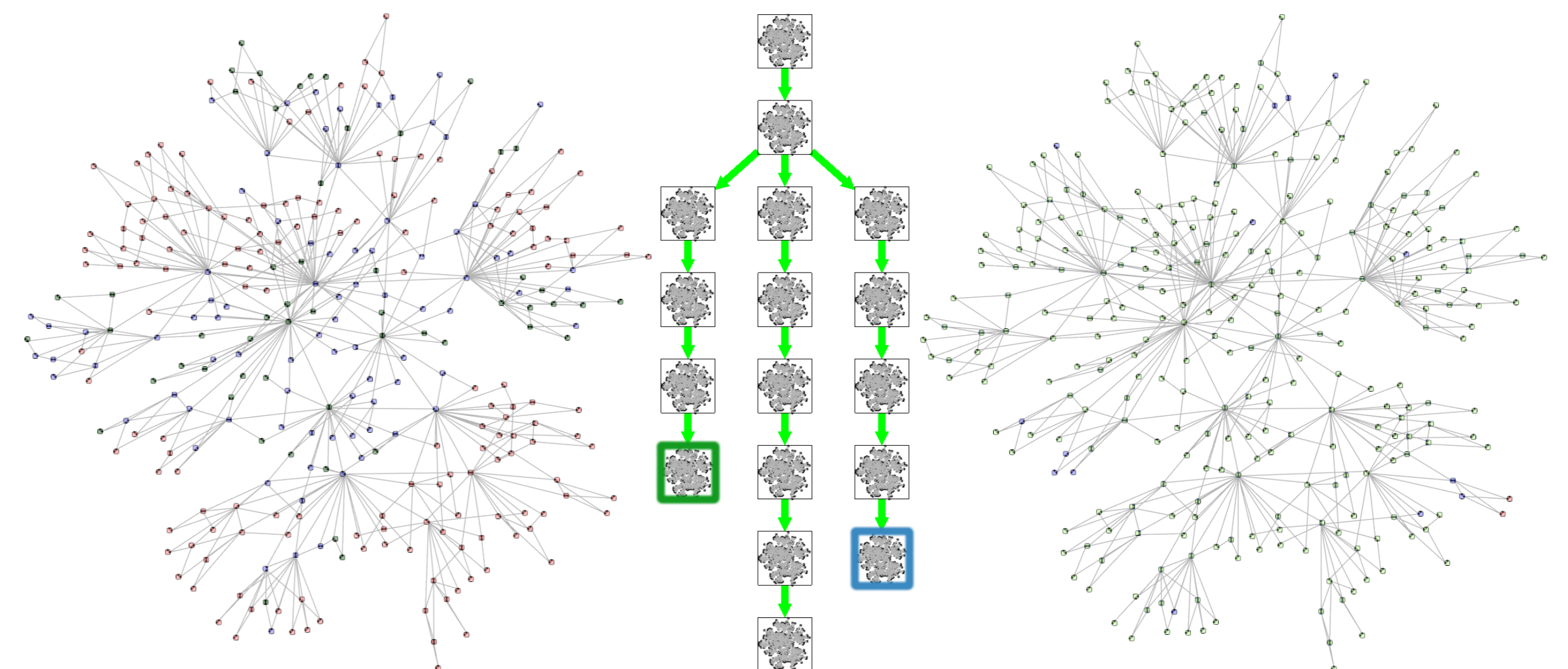
Extracted sub-community showing the propagation at different time steps.

## Acknowledgements

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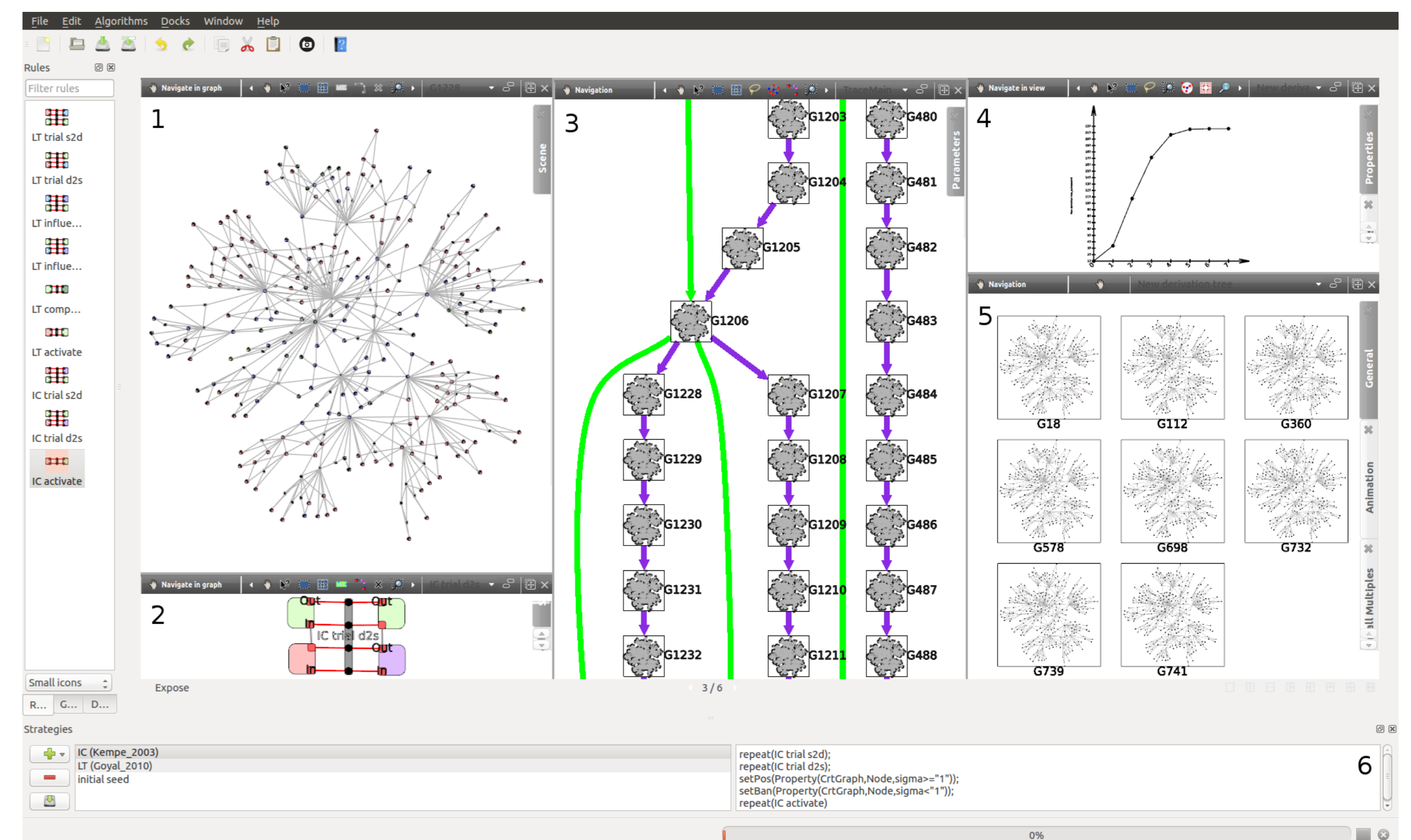
## 4 Results

The resulting application of several models on the same starting set can be seen as a *derivation tree*.



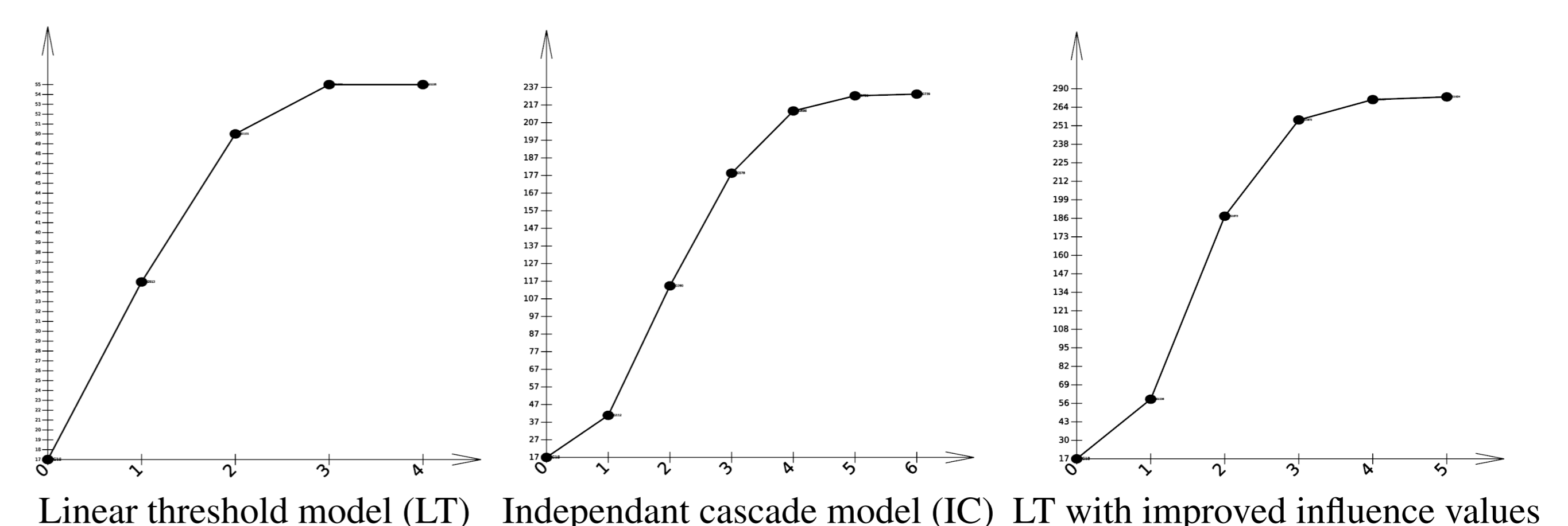
- Strategies, or rules, are triggered by simple drag and drop.
- Different models can be run in parallel to ease visual comparison.
- A derivation tree captures the history of multiple simulations.

### PORGY dashboard



Overview of the visualization framework PORGY: (1) one state of the graph; (2) edition of a rule; (3) portion of the derivation tree; (4) scatter plot; (5) small multiple and animation view; (6) strategy editor.

### Model comparison through parameter tracking



Comparing models: visual inspection of their activation profile.

## 5 Conclusion

- Rule-based modeling as a “universal” language for network propagation models
- Visual analysis and exploration to enhance objective comparison of models
- Need to expand our study to other models offering time-related evolution
- Plan to include topology change as part of models