

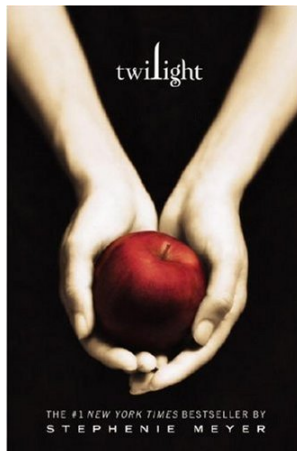
Watts' Network Cascades Model

A Simple Model of Global Cascades on Random Networks

Marco Brack Carsten Hartenfels

2016-08-05

- ▶ Motivation
- ▶ Simulation
- ▶ Explanation
- ▶ Watts' Model
- ▶ Findings
- ▶ Limitations



Twilight

Source: <https://en.wikipedia.org/wiki/File:Twilightbook.jpg>



WhatsApp

Source: <https://commons.wikimedia.org/wiki/File:WhatsApp.svg>



Political Coups

Source: <http://tinyurl.com/jmv529r>

The Cause Revealed

Network Cascades

Network Cascades

(Maybe)

Network Cascades

(Maybe)

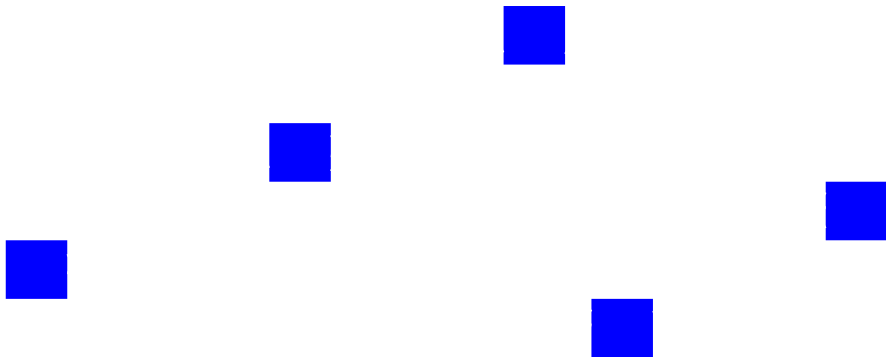
(It's a Nice Model Anyway)

Simulation

<https://github.com/turbopope/nss/tree/master/simulator>

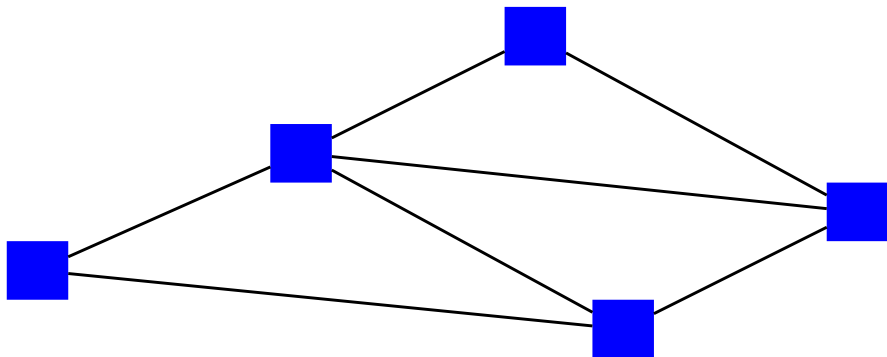
Explanation by Example

► Nodes



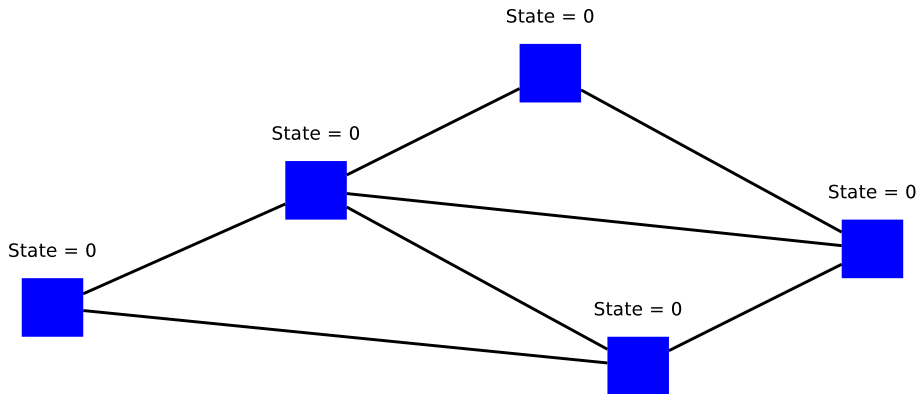
Explanation by Example

- Observe k Neighbors



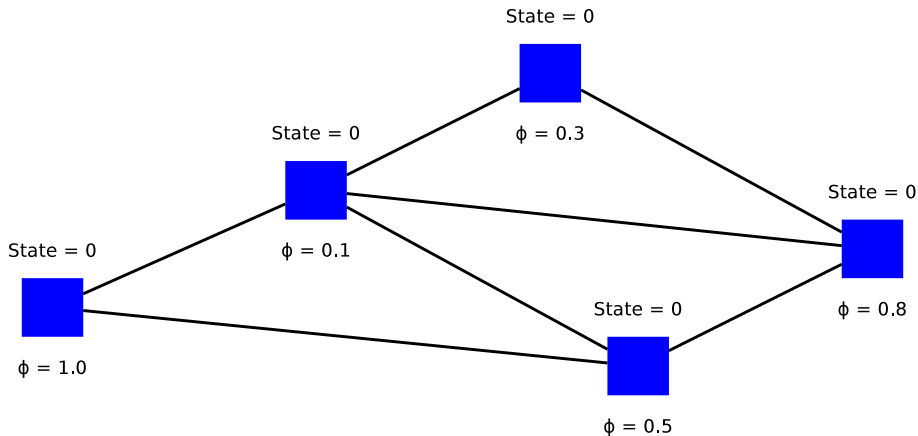
Explanation by Example

- State $\in \{0, 1\}$



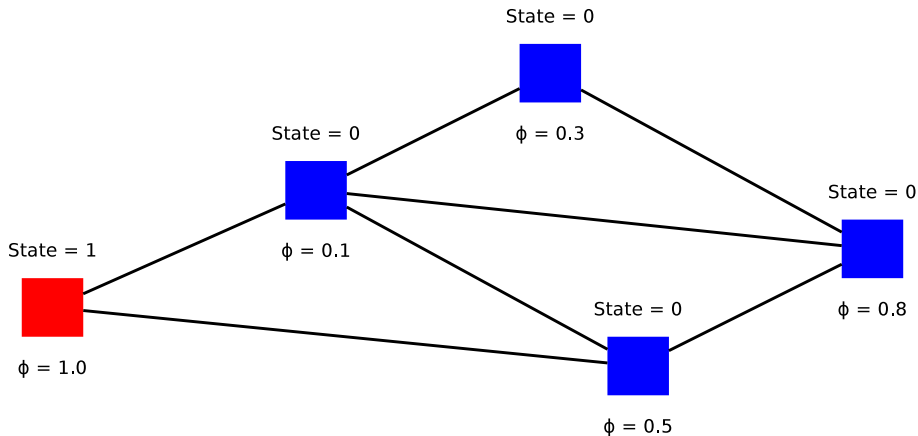
Explanation by Example

- Threshold $\Phi \in [0, 1]$



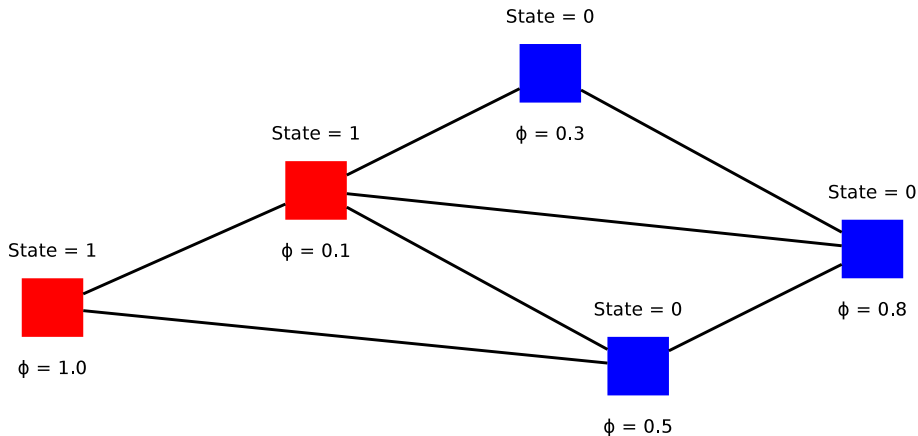
Explanation by Example

► Random Impulse Happens



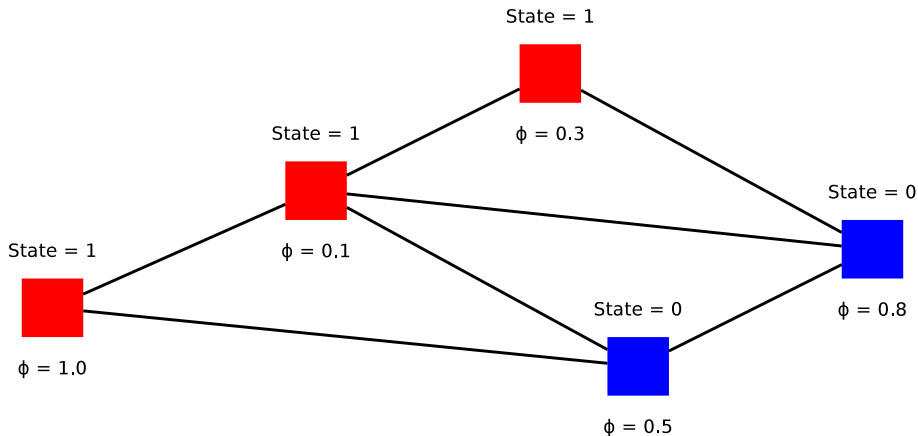
Explanation by Example

- Nodes Check in Random Intervals



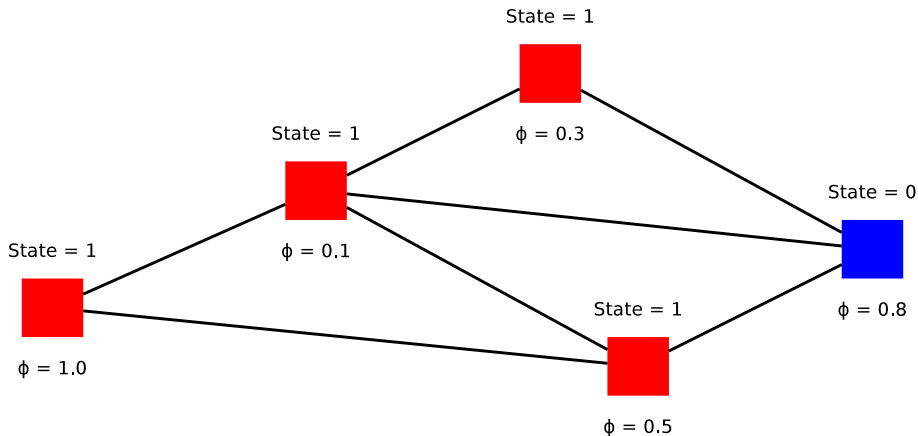
Explanation by Example

► Stuff Happens



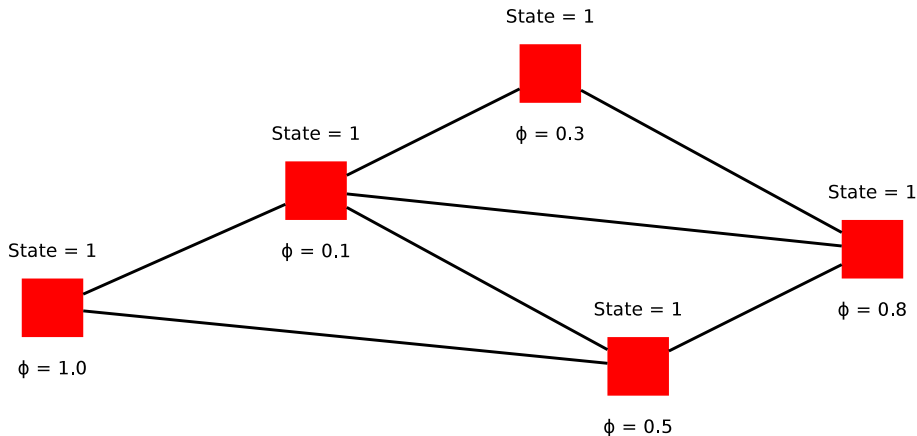
Explanation by Example

► Things Occur



Explanation by Example

► Coup Successful



- ▶ Each Person/Agent is a Node in a Graph
- ▶ Agents Have a State $\in \{0, 1\}$
- ▶ Agents Observe Their Neighbors
- ▶ Agents Change to a State 1 if Neighbor Threshold is Reached

Watts' Model – Random Graph

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- ▶ n Nodes

Watts' Model – Random Graph

- ▶ n Nodes
- ▶ p_k Probability of n to Have k Neighbors

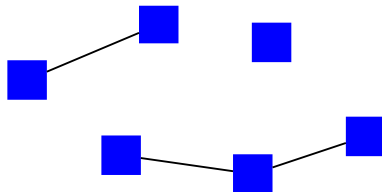
Watts' Model – Random Graph

- ▶ n Nodes
- ▶ p_k Probability of n to Have k Neighbors
- ▶ $z = \langle k \rangle$ Expectation Value or Average Degree

Watts' Model – Random Graph

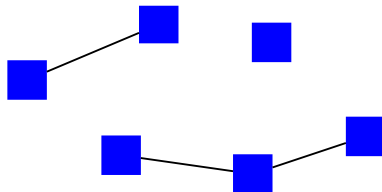
- ▶ n Nodes
- ▶ p_k Probability of n to Have k Neighbors
- ▶ $z = \langle k \rangle$ Expectation Value or Average Degree
- ▶ $p_k = \frac{e^{-z} z^k}{k!}$ Poisson-Distributed (Erdős–Rényi-Model with $p = \frac{z}{n}$)

- Cascades in Sparse Networks

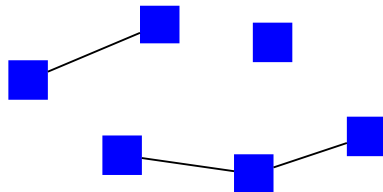


- ▶ Cascades in Sparse Networks

- ▶ Limited by Connectivity



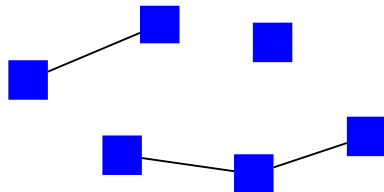
- ▶ Cascades in Sparse Networks



- ▶ Limited by Connectivity

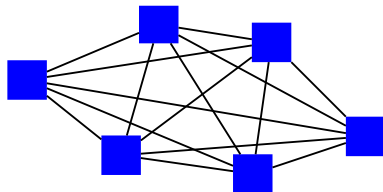
- ▶ Cascade Size Exhibits Power-Law Distribution

- ▶ Cascades in Sparse Networks

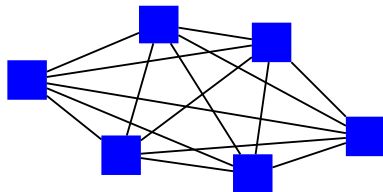


- ▶ Limited by Connectivity
- ▶ Cascade Size Exhibits Power-Law Distribution
- ▶ Most Highly Connected Cluster is Critical Triggers

- Cascades in Dense Networks



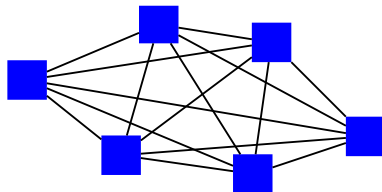
- ▶ Cascades in Dense Networks
 - ▶ Limited by Threshold



- ▶ Cascades in Dense Networks

- ▶ Limited by Threshold

- ▶ Cascade Size Bimodal (Most are Small, Some are Large)

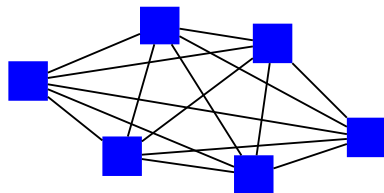


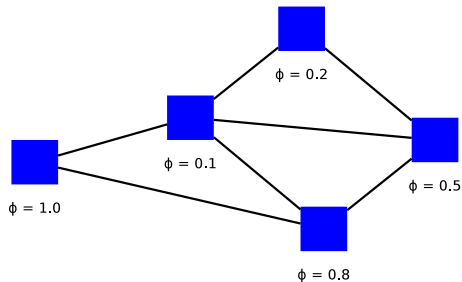
- ▶ Cascades in Dense Networks

- ▶ Limited by Threshold

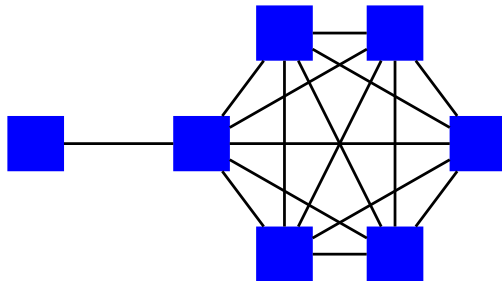
- ▶ Cascade Size Bimodal (Most are Small, Some are Large)

- ▶ Cluster with Average Degrees are Triggers (Because They are Frequent)





- Threshold Heterogeneity Increases Cascade Likelihood



- Degree Heterogeneity Decreases Cascade Likelihood

Limitations

- ▶ No Personal Knowledge

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- ▶ No Global Adoption Rate

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- ▶ Sample Size for Bimodal Distribution Very Limited

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- ▶ No Personal Knowledge
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- ▶ One-Way Threshold
- ▶ Sample Size for Bimodal Distribution Very Limited
- ▶ No Threats to Validity Mentioned

Thank You All For Listening