Available MSc Projects

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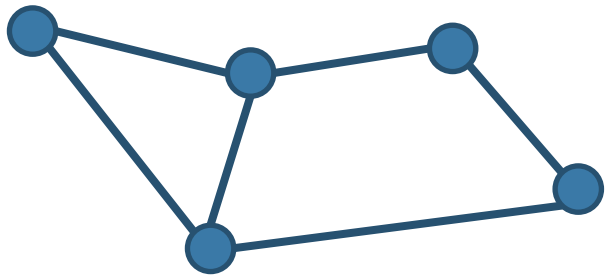
Overview

- Node Reliability Polynomials
- Non-Consensus Opinion Model with Byzantine Nodes
- MSc projects at Industry

Node Reliability Polynomials

Introduction

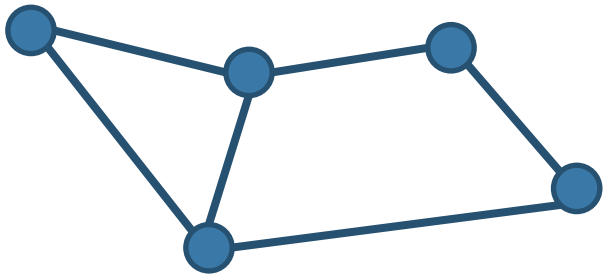
- Network availability : important robustness metric



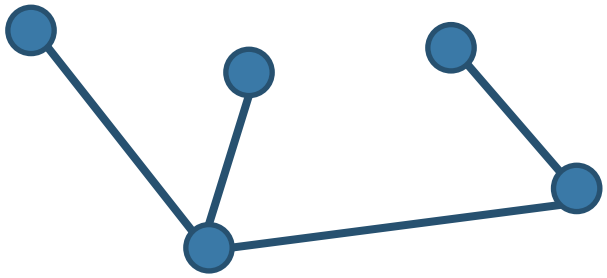
- N nodes
- L links
- undirected graph

- Network availability = Prob {network is **connected**}
  - Nodes always operational
  - Each link interdependently operational with probability *p*
  - All-terminal reliability

Introduction



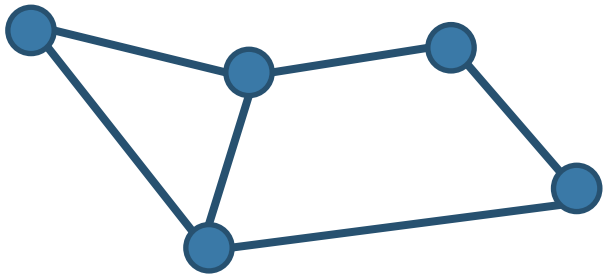
Introduction



- Is this network connected?

YES

Introduction



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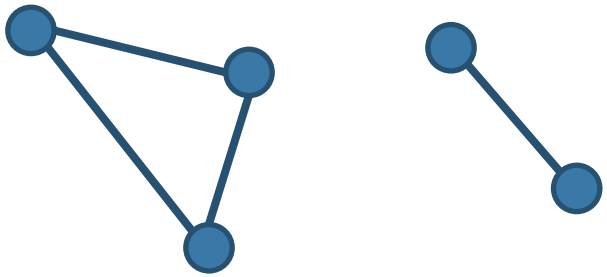
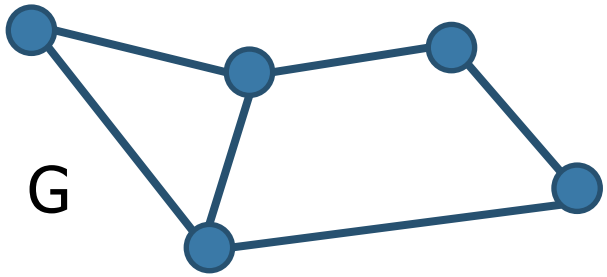


- Is this network connected?

NO

Reliability Polynomial



$R_G(p)$ = Prob {G is connected}

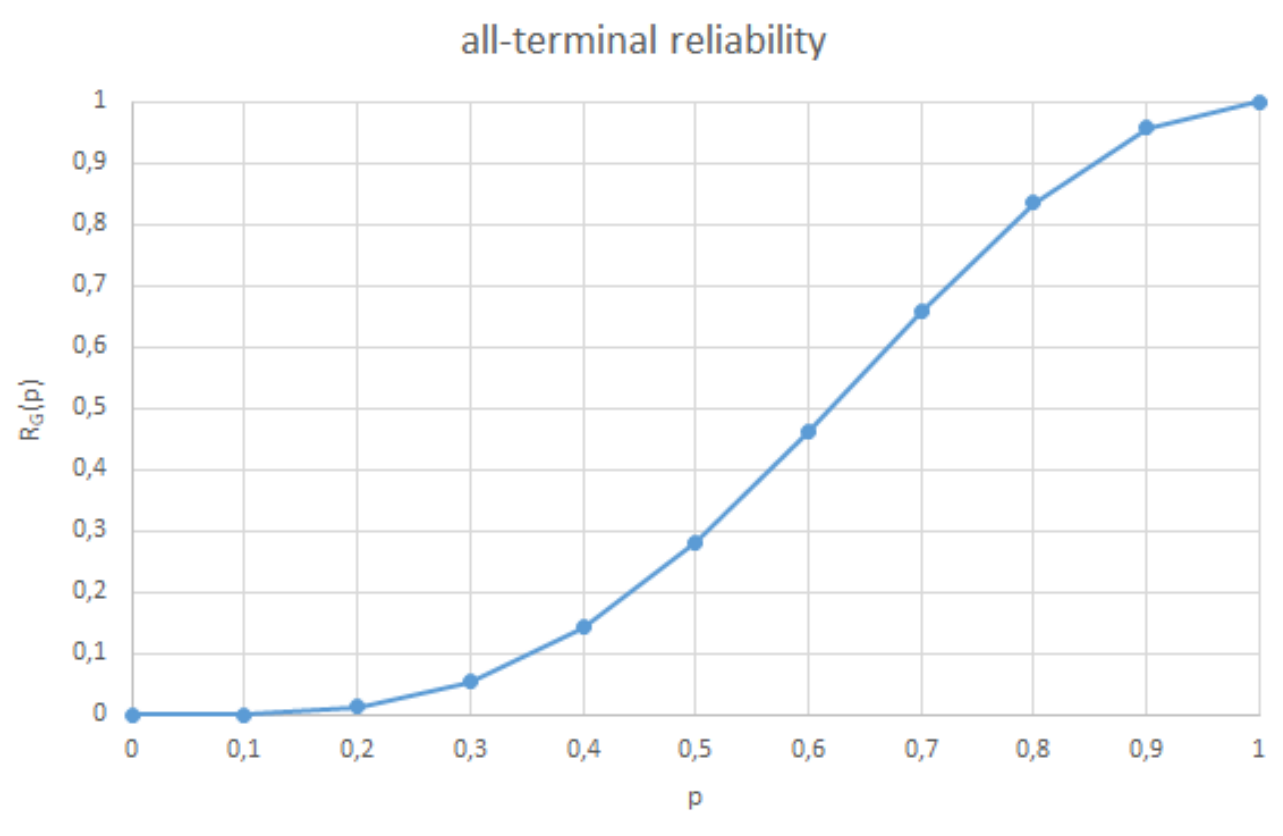
$$R_G(p) = F_0 p^L + F_1(1-p)p^{L-1} + F_2(1-p)^2 p^{L-2} + .. + F_{L-N+1}(1-p)^{L-N+1} p^{N-1}$$

F_i: # of sets of i links, whose removal leave G connected

$F_1 = 6$

$$R_G(p) = p^6 + 6p^5(1-p) + 11p^4(1-p)^2$$

Reliability Polynomial



J.I. Brown, Y. Koç and R.E. Kooij, Reliability polynomials crossing more than twice, *Proc. of 3rd Int. Workshop on Reliable Network Design and Modeling (RNDM'11)*, Budapest, Hungary, October 5-7, 2011, pp.135-140.

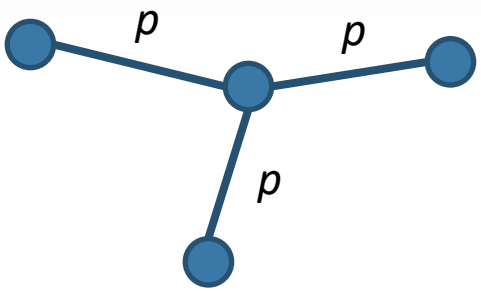
Node Reliability Polynomial

- Each node interdependently operational with probability *p*
- Links are perfectly reliable

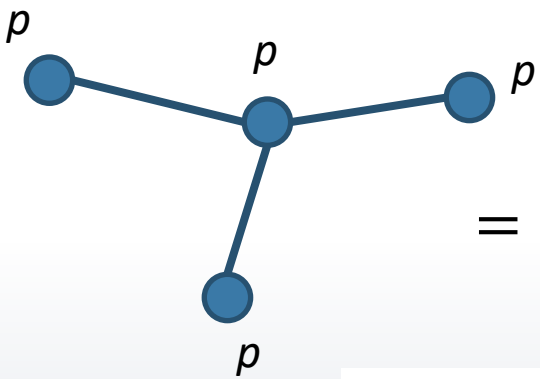
- Node reliability of G =

prob{at least one node is operational **and**
all operational nodes are in the same subgraph}

Node Reliability Polynomial



$$R_G(p) = p^3$$



$$NR_G(p) = p^4 + 3p^3(1-p) + 3p^2(1-p)^2 + 4p(1-p)^3$$

NETWORKS
An International Journal

On the roots of the node reliability polynomial

Jason Brown ✉, Lucas Mol

First published:13 August 2016

Node Reliability Polynomials

- Research questions
  - Theoretical perspective
    - What are generic properties of NRP's?
    - Can we construction pairs of graphs with intersecting NRP's?
  - Computational perspective
    - Can we generalize the method that works for RP's?
  - Applied perspective
    - Can we apply NRP's to real-world infrastructures?

Node Reliability Polynomials

- Requirements
  - Knowledge of graph theory
  - Affinity with mathematics
  - Experience with simulation

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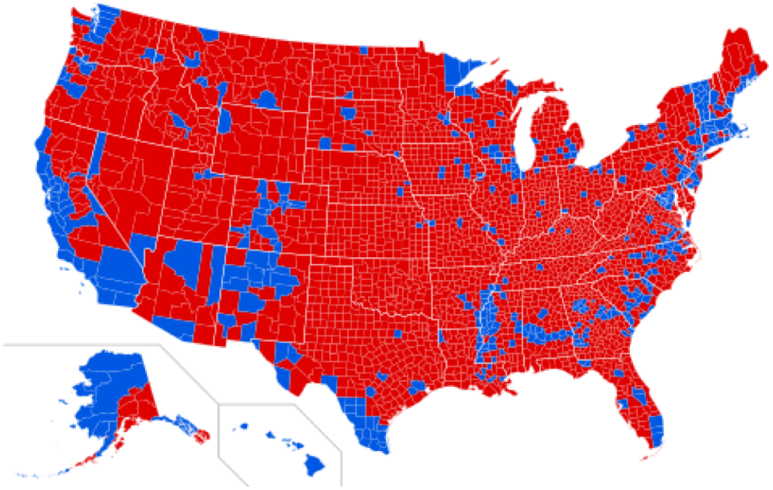
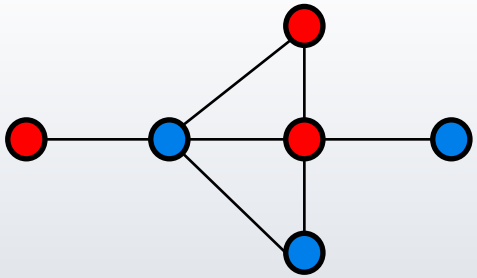
Non-Consensus Opinion Model with Byzantine Nodes

Introduction

- How do two competing opinions evolve in populations?



- Dynamic process on network
  - Node: human with an opinion
  - Link: indicates interactions between them

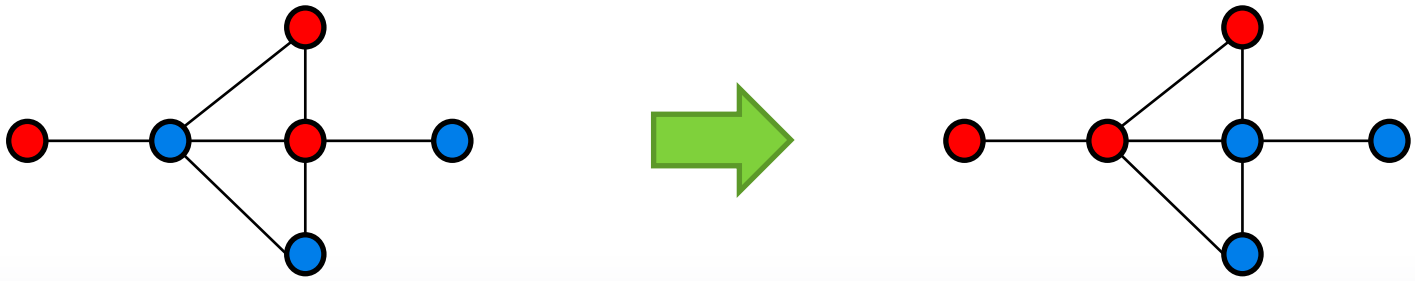


Non-consensus Opinion model

PRL 103, 018701 (2009) PHYSICAL REVIEW LETTERS week ending 3 JULY 2009

Dynamic Opinion Model and Invasion Percolation

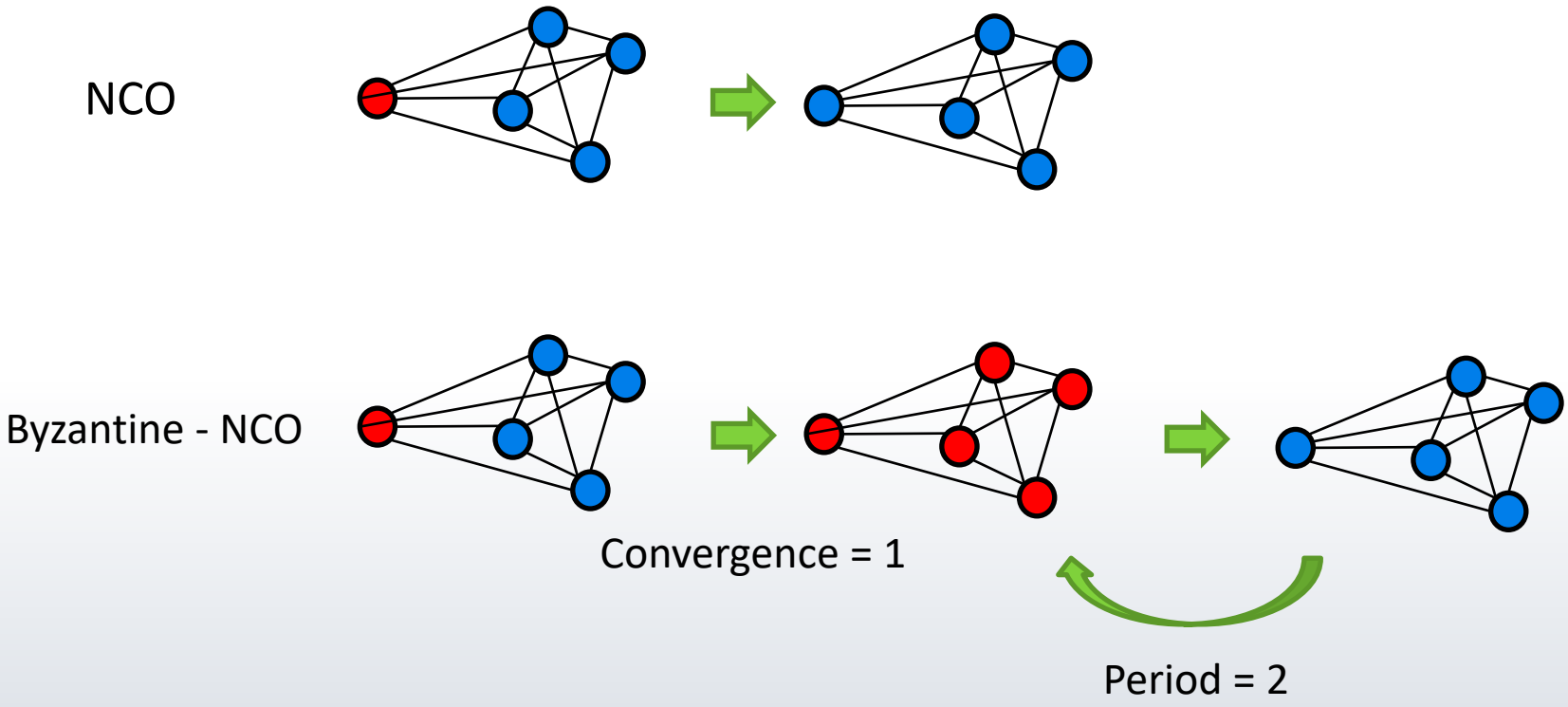
Jia Shao,[1] Shlomo Havlin,[2] and H. Eugene Stanley[1]



- Opinions can co-exist!

NCO model with Byzantine nodes

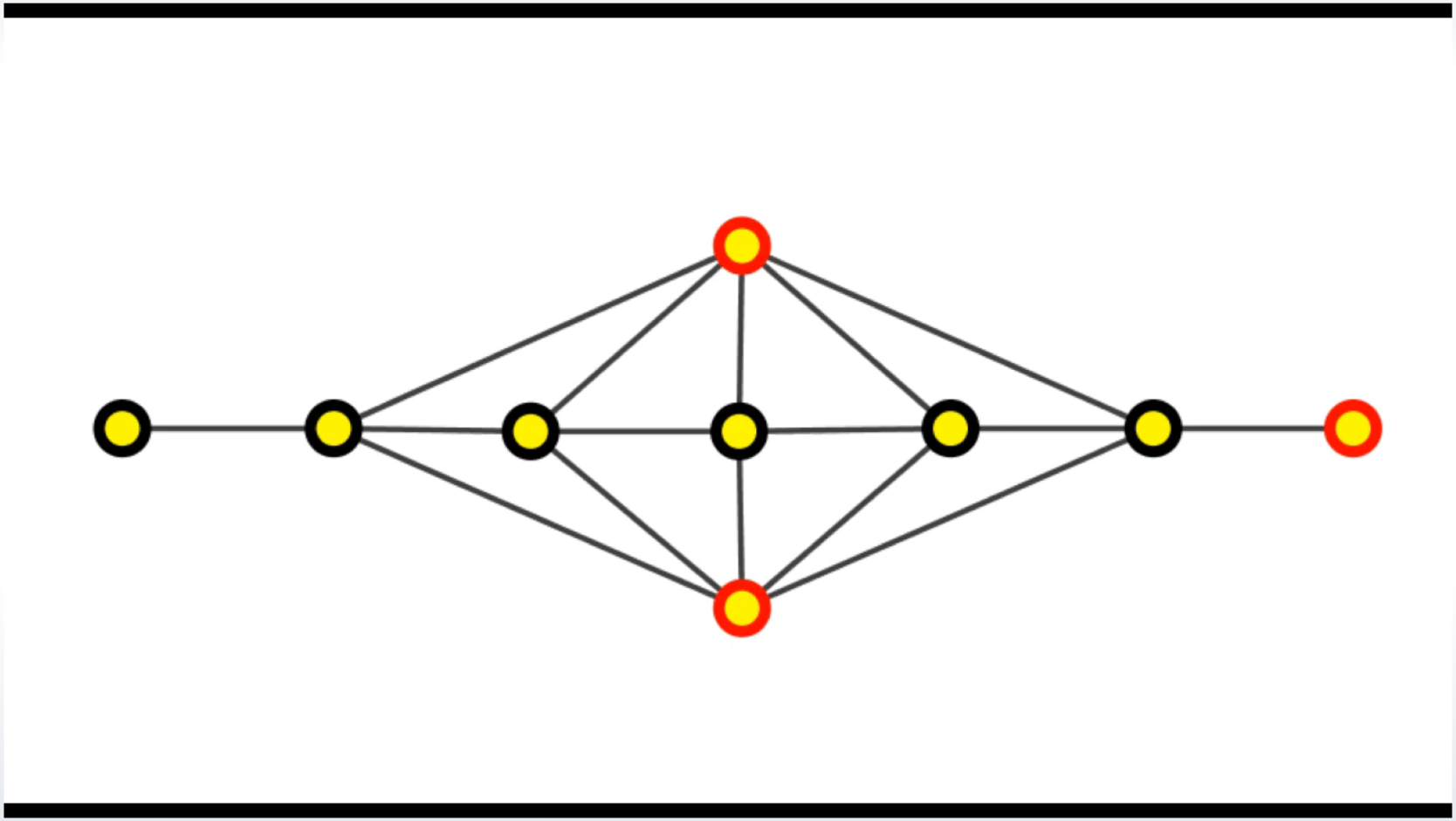
- Byzantine nodes always lie about their opinion



NCO model with Byzantine nodes

- Research questions
  - Typical steady-state behavior?
  - Relation steady-state with initial parameters?
    - Fraction on nodes initially “Blue”
    - Number of Byzantine nodes
  - Dynamics of Byzantine-NCO model?
    - Toy network models
    - Real-world networks
  - Application of the model?

NCO model with Byzantine nodes



NCO model with Byzantine nodes

- Requirements
  - Knowledge of graph theory
  - Experience with simulation

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MSc project in industry

NAS: affiliation with industry

Other external partners

Service and network provider to universities

Grid operator: gas and electricity

Other external partners

Example of previous project

Predicting intermittent network device failures based on network metrics from multiple data sources.

SURFnet actively monitors their infrastructure and stores all metrics in influxDB and Splunk. Using SNMP, Surf monitors the state of the individual components and stores them in influxDB, syslogs are stored in Splunk. Although this data is saved, no further processing is done or predictions based on the metrics are being made.

SURFnet wants to further improve the pro-active stance to prevent and predict disruptions and identify anomalies within the infrastructure. This includes preventing outages, predicting events and advancing capacity management. The monitoring metrics consist of unstructured data. The goal is to use current and historical metrics to predict future events. Extending upon this research, machine learning algorithms could be used to predict anomalies based on the historic data."