

Predicting Nodes' Influence in Boolean Networks

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Bled, Feb. 2011

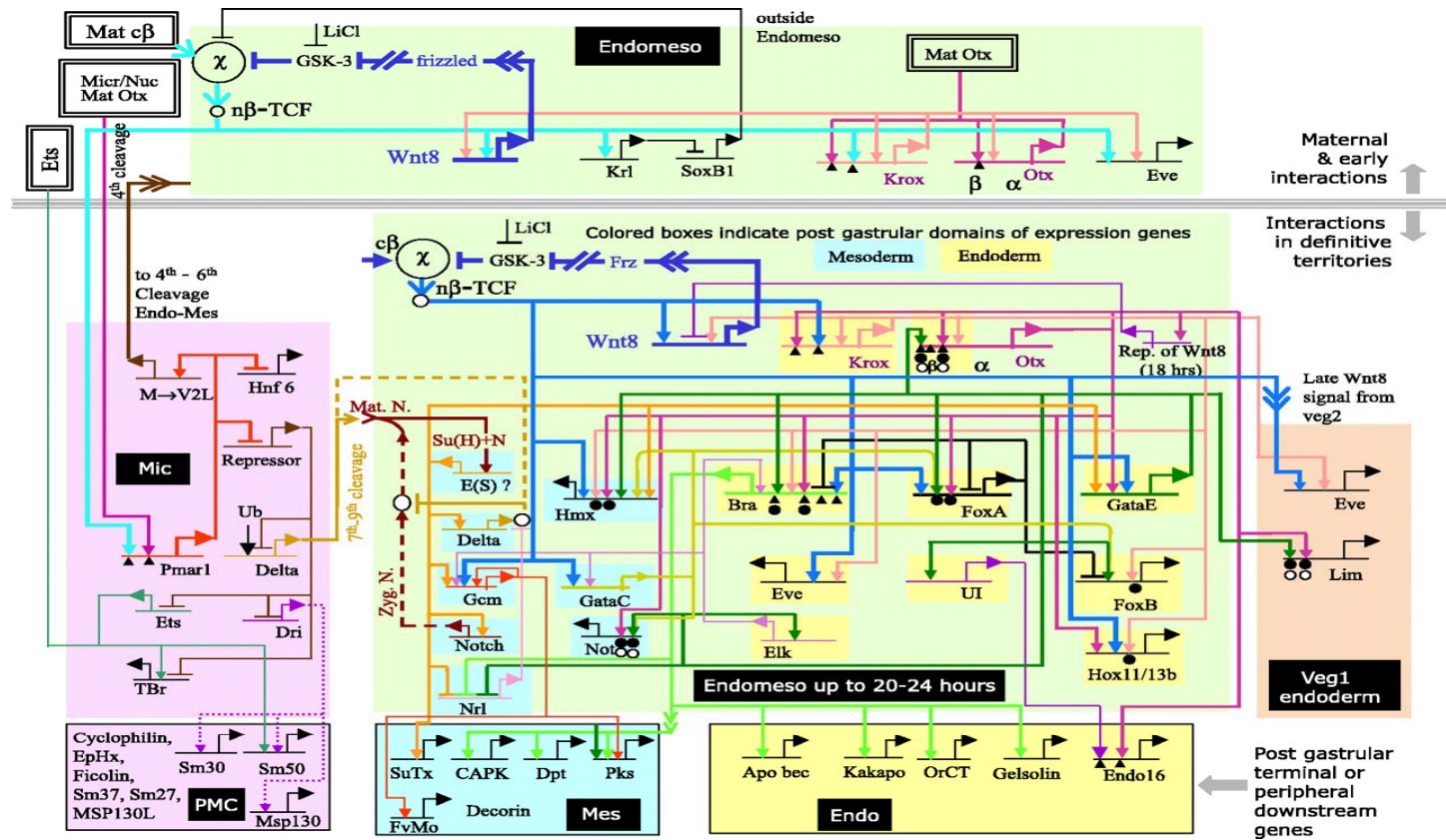
Predicting Nodes' Influence in Boolean Networks

- **Motivation**
- **Dynamics**
- **Methods and Results**

Motivation

- **Network**
- **Efficient Spreading**

Network

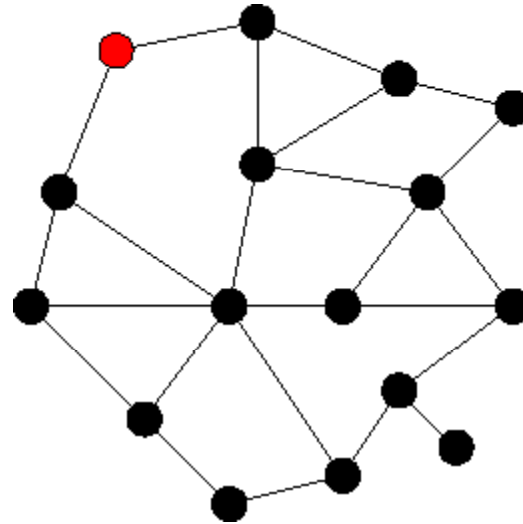




Efficient Spreading

- Which element is to be perturbed first such that the message spreads as widely as possible?

Computing the Efficient Spreading





Efficient Spreading

- Why predictor?
- How can I predict the influence of element i ?

Dynamics

- **Boolean Dynamics**



Boolean Dynamics

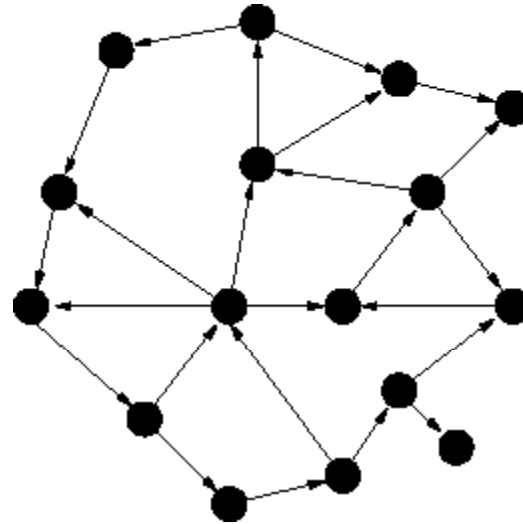
- Interactions-**Network**
- **ON/OFF**-States
- time evolution of states:

Boolean functions

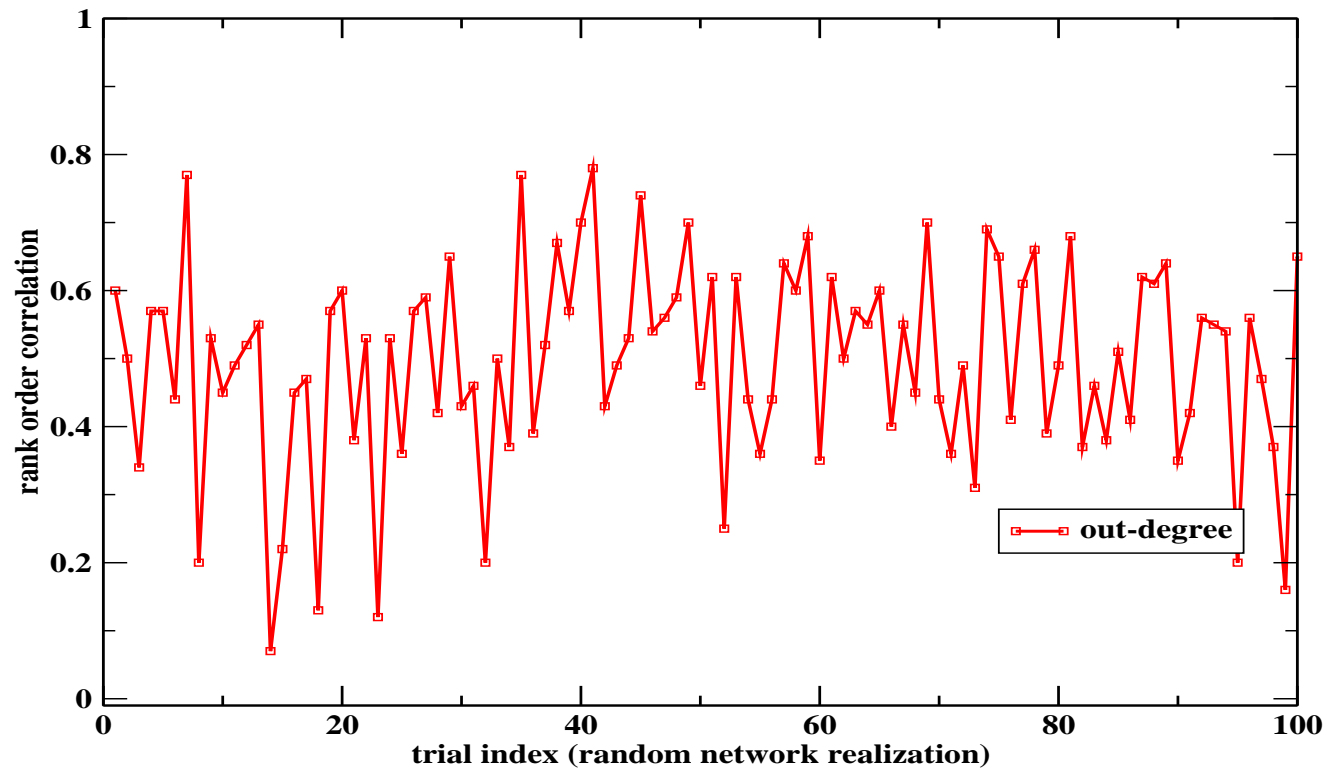
Methods and Results

- **Out-Degree**
- **Eigenvector Centrality**
- **Predictors in Different Phases**

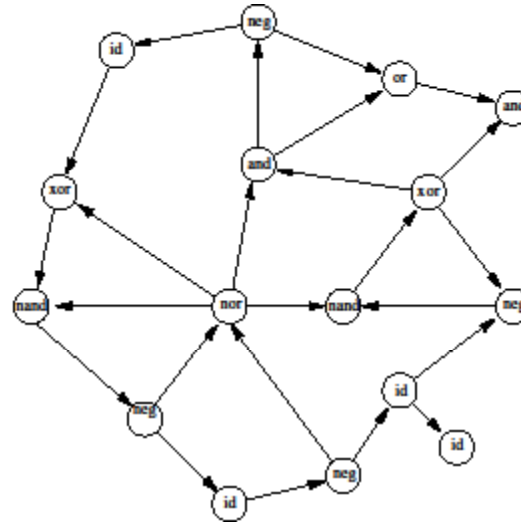
Out-Degree



Out-Degree



weighted Out-Degree



Activity

In a Boolean function, some variables have a greater influence over the output of the function than other variables.

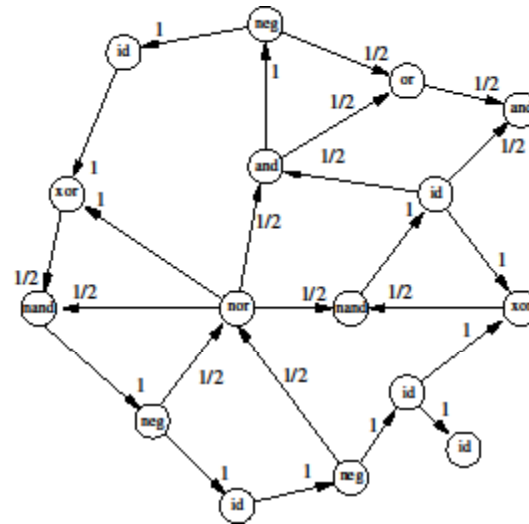
| A | B | $A \oplus B$ |
|---|---|--------------|
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

Activity

In a Boolean function, some variables have a greater influence over the output of the function than other variables.

| A | B | $A \oplus B$ | A & B |
|---|---|--------------|-------|
| 0 | 0 | 0 | 0 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |

weighted Out-Degree





weighted Out-Degree

**A good predictor for tracing the
perturbation in one time step later**



weighted Out-Degree

**A good predictor for tracing the
perturbation in one time step later**

Iterate



weighted Out-Degree

A good predictor for tracing the perturbation in one time step later

Iterate : Power method



weighted Out-Degree

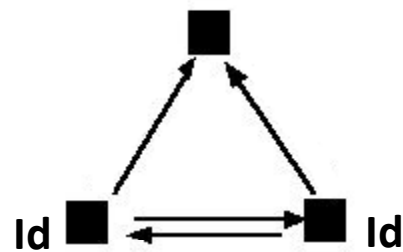
A good predictor for tracing the perturbation in one time step later

Iterate : Power method



Eigenvector Centrality

A Simple Example



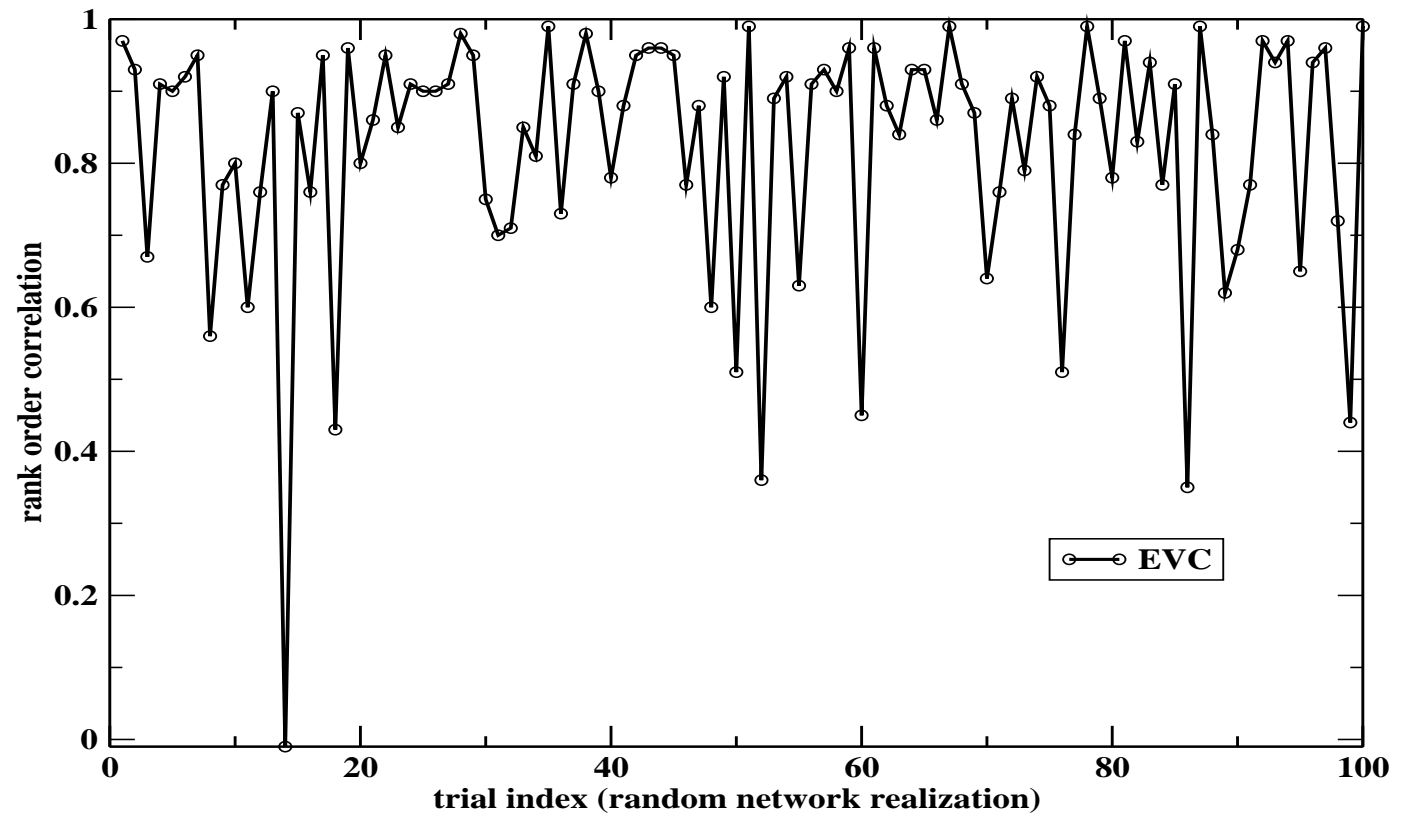
$$\begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0.5 & 0.5 & 0 \end{pmatrix}$$

Out – Degree = (2,2,0)

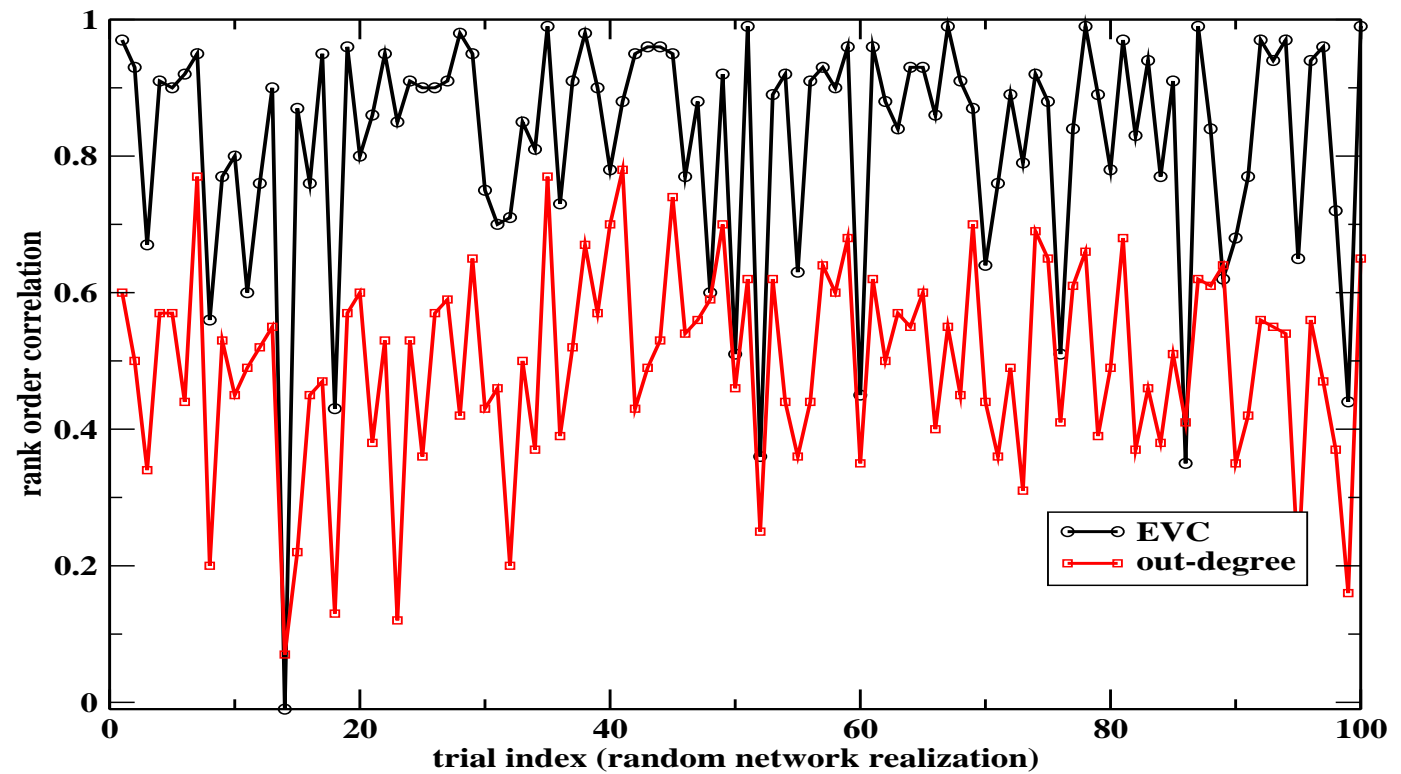
weighted Out – Degree = (1.5,1.5,0)

Eigenvector Centrality = (1,1,0)

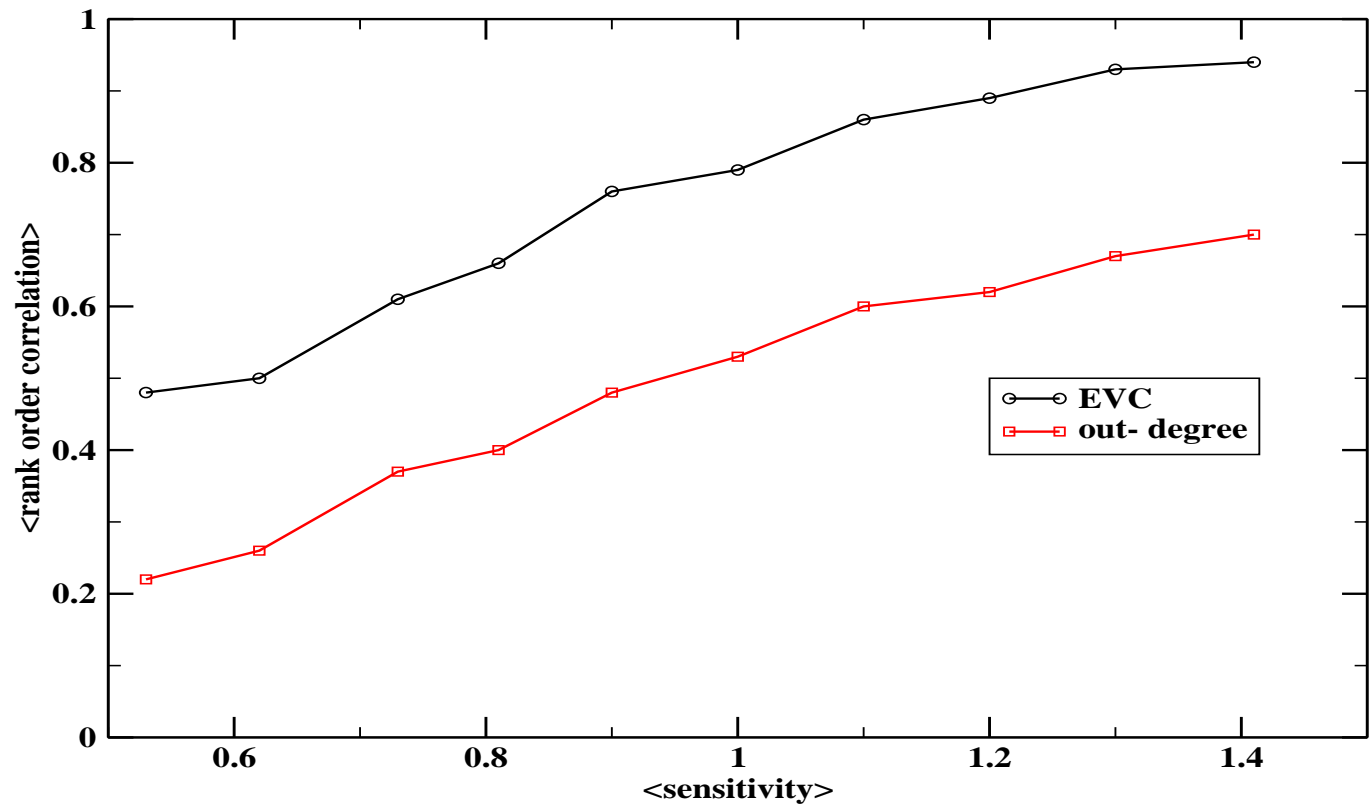
Eigenvector Centrality



Eigenvector Centrality



Predictors in different phases



Predicting Nodes' Influence in Boolean Networks

- **Out – Degree**
- **weighted Out – Degree**
- **Iterate**
- **Eigenvector Centrality**



Thanks

To be continued ...