EDISON: Computing Dynamics on Networks

NSF Software Development for CyberInfrastructure Grant OCI-1032677
Additional support by grants from DTRA V&V, DTRA CNIMS, NSF NetSE, NSF DIBBS

Team
Virginia Tech, Indiana U., SUNY Albany, Jackson State, Argonne National Lab, U. Chicago, NCAT, U. Houston Downtown
EDISON: Login/Make Account

- http://edisondev.vbi.vt.edu:8080/Edison-2.0/edison.jsp
- and
- http://edisondev.vbi.vt.edu/Edison-2.0/edison.jsp
Structural Characterization vs. Dynamics on Networks

Structural characterization

Number of triangles: 2
Average degree: 2.3
Diameter: 4
Degree per vertex:

Network dynamics

Time t=0

Time t=1

Time t=2
In real applications, it is AND., not VS.

Example: threshold-1 dynamics (previous slide)
The diameter of a graph is an upper bound on the number of time steps for the contagion to spread through a network.

Previous slide:
Diameter: 4
Time to spread contagion: 3

For complicated problems, this interaction is a “must” for understanding.
What Do We Need To Do Dynamics?

- A **graph**—identifies the system components and interactions.
- A set of **vertex states**—tells us the state of a vertex at each time.
- A set of **vertex functions**—this is the behavior of each agent (human).
- An **update scheme**—how the vertex functions are executed.

Vertex function: the threshold-1 function.
Update scheme: parallel (synchronous).
We want all state transitions.
EDISON Example, Exercises

• One example
  – Example on slides.
  – Example live demo.
  – Exercise.

• Goal: Use EDISON to run a dynamic analysis.
Effect of Seed Nodes

Run 1

Seed node

Run 2

Seed node
Effect of Seed Nodes

Run 1

Seed node

Run 2

Seed node

Analysis metadata
Login
Select graph
New analysis
Select dynamics model
Select nodes & assign model properties
Select seed nodes & assign properties
Save analysis
Submit analysis

Network Dynamics & Simulation Science Laboratory
Virginia Tech
Analysis With NetScience Graph

Graph: netscience; 1589 nodes and 2742 edges.
Vertex state set: \{0,1\}
Vertex function: progressive 1-threshold.
Update scheme: synchronous.

20 runs in simulation.
1 node seeded in state 1; all other nodes in state 0. Different vertex for each run.

Each of 20 runs in black. Point-wise average in red.
Login Screen
Analysis Log

The image shows a screenshot of the Edison web-based distributed system for discrete time interaction simulation. The interface includes a list of experiments with details such as category, status, and other attributes. Specific experiments highlighted include:

- real03: Category: social, status: Complete
- real02: Category: social, status: Complete
- real01: Category: social, status: Complete
- blah: Category: blah, status: New
- try01: Category: social, status: Complete
- test-today: Category: social, status: Complete

The page also displays graph information, model information, node attributes, and edge attributes. Example attributes include:

- Node Attributes:
  - node_clique_number
  - closeness_centrality
  - degree
  - betweenness_centrality
  - load_centrality
  - scientist
  - id
  - clustering

- Edge Attributes:
  - coauthorship
  - degree_product
  - betweenness_centrality

The interface provides options to view all experiments and search for specific experiments.
Experiment Information

Title: real15
Owner: ckuhiman
Category: social
Description: Basic analysis
Public Access: YES
Number of Runs: 25
Number of steps/Run: 100
Is Random seed defined: NO
Fixed random seed: 

Edison A Web Based Distributed System For Discrete Time Interaction Simulation
Welcome Ckuhiman | Logout

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Select Graph
Data for NetScience Graph

Graph Description:
Coauthorship network of scientists working on network theory and experiment, as compiled by M. Newman in May 2006. The network was compiled from the bibliographies of two review articles on networks, M. E. J. Newman, SIAM Review 45, 167-256 (2003) and S. Boccaletti et al., Physics Reports 424, 175-308 (2006), with a few additional references added by hand. The version given here contains all components of the network, for a total of 1589 scientists, and not just the largest component of 379 scientists previously published. The network is labeled with the label netScience. M. E. Newman, Phys. Rev. E 64

Your Selection:
- Graph: netscienc
- No of Nodes: 1589
- No of Edges: 2742
- Format: gml
- Directed: false
- Node Attributes: node_clique_number, closeness_centrality, degree, betweenness_centrality, load_centrality, scientist, id, clustering
- Edge Attributes: coauthorship, degree_product, betweenness_centrality
Behavior Model
Data for Progressive 2-State Model
Select Nodes
Assign Property Values
Assign Properties

**Edison**

A Web Based Distributed System For Discrete Time Interaction Simulation

Welcome Ckuhlman | Logout

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**Nodes And Edges Properties**

- **Title**: real15, **Graph**: netscience

**Set Name**: allNodes

**Query Type**:
- Node

**Description**: All of the nodes

**Enter Query**

- select nodes from netscience

**Query Results**

**Number of Node Sets**: 1

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Value</th>
</tr>
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<tbody>
<tr>
<td>Integer_node_traits</td>
<td>Model: 11</td>
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<tr>
<td></td>
<td>Sub_Model: 1</td>
</tr>
<tr>
<td></td>
<td>Threshold: 1</td>
</tr>
</tbody>
</table>

**Coverage in %**: 0%

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Set of Properties for Nodes

Edison - A Web Based Distributed System For Discrete Time Interaction Simulation

Nodes And Edges Properties :: Title - real15, Graph - netscience

Set Name: [ ] Description: [ ]

Query Type: [ ] Node [ ] Edge

Enter Query

View Graph Attributes

Create New Set

allNodes

Coverage in %

100%
Seed Nodes
Select Nodes For Seeding

---

**Seeds:** Title - real15, Graph - netscience

- **Set Name:** setA
- **Description:** Random set of seed nodes; one node per set

**Enter Query:**

select sample(25,1,random) nodes from netscience

**Buttons:**
- Search
- Validate
- Execute
- Upload File

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Virginia Tech Science Laboratory
Specify Seed Values
Specify Seed Values
Seed Sets
<table>
<thead>
<tr>
<th>Experiment</th>
<th>Category</th>
<th>Node Attributes</th>
<th>Edge Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>real15</td>
<td>social</td>
<td>node_clique_number(integer), closeness_centrality(real), degree(integer), betweenness_centrality(real), load_centrality(real), scientist(text), id(integer), clustering(real)</td>
<td>coauthorship(real), degree_product(integer), betweenness_centrality(real)</td>
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<tr>
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<td>social</td>
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</tr>
<tr>
<td>try01</td>
<td>social</td>
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</tbody>
</table>
Summary

• CINET has several tools.
• EDISON is performs network dynamics.
• Additions to the system are ongoing.
END