An Economist’s view of Web Science

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What is Web Science?

- Multidisciplinary exercise to
  - understand what the Web is
  - engineer its future
  - ensure its social benefit
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- Computer Science, Economics, Law, Management, Maths, Sociology . . .
Someone else’s picture
What is Economics?

- Individuals respond to incentives
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- Prices are useful to allocate scarce resources
- Competitive markets are efficient (but not fair)
- Quantitative framework for positive and normative analysis
Economics or computer science?

- Information and search
- Peer production and social computing
- Online markets: eBay v. Yahoo; Google’s click auction, ...
- Platforms and two-sided markets
- Incentives in distributed systems
Example: economics and networks
Some characteristics of networks

<table>
<thead>
<tr>
<th></th>
<th>WWW</th>
<th>Citations</th>
<th>Co-author</th>
<th>Ham Radio</th>
<th>Prison</th>
<th>High School Romance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Nodes</td>
<td>325,729</td>
<td>396</td>
<td>81,217</td>
<td>44</td>
<td>67</td>
<td>572</td>
</tr>
<tr>
<td>Randomness</td>
<td>0.5</td>
<td>0.62</td>
<td>3.5</td>
<td>5.0</td>
<td>590</td>
<td>1000</td>
</tr>
<tr>
<td>Avg. Degree</td>
<td>4.5</td>
<td>5</td>
<td>1.7</td>
<td>3.5</td>
<td>2.7</td>
<td>0.84</td>
</tr>
<tr>
<td>Avg. Clustering</td>
<td>0.11</td>
<td>0.07</td>
<td>0.16</td>
<td>0.06</td>
<td>0.001</td>
<td>0</td>
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</tbody>
</table>

Table: Characteristics of different social networks
How an economist would think about this

- An individual gets a benefit of $b$ from each direct link
- Gets a benefit of $b^2$ from each ‘friend of a friend’
- Forming links is costly $c \geq 0$
- 5 individuals who are considering whether to form links
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- What networks will form?
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- What networks are efficient?
- What networks will form?
- Depends on $b$ and $c$
Efficiency

- Very low: “complete” network
- Moderate: star
- Very large: empty network
Equilibrium

- c very low: “complete” network
- c moderate: all sorts of things
- c very large: empty network
Equilibrium

- $c$ very low: “complete” network
- $c$ moderate: all sorts of things
- $c$ very large: empty network

Inefficiency arises because of “free riding”
  - I prefer someone else to incur link cost
  - but everyone thinks like that
  - too few links created
Figure: The star network
Figure: An equilibrium network with moderate costs
The economic theory of networks

- Economic models can explain 3 key features
  - small worlds
  - highly clustered
  - fat tails
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- Implication 2: self-forming networks are inefficient
- Implication 3: tendency for concentration
- Implication 4: potential reasons for public policy
Some open questions

- How to measure and model the dynamics of networks?
- How to measure the value of user-generated content?
- Using online data to test models of network formation
- Role for policy in online networks
  - connectivity
  - ownership of data
  - subsidization