Advanced Social and Information Networks

Hari Sundaram
Associate Professor (CS, ADV)
hs1@illinois.edu
no laptops / smartphone usage please!

such usage negatively impacts your peers

This class will focus on strategic interaction on networks, where actors are resource constrained.
Examples of large-scale strategic behavior problems include
Sustainability
Public Health
congestion
A confluence of ideas from game theory, behavioral economics, advertising and computer science will play a key role in addressing these challenges.
A Stylized view

System

Observed behavior

Signals from the system

Social Signals
When do people cooperate?
What are examples when large scale technological networks have facilitated collective behavior?
San Marcos, California  [Schultz, 2007]
November Neighbor Comparison  

You used 28% MORE energy than your efficient neighbors.

<table>
<thead>
<tr>
<th>Efficient Neighbors</th>
<th>You</th>
<th>All Neighbors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1,450</strong></td>
<td>1,851</td>
<td><strong>2,759</strong></td>
</tr>
</tbody>
</table>

* This energy index combines electricity (kWh) and natural gas (therms) into a single measurement.

WHO ARE YOUR “NEIGHBORS”?  

ALL NEIGHBORS  
Approximately 100 occupied nearby homes that are similar in size to yours (avg 2,023 sq ft) and have both electricity and natural gas service.

You used 74% MORE energy than your efficient neighbors. This costs you an additional $425.
people tend to cooperate if they expect others to do so too
people who share resources have a selfish reason not to cooperate

[Hardin, 1968]
May 29, 1435, Valencia, Spain

Feb 1, 1483, Törbel, Switzerland
Elinor Ostrom, Nobel Laureate 2009

Small homogenous groups; ability to sanction, monitor and resolve conflicts in a low-cost manner.
The CS question:
How do we scale up?
mechanisms, realistic models, interventions
The system sets **mechanisms** that form the rules of the game.
Incentive compatible
The riot that wasn’t: How Twitter spread rumours of communal violence in Kolkata

On Monday, a road blockade was portrayed as a full-blown riot by some social media users – part of a worrying trend of misinformation being spread online.
How do we create incentive-compatible reporting on social networks?
The system can manipulate (delay, distort) information amongst peers.
Can peers cooperate to **discover** manipulation in polynomial time?
What happens when there are no mechanisms?
What happens when there are no mechanisms?
The **price of anarchy** is upper bounded by $\frac{4}{3}$ for all networks with **affine** $(ax+b)$ costs.
Adding edges to the network can make it worse!
How individuals make decisions is critical.
In this class, we will re-examine **rational behavior**, which forms the basis of game theory and mechanism design.
Stanley mows his lawn every weekend and it gives him terrible hay fever. I ask Stan why he doesn’t hire a kid to mow his lawn. Stan says he doesn’t want to pay the $10. I ask Stan whether he would mow his neighbor’s lawn for $20 and Stan says no, of course not.

Linnea is shopping for a clock radio. She finds a model she likes at what her research has suggested is a good price, $45. As she is about to buy it, the clerk at the store mentions that the same radio is on sale for $35 at new branch of the store, ten minutes away, that is holding a grand opening sale. Does she drive to the other store to make the purchase?

On a separate shopping trip, Linnea is shopping for a television set and finds one at the good price of $495. Again the clerk informs her that the same model is on sale at another store ten minutes away for $485.
Econs vs. Humans

Imperfect knowledge
Limited resources
Make sub-optimal decisions

Have complete knowledge
Always possess resources to
act on decisions
Make optimal decisions
Normative v. descriptive
1 mile + 1 inch

x?

1 mile

1 mile + 1 inch

1 mile
Expected utility: diminishing returns; focus on **levels** of wealth
Prospect theory: focus on changes to wealth
reciprocity
In 1985, Ethiopia endured one of the worst famines on record.
In 1985, Mexico City suffered a devastating earthquake.
Yet, Ethiopia, then one of the poorest countries in the world, offered $5,000 to help Mexico!
Because, in 1935, Mexico had sent aid to Ethiopia, when it was invaded by Italy.

How does the strength of the friendship affect behavior?
When did he decide to join?

\[ \sum_{i \in N_v} \omega_i \phi(i) \geq \theta_v \]

Linear Threshold model
Monday, Feb. 1st, 1960

Greensboro, NC, Woolworth’s sit-in
Models of individual decision making

Social Signals

Signals from the system

Observed behavior
Linda is thirty-one years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in antinuclear demonstrations.
Which alternative is more probable?

• Linda is a bank teller.
• Linda is a bank teller and is active in the feminist movement.
Assume that you have two choices: a nearly sure bet (97%, called ‘p’ bet) of winning $10, or a 37% chance of winning $30 (called ‘$’ bet)

what would you choose, p or $?
how much will you pay in exchange for the p bet?
how much will you pay in exchange for the $ bet?
We shall be discussing several open problems in this class, and brainstorm over solutions.
What we will not discuss in depth:

Privacy

System manipulation of messages

UI design

Decision scale (time, social)

Social Signals

System

Signals from the system

Observed behavior
CS598 CLASS MECHANICS

Everything you wanted to know
class website:

https://courses.engr.illinois.edu/cs598hs/sp2019/
Let’s go over the class schedule
paper review

1 paper presentation 15%
weekly, open ended questions

1 each week (pass / fail); can re-submit in case of fail for 50% credit

20% (total)
project

- proposal 10%
- paper 30%
- Final presentation 10%
- best presentation (extra credit) 2%
participation

feedback on final presentations 10%

class participation 5%
you can miss two classes; for every class beyond two, you will lose a third of a letter grade

i.e. $A \rightarrow A-$ (for missing three classes)

i.e. $A \rightarrow B+$ (for missing four classes)
academic integrity

zero tolerance policy!
Plagiarism deserves special mention. It is an academic violation to copy, to include text from other sources, including online sources, without proper citation. Any student found to be violating this code will be subject to disciplinary action.

http://www.cs.uiuc.edu/academics/honor-code
MEET THE TA

Rick