Social Computing Systems

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EECS 498, Winter 2017
(http://tiny.cc/socsClass)
Intro to Game Theory

(Just enough to impress your friends at parties)
What is game theory?

**Definition:** “the study of mathematical models of conflict and cooperation between intelligent rational decision-makers”

**Translation:** The study of *rational* motivation.

- A “rational” player seeks the biggest reward
Examples of a Social Computing “Games”
Coordination in Games

**Cooperative**: Contracts / communication allowed

- *Contract* = “we’re 100% committed to what we claim”

**Non-cooperative**: There is uncertainty in others claimed response
More Game Properties

**Simultaneous / Sequential**: Are decisions made at once or seq.?

**Temporal setting**: Is the setting discrete or continuous?
- If continuous, is feedback \((R)\) “separable”?

**Length**: Is the game played for 1 round, or 50? 1 minute or 10 days?
More Game Properties (Cont.)

**Perfect/imperfect info**: Do players know everything that is happening?

**Symmetry**: Are all players rewarded the same as each other?

**Zero-sum / non-zero-sum**: Does 1 player winning mean another loses?
What is the “Game” Configuration?
Cooperative/Non-Cooperative
Simultaneous / Sequential
Discrete/Continuous (separable?)
Length
Perfect/imperfect info
Symmetry
Zero-sum / non-zero-sum
What is the “Game” Configuration?
What does a solution look like?

A decision or policy. How do we get there?

- Compare outcomes
- Pick the best one

Ex:

Prisoner’s Dilemma

<table>
<thead>
<tr>
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<th>Reveal</th>
<th>Hold Out</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>P1</strong></td>
<td>(5yr, 5yr)</td>
<td>(10yr, Free)</td>
</tr>
<tr>
<td><strong>P2</strong></td>
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Dominant Strategies

One solution that is strictly better than all others

Can apply to one player, or many/all

\[
\begin{array}{c|c}
\text{P2} & \text{P1} \\
\hline
($5, $5) & ($100, $20) \\
($20, $20) & ($100, $5) \\
\end{array}
\]
## Dominant Strategies

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Dominant Strategies

One solution that is strictly better than all others

Can apply to one player, or many/all
Nash Equilibria

Non-cooperative game setting

- Recall: players can’t make contracts/commitments to play a certain way

**Stable state**: even knowing other players’ strategies, everyone still sticks with the same choice.
Nash Equilibria: Example

**Stag Hunt Problem**: N hunters, N hares, 1 stag

Everyone is needed to shoot the stag
  - Large reward

Anyone can shoot a hare alone
  - Smaller reward
You have died of dysentery.

[Oregon Trail]
Nash Equilibria: Example

Stag Hunt Problem

- N hunters, N hares, 1 stag

Stag-All  Hare-Some  P-Rest

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<th>Hare</th>
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<td>(200lb, 200lb)</td>
<td>(1lb, 0lb)</td>
</tr>
<tr>
<td>P-Rest</td>
<td>(0lb, 1lb)</td>
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Nash Equilibria: Example

Stag Hunt Problem

- N hunters, N hares, 1 stag

Why is this an equilibrium solution?
Nash Equilibria: Example

Stag Hunt Problem

- N hunters, N hares, 1 stag

P-Rest

Stag-All

P1

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What’s wrong with this “Nash” Equilibria?
Nash Equilibria in Practice

* Ex. for sellers/buyers, both-positive and both-negative reviews could be equilibria in some model formulations because of the desire to ‘retaliate’ for poor ratings.

Nash Equilibria in Practice?
Nash Equilibria in Practice?

* This claim applies to ‘peace’ and makes a lot of assumptions about the tensions at the time, rewards, etc. Remember that the equilibrium state promised by MAD (mutually-assured destruction) was a NEGATIVE reward outcome for all. This is why this setup actually helped us all to not blow up.
Our simplified model for ‘seeding’ versus ‘leaching’ for torrent files reduces this setting to a Stag and Hare problem. Adding uncertainty about the number of seeders required for a healthy torrent, and about the actions of other users gives us a probabilistic version of this model.
Intro to Mechanism Design

(Just enough to confuse your friends at parties)
Incentive Mechanisms in Practice

Demand is off the charts! Fares have increased to get more Ubers on the road.

2.0x
THE NORMAL FARE
$10 MINIMUM FARE
$0.60 / MIN $3.00 / MILE

I ACCEPT HIGHER FARE
NOTIFY ME IF SURGE ENDS
THIS RATE EXPIRES IN 3 MIN

EARN UP TO $100 FOR INVITING NEW DRIVERS

SURGE PRICING

SURGE PRICING: 1.00-4.50x
Games!