Modeling Destructive Group Dynamics in Online Gaming Communities

Akshay Patil, Juan Liu, Bob Price, Hossam Sharara & Oliver Brdiczka
Motivation

- **Groups** play an increasingly important role in online communities.

- Online groups are undermined when **members depart**, often taking resources + other members with them.
Motivation

• A member can quit his/her group for a variety of reasons

• Destructive Group Dynamics:
  – A member quits the group
  – The “quitting event” leads to substantial damage to the group
Problem Definition

Given interactions within and between groups of individuals,

• Can we predict if an individual’s quitting will cause significant damage to the group?
• Can we predict if and when an individual is going to quit the group?
Problem Domain

• Social Group:
  – Two or more individuals
  – Interactions with one another
  – Share similar characteristics/goals

• Online *gaming* communities have most highly developed group structures
  – Groups/Guild membership is often required to succeed in the game
World of Warcraft (WoW)
World of Warcraft (WoW)

- WoW: Massively Multiplayer Online Role-Playing Game (MMORPG)

- 11 million subscribers → Most popular MMORPG

- Players create characters/avatars in a virtual world

- Players play in a realm/server (instance of the game)
Factions
- A group of allies formed on racial and ideological basis
- Opposite factions are at-war against each other (Alliance vs. Horde)

Races
Each character in WoW has a race that determines its faction and abilities
Guilds in WoW

- A guild is an in-game association of characters (of one faction)
- A guild
  - Facilitates interactions among players and organization of large battles
  - Has leader(s)
  - Has its own social hierarchy and structure
- A character may need to send a formal application to join a guild
  - Character name, class, level, guild history, raiding experience
Destructive Group Dynamics (Example)

- **Quitting Event:** Character “Mardis” quits guild “Epic Pugz” and pulls friends out

- **Damage:** Guild “Epic Pugz” loses essential resources and becomes too small to survive

<table>
<thead>
<tr>
<th>February</th>
<th>March</th>
<th>April</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epic PugZ</td>
<td>Mardis quits</td>
<td>Mardis pulls 5 friends</td>
</tr>
<tr>
<td>31 members</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epic PugZ</td>
<td></td>
<td>9 members</td>
</tr>
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</tbody>
</table>
### WoW Dataset

- A complete census of 3 servers (realms) from WoW
- Time Range (6 months): Dec 2010 to May 2011

<table>
<thead>
<tr>
<th></th>
<th>Eitrigg</th>
<th>Bleeding Hollow</th>
<th>Cenarion Circle</th>
</tr>
</thead>
<tbody>
<tr>
<td>#Characters</td>
<td>176K</td>
<td>160K</td>
<td>140K</td>
</tr>
<tr>
<td>#Guilds</td>
<td>5K</td>
<td>5.5K</td>
<td>5.4K</td>
</tr>
<tr>
<td>Avg. Playing Time (hrs)</td>
<td>20.54 ± 49.37</td>
<td>25.48 ± 51.95</td>
<td>26.7 ± 58.25</td>
</tr>
<tr>
<td>%Characters changing guilds</td>
<td>25.01%</td>
<td>36.92%</td>
<td>26.35%</td>
</tr>
</tbody>
</table>
Social Network Construction

- **Co-Occurrence Heuristic**: A friendship link is placed between two characters if they belong to the *same guild* and were observed playing in the *same zone* at the *same time*.

- **Hybrid model**:
  - Two types of nodes: Characters and Guilds
  - Two types of links: Friendship and Membership

<table>
<thead>
<tr>
<th>Statistic on server Etrigg</th>
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<tbody>
<tr>
<td><strong>Number of Characters</strong></td>
</tr>
<tr>
<td><strong>Number of Guilds</strong></td>
</tr>
<tr>
<td><strong>Number of Edges</strong></td>
</tr>
<tr>
<td><strong>Avg. Collaboration Time</strong> (hrs.)</td>
</tr>
<tr>
<td><strong>% Characters changing Guild</strong></td>
</tr>
</tbody>
</table>
Are Quitting Events Independent?

- Quitting events are common in WoW (≥ 25% of characters change guilds)
- 70%-90% of quitting events do NOT follow a Poisson process, i.e. are not independent
Are Quitting Events Independent?

<table>
<thead>
<tr>
<th>Results for Server Eitrigg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Guilds</td>
</tr>
<tr>
<td>Number of Guilds with ≥ 30 quits</td>
</tr>
<tr>
<td>Guilds Following Poisson</td>
</tr>
<tr>
<td>Guilds NOT Following Poisson</td>
</tr>
</tbody>
</table>

• Quitting events are influenced by
  – (game engagement, game achievement, social interaction, group topology)
Quantifying Damage of a Quitting Event

- A character’s quitting decision is influenced by all preceding quitting events amongst his/her friends.

- **Corollary:** A character who quits a guild shares the blame for every friend that subsequently quits the guild.
Quantifying Damage of a Quitting Event

character C quits guild G to join new guild N

character c quits guild G to join new guild N

look back for time window T to find friends who to blame
Quantifying Damage of a Quitting Event

• **Blame:** Quitting events in the recent past receive high blame while quitting events in the distant past are assumed to have little impact.

\[ b_{F,C} = \frac{e^{\alpha(|t_F - t|)}}{\sum_{i \in F} e^{\alpha(|t_i - t|)}} \]

• **Damage Score:** Character’s aggregate share of blame for subsequent quitting events.
Predicting Potential Damage

• Supervised Learning:
  – Generate set of features (player, guild, game statistic, social and topological)
  – Mapping from feature set to potential damage score is learned from a training set
  – Binary Class Label: Substantial Damage or Non-Substantial Damage (pre-determined threshold)
## Prediction Results

- Random Forest with 10-fold cross validation

<table>
<thead>
<tr>
<th>Server</th>
<th>accuracy</th>
<th>Precision</th>
<th>Recall</th>
<th>F-meas.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eitrigg</td>
<td>82.50%</td>
<td>0.825</td>
<td>0.825</td>
<td>0.825</td>
</tr>
<tr>
<td>Cenarion Circle</td>
<td>81.23%</td>
<td>0.812</td>
<td>0.823</td>
<td>0.813</td>
</tr>
<tr>
<td>Bleeding Hollow</td>
<td>79.9%</td>
<td>0.799</td>
<td>0.799</td>
<td>0.799</td>
</tr>
</tbody>
</table>
Important Features

• Importance gauged by calculating correlation coefficient with damage score
  – **Playing Time:** The more a player plays, the more important he/she becomes in the guild, and hence the player quitting the guild is likely to cause more damage
  – **Collaboration Time:** High collaboration time indicates higher probability of inducing quits amongst his/her friends
  – **Weighted Degree** show a high correlation with damage scores
  – **Number of Friends** show a high correlation with damage scores
Predicting Quitting Events

• Given game trace till time ‘t’, can we predict whether a character will quit the guild within a specified future interval (Δ)

• Generate a set of features for a personal & social history window

• Predict whether the prediction window contains a departure/ quitting event
Predicting Quitting Events

- Personal history window
  - Finite 14 day buffer
- Social history window
  - Exponentially Weighted

- Does prediction window contain a departure event?
- Prediction window 7 Days
- Elapsed Time
- datetime_of_last_event
- datetime_to_predict
Prediction Results

- Unbalanced class problem → random sampling
- Disjoint character IDs in test / training set
- Random forest as classifier

<table>
<thead>
<tr>
<th>Server</th>
<th>Overall Accuracy</th>
<th>Non Quitting Event</th>
<th>Quitting Event</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Precision</td>
<td>Recall</td>
<td>F Measure</td>
</tr>
<tr>
<td>Eitrigg</td>
<td>82.7432</td>
<td>0.878</td>
<td>0.926</td>
</tr>
<tr>
<td>Cenarion Circle</td>
<td>89.0973</td>
<td>0.917</td>
<td>0.967</td>
</tr>
<tr>
<td>Bleeding Hollow</td>
<td>79.8396</td>
<td>0.855</td>
<td>0.91</td>
</tr>
</tbody>
</table>
Important Features

• Importance gauged by calculating correlation coefficient with quitting events
  – **Guild Membership:** The more guilds a player has been member of, the more likely the player is to quit the current guild
  – **Clustering Coefficient:** The more balanced the structure of a guild is, the less likely a player is to quit
  – **Playing Time Within Guild:** The longer a player plays within a guild, the less likely the player is to quit the guild
  – **Collaboration Time Within Guild:** The more a player has collaborated with other guild members, the less likely the player is to quit the guild
Conclusion

• Destructive group dynamics can be modeled from WoW in-game census

• We have built predictors *with reasonable accuracy* for
  – Potential impact of an imminent quitting event
  – If and when that quitting event will happen in a prediction window

• Building and combining diverse features is essential
Future Work

• *Constructive* group dynamics
  – Predict if and when a player joins a guild/group
  – What’s the potential gain

• Application of destructive group dynamics on other data sets
Thank you!

Questions?