Understanding Player Behaviors from Real-Time Strategy (RTS) Game Data: A Starcraft II case study

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Our Game Mining Group

Social Network, Web Mining, Trust Network, Recommender Systems, Software Engineering, Graph Mining, Network Modeling, Question Answering, Document Summarization, Information Retrieval
A geek-culture test: What’s wrong with this picture?

Live Long, and Prosper

- Han Solo

Analysis and Mining of Leisure Activity Data
Gamers are misunderstood
The Wild Gamers Appear!
Social is a natural part of gaming
Agenda

1. Introduction

2. Focus of game analytics

3. Starcraft II Case Study

4. Conclusion
Agenda

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Four Stakeholders

The Merchant Publishers

The Blacksmith Studios

The Wizard Scholars

The Adventurer Players
## Analytical Focus – Stakeholders’ Perspectives

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Business intelligence  
Churn  
Virality |
| **Studios** | How to make a game more fun?  
Game development  
Playtesting  
Balancing  
Detecting cheating, exploits, etc. |
| **Scholars** | How players behave in a gaming world?  
Group formation  
Epidemics  
Clandestine networks  
Economic behavior |
| **Players** | How to pwn more noobs (win more games)?  
Optimizing play |
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Zynga: “We’re an analytics company masquerading as a game company”

- “Success requires art + science”
- A/B Testing

- **Key Metrics:**
  - Churn
  - Viral Coefficient
  - Revenue Per User

- Over 95% of Zynga’s players never spend money on its games

- Use analytics to make changes catering to the spenders

- **Too much analytics?**: Tension between game designers and data analytic advocates

Source:
Ken Rudin, Actionable Analytics at Zynga: Leveraging Big Data to Make Online Games Fun and Social
http://online.wsj.com/article/SB10001424053111904823804576502442835413446.html
Is Zynga the first game company to adopt a successful data analytics strategy?
No, these guys were....
“Diamonds in the Data Mine”

• **CEO: Gary Loveman**
  – Ph.D. in Economics from MIT
  – Former Harvard Business School professor

• **As of 2010:**
  – Largest gaming company in the world
  – 70,000 employees
  – $8.9 billion USD in revenue

Source:
http://en.wikipedia.org/wiki/Caesars_Entertainment_Corporation
## Analytical Focus – Next Stakeholder

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PhDs do work in the game industry!

**Greg “Ghostcrawler” Street**  
Lead System Designer, World of Warcraft  
Ph.D. in Marine Science  
University of Texas, Austin

**Mike Ambinder**  
Ph.D. in Experimental Psychology  
University of Illinois

**Jane McGonigal**  
Game designer/researcher  
Ph.D. in Performance Study  
University of California, Berkeley
Valve’s Approach to Playtesting

- **Empirical methods of playtesting**
  - Direct observation
  - Verbal reports
  - Q&As
  - Stat Collection/Data Analysis
  - Design Experiments
  - Surveys
  - Physiological Measurements (EEG, EMG, etc.)

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Optimizing play |
Corrupted Blood Incident (2005)

Hakkar the Soulflayer

**Corrupted Blood**
Deal 263 to 337 damage every 2 sec.
Spread to nearby allies.

Infected player left the instance after defeating Hakkar.

Corrupted Blood
Deal 263 to 337 damage every 2 sec.
Spread to nearby allies.

Due to a glitch, the corrupted blood effect did not expire.

The infected player arrived at the populated area, e.g. city hub...
“Some characters with healing abilities volunteered their services, some lower-level characters who could not help would direct people away from infected areas, some characters would flee to uninfected areas, and some characters attempted to spread the disease to others”
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Theorycrafting

- Coined by Starcraft community (Game THEORY + StarCRAFT)
- The search for the optimal set of strategies using statistical analysis and mathematical modeling of game mechanics (Paul 2011)

Source:
http://gamestudies.org/1102/articles/paul
http://en.wikipedia.org/wiki/Theorycraft
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Research Goals & Challenges

- **Stakeholders: Players & Studios**

- Modeling behaviors of real-time strategy (RTS) players from the empirical data

- **What are the RTS player archetypes?**
  - Bartle’s Test of MMO players:
    - Achiever
    - Explorer
    - Socializer
    - Killer

- **Applying the models to predict winning/losing likelihoods, help players optimize their strategies, assist in game balancing, etc.**
Starcraft II’s Basics

- Pick a race to play
- Collect resources & expand one’s base
- Build up combat units
- Engage the opponent

**Goal:** Destroy the opponent’s last building or force the opponent to surrender
Starcraft for average people

- **Real-time strategy** game
- **The Three Games:** Mixture of Chess & Go (on steroids!)
- Highly imperfect information

MICRO-management  
MACRO-management

Source: http://wellplayed.org/forum/articles/thread/starcraft-isnt-chess
Macromanagement Behaviors

- Worker units
- Bases
- Production facilities
- Combat units
- Tech levels & upgrades
- Spending resources
- Utilizing special macro mechanics
- Etc.
Number of workers constructed across players’ skill levels

Source: Do you macro like a pro? (http://www.teamliquid.net/forum/viewmessage.php?topic_id=266019)
Micromanagement Behaviors

- Scouting
- Adapting to scouting information
- Map control
- Harassments
- Timing attacks
- Retreating
- Utilizing terrain features
- Etc.
Concave & Choke Point

Good positioning for Blue

Bad positioning for Blue

Harvesting & Annotating Starcraft II Replays

- Harvesting Replays
- Parsing Replays
- Annotating Replays
- Replays Repository

Starcraft II Players
Harvesting Replays

Parsing Replays

Replays Repository

http://www.gamereplays.org

http://www.sc2replayed.com

http://sites.google.com/site/sc2gears/

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<tbody>
<tr>
<td>0:00</td>
<td>Boxer</td>
<td>Select Command Center (102d8)</td>
</tr>
<tr>
<td>0:00</td>
<td>MC</td>
<td>Select Nexus (102f4)</td>
</tr>
<tr>
<td>0:00</td>
<td>Boxer</td>
<td>Train SCV</td>
</tr>
<tr>
<td>0:01</td>
<td>MC</td>
<td>Train Probe</td>
</tr>
<tr>
<td>0:01</td>
<td>Boxer</td>
<td>Select Command Center (102d8)</td>
</tr>
<tr>
<td>0:01</td>
<td>Boxer</td>
<td>Deselect</td>
</tr>
<tr>
<td>0:01</td>
<td>Boxer</td>
<td>Select Command Center (102d8)</td>
</tr>
<tr>
<td>0:01</td>
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# Actions Per Minute (APM) Spams

## Spammed Log

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</tr>
<tr>
<td>0:01</td>
<td>Boxer</td>
<td>Deselect</td>
</tr>
<tr>
<td>0:01</td>
<td>Boxer</td>
<td>Select SCV</td>
</tr>
<tr>
<td>0:02</td>
<td>Boxer</td>
<td>Select Command Center (102d8), deselect 1 unit</td>
</tr>
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## Non-spammed Log

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Diamond & Platinum players

Annotating Replays

Some predefined labels:
- Mining
- Building
- Training
- Scouting
- Attacking
Lessons Learned

- SMU Starcraft II Players were highly receptive to the project
  - More than 100 replies received

- Replay annotation is time consuming
  - 3 man-hours for 15 min game

- Annotator agreements were surprisingly low

- Automatic segmentation of replays is viable
  - Over 90% accuracy for simple labels
  - Noises can be reduced by 30%-50% by preprocessing the replay logs
  - Work in progress

- Game replay data are quite interesting to work with
  - Interdependency of events
  - Imperfect decision making
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Help Me, Help You

- Gamers are very passionate about their hobby
- Skilled gamers are meticulously and naturally better at solving problems
- Crowdsourcing and Human Computation opportunity
- Gamification.org

“In a matter of 10 days, gamers were able to do what biochemists have been trying to do for a decade: decipher the structure of a protein called retroviral protease, an enzyme that is key to the way HIV multiplies. Being able to see how this protein builds will likely help scientists develop drugs to halt that growth.”

Other Projects

- SFU Cognitive Science Lab
- Using replay files and survey questions to study players’ cognitive processing in real-time resource management scenarios
- Skill differences between expert vs. novice

Source: http://skillcraft.ca/
Thank you and GG

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