Analysis of player’s in-game performance vs rating: Case study of Heroes of Newerth

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Problem

- Ranking and rating of players in online multiplayer match based games
  - Mostly evolved from Elo rating system developed for chess
  - Only take into account the outcome of the match

- Are the in-game performance parameters reflected well in the assigned rating?

- Analysis of the correlation between in-game parameters and the rating assigned by the game’s rating system

- This study confirmed several anomalies and weaknesses in rating system which can be exploited by the players
Outline

- Problem
- Introduction
- Methodology
- Results
- Conclusion
Introduction

Player ranking
- Player’s position on a list of players of specific game based on rating

Player rating
- Numerical skill indicator assigned to specific player or team

Match based games
- First Person Shooters
- Real Time Strategies
- MMORPGs
- Multiplayer Online Battle Arenas (MOBA)
- ...

Case study: Heroes of Newerth (MOBA)
- Match making rating - MMR
MOBAs

- A “player created” game genre
- Popularized by *Defence of the Ancients* custom map for Blizzard’s Warcraft 3
  - *Sacrifice* by Shiny Entertainment
  - *Aeon of Strife* - map for Starcraft
  - Dota suppressed the popularity of “mother game” - Warcraft 3
  - “Stand alone” MOBA games such as League of Legends (LoL), Heroes of Newerth, Demigod...

- Mostlly free to play bussiness model, but REAL games
  - WoW 12 million monthly users - LoL 35 million
  - CoD MW 3 million daily users peak- LoL 12 million
  - Top 100 games on steam 650k concurrent users - LoL 3 million*
  - Halo 2 billion hours of play since 2004 - LoL 1 billion a month
HoN Gameplay

♦ Match based
  - Each match starts a new
  - Match statistics and outcome saved
  - Long term goal - improvement (rating, skill, statistics...)

♦ Team based - two opposing teams
  - Up to 5 players per team
  - Goal - destroy opposing teams main building

♦ Heroes
  - One per player
  - Unique skill subset per hero
  - Various roles
  - Improved through gathering experience and equipment
HERO: ENGINEER

NUMBER OF ALT AVATARS: 3

PLAY STYLE: CC MAGIC

Q  THE KEG  RANGE: 800 | MANA COST: 80,100,120,140

Target a location to deal 100 / 150 / 200 / 250 Magic Damage and a 1.25 / 1.5 / 1.75 / 2 second Stun in an area around that position. Units hit with this ability are pushed away from the impact. Engineer can be pushed himself, but not damaged or stunned.

W  STEAM TURRET  RANGE: 800 | MANA COST: 100

Click and drag cursor to create a turret that shoots in a cone for 5 seconds. Deals up to 100 / 200 / 300 / 400 Magic Damage and pushes enemies away. Slows Movement Speed for 3.5% per bullet, for a max of 35% slow.

E  SPIDER MINES  MANA COST: 90,100,110,120

Activate to place a Spider Mine at your location. Up to 9 may be placed at once, each dealing 150 / 200 / 250 / 300 Magic Damage. Consume one charge to place a mine. Up to 1 / 2 / 2 / 3 charges may be stored, refreshing every 30 seconds. Spider mines are stealthed and appear when an enemy comes near them, chasing them until contact. Each mine grants vision around itself.

R  ENERGY FIELD  MANA COST: 200

Activate to create an Energy Field for 6 / 8 / 10 seconds. Deals 50 / 75 / 100 Magic Damage per second. Enemies who enter or exit the Field take 100 True Damage and a 2 second Silence.
Hero improvement

Hero of starting level with starting items

Hero of maximum level with advanced items
HoN Mechanics

- None Player Characters
  - Spawn periodically for each team (creeps)
  - Grow in strength
  - Neutral

- Reward/penalty system
  - Killing blows
  - Destroying buildings
  - Dying

- Map vision (fog of war)
  - Static buildings
  - Dynamic - friendly units and wards
HoN Mechanics II

HoN Map with indication of creep pathways

Hero killing a creep and earning experience and gold
Data gathering methodology

- Player rating data - HoN’s official web site
- Supplemental data - www.honedge.com
  - Used to obtain data by querying game database
  - No longer possible
- Dataset includes
  - 338,681 player
  - Active within 30 days before 19.10.2012
- Dataset subset
  - For computational and presentational purposes
  - ~ 3000 players
  - Higher chance of picking players with MMR of
  - Beta distribution used for sampling so sample
Dataset statistics

- Whole dataset well described with normal distribution
- Slight incline around 1500 rating (starting point)
- Dataset subset limit on 1950 and 1050 rating
Validation of sampling

- Five different subsets created and plotted
Inspected in-game metrics

Are the in-game performance parameters reflected well on the assigned rating?

- All parameters fitted to $1 + a \cdot MMR + b \cdot MMR^2$ dependency
- Parameters investigated:
  - Number of games played
  - Account age
  - Win/loss ratio
  - Kill/death and assist/death ratio
  - Gold and experience per minute
  - Action rate
  - Denying
  - Wards per minute
  - Game duration
Games played & account age

More games - not always higher rating

Very evident beta end and switch to F2P model
Win/loss ratio

- Win more - get better rating 😊
Both K/D and A/D ratio positively correlated with MMR

Smurfs - highly skilled players on low rating
Both K/D and A/D ratio positively correlated with MMR

Again the high of XPM and GPM on very low rating
Action rate

- Action rate positively correlated with MMR
Higher rated players ward more
Best of the best are an exception
Number of denies

- Very indicative metric and very dependant on the rating
Game duration

- Game duration spikes
  - 15 minutes first concede mark (5 players conceding)
  - 30 minutes second concede mark (4 players conceding)
- Games tend to last less as rating increases
Conclusions & Future work

- MMR system does capture player “skill”, however...
  - Some anomalies are observed
  - “Smurfs” are still a problem
  - Algorithm works rather slowly
  - Algorithm’s weakness is taking only the outcome of the match as input

- Possible future work
  - Player behaviour patterns
  - Identification of unbalances between heroes using statistical approaches
  - Design of role based rating system
  - Improvements of matchmaking system