# Eloworld - a game-theoretic simulation of social grouping

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March 23, 2012

# Some terminology

**Intelligent agents** are "autonomous entit[ies] which observe through sensors and act upon an environment using actuators ... and direct [their] activity towards achieving goals."

**Social capital** is "the value of social relations and the role of cooperation and confidence to get collective or economic results."

**Social grouping** is "two or more humans who interact with one another, share similar characteristics and collectively have a sense of unity."

# What is Eloworld?

- A game-theoretic simulation of social grouping
- An experiment in computational modelling
- An exploration of swarm based intelligence
- An examination of the ELO rating system

# The World

- A two-dimensional Cartesian plane
- Finite in both dimensions
- Non-toroidal
- Obstacle and collision free

# The Game

- Zero-sum (qualitatively)
- Glorified dice rolls, with a bias
  - Each player has a true skill in the range (0 .. 1)
  - Each player then makes a roll in the range (true skill .. 1)
  - The players add their true skill to their roll, and compare
    - If difference of scores <= 0.1, draw (each earns .5 points)
    - Else, higher score gains 1 point, lower score gains 0 points.

# The ELO Rating System

- A simple numeric rating of so-called “proven skill”
- Devised by Arpad Elo for competitive Chess

## Mathematical details

Expected score for player $A$ facing player $B$ is (0 .. 1):

$$E_A = \frac{1}{1+10^{(R_B - R_A)/400}}$$

Adjusted rating for player $A$ after a game with player $B$:

$$R'_A = R_A + K(S_A - E_A)$$

Where $K$ is a sliding constant based upon the player’s current ELO rating.

# The Agents

- Consist of various properties:
  - position (x,y)
  - current ELO score
    - letter-grade ranking
    - current $K$-value
    - differential
  - true skill (0..1)
  - whim (0..1)
  - number of games played
  - list of recently played opponents

# The Agents

- Simple behavior:
  - Find target
    - Look at every agent's ELO
    - Find the highest ranked player within differential
    - Reject if in the recently played list
  - Move towards target
    - If no valid target, move in a random direction
  - If in same location as target, challenge to a game
    - If within target's differential, a game is played
    - Else, if target's whim roll is high, play a game
    - Else, target rejects, no game is played

# Results

- Emergence
  - Agents actively strive to increase and protect their ELO rating
  - Agents vary game playing partners
- Convergence
  - Agents tend to converge around the center of the world
  - Such convergence leads to one large social group
- Social mobility
  - Agents are able to move through social classes by way of changing ELO ratings
  - Agents act in a way that mirrors their social standing

# Demo time?

- One second while I set things up...

# Sources

- https://github.com/gatesphere/eloworld
- http://en.wikipedia.org/wiki/Intelligent_agent
- http://en.wikipedia.org/wiki/Social_capital
- http://en.wikipedia.org/wiki/Social_group
- http://en.wikipedia.org/wiki/Elo_rating_system

# Any questions?

- Feel free to ask.