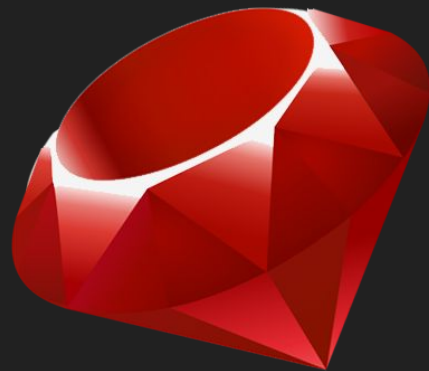# Adversarial Search in Game Environments

Kenneth Willeford

Personal Background

- Game Development
  - Poor Family
  - Carefully Picking Out Games
    - Game Reviews
    - Replayability
    - Adventure/RPG
  - RPG Maker
    - Make own games.
    - RGSS (Ruby Game Script System)

A.I and Games

- Simple Reflex Agents
  - Hack and Slash
  - Shooters
  - Too many Agents…
- Adversarial Agents
  - Fighters
  - Turn-Based Games
  - Only a few agents or time isn't critical…
- Computational Compromise
  - Pixel Perfect Action Infeasible
    - Grid Space and Cube Space
    - Commitment Periods

RPG Maker: Dueling AIs

- Explore Agent Behavior in Expectimax and Minimax.
- Important Differences
  - Agents require more than one hit to die.
    - Chance to learn from mistakes.
  - Competing agents are on equal ground.
  - Possibly multiple utility functions.

- Abstract Behavioral Patterns?

Performance Measure

Rational Thought and Action

- It's better to have more HP.
- It's better to reduce enemy HP.
- Maximizing my health and minimizing the enemy's health is best.

Humanly Thought and Action

- The importance of Attacking/Defending is relative.
  - If my health is low and the enemy's is high I should avoid all damage and look for an opening.
  - If my opponent is weak I should go for a finishing blow regardless of the damage I take.

Environment

- Grid Space
- RPG World
  - Stats
- Arbitrary Open Space
  - Impassable objects?
    - Grid Search
    - Manhattan Distance
- Falcao ABS
 - Coupling to Actuators
  - Coupling to Sensors
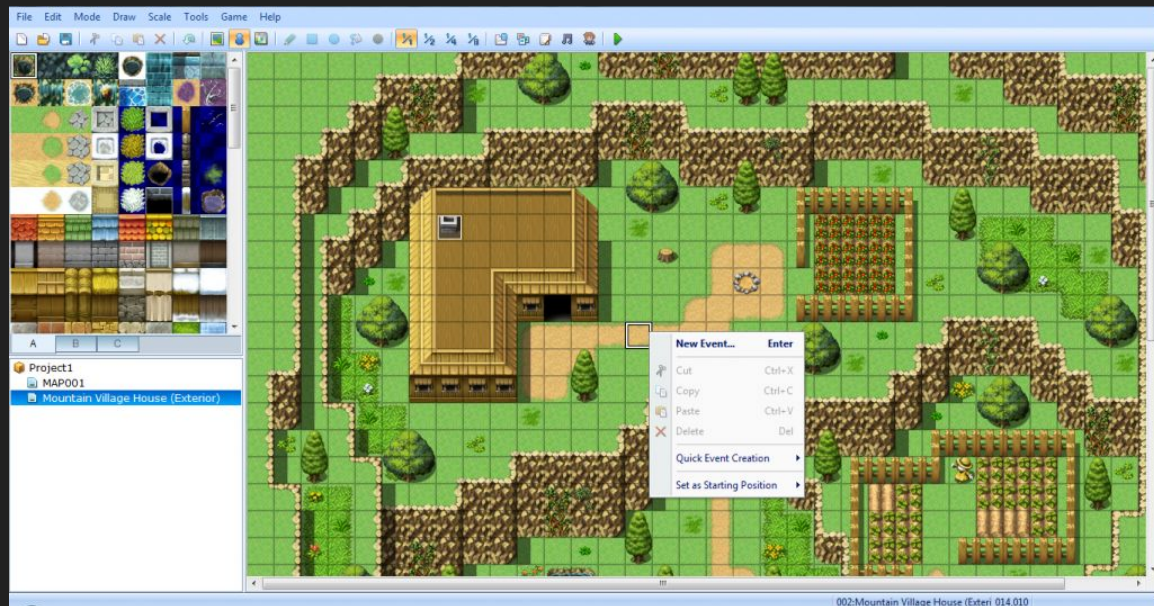
Actuators

1. Move Up/Down/Left/Right
2. Melee - Melee does 2 damage at a close range.
3. Guarding - Reduces damage by 1.
4. Projectile - Inflicts 1 damage at a distance.

- Actions have cooldowns.
- As it goes along there may be multiple options for a given actuator category.

Sensors

- Fully Visible
- Can View Each Other's Statistics
- Know Each Other's Position
- Know Each Other's Actuator Statistics
  - Cooldowns
  - Damage Inflictable
- Intentional Error?
  - Sensors are Restrictable
  - Approximations instead of Exact?
    - Humanly Thinking?
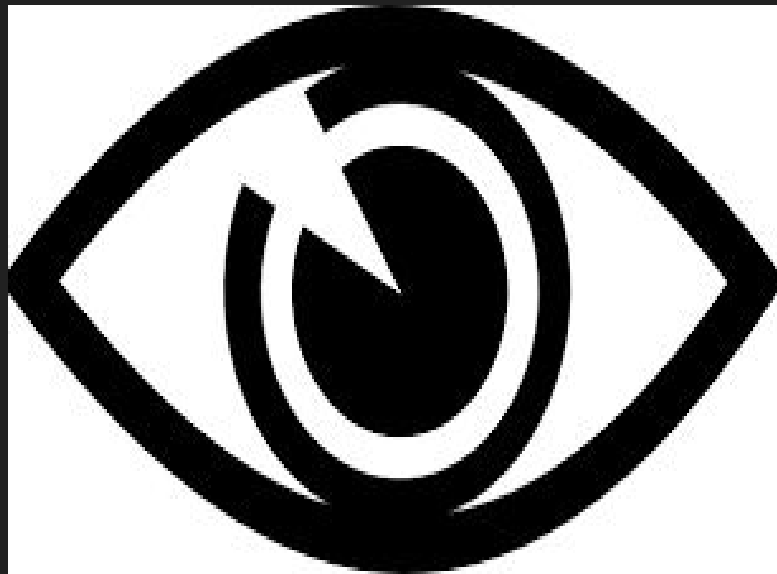
Adversarial Search Methods

- Agent Position
- 'Skill Statistics'
- 'Psychological Factor'
  - Trial and Error Learning
- Branching Factor is Minimum of 7
  - Keep game-ply to a minimum.
  - Test for good balance
- Adversarial Search Methods Compared
  - Expectimax vs Expectimax
  - Minimax vs Minimax
  - Expectimax vs Minimax
  - Repeated with different behavioral patterns?..

Evaluation Ideas

- Safe Moves have positive utility.
- Unsafe Moves have negative utility.
- Decisive Moves have high positive utility.
- Poort Moves have very negative utility.

- Separation of Actuators into Classifications
  - Safety
    - Movement/Guarding
  - Aggressive
    - Melee/Projectile

- Behavioral Searching
  - Preference of Actuators
  - Restriction of Sensors
  - Minimax vs Expectimax
- Psychological Damage
  - Punished = Damage
  - Good = Reward
  - Simple Learning?

- Behavioral Abstraction?

Questions?