Applying AI Techniques to Ramsey Games

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Ramsey Games

How the Game is played:

1. Initial Board: Graph with n nodes, NO edges.
2. Players alternate turns:
   Player I connects two nodes with a RED edge.
   Player II connect two nodes with a BLUE edge.
3. First player to get a triangle in their color WINS

Motivation

Three Problems:

1. Compare AI game techniques.
   - 1.1 Mini-max: use Alpha-Beta to Prune Game Tree.
   - 1.2 Monte Carlo Methods: Play move with highest prob of winning.
2. For each n what is outcome (wins, lose, or draw).
3. If both players play random, then what is prob of win, lose, or draw.

Alpha-Beta Pruning

Can we evaluate the entire Game tree? TOO BIG. Instead:

1. Figure out how to STATICALLY evaluate a position.
2. Look ahead a fixed number of moves.
3. Work backwards to make best move.
4. Be clever about what nodes NOT TO look at.

Monte Carlo

For each move m we wonder- is it a good move? To find out we:

1. Make move m and then both play RANDOMLY who wins?
2. Repeat this LOTS of times.
3. Be clever about what nodes TO look at.

THEN we Pick move m with the highest prob of WINNING.

Random and Non-Random

Eighten Nodes, want K_4. Alpha-Beta.

Depth 3 beats Depth 1 10 out of 11 times (literally)

Random and Non-Random

Six Nodes, want triangle:

1. If both Players play Perfect then Player I wins.
2. If both Players play Random then Player I wins 60%.

Eighteen Nodes, want K_4:

1. If both Players play Perfect then Player I wins.
2. If both Players play Random then Player I wins 50%.

Upshot: Last result might lead to interesting mathematics.

Monte Carlo RULES!

Player I and II both play Monte Carlo on 6 node game.

number of simulations per move	Percent of WINS for player I
200	75%
400	80%
600	83%
800	85%
1000	85%
1200	86%
1400	95%

UPSHOT: Mo' simulations, Mo' wins!
UPSHOT: Big jump at end– Interesting! Why?