Combinatorial Game Representation and Analysis of Snort

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Outline

Fairness A game is said to be *fair* if draws may occur.

Progressively Bounded A game is said to be *progressively bounded* if the game is guaranteed to end within a finite amount of time.

Solving Games

We say that a game can be solved in one of two levels:

Weak Solution The outcome can be determined in any state.

Strong Solution The outcome can be determined in any state which can produce perfect play from any position within a reasonable amount of time.

Snort Description

Two players Red and Blue

Board map (usually planar)

Moves
- Red colors an available region red
- Blue colors an available region blue

Constraints no two regions can have the opposing color

Gameover player with no moves loses

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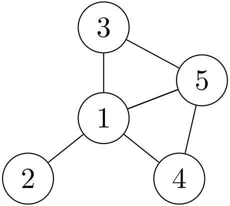
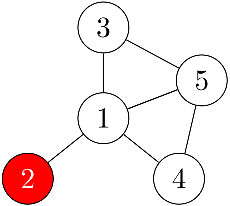
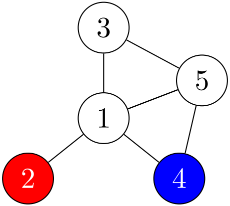


Snort Demo: 1



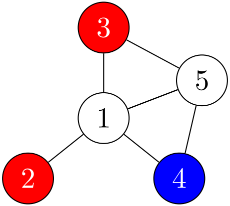
Red selects vertex 2

Snort Demo: 2



Blue selects vertex 4

Snort Demo: 3



Red selected vertex 3

Red player wins

Snort Classification

1. Determinate
2. Zero-sum
3. Perfect information
4. Sequential
5. Normal-play
6. Unfair

Unfairness

Theorem

Snort is an unfair game.

Proof.

Any game that is a zero-sum, partisan, progressively-bounded game with no ties, has a winning strategy for a player that depends on the currently given state. □

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Snort: Progressively Bounded

Lemma

Snort is progressively bounded.

Proof.

Given that there are n vertices and there are four vertex states, there is at most $o(4^n)$ possible game configurations. Hence, the state space is finite.

Further, each move locks a particular vertex to a configuration which reduces the state space size. Consequently, there will be at most $O(n)$ moves before a gameover state is reachd. □

Unfairness

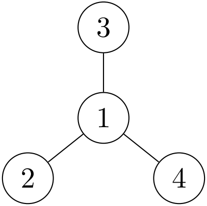
Conclusion:

Theorem

Snort is an unfair game.

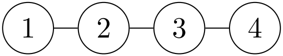
Trivial Graph Families: Star Graphs

All star graphs are **N**-positions.



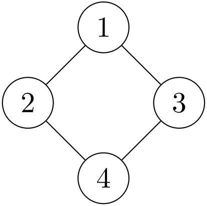
Nontrivial Graph Families: Path Graphs

All path graphs are **N**-positions.



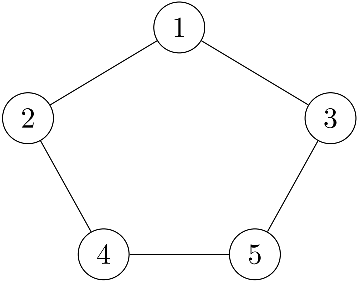
Nontrivial Graph Families: Even Cycle Graphs

All even cycle graphs are **P**-positions.



Nontrivial Graph Families: Odd Cycle Graphs

All odd graphs are **N**-positions.



Game Variants

Consider games of three players or more:

- The state space increases exponentially
- Collusion is an important factor
- Star graphs are still trivial

Consider expanding the space between player pieces:

- Fewer valid board configurations
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Thank you. Snort simulator and solver are available on GitHub:
https://github.com/Hydrotoast/SnortSolver