Multi Agent Systems – 2011
Epistemic Logic: Pandora's Box

Pandora's Box

A Timeless Game of Psychology and Curiosity by Ben Stanley

By Amirhossein Shantia and Ron Snijders

Outline

- Introduction

- Theoretical Analysis

- Implementation

- Conclusion

- Future work

Introduction: Problem description

How can Epistemic Logic be used in the game "Pandora's Box" to potentially increase the performance of an AI player?

Introduction: Pandora's Box: The Myth

The Myth

Introduction: Pandora's Box: The Game

The Game
Invented by Ben Stanley

- Equal amount of black and white stones per player.
- Hope stone
- Goal: To gain as many white stones as possible

- In each turn a player must:
  - Put one stone in Pandora's Box,
- And may:
  - Swap its stones with another player.

- If a player puts its last stone in the box, the player gets stones within Pandora's Box.
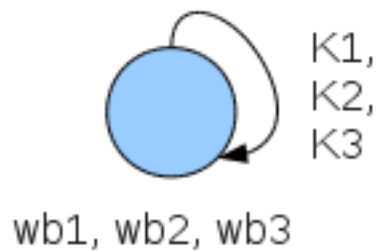- Final score per player: *number of white stones – number of black stones*

Introduction: Goals

- Analyzing the game

- Implement the game

- Automatic model creation

- Improve AI players performance by the use of epistemic logic

Theoretical Analysis: 2 stones per player (3 players)
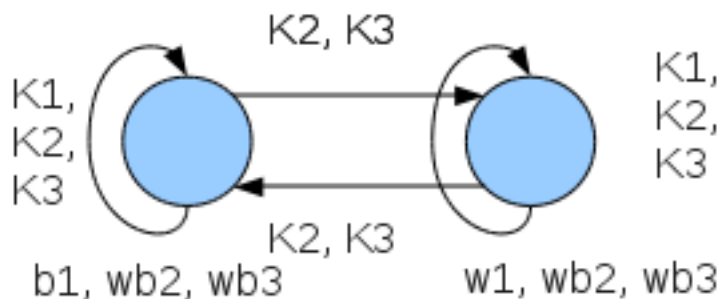
Initial mode: (start of game)

Beginning of The Game

K1,
K2,
K3

wb1, wb2, wb3

Theoretical Analysis: 2 stones per player (3 players)

First move:

Player 1 starts the game. He puts a white stone in the Box.
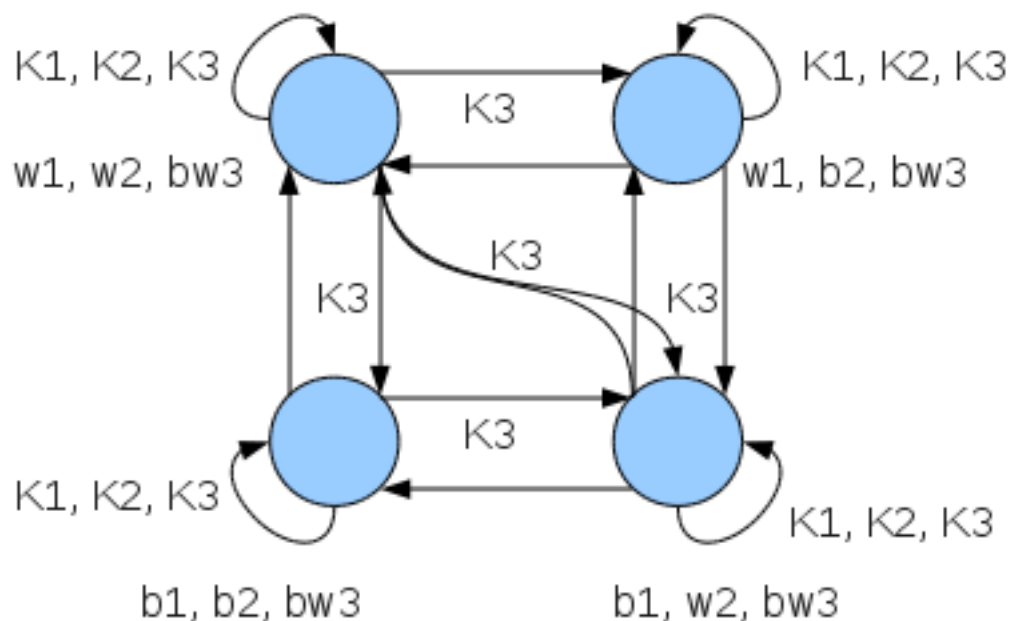Player 1 does not switch hands.

Theoretical Analysis: 2 stones per player (3 players)

Second move:

Player 2 puts a black stone in the Box and switch hands with Player 1.

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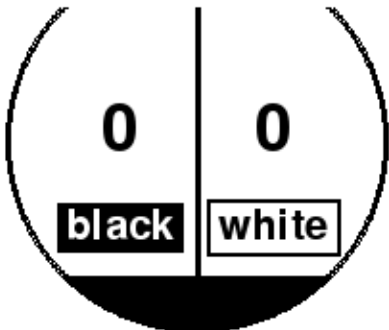## Theoretical Analysis: 4 stones per player (3 players)

- In case of 4 stones and 3 players:
  - Keep track of nested swapping of stones
  - Game gets more challenging
  - Exponential increase of possible states.

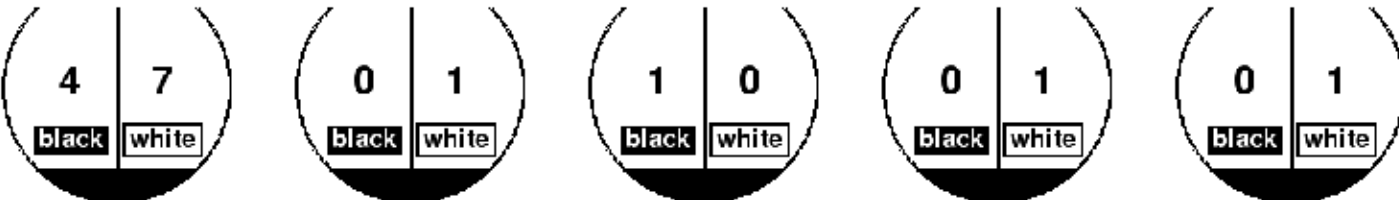## Implementation: The main game GUI
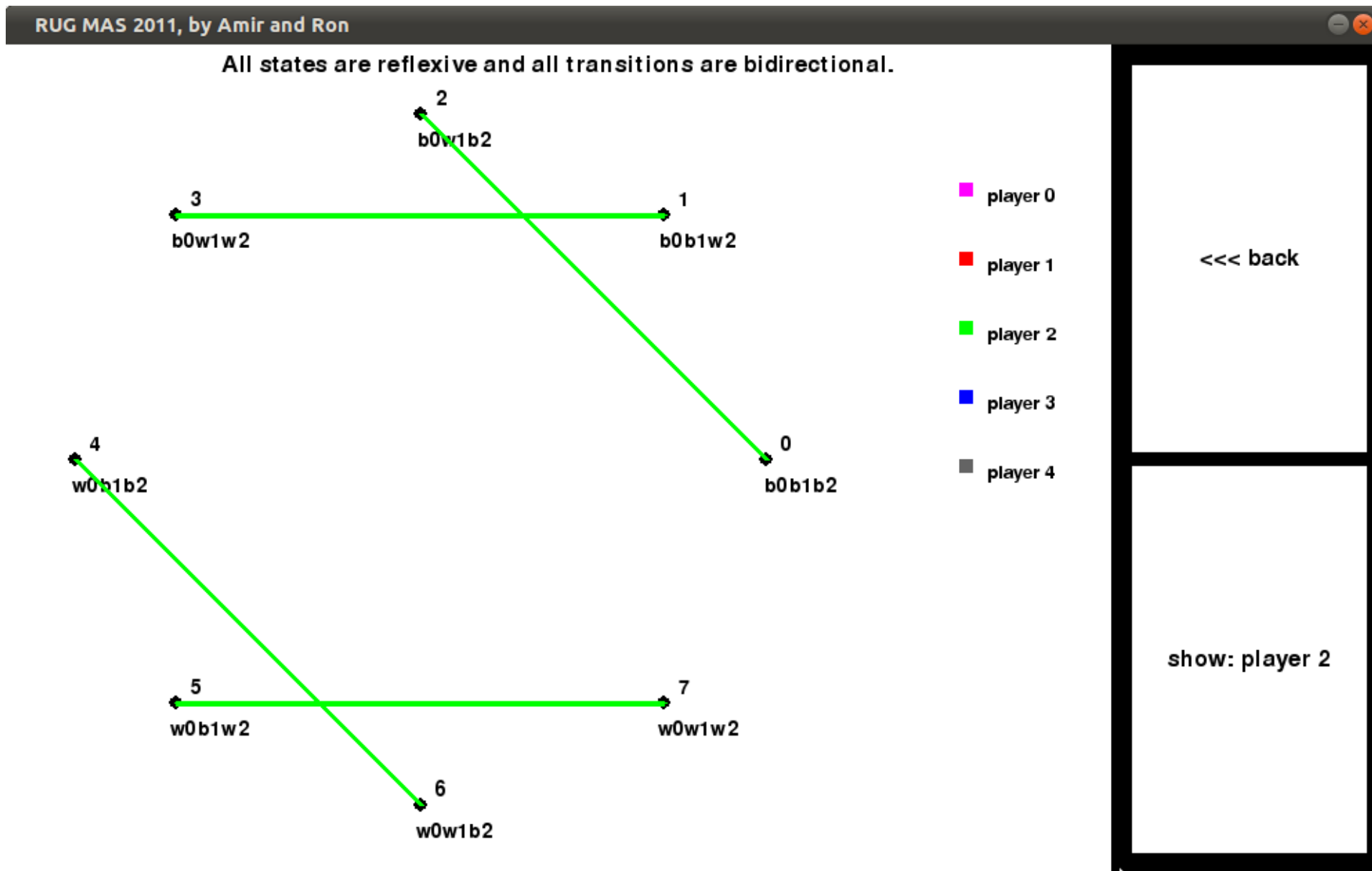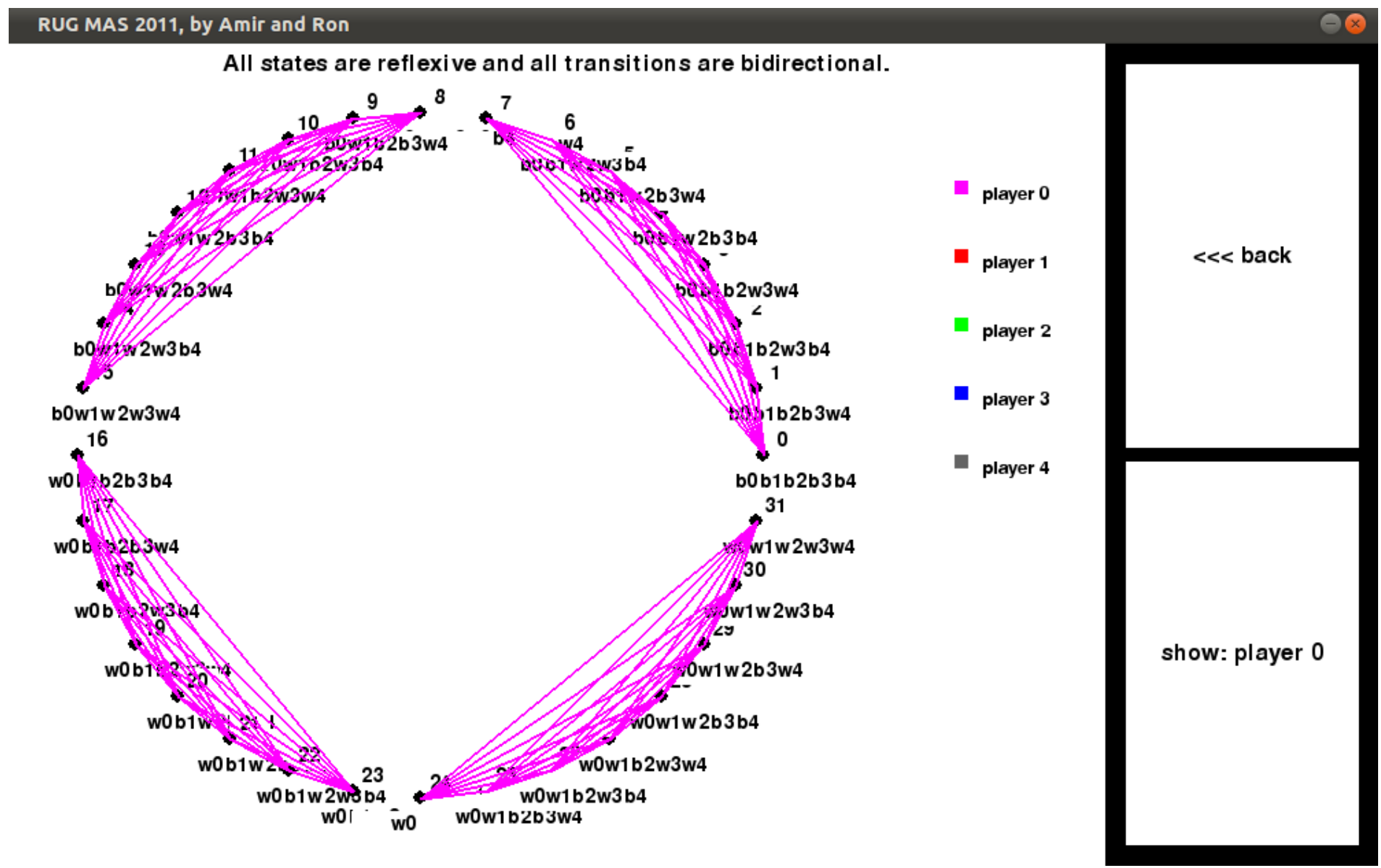
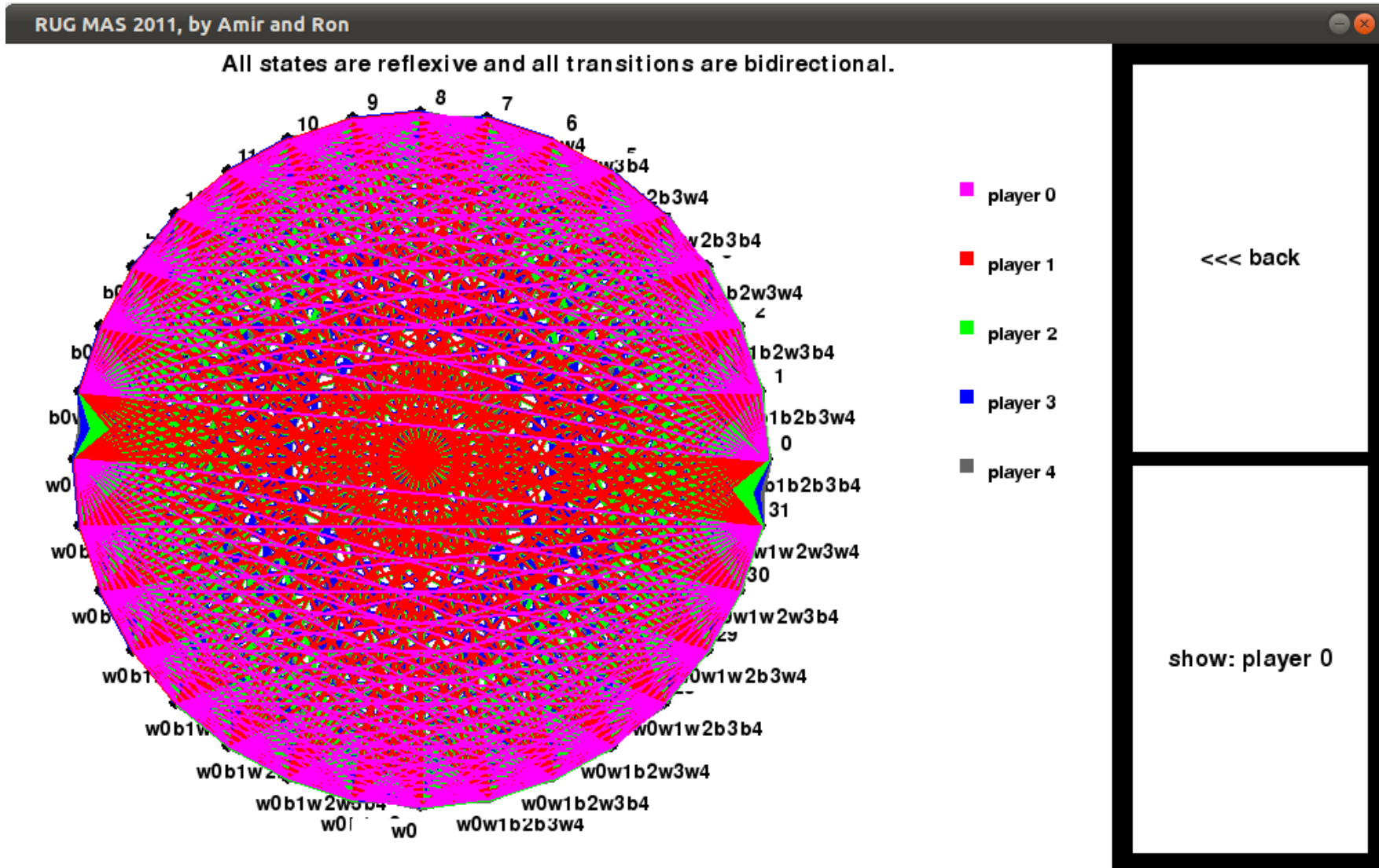## Implementation: Example: 2 stones no swapping
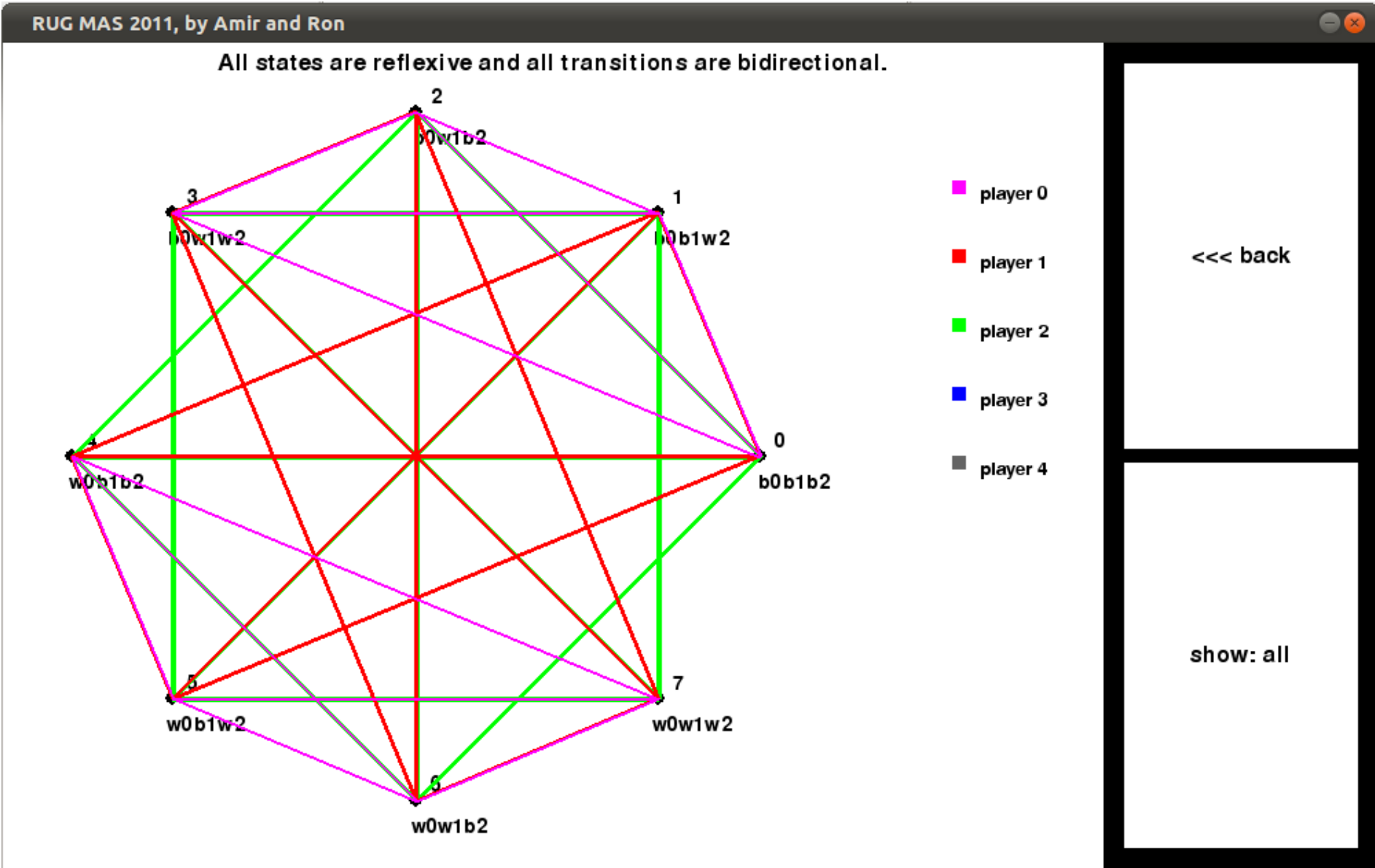
Implementation: Example: 2 stones swap for p2 to p0

Implementation: Example: 2 stones and 5 players with swap

Implementation: Example: 2 stones & 5 players

The total amount of possible states and transitions grows very fast with the number of stones and players.

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Conclusion

• The game needs to be played with a sufficient amount of players and stones to make it more challenging.

• However, many players and stones results in models with a lot of states.

• The use of Epistemic Logic in the game "Pandora's Box" can be useful to increase the performance of an AI player.

Future work

• Automatic model creation for more then 2 stones per player.

• Find ways to cope with the huge amount of states in the model (reduced models).

• Use Epistemic Logic in an AI player to improve its performance.

Thank you!

Any questions?

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