Distributed Safety Games

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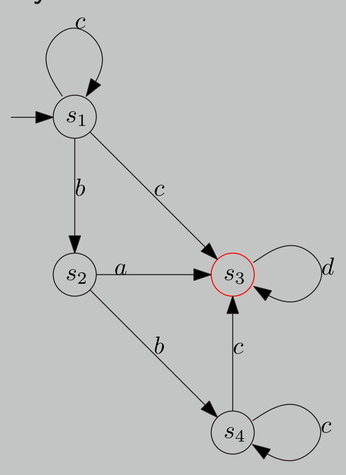
Introduction

Various games have been designed to model various situations, where it is hard to decide the correct action to take for a system. Games with complete information with various winning conditions safety, reachability, muller, parity, rabin etc have been studied extensively, various theorems have been proved and good algorithms have been designed. On the other hand, in games with partial information players may not have complete knowledge of the ongoing play. Multiplayer games with partial information become complex. We consider one such incomplete information game, where one of the players in a two player game has a distributed nature. We look at an example where one of the players, the system consists of a team of two processes, and see what new issues arise due to the non sequential nature of the game.

Safety game

A safety game is played over a sequential transition system. Environment and System are the two players.



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Play

A play consists of a sequence of moves.

- Environment plays by choosing an action **a**, **b** or **c**.
- System plays by choosing a transition in the present state on the action played by Environment.

Strategy

- A strategy for the System is a function or program that tells the System what to play or which transition to take.
- A strategy for the Environment is a function or program that tells the Environment what to play or which action to take.
- A play is played according to a strategy when each move abides by the strategy.

Some Notes

Determinized

Safety games are determined.

Memoryless

Safety games have uniform memoryless strategies for each player.

Fixpoint Algorithm

There is a fixpoint algorithm to calculate the winning regions and winning strategies for each player.

Distributed Safety Game

A Game consists of

- a Game Arena
- a start state
- a winning condition

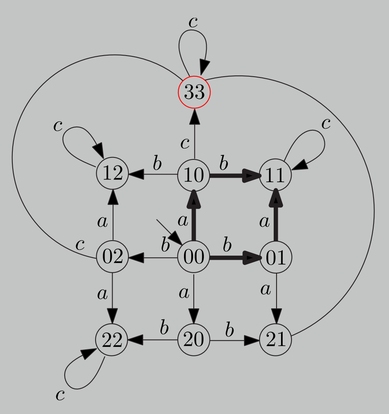
A Distributes Safety Game consists of

an Asynchronous automaton
a global start state
a set of safe global states.

A distributed safety game is played by Environment and a System consisting of a set of processes or agents. Each process participates in a set of actions.

Global View

The global picture would look like

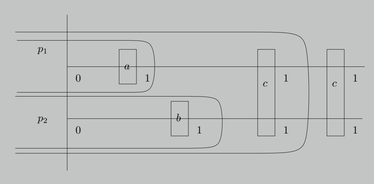


$\mathcal{P} = \{p_1, p_2\}$
$\Sigma = \{a, b, c\}$
$\Sigma_1 = \{a, c\}$
$\Sigma_2 = \{b, c\}$

- Process 1 participates in actions **a** and **c**.
- Process 2 participates in actions **b** and **c**.
- When environment plays an **a**, process 1 chooses a transition based on its knowledge.
- When environment plays a **c**, process 1 and 2 choose a transition based on there combined knowledge.

Play

A Play would look like



$\mathbf{(0,0)b(0,1)a(1,1)(c(1,1))^{\omega}}$

Some Notes

Determinized

Distributed Safety games are not determined.

Memoryless

For Distributed Safety games the system has limited memory strategies.

Fixpoint Algorithm

There is a fixpoint algorithm to calculate the winning regions and winning strategies for each player.

References

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