Internship proposal:
Algorithms for Parity Games

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January 20, 2018

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Localisation: LaBRI (Bordeaux)

Sujet du stage: Ce stage propose d'étudier d'un point de vue pratique et théorique différents algorithmes pour les jeux de parité.

Thèmes: Théorie des jeux, Théorie des automates

We describe the model of parity games, which appears in formal verification as the model-checking games for modal μ-calculus.

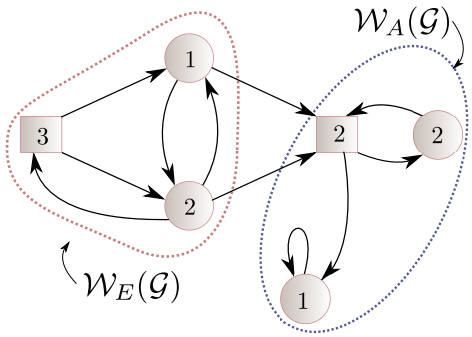

Figure 1: An example of a parity game. The labels on the vertices are called priorities.

Parity games are played in a directed graph with two types of vertices: circles controlled by Eve and squares controlled by Adam. A play consists in describing a path in the graph: when the current vertex is a circle Eve chooses the edge to follow, and when it is a square Adam chooses. The play stops when some vertex is visited for the second time, forming a loop. The parity objective specifies that Eve wins if the largest priority in the loop is even, and Adam wins otherwise.

We let $W_E(\mathcal{G})$ denote the set of vertices from which Eve has a winning strategy in the game $\mathcal{G}$, and $W_A(\mathcal{G})$ for Adam. In the example, $W_E(\mathcal{G})$ is circled in red and $W_A(\mathcal{G})$ in blue. For instance, a winning strategy for Eve consists of going from the vertex with priority 2 to the vertex with priority 1 and vice-versa, ensuring a loop with largest priority 2.

Objectives of the internship

Many algorithms have been constructed for solving parity games. Although no polynomial time algorithm is known, two recent breakthroughs led to quasipolynomial time algorithms. The goal of the internship is to study these algorithms in depth taking both a practical and theoretical point of view. A more ambitious goal is to improve on these algorithms.