CI in General Game Playing - To Date Achievements and Perspectives

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Abstract. Multigame playing agents are programs capable of autonomously learning to play new, previously unknown games. In this paper, we concentrate on the General Game Playing Competition which defines a universal game description language and acts as a framework for comparison of various approaches to the problem. Although so far the most successful GGP agents have relied on classic Artificial Intelligence approaches, we argue that it would be also worthwhile to direct more effort to construction of General Game Players based on Computational Intelligence methods. We point out the most promising, in our opinion, directions of research and propose minor changes to GGP in order to make it a common framework suited for testing various aspects of multigame playing.

1 Introduction

One of the most interesting areas of contemporary research on application of Artificial Intelligence (AI) and Computational Intelligence (CI) to mind games is the topic of multigame playing, i.e. development of agents able to effectively play any game within some general category being informed only about the rules of each of the games played. This poses a unique challenge to the AI community, as all the most successful game playing agents to date have been developed to achieve master level of play only in their specific games. Creating a system exhibiting high playing competency across a variety of previously unknown games would be a significant step in CI/AI research.

In the remainder of this paper we introduce the General Game Playing (GGP) framework and deal with the CI perspectives in GGP. We devote chapter 4 to analysis of possible machine learning approaches to GGP – identifying elements of existing programs (mainly AI-based) that can be incorporated into soft learning solutions and proposing a number of possible research directions. Finally, in chapter 5 we argue that GGP can easily become a universal multigame playing platform, useful in many research areas, even outside the context of the GGP tournament, as long as some necessary extensions are introduced into the standard.

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2 General Game Playing Competition

General Game Playing (GGP) [3] is one of several approaches to the multigame playing topic. It was proposed at Stanford University in 2005 in the form of General Game Playing Competition held annually at the National Conference for Artificial Intelligence [4]. General Game Players are agents able to interpret game rules described as a set of Game Description Language (GDL) [6] statements in order to devise a strategy allowing them to play those games effectively without human intervention.

The competition always includes a wide variety of games, both known previously and devised specifically for the tournament. Contestants should be prepared to deal with games of various complexity, varied branching factors and numbers of players, both cooperative and competitive.

2.1 Game Description Language

Game Description Language (GDL) [6] is used to describe the rules of the class of games playable within the GGP framework, i.e. finite, discrete, deterministic multi-player games of complete information. GDL describes games in a variant of Datalog. Game states are defined in terms of facts and algorithms for computing legal moves, subsequent game states, termination conditions and final scores for players are represented as logical rules.

3 GGP Competition Winners

In this section, selected most notable achievements in the field of GGP agents development are described. As it will become evident in the following sections, the winners of the first four editions of the contest relied on AI rather than CI methods. We believe, however, that elements of these successful AI solutions may be transferable to more CI-focused approaches, and these transferable aspects will be described in more detail in further chapters.

3.1 Cluneplayer

Cluneplayer [1], developed by James Clune, was the champion of the first and vice-champion of the second GGP tournament. It relies heavily on game domain specific observation that most mind games share a number of common concepts important in close-to-optimal play. Extracting definition of these crucial game features from game description should allow construction of a new simplified game in the form of a compound lottery based on the three core aspects of the original game: *expected payoff*, *control* (or mobility) measure and *game termination* probability (or game longevity). The expected outcome of thus created model approximates original game state evaluation.