YAVALATH: SAMPLE CHAPTER FROM *EVOLUTIONARY GAME DESIGN*

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ABSTRACT

The following chapter from *Evolutionary Game Design* (Browne 2011) describes
Yavalath, the first computer-generated board game to be commercially published.

LUDI is a software system that creates new combinatorial games by evolving the rule sets of known games into new combinations, then testing them for playability and quality. It was developed as a proof-of-concept for my 2008 PhD thesis *Automatic Generation and Evaluation of Recombination Games* (previously reviewed in the ICGA Journal by Ingo Althöfer (2010)), to test whether automated methods could be harnessed to search for new combinatorial games, and – more importantly – to recognise good games when they arose. A "good" game in this context is one with the potential to interest human players.

Once a suitable *game description language* was defined, and a number of sample games defined for the initial population in the form of symbolic expressions, the generation of new rule sets was then a reasonably straightforward task, using an evolutionary approach and standard *genetic programming* mutation and crossover operators. A more significant hurdle to be overcome was the subsequent evaluation of the new games. Rule sets for combinatorial games are typically highly optimised and finely tuned by the designer, to play as well as possible with as few rules as possible. Random changes to a rule set will generally not improve a game – a diligent designer will already have tried the obvious variations – but simply break it, hence it could be expected that an evolutionary search would be likely to produce many unplayable games.

The quality of each candidate game was estimated by running a number of self-play trials between two AI players; direct evaluation from rule sets is not sufficient, as games reveal their true nature during actual play. A simple *playability filter* was used to detect blatantly unplayable games, filtering out around 98% of evolved individuals, and the surviving individuals were then studied in more detail and ranked according to a number of aesthetic criteria, previously correlated with human player rankings of the set of source games.

Of the 1,389 games evolved by LUDI, 19 proved to be playable, and two – christened Yavalath and Ndengrod by the system – proved to be of notable quality, and were commercially released in 2009 by Spanish publisher nestorgames.[2] Yavalath, especially, has been well received by players, and constitutes the first known case of a high quality (publishable) game to be designed using a fully automated approach.

Evolutionary Game Design summarises this earlier work, but goes further to frame it within the context of computational creativity, and to examine where LUDI succeeded and where it failed, with the benefit of hindsight; some interesting developments have emerged over the years as the evolved games are played more and examined in more detail. The author and ICGA editor chose to publish this particular chapter, as Yavalath represents the culmination and highlight of the LUDI project.

References
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I. Althöfer (2010) "Reviews: *Automatic Generation and Evaluation of Recombination Games,* Doctoral Thesis, Cameron Browne"*, ICGA Journal,* 33:4, 215-216.

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[2] http://www.nestorgames.com (Ndengrod is released under the name Pentalath)