HUMAN SUPERIORITY RESTORED

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Reviewed by Dap Hartmann

The 12th Advances in Computer Games (ACG) conference took place in Pamplona, Spain, on May 11-13, 2009, in conjunction with the 13th Computer Olympiad and the 16th World Computer Chess Championship. This 234 page book contains the 20 papers (out of the 41 papers submitted) which were accepted to the conference. A wide variety of games are addressed in these papers. Most of the 'old favorites' are present, like Chess, Go, and Chinese Chess, although there are no papers on Checkers, Shogi, or Bridge. Instead, I learned about games that I was thus far unfamiliar with. In the limited space of this review, I will focus on just one of these newbies instead of summarizing the content of every paper in a few sentences. For those readers who do prefer such a summary, I recommend the excellent five-page Preface by the editors, Jaap van den Herik en Pieter Spronck.

Arimaa is a game that I was not familiar with. My mistake, because the inventor of this game, Omar Syed of Cleveland, OH, already published a paper on Arimaa in the June 2003 issue of the *ICGA Journal*. The defeat of the chess world champion Gary Kasparov by DEEP BLUE in 1997, inspired Syed, an Indian American computer engineer who previously worked for NASA, to invent a game that was relatively easy to play for humans but very difficult for computers to play well. He made the rules of the game simple enough for his four year old son Aamir to understand. Syed named the game Arimaa by reversing his son's name and preceding it with an A. He registered the trademark 'Arimaa', and was granted a patent on the invention of the game (US Patent No. 6,981,700). The patent lists both Omar and Aamir Syed as the inventors.

Arimaa is a two-player zero-sum board game with perfect information that can be played using a regular chess set and simply renaming the pieces. From strongest to weakest, each side has one Elephant, one Camel, two Horses, two Dogs, two Cats, and eight Rabbits. This hierarchy is intuitively clear to humans and a first indication that the game was explicitly designed to suit humans better than computers. Arimaa is not a war of black against white human armies, but a battle between gold and silver herds of animals. I use herds for lack of a better word, because while Horses indeed move in herds, Elephants do so in memories and Camels in caravans.

Space does not allow me to explain the rules and provide more background information about this intriguing game. For this and much more I gladly refer the reader to the abundant Arimaa website (www.arimaa.com). Suffice it here to mention that the players may freely determine the initial setup of their 16 pieces on their first two rows of the board, that there are 2,000 to 3,000 opening moves (depending on the initial setup), and that the branching factor during the middle game ranges from 5,000 to 40,000. With 64 million different initial positions, the notion of a database of opening moves is eradicated, while the branching factor discourages a brute-force approach in a computer implementation of the game. Superiority in selective search is why chess grandmasters managed to keep computers at bay until computers became powerful enough to use brute-force searching to sufficient depth. The human selective search tree was then merely a subset of the computer's exhaustively searched full game tree, and thus the human advantage disappeared. Arimaa was created explicitly to restore the human intellectual advantage by having a full game tree that is prohibitively large to search completely by brute computing force. To emphasize his strong conviction that a computer will not be able to defeat the best human Arimaa players, Syed offers a $10,000 prize to the computer that can beat three selected humans in an official Arimaa match. Thus far, there have been seven annual challenges, all won by the humans.

Frankly, I am surprised that in the seven years since that first ICGA publication no other papers or reports were published in this journal or presented at conferences. On the Arimaa website mentioned earlier, I found that no less than five (master) theses were devoted to Arimaa, including a 2006 M.Sc. thesis by Christ-Jan Cox which was supervised by the editors of the present book. One interesting finding by Cox is that the complexity of

Arimaa (state space complexity as well as game space complexity) does not exceed that of Go. Why did Cox not write any papers for the ICGA Journal?

This brings me to the Arimaa paper in these proceedings: 'Plans, Patterns, and Move Categories Guiding a Highly Selective Search' by Gerhard Trippen from the University of British Columbia. He is the author of the RAT, an Arimaa playing program that finished last in the 2009 Arimaa Computer World Championship. For some reason, Arimaa playing programs are called 'bots' and not 'engines', as most chess programs are refereed to. According to Trippen: "RAT follows an approach different from […] the traditional alpha-beta search. RAT follows a more human way of thinking by first analyzing the position, finding suitable plans, and then trying a certain highly selective number of moves." That makes sense when you have 5,000 to 40,000 moves to choose from in a middle game position. After RAT has chosen a plan, it generates only moves that assist in accomplishing that plan. On average, only 5 moves are considered. Even for a chess program this would be considered a highly selective search, reminiscent of Botvinnik's claims for his illusive PIONEER program. Although Trippen briefly mentions Botvinnik, he feels more kinship to David Wilkins' PARADISE program than to PIONEER. Moreover, he likens RAT to Jim Gillogly's TECHNOLOGY CHESS PROGRAM in its approach to the game of chess 40 years ago. An appropriate comparison is that both programs attempt a human approach in a complex game which is dominated by humans. A second similarity is that the TECHNOLOGY CHESS PROGRAM and RAT evaluate only on material and that both perform rather poorly against humans and against other computers. But it is commendable that another attempt is made to mimic the human decision making process rather than apply pure brute force. Human superiority is restored and computers are thrown back four decades in time by the substitution of Arimaa for Chess. Any wagers on what the situation will be 40 years from now? I strongly encourage chess programmers to take up Arimaa, because it is a simple yet exciting game, but most of all because there is so much new territory to explore. When that happens, I predict that Syed will lose his $10,000 within 10 years.

As a piece of friendly advice to both authors and editors, I would like them to pay better attention to the figures in some of the papers. Most scientific journals and conference proceedings are printed in black and white, while most authors supply their figures in color. The translation from color to black and white occasionally presents some problems. For example, two figures in Trippen's paper show Arimaa board positions that are difficult to read. The gold and silver pieces are all grey and can only be distinguished by the orientation of the heads of the animals. And the squares of the board, which were pastels in the original images, are now also grey. The Arimaa community should agree upon less figurative style for the board and the pieces so that clearer diagrams of game positions can be printed in black and white. Just like the chess pieces in chess diagrams do not look like the actual pieces on the board, Arimaa pieces should not try to resemble the actual animals they represent. These minor details aside, this is another great installment of the Advances in Computer Games series. Keep piling them on. And please give us more papers on Arimaa.