THE 1st ICGA ABALONE TOURNAMENT

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1 Introduction

The game Abalone was invented in 1989, and ranked “Game of the Decade” at the international game festival in 1998. It has been sold in 30 countries and is considered one of the most popular “classical” board games. The object of the game is to push six of your opponent’s pieces off the hexagonal board. This is accomplished by using a row of your pieces to push a smaller row of your opponent’s. You can only push using a maximum of three pieces which means you can never push more than two at a time.

For many years official tournaments have been taking place but there seems to be few highly qualified players. That also means that the amount of fitting opponents for these players is very limited. Under these circumstances it is difficult to improve knowledge about the game’s theory.

Up until now Abalone seemed to be a hard task for computers. The branching factor of Abalone is about two times higher than that of chess and even though there were many programs available on the web none of them had been a real challenge for experienced players. Nevertheless in the last four years a program called AbaPro has been constructed which remains unbeaten by humans as well as computers and has now just competed in the first ICGA Abalone computer tournament.

2 The tournament

It was probably due to the shortage of advanced programs that the only two participants in the Abalone tournament were Peer Sommerlung with his program Nacre and Tino Werner with AbaPro. The competition consisted of 8 games (or 4 rounds) and they were played using the Belgian Daisy opening which has also been the standard opening at human tournaments for some years now. In contrast to the classical opening with a very stable starting position the new Daisy opening doesn’t carry the risk of endless and boring games from the beginning. In computer-computer games where the players don’t use long-time strategies the risk of a tie or an endless game is very high.

Fortunately it was only the 4th game where such a situation occurred. From the 40th move on there was no further development. Neither player had made a mistake but nevertheless couldn’t find a way to reach a better situation. Maybe that game could have been defined as a tie but in the end, when time was almost up for both players, Nacre gave up because of too many crashes. Even though, in this game, the programs (and therefore also the operators) had to race against the clock, the atmosphere was noticeably relaxed and friendly.

3 Game three

Gert Schnider, three times World Champion of Abalone, was kind enough to comment on this game and to make a general statement about the tournament.

A location on the board is denoted by a coordinate of the form [a-i][1-9]. The letters indicate horizontal

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Table 1: Results

<table>
<thead>
<tr>
<th>Game</th>
<th>Black-White</th>
<th>Score</th>
<th>Time Used</th>
<th>Moves</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nacre-AbaPro</td>
<td>2-6</td>
<td>15:00 - 22:50</td>
<td>55</td>
</tr>
<tr>
<td>2</td>
<td>AbaPro-Nacre</td>
<td>3-1</td>
<td>22:15 - 23:20</td>
<td>71</td>
</tr>
<tr>
<td>3</td>
<td>Nacre-AbaPro</td>
<td>5-6</td>
<td>13:30 - 08:25</td>
<td>34</td>
</tr>
<tr>
<td>4</td>
<td>AbaPro-Nacre</td>
<td>5-4</td>
<td>26:50 - 27:10</td>
<td>107</td>
</tr>
<tr>
<td>5</td>
<td>Nacre-AbaPro</td>
<td>5-6</td>
<td>17:50 - 16:55</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>AbaPro-Nacre</td>
<td>6-2</td>
<td>11:50 - 13:07</td>
<td>53</td>
</tr>
<tr>
<td>7</td>
<td>Nacre-AbaPro</td>
<td>2-6</td>
<td>09:40 - 10:40</td>
<td>46</td>
</tr>
<tr>
<td>8</td>
<td>AbaPro-Nacre</td>
<td>6-2</td>
<td>18:05 - 15:20</td>
<td>51</td>
</tr>
</tbody>
</table>

In the tournament in general the disparity in strength between the two programs was clearly visible. AbaPro plays the opening very accurately, gets to the centre early and does not mind losing two or three stones for it. The points where it is still deficient is in winning won games and in avoiding the possibility of a draw when it is leading. I was able to hold some lost positions out of the tournament games against it and in game four the position was drawish for a long time until Nacre, in defense, made a wrong move and its operator resigned because of system troubles.

Gert Schnider, three times MSO World Champion of Abalone
4  Tino’s comment

Before I heard from the Computer Olympiad, I hadn’t heard of other advanced Abalone programs and I had accepted that there was nobody to take up my challenge. Therefore I was very glad to hear from a second participant only one month before the tournament. I was really curious about Peer’s program and was looking forward to the Olympiad.

The engine of AbaPro had not been modified for two years, so I wanted to use the remaining little time before the tournament to “perk it up” a bit. I created an opening book that was calculated by the computer but sorted out by myself. Because of time pressure it contains only 8 moves but they have been calculated with a deeper search than would be possible during a tournament. Even though a professional selection of the reasonable branches would have been more effective AbaPro was able to fall back on the opening book in most of the tournament games.

The second feature that was useful for the tournament was the time management. AbaPro uses a fixed depth search combined with forward pruning. In most cases the pruning will remove most of the nodes resulting in fast play, but in some special game situations it is not so the thinking time per move increases enormously. In order to prevent loosing a game because of running out of time the searching depth is reduced before the search starts if the remaining time is too short.

Even though my program won all its games I discovered some weaknesses. Firstly it paid a bit too much attention to reaching a central position and too little attention to pushing out the marbles. And so, in two of the first five games in the tournament, AbaPro consciously lost three or four marbles during the first 12 moves. Although the rest of the marbles were concentrated around the centre, it was much more difficult to both maintain a secure position and push out the opponents marbles.

I decided to increase the eject influence for the last three games, which led to a maximum loss of only two marbles. During the first 12 moves it didn’t lose a single marble but this was most probably also because of the improvements of Nacre in the meantime. In contrast to AbaPro, Nacre learned from the first five games to put more stress on reaching the centre in the opening phase than pushing out marbles. It was amazing to see Nacre’s obvious progress after learning from only a few games.

We also played a test game on the same level (searching depth) in order to compare the quality of each evaluation function. Even though the calculation time was 100 times faster, AbaPro still won.

I noticed a second weakness during a friendly game against another program. AbaPro easily reached a winning position, but needed 145 moves to finish the game. It seemed that the program didn’t try to concentrate its marbles but kept an equally spread out arrangement. AbaPro couldn’t decide to attack in one specific direction and stayed in the centre. After a very interesting discussion with Peer at the end of the Olympiad I was able to get this problem under control.

In the future I want to concentrate more on having better control of the calculation time. When both players have reached a relatively stable position, AbaPro often wastes a lot of time in finding nothing. Reducing the ply makes it even less possible to find a winning strategy, so instead I’ll try to make it search inside a closer funnel as the value of the different moves becomes closer and closer.

If you are interested in knowing more about general methods of AbaPro, as for example the evaluation function or the heuristic pruning, take a look at the article on http://beam.to/aba-pro.

5  Peer’s comment

In January 2003 I read Tino’s challenge on the web. He claimed to have the worlds best Abalone program and wanted to prove it. I learned the rules for Abalone six years ago, and wrote an extremely simple program that could move the pieces but never win. So, I decided to clean up the dusty old program. I did not have much spare time, only a couple of hours every week, which made me decide on an artificial neural
network which could improve without much assistance.

Since I knew I had a lot of work to do to catch up with Tino’s program, I was not sure that I would sign up at all. After all, he had already played the human world champion and won. However, as time passed, a lot of mental energy was bound in the project, so when the deadline got closer and my program was at the level of a good intermediate player I thought “what the heck, the trip will be fun” and registered my program.

The Abalone server implements an ELO system similar to Chess. I knew AbaPro could easily beat the best players, rated about ELO 2700. My program had only managed to beat ELO 1700 players. On the other hand, Nacre had played a few games against his limited demo version available on the net, and was capable of winning 1 out of 5 games, so I might just have a little chance of winning a game or two. I had already beaten every other Abalone implementation I could find on the net.

After the match I was a little disappointed. I lost every single game and on top of that had a huge number of crashes. Not exactly a blinding success. Since my program was capable of improving its game when it lost a game, I trained it between Sunday and Monday, and it did indeed play better than the original version. Unfortunately it did so by mimicking AbaPro, which just made it easier for AbaPro to predict which moves Nacre would make. Sigh. The last three games were lost quickly without much of a fight.

I experimented with the time control code, and found that it played best when it was only allowed to interrupt the search every time a ply was fully completed. Nacre has no move ordering, and this combined with the zig-zag behaviour of the evaluation function causes many inferior moves to be selected at the beginning of a new search depth iteration.

Perhaps we will see Colin Springer participating next year. He was the unbeaten winner in 1993 of an Abalone Computer tournament at Waterloo University. Recently I contacted him to lure him into our friendly competition.