Computer Shogi 2000 through 2004

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Since the first computer shogi program was developed by the author in 1974, thirty years has passed. During that time,shogi programming has attracted both researchers and commercial programmers and playing strength has improved steadily. Currently, the best programs have a level that is comparable to that of a very strong amateur player (about 5-dan). In the near future, a good program will beat a professional player. The basic structure of strong shogi programs is similar to that of chess programs. However, the differences between chess and shogi have led to the development of some shogi-specific methods. In this paper the author will give an overview of the history of computer shogi, summarize the most successful techniques and give some ideas for future directions of research in computer shogi.

1. Introduction

Shogi, or Japanese chess, is a two-player complete information game similar to chess. As in chess, the goal of the game is to capture the opponent's king. However, there are a number of differences between chess and shogi: the shogi board is slightly bigger than the chess board (9x9 instead of 8x8), there are different pieces that are relatively weak compared to the pieces in chess (no queens, but gold generals, silver generals and lances) and the number of pieces in shogi is larger (40 instead of 32).

But the most important difference between chess and shogi is the possibility to re-use captured pieces. If a piece from the opponent is captured, it is put next to the board. When it is a player's turn to move, he can either play a move with a piece on the board or put one of the pieces previously captured (called a *piece in hand*) back on an empty square (this type of move is called a *drop*). For a more detailed description of the rules of shogi, see [Legg1966].

There are only a few restrictions on where a piece can be dropped. Creating a double pawn by a drop is not allowed, but dropping a piece to check or mate is perfectly legal (with one exception: mate with a pawn drop is not allowed). As a result of these drop moves, the number of legal moves in shogi is on average much larger than for chess. In chess the average number of legal moves is estimated at 35, while for shogi the figure is about 80 [Mats1994]. In the endgame, the situation is even worse, as in most endgame positions there will be various pieces in hand and the number of legal moves can easily grow to over 200.

Since shogi is similar to chess, the techniques that have proven effective in chess also have been the foundation of most shogi programs. However, to deal with the high number of legal moves in shogi, shogi-specific methods have to be developed because a deep search is more difficult than in chess. Shogi can therefore be considered as an intermediate step between chess and Go [Mats1996].

The improvement of shogi programs from 2000 through 2004 has been impressive. After the latest computer shogi tournament, Kiyokazu Katsumata (a professional shogi player who has watched and reviewed the computer shogi tournament for 10 years) estimated the strength of the top programs at about 5-dan.

In this paper the author will give a brief overview of the history of computer shogi in Section 2. In Section 3, we will look at an overview of the techniques that have been most successful. In Section 4 there will be an explanation of some of the recent developments in computer shogi. In Section 5 there will be a brief discussion of the pairing systems that have been used in the preliminary contests of the recent championships. We will end with some conclusions and ideas about the future direction of computer shogi in Section 6.

2. A Brief History of Computer Shogi

The first shogi program was developed by the research group of the author in November 1974. At that time, shogi seemed so complex that the prediction was that it would take about 50 years for shogi programs to reach the level of a 1-dan amateur (club-level player, a master). However, this prediction proved quite wrong, and in 1995 Hiroyuki Iida (a professional shogi player and an associate professor at Shizuoka University) estimated that the strength of the top programs was already a strong 1-dan.

One of the most important reasons for this was the establishment of the *Computer Shogi Association* (CSA) in 1986 by Yoshiyuki Kotani and the author. This organization started organizing computer shogi tournaments in 1990, tournaments that were also supported by the *Nihon Shogi Renmei*, the Japanese shogi organization.

2.1 The Computer Shogi Championships (1990-2004)

The first computer shogi championship was held on December 2nd 1990. Table 1 gives an overview of all the computer shogi tournaments that have been held since then. From this table it can be seen that computer shogi tournaments have become big events. In the last tournament, there were 43 participants. Since 1996, the finals of the tournament have been a round robin of eight programs (except in 2001, when there was a round robin of ten programs). These eight programs are decided by taking the five (or seven) strongest programs from the first day(s) of the tournament, and adding the three best programs from the previous year's contest.

The first CSA tournament was won by Eisei Meijin (made by Yoshimura), but even though this program is still strong and has participated in most tournaments since 1990, its only other top three finish was in the 1991 tournament. Kiwame/Kanazawa (both programs written by Shinichiro Kanazawa) have won the CSA tournament five times and have been runner-up three times. IS Shogi (written by Tanase, Kishimoto, et al.) has won four times and has been runner-up once.

Other past winners are YSS (Yamashita), which has won twice and is the reigning champion, Morita Shogi (written by Morita), and Gekisashi (Tsuruoka, et al). In the last two tournaments, YSS, IS, and Gekisashi have kept their seed positions.

In recent years, there have also been a number of foreign entries. The best results have been achieved by Jeff Rollason, from England, with his program Shotest, which entered for the first time in 1997 and finished third in both the 1998 and the 1999 tournaments, and KCC from Korea, which entered for the first time in 1999 and finished third in both the 2001 and the 2002 tournaments. Other foreign entries have been GNU Shogi by Matthias Mutz from Germany, Shocky by Pauli Misikangas from Finland, SPEAR by Reijer Grimbergen from the Netherlands, Shogi Gold by Andrew Pearce from Australia, Daizin

Table 1: Results of the computer shogi tournaments 1990-2004.

CSA=CSA Tournament; SGP=Computer Shogi Grand Prix; CO=MSO/Computer Olympiad.

	Date	Entries	Winner	2nd	3rd
CSA1	Dec 2 1990	6	Eisei Meijin	Kakinoki	Morita
CSA2	Dec 1 1991	9	Morita	Kiwame	Eisei Meijin
CSA3	Dec 6 1992	10	Kiwame	Kakinoki	Morita
CSA4	Dec 5 1993	14	Kiwame	Kakinoki	Morita
CSA5	Dec 4 1994	22	Kiwame	Morita	YSS
CSA6	Jan 20-21 1996	25	Kanazawa	Kakinoki	Morita
CSA7	Feb 8-9 1997	33	YSS	Kanazawa	Kakinoki
CSA8	Feb 12-13 1998	35	IS	Kanazawa	Shotest
CSA9	Mar 18-19 1999	40	Kanazawa	YSS	Shotest
SGP1	Jun 19-20 1999	8	Kakinoki,YSS		IS, KCC
CSA10	Mar 8-10 2000	45	IS	YSS	Kawabata
CO1	Aug 21-25 2000	3	YSS	Shotest	Tacos
CSA11	Mar 10-12 2001	55	IS	Kanazawa	KCC
CO2	Aug 18-21 2001	3	Shotest	Spear	Tacos
CSA12	May 3-5 2002	51	Gekisashi	IS	KCC
CO3	Jul 6-9 2002	5	IS	Kanazawa	Shotest
SGP2	Oct 18-19 2002	8	IS,YSS		Kakinoki
CSA13	May 3-5 2003	45	IS	YSS	Gekisashi
CO4	Nov 24-26 2003	3	YSS	IS	Tacos
CSA14	May 2-4 2004	43	YSS	Gekisashi	IS

from Korea, and Inaka Shodan by Till Plewe from Germany et al. Shocky managed to qualify for the final of the 2000 CSA tournament.

Until 1999, the CSA tournament was the only computer shogi tournament, but there have been *Computer Shogi Grand Prix* organized as part of an international shogi festival called the *Shogi Forum*. The Computer Shogi Grand Prix were invitation tournaments each for the best 8 programs of the previous CSA tournament. The first Grand Prix (1999) was won by Kakinoki Shogi (Kakinoki) and YSS. The second Grand Prix (2002) was won by IS and YSS. Finally, there have also been (very small) computer shogi tournaments held as part of the Computer Olympiads from the 2000 Mind Sports Olympiad. These tournaments were won by YSS (in the first tournament), Shotest (in the second), IS (in the third), and YSS again (in the fourth).

2.2 The 2004 CSA Computer Shogi Championship

Now let's look at the results of the latest CSA Computer Shogi Championship in a little more detail. The 14th tournament was held May 2nd through May 4th, 2004. This tournament had 43 participants and was played for three days: two days of qualification tournaments were played with the Swiss tournament system (section 5) and the finals were then held on a single day. YSS won the tournament for the second time after it won in 1997 for the first time.

The detailed results of the finals are given in Table 2. TACOS, written by the Iida lab, from Shizuoka University, was the only new finalist. The frequent finalists Kakinoki and Kanazawa did not qualify last year but returned this year. Kakinoki achieved the 100-win plateau this year. It has entered every tournament from the first through the last (14th) and actually has won 101 times in both preliminary contests and the finals. The second most frequent winner is YSS, which has won 87 times. The most frequent winner of the foreign program is KCC, which is the 7th most frequent winner overall, with 52 wins. The second is SPEAR, which is the 13th most frequent winner overall, with 43 wins.

The foreign entries did not do very well this year, as KCC was

Table 2: Results of the finals of the 2004 CSA championship.

No.	Program Name	1	2	3	4	5	6	7	Pt	SB	MD
1	YSS	8+	5+	6+	4+	7+	2+	3-	6	18	12
2	Gekisashi	5+	7+	8+	6-	3+	1-	4+	5	14	9
3	IS Shogi	7+	6+	5-	8+	2-	4-	1+	4	12	5
4	KCC Shogi	6+	8+	7+	1-	5-	3+	2-	4	10	5
5	Kakinoki Shogi	2-	1-	3+	7-	4+	6-	8+	3	9	4
6	Eisei Meijin	4-	3-	1-	2+	8+	5+	7-	3	9	3
7	TACOS	3-	2-	4-	5+	1-	8-	6+	2	6	0
8	Kanazawa Shogi	1-	4-	2-	3-	6-	7+	5-	1	2	0

the only foreign program in the final and ended fourth in the table. Although computer contests are still dominated by Japanese programs, computer shogi is now international. More details about the 14th CSA tournament can be found in [Grim2004], [Taki2004]. The winner, YSS, challenged Professional 5-dan Kiyokazu Katsumata after the tournament with a Rook handicap. Although the 2003 champion, IS Shogi, challenged him after that tournament with a Rook and a Bishop handicap game and won the game, almost nobody imagined that the program could beat a human professional with a Rook handicap. Student champions used to challenge professional champions with this handicap and won approximately one third of the time. This time, YSS beat Katsumata 5-dan with a surprise. For those familiar with shogi and the notation used in shogi game records, we have given in the appendix the game between the two top programs, YSS and Gekisashi, and that between YSS and Katsumata 5-dan.

3 . Techniques used in Computer Shogi Programs

As pointed out earlier, shogi is similar to chess, and strong shogi programs have a structure that is similar to that of chess programs. Typically, mini-max game trees are built that are explored by an iterative alphabeta search. Shogi programs also make use of common refinements of this scheme such as PVS-search, quiescence search, aspiration search, null-move pruning, history heuristic and killer moves.

Despite these similarities, however, the specific features of shogi have made it necessary to explore other methods. In this section we will look at the following elements, which need to be handled differently in shogi, or are shogi specific: *data structures, the evaluation function, hash tables,and tsume shogi* [Taki2000].

3.1 Data Structures

Probably the best English overview of the data structures used in shogi is given by Yamashita on his webpage [YamaWWW]. The most important extra data structure that is used in shogi seems to be the *kiki table* (or piece attack table). In the kiki table, information about which piece attacks which square is stored. In shogi, the kiki table is very important as it is accessed by a number of other modules in the program, such as the evaluation function and the mating search. Because this data structure is used in different parts of the program, it is worth the effort of updating it at every move. In chess, having a kiki table would probably not be effcient.

3.2 The Evaluation Function

The evaluation function of chess contains many different features, but material is the dominant component. For example, it is almost impossible to have enough positional compensation for the loss of a queen. In shogi, the balance between material and king safety is the most important part of the evaluation function [Kana2000, Tana2000].

In shogi, captured pieces do not disappear from the game, so a game of shogi almost always ends with one of the kings being mated (there are some possibilities of a draw in shogi, but less than 1% of professional games end in a draw). Therefore, the endgame in shogi is usually a mating race where the speed of the attack has the highest priority. Losing a strong piece such as a rook often leads to disaster in the opening and middle game, but can be completely insignificant in the endgame.

Strong shogi programs therefore need an understanding of the stage of the game (opening, middle game or endgame). The weights of the features of the evaluation function can change dramatically based on this game stage. A game of shogi usually has a slow build-up, so in the opening there is almost no weight given to the king's safety. The most important features are material balance, castle formations, the mobility of major pieces (in shogi, the rook and bishop are the strongest pieces) and the control of squares near the center. In the middle game increasing weight is given to the king's safety, even though material still is the most important feature. In the endgame the king's safety takes priority over material considerations. The best shogi programs can handle these transitions quite well and are able to accurately adjust their evaluation function during the game [Yama1998].

3.3 Hash Tables

The possibility of having pieces in hand also changes the way in which hash tables are used in shogi. In chess, only the pieces on the board matter, so hash tables are only used for transpositions. Transpositions are the same for chess and shogi: if two board positions are identical and the same player is to move, then there is a transposition if the pieces in hand for both players are identical. However, in shogi it is also possible to have *domination* of positions:

Definition 1 *A position P is* dominating *a position Q if the pieces on the board in P and Q are identical, the same player is to move in P and Q and the pieces in hand for the player to move in P are a superset of the pieces in hand of the player to move in Q.*

A search can be stopped in these types of positions as this is a cycle with a material advantage (or disadvantage) for the player to move.

To deal with domination in shogi, the hashing of shogi positions is only done on the pieces on the board and an extra hashcode is stored in the hash table for the pieces in hand [Seo1999].

3.4 Tsume Shogi

Tsume shogi, or checkmating problems in shogi, has been an independent research domain for many years. Unlike the mating problems in chess, each move by the attacker in a tsume shogi problem must be a check, finally leading to mate in all variations. The aim of the defender in a tsume shogi problem is to prolong the mate as long as possible and the solution of a tsume shogi problem is the longest variation that leads to mate.

The best tsume shogi solver has been developed by Nagai [Naga2002]. His program uses a df-pn search. This algorithm is a depth-first search and uses proof and disproof numbers. Nagai's algorithm solved almost all 300-or-more-ply tsume shogi problems.

Most strong shogi programs use a tsume shogi solver to find mate in the final stages of the game. However, because of the rule that each move by the attacker must be a check, the use of the tsume shogi solver is limited. Seo showed that the branching factor of an average search tree in tsume shogi is only about 5 [Seo1995], which is very different from the branching factor of the search tree in general endgame positions.

4. Recent Developments in Computer Shogi

Of course, all methods used in computer shogi are still being revised and improved. However, there are also some new ideas that have been developed recently, which we summarize here.

4.1 Half-Ply Extension

YSS uses an iterative deepening alpha-beta algorithm with a "half-ply" extension [Yama1998]. A similar but different singular extension method was used by Deep Blue and succeeded in beating Kasparov in 1997. A half-ply extension applies for each best move when extending trees. For example, suppose usually the leaves are depth-three, and the arc of the best moves are thick lines. There is a 1.5-ply extension (three half plies) in the leftmost branch, which is extended one more ply (fractional 0.5 is temporarily abandoned). There are also some 1.0-ply extensions. At the leftmost arc from the leftmost depth-three node, there is also one more 0.5-ply extension, and two 0.5s makes 1.0. This means there were depth-five leaves at the leftmost node of the tree (Figure 1).

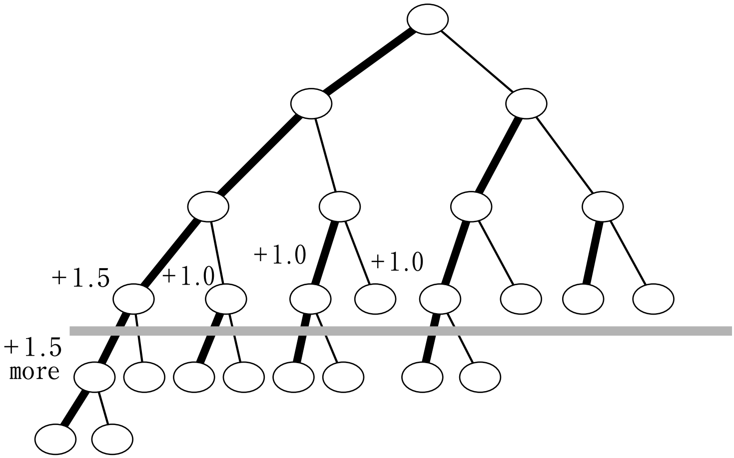

Figure 1: Half-Ply Extension

4.2 Probability Realization Search

GEKISASHI uses a probability realization search. Usually, if the program uses an alpha-beta or similar searching algorithm, the evaluation occurs in the same depth or same number of plies. Strong human players do not use this style. They cut the tree at a shallow stage if the move rarely occurs, but think very deeply if the move occurs many times. This idea simulates the strong human player's thinking and calculates the probability of all positions, cutting out if the probability is less than a certain threshold. The move's probability is calculated using categorizing and is counted from the professional player's game record [Tsur2003]. For example, "check with mandatory advance" 0.8, "let a rook escape from the attack" 0.7.

4.3 Extended Use of the Tsume Shogi Solver

As pointed out above, tsume shogi solvers outperform human experts, so a logical step is to use the tsume shogi solver during a normal tree search. IS SHOGI seems to be the program that is most advanced in this respect [Tana2000]. First of all, if the opponent is threatening mate, the moves in the mating sequence are added to the list of killer moves.

A more sophisticated use of the tsume shogi solver is to store a mating sequence that has been found for future use. A problem in shogi is that by dropping pieces it is possible to play long checking sequences that push the winning variation over the search horizon. IS SHOGI uses the tsume shogi solver to find mating threats in the endgame. The sequences that lead to mate are then stored and the tree node is marked as being a mating threat. If the opponent then starts a sequence of checks that continue until the search horizon is reached, the stored mating sequences are retrieved and it is tested whether these also work in the position at the end of the variation that was searched.

5 . Pairing System for the Preliminary Contests

The author himself used to write computer shogi programs but recently has been writing a Swiss style pairing system [Taki2003]. The program was used in the 2002-2004 championships using modified (accelerated) Swiss systems and was also used in the 2002 computer go championship in Edmonton, Canada, using just a Swiss system. In the latest championship the following algorithm was used:

(1) no two players are paired twice

(2) every round, the entrants are re-sorted and categorized according to the number of wins. Then, in the same-win group, the holder of the most SOS pairs with the holder of the least SOS, etc. If the number of entrants in the same-wins is odd, the holder of the most SOS is exempted and it pairs with a next rank program (usually the bottom). The number of pairings in the top rank programs dominates the above method.

(3) if an entrant has to pair with a lower rank entrant, it pairs with the bottom of the lower rank entrants if the higher program is a higher rank in the higher entrants; if not, it pairs with the top of the lower rank entrants.

This algorithm seemed to work well in the last championship.

Table 3 shows the second preliminary contest (after the 8th round was played and pairings were made for the 9th round). The top five programs would proceed to the final. There were already two finalists, TACOS and KCC Shogi, and five candidates, Kakinoki Shogi, Eisei Meijin, Bingo Shogi, Kinoa Shogi, and Kanazawa Shogi. In the 9th round, there were the matches TACOS vs KCC, Kakinoki vs Kinoa, Eisei vs Bingo, and Kanazawa vs Ryu-no-Tamago. Kakinoki, Eisei, and Bingo would each proceed to the final if they won or drew their match. Kinoa would proceed if it won its match. If the Eisei-Bingo match was a draw, then these two programs and the winner of the Kakinoki-Kinoa match (if this was also a draw, then Kakinoki) proceed to the final. If the Eisei-Bingo match was not a draw, then the winner of this match plus Kakinoki or Kinoa and Kanazawa (only if it won its match against Ryu-no-Tamago) would proceed to the final. Actually, KCC, Kakinoki, Eisei, and Kanazawa won the 9th round, and those four programs and TACOS proceeded to the final (Table 4).

6 . Conclusions and Expectations for the Future

Shogi programs have improved significantly in the past few years and are a good match for most strong amateur players. Unfortunately, there is no tradition of playing shogi programs against human players under tournament conditions, so it is not completely clear how strong shogi programs actually are.

We feel that the near future will be very important for computer shogi as the latest CSA tournament was the closest ever and the differences in strength between the programs seems to be getting smaller. It will therefore be interesting to see if there is some kind of limit to the methods that are now being used in computer shogi, or if this is the start of a combined effort of a large number of programs towards the ultimate goal of beating the best players in the world.

As for this ultimate goal, the best human player, Yoshiharu Habu, is one of the few professionals who recognizes how much shogi pro-

Table 3: Second preliminary contest of the 2004 CSA championship (after the 8th round).

No.	Program Name	1	2	3	4	5	6	7	8	9	Pt	SOS	SB	MD
1*	TACOS	18+	12-	3+	14+	13+	16+	7+	4+	2	7.0	35.0	31.0	22.0
2*	KCC Shogi	24+	6+	16-	13+	20+	3+	4+	7+	1	7.0	31.5	28.5	22.5
3	Kakinoki Shogi	17+	5+	1-	16+	9+	2-	10+	11+	6	6.0	39.5	25.5	16.5
4	Eisei Meijin	21+	7+	6+	12+	16+	11+	2-	1-	5	6.0	37.5	23.5	16.0
5	Bingo Shogi	14+	3-	10+	18+	12+	7-	11+	8+	4	6.0	35.5	24.5	16.5
6	Kinoa Shogi	8+	2-	4-	20+	24+	10=	21+	18+	3	5.5	29.5	12.0	7.0
7	Kanazawa Shogi	9+	4-	12+	8+	17+	5+	1-	2-	10	5.0	43.0	23.0	14.0
8	Nara Shogi	6-	24+	21+	7-	11+	13+	16+	5-	9	5.0	29.5	13.0	9.0
9	Shoo	7-	21+	23+	11-	3-	20+	17+	12+	8	5.0	27.0	12.0	7.0

Table 4: Results of the second preliminary contest.

No.	Program Name	1	2	3	4	5	6	7	8	9	Pt	SOS	SB	MD
1*	KCC Shogi	23+	8+	14-	10+	17+	4+	3+	5+	2+	8.0	45.5	41.5	33.5
2*	TACOS	19+	11-	4+	15+	10+	14+	5+	3+	1-	7.0	49.0	36.0	26.0
3*	Eisei Meijin	22+	5+	8+	11+	14+	9+	1-	2-	6+	7.0	48.5	33.5	25.5
4*	Kakinoki Shogi	18+	6+	2-	14+	12+	1-	13+	9+	8+	7.0	48.0	33.0	24.0
5*	Kanazawa Shogi	12+	3-	11+	7+	18+	6+	2-	1-	13+	6.0	51.5	29.5	20.5
6	Bingo Shogi	15+	4-	13+	19+	11+	5-	9+	7+	3-	6.0	47.5	27.5	18.5
7	Nara Shogi	8-	23+	22+	5-	9+	10+	14+	6-	12+	6.0	39.5	22.0	16.0
8	Kinoa Shogi	7+	1-	3-	17+	23+	13=	22+	19+	4-	5.5	41.5	15.0	8.0
9	Hyper Shogi 10	17+	13+	10+	12+	7-	3-	6-	4-	20+	5.0	46.5	20.5	12.5
10	KFEnd	16+	21+	9-	1-	2-	7-	17+	20+	15+	5.0	43.0	17.0	10.0
11	Isobe Shogi	24+	2+	5-	3-	6-	18+	19+	12-	16+	5.0	42.0	18.0	10.0
12	Shoo	5-	22+	24+	9-	4-	17+	18+	11+	7-	5.0	38.0	14.0	8.0
13	Ryu-no-Tamago	20+	9-	6-	18+	21+	8=	4-	14+	5-	4.5	42.5	13.0	6.0
14	Ootsuki Shogi	21+	16+	1+	4-	3-	2-	7-	13-	19+	4.0	49.5	18.0	7.0
15	Aoi	6-	18-	20-	2-	16+	23+	24+	17+	10-	4.0	33.0	9.0	4.0
16	Nazoteki Dengi	10-	14-	17-	20+	15-	24+	21+	22+	11-	4.0	30.0	9.0	5.0
17	SPEAR	9-	20+	16+	8-	1-	12-	10-	15-	24+	3.0	40.5	8.0	3.0
18	GPS Shogi	4-	15+	19+	13-	5-	11-	12-	23+	21-	3.0	38.5	8.0	3.0
19	K-Shogi	2-	24+	18-	6-	20+	21+	11-	8-	14-	3.0	37.5	7.0	3.0
20	Usapyon	13-	17-	15+	16-	19-	22+	23+	10-	9-	3.0	31.5	7.0	2.0
21	Sekita Shogi 9	14-	10-	23+	22-	13-	19-	16-	24+	18+	3.0	27.5	5.0	1.0
22	Yano Shogi 7	3-	12-	7-	21+	24+	20-	8-	16-	23-	2.0	35.5	4.0	0.0
23	Shuto Shogi	1-	7-	21-	24-	8-	15-	20-	18-	22+	1.0	35.5	2.0	0.0
24	Oki	11-	19-	12-	23+	22-	16-	15-	21-	17-	1.0	30.0	1.0	0.0

grams have improved. When asked in 1996 when he thought a computer would beat him, his clear answer was: "2015". This sounds like a reasonable estimate, but there is still a lot of work to do, as Habu (already a living legend) will be only 45 years old by then and very much at the peak of his abilities.

To beat Habu, we might need the help of special purpose hardware like the chess chip that was used in Deep Blue. Feng-hsiung Hsu of the Deep Blue team has shown an interest in designing such a chip for shogi, but so far there have been no concrete steps taken to design one. Shogi hardware has just started. Hori, Grimbergen, et al. started to design tsume shogi hardware using field programmable gate array architecture and plan to develop it for a shogi program as well [Hori2000].

Acknowledgement

The author is grateful to Reijer Grimbergen and the members of the CSA for their kind help.

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Appendix

Black: YSS
White: GEKISASHI
14th CSA Computer Shogi Championship, Round 6, May 4th 2004

1.P7g-7f, 2.P8c-8d, 3.P6g-6f, 4.P3c-3d, 5.R2h-7h, 6.P8d-8e, 7.B8h-7g, 8.S7a-6b, 9.K5i-4h, 10.K5a-4b, 11.K4h-3h, 12.K4b-3b, 13.K3h-2h, 14.B2b-4d, 15.L1i-1h, 16.P1c-1d, 17.G4i-5h, 18.P1d-1e, 19.K2h-1i, 20.K3b-2b, 21.S3i-2h, 22.P5c-5d, 23.G6i-5i, 24.G6a-5b, 25.G5i-4i, 26.S3a-3b, 27.G4i-3i, 28.B4d-5c, 29.P5g-5g, 30.P7c-7d, 31.S7i-6h, 32.P4c-4d, 33.S6h-5g, 34.N8a-7c, 35.S5g-4f,

36.P8e-8f, 37.P8gx8f, 38.B5cx8f, 39.R7h-8h, 40.B8fx7g+, 41.R8hx8b+, 42.+B7gx9i, 43.P7f-7e, 44.+B9ix6f, 45.P7ex7d, 46.N7c-6e, 47.P7d-7c+, 48.B*8d, 49.+P7cx6b, 50.+B6fx3i, 51.S2hx3i, 52.B8dx3i+,53.S*2h, 54.S*3h, 55.S2hx3i, 56.S3hx3i+, 57.B*2h, 58.P*8a, 59.+R8bx8a, 60.S*3h, 61.B2hx3i, 62.S3hx3i, 63.R*3h, 64.L*2d, 65.S*3f, 66.L2dx2g+, 67.S3fx2g, 68.B*4i, 69.P*2h, 70.B4ix3h+, 71.S2gx3h, 72.G5b-5c, 73.B*7e, 74.R*7h, 75.B7ex5c+, 76.G*4b, 77.+B5cx4b, 78.G4ax4b, 79.G*4i, 80.P*7a, 81.B*6f, 82.P5d-5e, 83.B6fx3i, 84.P5ex5f, 85.+R8ax9a, 86.P5f-5g+, 87.S4fx5g, 88.N6ex5g+, 89.B3ix5g, 90.P*5f, 91.B5g-6f, 92.S*5g, 93.G5hx5g, 94.P5fx5g+, 95.B6fx5g, 96.B*4e, 97.+R9a-8b, 98.G*4a, 99.P*5b, 100.B4e-6g+, 101.+R8b-8g, 102.R7h-7f+, 103.+R8gx7f, 104.+B6gx7f, 105.P5b-5a+, 106.P*5f, 107.N*1d,
108.K2b-3c, 109.+P5ax4a, 110.S3bx4a, 111.R*3a, 112.S4a-3b, 113.S*2b, 114.K3c-4c, 115.L*5e, 116.R*5d, 117.G*5c, 118.K4cx5c, 119.R3a-5a+, 120.G4b-5b, 121.+R5ax5b, 122.K5c-6d, 123.+R5bx6c (resigns)

White: Kiyokazu Katsumata Professional 5-dan (Rook handicap)
Black: YSS
14th CSA Computer Shogi Championship, Exhibition, May 4th 2004

—1.P3c-3d, 2.S3i-4h, 3.P4c-4d, 4.P7g-7f, 5.S3a-4b, 6.P4g-4f, 7.G4a-3b, 8.G6i-7h, 9.S4b-4c, 10.G4i-5h, 11.K5a-6b, 12.P6g-6f, 13.K6b-7b, 14.S7i-6h, 15.S7a-6b, 16.K5i-6i, 17.P5c-5d, 18.P2g-2f, 19.P7c-7d, 20.S6h-6g, 21.P6c-6d, 22.B8h-7g, 23.P9c-9d, 24.K6i-7i, 25.P9d-9e, 26.S6g-5f, 27.N8a-7c, 28.P4f-4e, 29.P4dx4e, 30.S5fx4e, 31.P*4d, 32.S4e-5f, 33.G6a-5b, 34.K7i-8h, 35.P8c-8d, 36.G5h-6g, 37.G5b-6c, 38.S4h-4g, 39.S6b-5c, 40.S4g-4f, 41.P1c-1d, 42.P3g-3f, 43.N2a-3c, 44.S4f-3g, 45.P4d-4e, 46.P1g-1f, 47.S5c-4d, 48.P2f-2e, 49.P5d-5e, 50.S5f-4g, 51.S4c-5d, 52.P2e-2d, 53.P2cx2d, 54.R2hx2d, 55.P*2c, 56.R2d-2f, 57.B2b-3a, 58.B7g-5i, 59.P6d-6e, 60.P6fx6e, 61.S5dx6e, 62.P*6f, 63.S6e-5d, 64.R2f-2h, 65.P8d-8e, 66.N8i-7g, 67.P8e-8f, 68.P8gx8f, 69.B3ax8f, 70.P*8d, 71.B8f-6d, 72.P1f-1e, 73.P1dx1e, 74.P*1d, 75.G3b-2b, 76.L1ix1e, 77.P*1b, 78.B5i-6h, 79.P*6e, 80.N7gx6e, 81.N7cx6e, 82.P6fx6e, 83.S5dx6e, 84.P*2d, 85.P*6f, 86.G6g-7g, 87.P7d-7e, 88.P2dx2c+, 89.P7ex7f, 90.G7g-8f, 91.P6f-6g+, 92.G7hx6g, 93.P*6f, 94.G6gx7f, 95.S6ex7f, 96.G8fx7f, 97.P6f-6g+, 98.N*7e, 99.G*7h, 100.K8h-8g, 101.G7hx6h, 102.P8d-8c+, 103.K7b-6b, 104.N7ex6c+, 105.K6bx6c, 106.S*7b, 107.K6c-5d, 108.G*6e, 109.K5d-5c, 110.R2hx6h, 111.+P6gx6h, 112.G6ex6d, 113.K5c-4b, 114.P*4c, 115.K4bx4c, 116.B*5d, 117.K4c-4b, 118.G*4c, 119.K4b-5a, 120.S7b-6a+, 121.K5ax6a, 122.+P8c-7b, 123.K6a-5a, 124.+P7b-6b, 125.K5ax6b, 126.G6d-6c (resigns)