Contemporary Computer Shogi (May 2017)

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Computer shogi was first developed by the author and a research group in late 1974. It has been steadily improved by researchers and commercial programmers using game-tree making and pruning methods, opening and middle game databases, and feedback from research into tsume-shogi (mating) problems. It has now reached top professional level. In this paper, the author discusses contemporary computer shogi, especially how programs behaved at the 27th World Computer Shogi Championship, held in May 2017, where 58 teams applied, 50 of which actually entered the competition.

0. Introduction

The 27th World Computer Shogi Championship was held in Kawasaki, Japan, May 3-5, 2017. The team named elmo won the tournament. This was the first championship win for elmo, which had entered for the second time. The runner-up was the winner of the 25th and 26th championships, Ponanza Chainer. Third was the runner-up of the 26th championship, Giko. Fourth was GodWhale, fifth was The Minstrel's Ballad: Tanuki's Reign, sixth was Yomita, seventh was HoneyWaffle, and eighth was NineDayFever. The winner and fifth

Table 1. Results of the World Computer Shogi Championships

No.	Date	Number of Participants	Winner	Runner-Up	Second Runner-Up
1	1990.12.2	6	Eisei Meijin	Kakinoki	Morita
2	1991.12.1	9	Morita	Kiwame	Eisei Meijin
3	1992.12.6	10	Kiwame	Kakinoki	Morita
4	1993.12.5	14	Kiwame	Kakinoki	Morita
5	1994.12.4	22	Kiwame	Morita	YSS
6	1996.1.20-21	25	Kanazawa	Kakinoki	Morita
7	1997.2.8-9	33	YSS	Kanazawa	Kakinoki
8	1998.2.12-13	35	IS	Kanazawa	Shotest
9	1999.3.18-19	40	Kanazawa	YSS	Shotest
10	2000.3-8-10	45	IS	YSS	Kawabata
11	2001.3.10-12	55	IS	Kanazawa	KCC
12	2002.5.2-5	51	Gekisashi	IS	KCC
13	2003.5.3-5	45	IS	YSS	Gekisashi
14	2004.5.2-4	43	YSS	Gekisashi	IS
15	2005.5.3-5	39	Gekisashi	KCC	IS
16	2006.5.3-5	43	Bonanza	YSS	KCC
17	2007.5.3-5	40	YSS	Tanase	Gekisashi
18	2008.5.3-5	40	Gekisashi	Tanase	Bonanza
19	2009.5.3-5	42	GPS	Ootsuki	Monju
20	2010.5.2-4	43	Gekisashi	Shueso	GPS
21	2011.5.3.-5	37	Bonkras	Bonanza	Shueso
22	2012.5.3-5	42	GPS	Puella alpha	Tsutsukana
23	2013.5.3-5	40	Bonanza	ponanza	GPS
24	2014.5.3-5	38	Apery	ponanza	YSS
25	2015.5.3-5	39	ponanza	NineDayFever	AWAKE
26	2016.5.3-5	57	ponanza	Giko	taishogun
27	2017.5.3-5	50	elmo	Ponanza Chainer	Giko

Kanazawa is the successor to Kiwame.
Puella alpha is the successor to Bonkras.
Ponanza Chainer is the successor to ponanza.

Table 2. The Results of the First Preliminary Contest

No.	Program Name	1	2	3	4	5	6	7	Pt	SOS	SB	MD
1*	elmo	2+	13+	4+	8+	3+	5+	17+	7.0	35.0	35.0	25.0
2*	GodWhale	1-	22+	21+	16+	11+	8+	5+	6.0	31.0	24.0	16.0
3*	nozomi	36+	9+	16+	11+	1-	6+	4+	6.0	30.0	23.0	18.0
4*	Kakinoki Shogi	21+	23+	1-	15+	12+	7+	3-	5.0	32.0	19.0	11.0
5*	HoneyWaffle	23+	21+	14+	12+	6+	1-	2-	5.0	32.0	19.0	11.0
6†	Meijin Cobra	24+	20+	10+	7+	5-	3-	18+	5.0	30.0	19.0	11.0
7*	Squirrel	26+	18+	9+	6-	20+	4-	14+	5.0	28.5	18.5	10.5
8*	Tanuki's Reign	34+	29+	13+	1-	14+	2-	15+	5.0	28.0	15.0	10.0
9*	CGP	28+	3-	7-	10+	30+	22+	11+	5.0	26.5	15.5	9.0
10*	Mattari Yuchan	18=	26+	6-	9-	34+	21+	24+	4.5	23.5	10.0	6.0
11*	ShibauraSoftmax	15+	25+	19+	3-	2-	24+	9-	4.0	30.5	13.5	6.5
12	Katsudon Shogi	17+	27+	25+	5-	4-	15-	23+	4.0	26.5	12.5	6.0
13	Novice	22+	1-	8-	31+	28+	17-	20+	4.0	26.0	10.0	5.0
14	Shibaura Jr.	30+	19+	5-	28+	8-	20+	7-	4.0	25.5	10.5	5.0
15	Qinoa Shogi	11-	35+	31+	4-	16+	12+	8-	4.0	25.0	11.0	6.0
16	Claire	29+	34+	3-	2-	15-	25+	22+	4.0	25.0	9.0	5.0
17	SilverBullet	12-	33+	35+	20-	18+	13+	1-	4.0	24.5	10.5	5.5
18	Komaasobi	10=	7-	24+	30+	17-	28+	6-	3.5	25.5	7.0	2.0
19	scherzo	31+	14-	11-	29-	27=	30+	33+	3.5	18.5	6.0	2.0
20	Garyu	32+	6-	27+	17+	7-	14-	13-	3.0	26.5	8.5	2.5
21	dainomaruDNNc	4-	5-	2-	33+	32+	10-	31+	3.0	26.5	6.0	2.0
22	GAN Shogi	13-	2-	34+	23+	25+	9-	16-	3.0	26.0	7.0	3.0
23	Yamada Shogi	5-	4-	30+	22-	26+	29+	12-	3.0	24.0	7.0	2.0
24	kaitei	6-	32+	18-	27+	29+	11-	10-	3.0	23.5	6.5	2.0
25	Oki	35+	11-	12-	32+	22-	16-	28+	3.0	20.0	5.0	2.0
26	Mumyo8	7-	10-	28-	35+	23-	32+	29+	3.0	19.5	5.0	2.0
27	Anicca	33+	12-	20-	24-	19=	31-	35+	2.5	18.5	3.0	0.0
28	Narikin Shogi	9-	36+	26+	14-	13-	18-	25-	2.0	22.5	3.0	0.0
29	libshogi	16-	8-	36+	19+	24-	23-	26-	2.0	21.5	3.5	0.0
30	tenuki	14-	31+	23-	18-	9-	19-	36+	2.0	21.0	2.0	0.0
31	NiCore Shogi	19-	30-	15-	13-	35+	27+	21-	2.0	20.0	3.5	0.0
32	MechaLadyShogi	20-	24-	33+	25-	21-	26-	34+	2.0	18.0	3.0	0.0
33	KifuWarabe	27-	17-	32-	21-	36+	34+	19-	2.0	16.0	1.0	0.0
34	16shiki-iroha	8-	16-	22-	36+	10-	33-	32-	1.0	20.5	0.0	0.0
35	President_X	25-	15-	17-	26-	31-	36+	27-	1.0	18.5	0.0	0.0
36	Mirage	3-	28-	29-	34-	33-	35-	30-	0.0	16.0	0.0	0.0

*qualified for the second preliminary contest; †qualified but quit the second preliminary contest.

through seventh finalists were second-time (26th and 27th) entrants.

Yasuhiro Masuda, a professional 4-dan of the Nihon Shogi Renmei (the Japan Shogi Association, JSA) and Rookie of the Year in 2016, as well as authorities of professional shogi and other professionals who watched the championship, commented that the top finalists had now reached top professional level and they themselves would like to follow (or even prefer) the moves of computer shogi.

Here, the author discusses contemporary computer shogi and computer shogi in the near future through the game records of the 27th World Computer Shogi Championship.

1. The 27th World Computer Shogi Championship

The 27th World Computer Shogi Championship was held at the Kawasaki Industrial Promotion Hall at Kawasaki, Japan, May 3-5, 2017. The championship was managed by the Computer Shogi Association (CSA), co-managed by the Game Sciences Laboratory of Waseda University (GSL-WU), with special help from the JSA, financially supported by Dwango Co., Ltd. (Dwango), Qinoa Inc., and Shota Chida 6-dan, and supported by the Ministry of Internal Affairs and Communications (MIC), the Ministry of Education,

Table 3-1. Second Preliminary Contest (after the 8th round)

No.	Program Name	1	2	3	4	5	6	7	8	9	Pt	SOS	SB	MD
1*	elmo	18+	19+	17+	3-	7+	2+	4+	5+	10	7.0	37.0	31.0	21.0
2*	Ponanza Chainer	23+	16+	22+	6+	3+	1-	5+	4+	7	7.0	34.0	27.0	20.0
3*	Giko	24+	17+	8+	1+	2-	4-	9+	7+	6	6.0	37.0	25.0	18.0
4	GodWhale	10+	5+	11+	15+	6-	3+	1-	2-	8	5.0	43.0	24.0	14.5
5	Tanuki's Reign	12+	4-	7+	21+	8+	6+	2-	1-	9	5.0	41.0	22.0	14.0
6	Yomita	9+	14+	16+	2-	4+	5-	7-	13+	3	5.0	38.0	21.0	13.0
7	taishogun	19+	18+	5-	11+	1-	13+	6+	3-	2	5.0	37.5	19.5	11.5
8	nozomi	13+	20+	3-	10+	5-	9-	15+	21+	4	5.0	34.5	18.5	10.5
9	HoneyWaffle	6-	22+	15-	12+	17+	8+	3-	11+	5	5.0	33.0	18.5	11.5
10	Qhapaq	4-	12+	20+	8-	13-	18+	16+	15+	1	5.0	30.5	16.5	9.5
11	NineDayFever	20+	13+	4-	7-	14+	15=	12+	9-	21	4.5	33.5	15.0	8.0
12	Apery	5-	10-	19+	9-	21+	17+	11-	18+	15	4.0	31.5	12.0	6.0
13	Nanoha	8-	11-	24+	16+	10+	7-	17+	6-	14	4.0	30.5	11.0	6.0
14	Usapyon2'TURBO	22-	6-	23+	17-	11-	19+	20+	16+	13	4.0	24.5	10.0	6.0

Note: SOS, SB, and MD are calculated here just after the 8th round.
*elmo, Ponanza Chainer, and Giko had qualified for the final.

Culture, Sports, Science and Technology, Japan (MEXT), the Ministry of Economics, Trade and Industry (METI), the Information Processing Society of Japan (IPSJ), the Japan Information Technology Services Industry Association (JISA), Waseda University (WU), the National Institute of Technology, Kisarazu College (NIT-KC), and the Cognitive Science and Entertainment Research Station of the University of Electro-Communication (CERS-UEC). For this championship, 58 teams applied, of which 50 actually entered the tournament.

As mentioned above, the tournament lasted for three days. The first and second days were for the preliminary contests, with the third day reserved for the final. Eight newcomers entered, although eleven (11) applied. No teams returned after an absence, although one returnee applied. Gekisashi applied but did not enter, and YSS, the 25-times-in-a-row finalist, did not apply for the 2017 Championship.

There were two prizes sponsored by CERS-UEC: elmo was awarded the newcomer prize as it achieved the highest result (it was actually the winner) among first- and second-time participants; however, no team was awarded the good idea prize. If Ponanza Chainer, which used deep-learning, had won the tournament, the good idea prize would have gone to that program, but in the end it did not win the tournament.

There was one foreign team in the tournament: Mumyo8, from the USA.

Professional shogi players Shuji Sato (7-dan), Yasuhiro Masuda, Shota Chida (6-dan), and Yusuke Toyama (5-dan) commented on a number of games in the finals to the audience at the tournament and declared that the top programs among the finalists had already reached and are going to go beyond top professional level. The strength of the top programs has continued to increase.

1.1. First Preliminary Contest

The first preliminary contest was held on the first day. There were 7 Swiss-style games. The top 10 programs joined the second preliminary contest. Thirty-six (36) programs entered the first preliminary contest.

The candidates expected to proceed to the second stage were Tanuki's Reign, Meijin Cobra, Kakinoki, Qinoa, Shibaura Jr., Mumyo8, nozomi, and GodWhale.

As shown in Table 2, elmo, with 7 wins and no losses, GodWhale and nozomi, with 6 wins and 1 loss, proceeded to the second day. Other programs that qualified were Kakinoki Shogi, HoneyWaffle, Squirrel, Tanuki's Reign, CGP (5 wins, 2 losses), Mattari Yuchan (4 wins, 2 losses, 1 draw), and ShibauraSoftmax (4 wins, 3 losses). Katsudon Shogi, Novice, Shibaura Jr., Qinoa Shogi, Claire, and SilverBullet won four games but did not proceed to the second day because the SOSs of those programs were shorter. Meijin Cobra won five games and qualified, but quit because the programmer did not think it performed well.

1.2. Second Preliminary Contest

The second preliminary contest was held on the second day. There were 9 Swiss-style games. The top 8 programs proceeded to the third day of competition.

There were 14 seeded and 10 qualifying programs in the second preliminary contest. The candidates expected to proceed to the final were former finalists Ponanza Chainer, Giko, taishogun, Apery, NineDayFever, Yomita, and Usapyon2'TURBO, together with qualifying programs elmo, GodWhale, and nozomi.

After the eighth round, elmo and Ponanza Chainer had earned seven points, while Giko had earned six points and had thus qualified to proceed. GodWhale, Tanuki's Reign, Yomita, taishogun, nozomi, HoneyWaffle, and Qhapaq had earned five points, while NineDayFever had earned four and a half points; these eight teams competed for the remaining five seats (Table 3-1).

As shown in Table 3-2, elmo and Ponanza Chainer, with 8 wins and 1 loss, proceeded to the final. Other programs that qualified were GodWhale, Yomita, Giko, HoneyWaffle (6 wins and 3 losses), NineDayFever (5 wins, 3 losses, 1 draw), and Tanuki's Reign (5 wins, 4 losses). However, taishogun, Qhapaq, nozomi, Apery, and Nanoha won five games but did not proceed to the final because the SOSs of those programs were shorter. The 16th and upper programs had each been seeded for the second contest. The qualifying programs, elmo, GodWhale, HoneyWaffle, Tanuki's Reign, and nozomi, but no first-time-entrants, had been seeded for the second contest.

The loss of Ponanza Chainer to elmo was a considerable surprise to championship observers because Ponanza Chainer had won against Amahiko Sato, professional Shogi Meijin, at the second Den-o-sen, in April 2017. (As shown in Table 6, it won against Amahiko Sato again in May 2017.)

1.3. The Final

The final was held on the third day. There was a round robin of 8 programs, with each program playing each other once.

The candidates for victory were elmo, a second-time-entrant, and the champion of the 26th WCSC, Ponanza Chainer. Ponanza Chainer (the successor to ponanza) lost only one game in the 26th WCSC. It had lost a game against Giko in the second preliminary contest, but won against Giko in the final at the 26th WCSC. Similarly, Ponanza Chainer had lost only one game against elmo in the second preliminary contest.

Table 3-2. The Results of the Second Preliminary Contest

No.	Program Name	1	2	3	4	5	6	7	8	9	Pt	SOS	SB	MD
1*	elmo	15+	20+	19+	5-	9+	2+	3+	8+	10+	8.0	45.0	39.0	28.0
2*	Ponanza Chainer	23+	14+	21+	4+	5+	1-	8+	3+	9+	8.0	44.0	36.0	29.0
3*	GodWhale	10+	8+	7+	18+	4-	5+	1-	2-	11+	6.0	52.0	30.0	20.5
4*	Yomita	6+	16+	14+	2-	3+	8-	9-	13+	5+	6.0	49.0	31.0	21.0
5*	Giko	24+	19+	11+	1+	2-	3-	6+	9+	4-	6.0	47.0	27.0	19.0
6*	HoneyWaffle	4-	21+	18-	12+	19+	11+	5-	7+	8+	6.0	42.0	26.5	18.0
7*	NineDayFever	17+	13+	3-	9-	16+	18=	12+	6-	22+	5.5	41.5	21.0	13.0
8*	Tanuki's Reign	12+	3-	9+	22+	11+	4+	2-	1-	6-	5.0	52.0	24.0	15.0
9	taishogun	20+	15+	8-	7+	1-	13+	4+	5-	2-	5.0	50.5	23.5	14.5
10	Qhapaq	3-	12+	17+	11-	13-	15+	14+	18+	1-	5.0	44.5	20.5	12.0
11	nozomi	13+	17+	5-	10+	8-	6-	18+	22+	3-	5.0	43.5	20.5	12.5
12	Apery	8-	10-	20+	6-	22+	19+	7-	15+	18+	5.0	38.0	16.5	9.5
13	Nanoha	11-	7-	24+	14+	10+	9-	19+	4-	16+	5.0	37.5	16.0	11.0
14	OkaraManju	18+	2-	4-	13-	20+	17+	10-	16-	24+	4.0	38.5	10.5	6.5
15	GPS Shogi	1-	9-	22+	21+	18-	10-	23+	12-	20+	4.0	36.5	10.0	6.0
16	Usapyon2'TURBO	21-	4-	23+	19-	7-	20+	17+	14+	13-	4.0	34.5	12.0	7.0
17	Squirrel	7-	11-	10-	24+	21+	14-	16-	23+	19+	4.0	30.5	7.0	4.0
18	Shueso	14-	23+	6+	3-	15+	7=	11-	10-	12-	3.5	41.5	11.0	4.0
19	takotto	22+	5-	1-	16+	6-	12-	13-	24+	17-	3.0	41.0	7.0	3.0
20	CGP	9-	1-	12-	23+	14-	16-	24+	21+	15-	3.0	34.0	4.0	1.0
21	Kakinoki Shogi	16+	6-	2-	15-	17-	24+	22-	20-	23+	3.0	33.0	5.0	1.0
22	Himawari	19-	24+	15-	8-	12-	23+	21+	11-	7-	3.0	31.5	4.0	1.0
23	ShibauraSoftmax	2-	18-	16-	20-	24+	22-	15-	17-	21-	1.0	32.5	0.0	0.0
24	Mattari Yuchan	5-	22-	13-	17-	23-	21-	20-	19-	14-	0.0	32.0	0.0	0.0

*elmo, Ponanza Chainer, GodWhale, Yomita, Giko, HoneyWaffle, NineDayFever, and Tanuki's Reign qualified for the final.

Table 4. The Results of the Final

No.	Program Name	1	2	3	4	5	6	7	Pt	SB	MD
1	elmo	5+	8+	7+	3+	6+	4+	2+	7.0	21.0	15.0
2	Ponanza Chainer	8+	5+	3+	7+	4+	6+	1-	6.0	15.0	11.0
3	Giko	6-	4+	2-	1-	5+	8+	7+	4.0	9.0	5.0
4	GodWhale	7+	3-	5+	8+	2-	1-	6+	4.0	7.0	4.0
5	Tanuki's Reign	1-	2-	4-	6+	3-	7+	8+	3.0	4.0	2.0
6	Yomita	3+	7-	8+	5-	1-	2-	4-	2.0	4.0	0.0
7	HoneyWaffle	4-	6+	1-	2-	8+	5-	3-	2.0	2.0	0.0
8	NineDayFever	2-	1-	6-	4-	7-	3-	5-	0.0	0.0	0.0

Elmo and Ponanza Chainer each won 6 games in a row, so the last game of the final was the decisive game for the championship. Elmo won the game and was declared the winner of the championship for the first time. Elmo lost only one game against Giko in the second preliminary contest, but it won against Giko in the final by declaration of a win.

The results of the 27th World Computer Shogi Championship were elmo, the winner (7 points), Ponanza Chainer, the runner-up (6 points), Giko, third (4 points), GodWhale, fourth (4 points), Tanuki's Reign, fifth (3 points), Yomita, sixth (2 points), HoneyWaffle, seventh (2 points) and NineDayFever, eighth (0 points). The finalists all performed at a very high level (Table 4).

Elmo used a 2CPU (32-core) PC, Ponanza Chainer a 1092-core with 128 GPU, Giko a 129 CPU (1158-core) PC, while Yomita, which came in 6th in this tournament, used a 1 CPU (4-core) PC.

Table 5 indicates the number of times access was made to the live top page and unique IPs, the number of instances of blog access and number of visitors, the number of instances of access to the CSA top page, the number of Championship page visitors, the number of Niconico visitors, and the number of GodWhale visitors.

The game record of the final (elmo versus Ponanza Chainer) and some game positions are indicated here in the appendix.

Table 5 Access Information

No. of Live Top Page instances of access			No. of Unique IPs	
First Day	8,545	(13,763)	2,682	(3,132)
Second Day	26,868	(29,762)	8,129	(9,430)
Third Day	30,278	(28,349)	12,655	(11,306)
Next Day	2,990	(2,093)	3,328	(2,103)

No. of instances of blog access			No. of blog visitors	
First Day	14,409	(10,288)	3,182	(2,744)
Second Day	18,722	(13,145)	3,819	(4,020)
Third Day	18,088	(14,189)	4,195	(4,070)
Next Day	2,060	(2,260)	842	(989)

No. of instances of CSA top page access			No. of Championship page visitors	
First Day	4,083	(3,895)	2,830	(10,734)
Second Day	5,762	(5,531)	3,168	(9,799)
Third Day	6,569	(5,494)	2,802	(6,720)
Next Day	1,998	(1,754)	562	(3,967)

No. of Niconico visitors [comments]		No. of GodWhale visitors [comments]	
First Day		7,515 [16,377]	(8,003 [25,621])
Second Day	76,781 [11,658] (83,535 [12,570])	6,643 [23,592]	(10,662 [37,346])
Third Day	78,943 [24,430] (85,870 [16,548])	7,593 [17,939]	(9,250 [24,458])

The figures come from three days after the third day for Niconico data and four days (two days) after the third day for GodWhale data.
In parentheses: instances of access during the 26th WCSC

Table 6 Den-O-Sen

Date	Event	Professional Human Player	Computer	Winner	Time Spent (Byoyomi)
2012.1.14	First Shogi Den-O-sen	Kunio Yonenaga Eisei Kisei	Bonkras*	Computer	3 hours (60sec.)
2013.3.23	Second Shogi Den-O-Sen	Koru Abe 4-dan*	Shueso	Human	4 hours (60 sec.)
2013.3.30		Shin'ichi Sato 4-dan	ponanza*	Computer	
2013.4.6		Kohei Funae 5-dan*	Tsutsukana	Computer	
2013.4.13		Yasuaki Tsukada 9-dan	Puella alpha*	draw	
2013.4.20		Hiroyuki Miura 8-dan*	GPS Shogi	Computer	
2014.3.15	Third Shogi Den-O-Sen	Tatsuya Sugai 5-dan*	Shueso	Computer	5 hours (60 sec.) (chess clock)
2014.3.22		Shin'ya Sato 6-dan	Yaneura-O*	Computer	
2014.3.29		Masayuki Toyoshima 7-dan*	YSS	Human	
2014.4.5		Taku Morishita 9-dan	Tsutsukana*	Computer	
2014.4.12		Nobuyuki Yashiki 9-dan*	ponanza	Computer	
2015.3.14	Shogi Den-O-Sen Final	Shintaro Saito 5-dan*	Apery	Human	5 hours (60 sec.) (chess clock)
2015.3.21		Takuya Nagase 6-dan	Selene*	Human	
2015.3.28		Akira Inaba 7-can*	Yaneora-O	Computer	
2015.4.4		Yasuaki Murayama 7-dan	ponanza*	Computer	
2015.4.11		Chikara Akutsu 8-dan*	AWAKE	Human	
2016.4.9-4.10	First Den-O-Sen (Ei-O vs. Den-O)	Takayuki Yamasaki 1st Ei-O	PONANZA 3rd Den-O*	Computer	8 hours (60 sec.) (chess clock)
2016.5.21-5.22		Takayuki Yamasaki 1st Ei-O*	PONANZA 3rd Den-O	Computer	
2017.4.1	Second Den-O-Sen (Ei-O vs. Den-O)	Amahiko Sato 2nd Ei-O	PONANZA 4th Den-O*	Computer	5 hours (60 sec.) (chess clock)
2017.5.20		Amahiko Sato 2nd Ei-O*	PONANZA 4th Den-O	Computer	

Dan shown as of match date. *First player

2. The Den-O-Sen

The first Den-O-Sen was held on January 14, 2012. This was a match between a retired professional, the late Kunio Yonenaga, and a computer program, Bonkras (first player). This match was managed by the JSA, Dwango Co., Ltd., and Chuokoron-Shinsha, Inc. Bonkras won the match.

The second and the third Den-O-Sens and the Den-O-Sen final were five-game matches between five professional players and five computer programs sponsored by Dwango and the JSA, in 2013, 2014, and 2015 respectively. The results were one win, three losses, and one draw; one win, and four losses; and three wins and two losses.

After the Den-O-Sen final, a new human-player-selection procedure --- choosing the winner of the Ei-O-Sen tournament --- was adopted by the JSA, while the computer program chosen was the winner of the Den-O tournament.

The first such Den-O-Sen match was a match consisting of two two-day games between Takayuki Yamasaki (first Ei-O) and Ponanza (third Den-O), held on April 9-10 and May 21-22, 2016. Ponanza beat Yamasaki-Ei-O by 2-0.

The second (and last) Den-O-Sen match was also a two-game match (though each game was completed on a single day) between Amahiko Sato (second Ei-O and the Meijin title holder) and Ponanza (fourth Den-O), held on April 1 and May 20, 2017. Ponanza beat Sato Ei-O by 2-0. This time it was not a big surprise that even Meijin Sato was defeated.

3. Computer Shogi in the Near Future

Professional players who watched the WCSC declared that the top programs had already reached or gone beyond top professional level. The strong computer shogi program Ponanza Chainer, which beat a professional meijin, was beaten by another program, elmo, while elmo was itself beaten by Giko. This means that there are a number of programs that are stronger than or of the same strength as top professional players. What is more, it seems highly likely that computer shogi will get yet stronger.

Most human shogi players do not properly understand the moves of computer shogi. For the purpose of watching (and enjoying) a game between computer shogi programs, computer shogi programs should disclose why a particular move was chosen, disclosing the thinking tree behind it, with evaluation.

We are at a stage that is close to solving shogi, but it will still take a very long time to solve.

4. Conclusion and Acknowledgments

Here, we have considered contemporary computer shogi, in particular how competitors performed at the 27th World Computer Shogi Championship. The strength of the top programs is clearly stronger than that of the top human players. This means that the stage of computer shogi now reached is showing us a new page.

The author is grateful to the GSL-WU for co-management, to the JSA for its generous

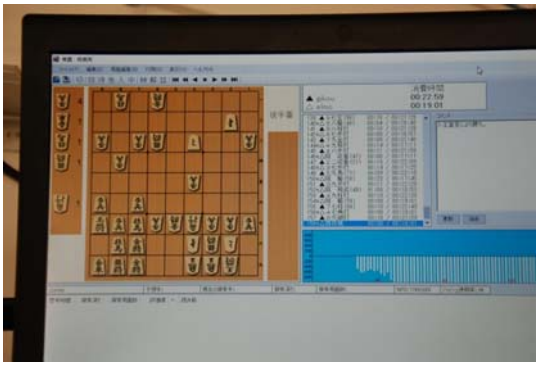
Makoto Takizawa (second right in front line), the winner, elmo's programmer, after winning the 27th championship

The commentator Yasuhiro Masuda 4-dan (Rookie of the Year in 2016)

Issei Yamamoto, the runner-up, Ponanza Chainer's programmer (third right in front line) and Yusuke Toyama 5-dan (behind Mr. Yamamoto) watching a game.

Shota Chida 6-dan (second right) who supported the Championship watching a game (at the 2nd Preliminary Contest on May 4, 2017). Other pictures were taken on May 5, 2017.

Yosuke Demura, the second runner-up, Giko's programmer (in front), and Motoki Yamada from Qinoa Inc. (wearing a white shirt) watching a game.



Giko versus elmo (on move 158, declaration of a win by elmo)

assistance, to Dwango Co., Ltd., Qinoa Inc., and Shota Chida 6-dan for their financial support, and to the MIC, MEXT, METI, the IPSJ, the JISA, WU, NIT-KC, and CERS-UEC for their support. The author is also grateful to the members of the CSA for their kind help.

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Appendix The game records of elmo versus Ponanza Chainer in the final

Final of the 27th World Computer Shogi Championship, May 5, 2017
Black: elmo
White: Ponanza Chainer

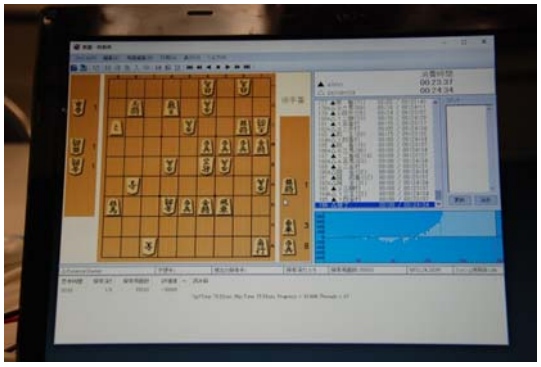
1.P7g-7f 2.G4a-3b 3.P2g-2f 4.P8c-8d
5.B8h-7g 6.P3c-3d 7.S7i-7h 8.S3a-4b
9.B7gx2b+ 10.G3bx2b 11.S7h-7g 12.S4b-3c
13.P3g-3f 14.S7a-6b 15.N2i-3g 16.P6c-6d
17.S3i-3h 18.P1c-1d 19.P4g-4f 20.G2b-3b
21.K5i-6h 22.K5a-4b 23.P2f-2e 24.S6b-6c
25.P9g-9f 26.P7c-7d 27.P9f-9e 28.N8a-7c
29.S3h-4g 30.G6a-6b 31.G4i-4h 32.P1d-1e
33.S4g-5f 34.R8b-8a 35.R2h-2i 36.S6c-5d
37.K6h-7h 38.P6d-6e 39.G6i-5h 40.B*6d
41.G4h-4g 42.P4c-4d 43.L1i-1h 44.K4b-3a
45.R2i-1i 46.N7c-8e 47.S7g-8f 48.R8a-7a
49.G5h-6h 50.P7d-7e 51.P7fx7e 52.B6dx7e
53.P*7g 54.B7e-6d 55.P1g-1f 56.P1ex1f
57.P3f-3e 58.P3dx3e 59.L1hx1f 60.P*1d
61.P*3d 62.S3c-2b 63.R1i-1g 64.P9c-9d
65.P4f-4e 66.Px9e 67.Px4d 68.P9e-9f
69.P*9h 70.P*4b **71.B*1i (Fig. A)** 72.P*7f
73.P7gx7f 74.G6b-5b 75.R1g-1h 76.L1a-1b
77.S8f-7e 78.B6dx7e 79.N3g-4e 80.S5dx4e
81.S5fx4e 82.P9f-9g+ 83.P9hx9g 84.B7ex9g+
85.L9ix9g 86.L9ax9g+ 87.N8ix9g 88.L*1g
89.R1hx1g 90.R7ax7f 91.P*7g 92.S*8i
93.K7hx8i 94.N8ex7g+ 95.L*7i 96.P*7h
97.L7ix7h 98.+N7gx7h 99.G6hx7h 100.L*7g
101.G7h-6h 102.L7g-7i+ 103.K8i-9h 104.+L7i-7h
105.L*7i **(Fig. B)** 106.P*7g 107.S*8f 108.+L7hx6h
109.S8fx7g 110.R7fx7g+ 111.L7ix7g 112.P*7f
113.R*7a 114.N*5a 115.R7ax7f+ 116.+L6h-7h
117.S*8i 118.S*7i 119.N*8h 120.P*7e
121.+R7f-8f 122.+L7hx8i 123.K9hx8i 124.S7i-6h=
125.K8i-7h 126.G*6i 127.N8h-7f 128.P7ex7f
129.+R8fx7f 130.P1d-1e 131.L1fx1e 132.L1bx1e
133.R1gx1e 134.N*4a 135.R1e-1h 136.N5a-6c
137.+R7f-7b 138.S6h-7i+ 139.K7h-8h 140.L*1g
141.R1hx1g 142.G6i-6h 143.P8g-8f 144.S*9f
145.B*8g 146.S9fx8g+ 147.K8hx8g 148.G6hx6g
149.K8g-9f 150.P*9d 151.P*9e 152.B*7h
153.S*8g 154.B7h-6i+ 155.L7g-7c+ 156.N6c-7e
157.P9ex9d 158.N7ex8g+ 159.K9f-9e 160.G5b-5a
161.K9ex8d 162+N8gx8f 163.+R7b-7a 164.G5a-5b
165.P*6c 166.S*5a 167.P9d-9c+ 168.P*1f
169.R1g-3g 170.P2c-2d 171.K8d-8c 172.S2b-2c
173,P6c-6b+ 174.S5ax6b 175.+L7cx6b 176.G5bx6b
177.+R7ax6b 178.+B6i-9f 179.P2ex2d 180.S2c-1b
181.L*1e 182.P*8b 183.K8cx8b 184.L*1d
185.L1ex1d 186.+B9f-6c 187.L1dx1b+ 188.+B6cx4e
189.G*2b 190.G3bx2b 191.+L1bx2b 192.K3ax2b
193.S*2c 194.K2b-1c 195.G*1d resigns

Fig. A 71.B*1i

Almost all viewers, including the commentators, were surprised.

Fig. B 105.L*7i

Human players usually make a mistake around this move, but elmo played correctly and won (see the game record above).



elmo versus Ponanza Chainer (After move 195, Ponanza Chainer resigned.)