Contemporary Computer Shogi (May 2019)

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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 databases, and feedback from research into tsume-shogi (mating) problems. It has now exceeded top professional level. In this paper, the author discusses contemporary computer shogi, especially how programs behaved at the 29th World Computer Shogi Championship, held in May 2019, where 61 teams applied, 56 of which actually entered the competition.

0. Introduction

The 29th World Computer Shogi Championship was held in Kawasaki, Japan, May 3-5, 2019. A newcomer, YaneuraO, won the tournament. Although the programmer of YaneuraO, Motohiro Isozaki, had made and provided a module

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	51	ponanza	Giko	taishogun
27	2017.5.3-5	50	elmo	Ponanza Chainer	Giko
28	2018.5.3-5	56	Hefeweizen	PAL	Apery
29	2019.5.3-5	56	YaneuraO	Kristallweizen	Tanu-King

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

library named the YaneuraO module, which many entrants had made use of, Mr. Isozaki himself had not previously entered the tournament. The runner-up was the winner of the 28th championship, Kristallweizen, whose former name was Hefeweizen. Third was Tanu-King, whose former name was "the end of genesis T.N.K. evolution turbo type D". Fourth was elmo, fifth was Qhapaq di molto, sixth was PAL, seventh was a newcomer, Suisho, and eighth was Meijin Cobra. The runner-up and sixth finalists were second-time (28th and 29th) entrants.

Daisuke Suzuki, an executive director and a professional 9-dan of the Nihon Shogi Renmei (the Japan Shogi Association, JSA), as well as other professionals who watched the championship, commented that the top finalists had now exceeded top professional level and they themselves would like to follow (or even prefer) the moves of computer shogi. Here, the author discusses

Table 2. The Results of the First Preliminary Contest

No.	Program Name	1	2	3	4	5	6	7	8	Pt	SOS	SB	MD
1*	YaneuraO	5+	30+	9+	6+	3+	2+	4+	10+	8.0	44.0	44.0	34.0
2*	Suisho	4+	38+	8+	7+	11+	1-	17+	3+	7.0	40.5	32.5	25.0
3*	Daigorilla	14+	27+	21+	10+	1-	8+	5+	2-	6.0	43.0	28.0	19.0
4*	CGP	2-	18+	15+	9+	16+	11+	1-	7+	6.0	42.5	27.5	18.5
5*	NineDayFever	1-	16+	12+	13+	19+	6+	3-	20+	6.0	42.0	28.0	18.0
6*	Ayame	32+	29+	20+	1-	7+	5-	16+	8+	6.0	38.0	24.0	16.0
7*	dainomaruDNNc	27+	14+	23+	2-	6-	12+	9+	4-	5.0	41.0	22.0	14.0
8*	dlshogi	15+	24+	2-	17+	10+	3-	18+	6-	5.0	40.5	21.5	12.5
9	Nanoha	12+	22+	1-	4-	28+	21+	7-	19+	5.0	39.0	20.0	12.0
10	NENE Shogi	39+	23+	18+	3-	8-	13+	11+	1-	5.0	38.5	19.5	13.0
11	Crazy Shogi	25+	19+	17+	31+	2-	4-	10-	21+	5.0	37.0	19.0	12.0
12	Aoba Zero	9-	34+	5-	23+	26+	7-	25+	18+	5.0	33.5	17.5	11.5
13	ShibauraSoftmax	37+	20+	16-	5-	27+	10-	22+	17+	5.0	32.0	17.0	11.0
14	Kakinoki Shogi	3-	7-	40+	22+	17-	30+	23+	16+	5.0	31.0	16.0	11.0
15	Usapyon Extra	8-	26=	4-	34+	35+	22-	33+	31+	4.5	28.5	10.0	5.0
16	KatsudonShogi	30+	5-	13+	21+	4-	26+	6-	14-	4.0	38.5	15.5	7.5
17	Miacis	29+	32+	11-	8-	14+	24+	2-	13-	4.0	37.0	15.0	7.0
18	Tenuki	38+	4-	10-	25+	20+	19+	8-	12-	4.0	34.5	13.5	8.0
19	QinoaShogi	36+	11-	22+	24+	5-	18-	26+	9-	4.0	33.5	13.5	7.5
20	Yamada Shogi	31+	13-	6-	33+	18-	32+	27+	5-	4.0	33.0	12.0	6.0
21	Himawari	40+	28+	3-	16-	29+	9-	24+	11-	4.0	31.0	11.0	6.0
22	ichbinichi	34+	9-	19-	14-	38+	15+	13-	30+	4.0	30.0	11.0	5.0
23	TMOQ	35+	10-	7-	12-	34+	29+	14-	28+	4.0	30.0	10.0	5.0
24	fail. of s-bunt	26+	8-	28+	19-	31+	17-	21-	29+	4.0	29.5	12.5	6.0
25	GCT	11-	36+	29-	18-	33+	28+	12-	27+	4.0	28.0	11.0	6.0
26	SMS Shogi	24-	15=	33+	36+	12-	16-	19-	34+	3.5	28.5	7.0	2.0
27	Claire	7-	3-	35+	39+	13-	31+	20-	25-	3.0	30.5	6.5	2.0
28	Mattari Yuuchan	33+	21-	24-	30+	9-	25-	32+	23-	3.0	30.0	9.0	3.0
29	Garyu	17-	6-	25+	35+	21-	23-	37+	24-	3.0	30.0	8.0	2.0
30	Wizard of Odds	16-	1-	37+	28-	36+	14-	35+	22-	3.0	30.0	6.0	2.0
31	Scherzo	20-	37+	32+	11-	24-	27-	36+	15-	3.0	27.5	7.0	2.0
32	Dharma Shogi	6-	17-	31-	40+	39+	20-	28-	38+	3.0	24.0	4.0	1.5
33	narikinshogi	28-	40+	26-	20-	25-	38+	15-	35+	3.0	23.5	4.5	1.5
34	komaasobi	22-	12-	36-	15-	23-	40+	39+	26-	2.0	25.5	2.5	0.0
35	NicoreShogi	23-	39+	27-	29-	15-	37+	30-	33-	2.0	24.0	3.5	0.0
36	Kifuwarabe	19-	25-	34+	26-	30-	39+	31-	37-	2.0	23.0	3.5	0.0
37	st34	13-	31-	30-	38-	40+	35-	29-	36+	2.0	20.5	3.0	0.0
38	Windfall	18-	2-	39-	37+	22-	33-	40=	32-	1.5	25.5	2.0	0.0
39	16 Shiki Iroha	10-	35-	38+	27-	32-	36-	34-	40=	1.5	19.5	1.5	0.0
40	FTS3	21-	33-	14-	32-	37-	34-	38=	39=	1.0	22.0	0.0	0.0

*qualified for the second preliminary contest.

contemporary computer shogi and computer shogi in the near future through the game records of the 29th World Computer Shogi Championship.

1. The 29th World Computer Shogi Championship

The 29th World Computer Shogi Championship was held at the Kawasaki Industrial Promotion Hall in Kawasaki, Japan, May 3-5, 2019. 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), Nomura Securities Co., Ltd. (NSC), Mynavi Publishing Corporation (Mynavi), and Sayuri Takebe Lady 4-dan, and supported by the Ministry of Internal Affairs and Communications (MIC), the Ministry of Education, Culture, Sports, Science and Technology, Japan (MEXT), the Ministry of Economics, Trade and Industry (METI), Kawasaki City, 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, 61 teams applied, of which 56 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. Nine newcomers entered, although twelve (12) had applied. Four teams applied and returned after an absence.

There were two prizes sponsored by CERS-UEC: YaneuraO was awarded the newcomer prize, as it achieved the highest result (it was actually the winner) among first- and second-time participants. The Novice team was awarded the good idea prize.

There was two foreign teams in the tournament: Mumyo8, from the USA and Crazy Shogi, from France.

Professional shogi players Daisuke Suzuki, Akira Nishio 7-dan, Shota Chida 7-dan, Hiroyuki Iida 7-dan, Koru Abe 6-dan, Tatsuya Sanmaido 6-dan, Yuusuke Toyama 6-dan, and Kiyokazu Katsumata 6-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 surpassed top human level and that their strength continues to increase.

1.1. First Preliminary Contest

The first preliminary contest was held on the first day. There were eight Swiss-style games.

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*	Kristallweizen	16+	5+	6+	18+	2+	3-	9+	7+	4	7.0	40.0	33.5	24.0
2*	YaneuraO	13+	23+	11+	3+	1-	5+	4=	10+	8	6.5	38.0	25.5	18.0
3*	PAL	24+	12+	10+	2-	14+	1+	6+	4=	5	6.5	36.5	24.5	17.5
4	Qhapaq di molto	8+	11-	15+	7+	6+	9=	2=	3=	1	5.5	40.5	19.0	10.0
5	elmo	10=	1-	24+	13+	15+	2-	11+	9+	3	5.5	34.5	16.5	12.0
6	Tanu-King	23+	13+	1-	16+	4-	14+	3-	12+	7	5.0	36.0	17.0	12.0
7	NineDayFever	9-	15+	21+	4-	18+	11+	8+	1-	6	5.0	35.0	18.0	11.0
8	Suisho	4-	20+	17+	11+	9-	12+	7-	14+	2	5.0	33.0	18.0	11.0
9	Meijin Cobra	7+	17-	14+	19+	8+	4=	1-	5-	10	4.5	38.0	17.0	9.0
10	Novice	5=	16-	3-	17+	21+	19+	13+	2-	9	4.5	34.5	12.0	6.0
11	GodWhale	20+	4+	2-	8-	19+	7-	5-	22+	16	4.0	35.5	13.5	6.0
12	nozomi	19+	3-	18+	14-	16+	8-	17+	6-	15	4.0	33.5	13.0	6.0
13	HoneyWaffle	2-	6-	20+	5-	22+	15+	10-	17+	14	4.0	33.5	12.0	6.0
14	Apery	21+	22+	9-	12+	3-	6-	16+	8-	13	4.0	33.0	12.0	6.0
15	Shueso	17+	7-	4-	20+	5-	13-	21+	18+	12	4.0	31.0	11.0	6.0
16	dlshogi	1-	10+	23+	6-	12-	22+	14-	24+	11	4.0	27.5	7.5	3.0

Note: SOS, SB, and MD are calculated here just after the 8th round.
*Kristallweizen, YaneuraO, and PAL had qualified for the final.

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*	Kristallweizen	17+	4+	6+	18+	2+	3-	8+	9+	7+	8.0	49.0	42.5	32.0
2*	YaneuraO	12+	23+	11+	3+	1-	4+	7=	10+	5-	6.5	48.5	29.0	21.5
3*	PAL	24+	13+	10+	2-	14+	1+	6+	7=	4-	6.5	46.5	28.0	20.0
4*	elmo	10=	1-	24+	12+	15+	2-	11+	8+	3+	6.5	45.0	25.5	19.0
5*	Suisho	7-	19+	16+	11+	8-	13+	9-	14+	2+	6.0	44.0	28.5	18.0
6*	Tanu-King	23+	12+	1-	17+	7-	14+	3-	13+	9+	6.0	44.0	24.0	18.0
7*	Qhapaq di molto	5+	11-	15+	9+	6+	8=	2=	3=	1-	5.5	52.0	21.0	11.0
8*	Meijin Cobra	9+	16-	14+	20+	5+	7=	1-	4-	10=	5.0	47.0	18.0	9.0
9	NineDayFever	8-	15+	21+	7-	18+	11+	5+	1-	6-	5.0	46.5	22.0	13.0
10	Novice	4=	17-	3-	16+	21+	20+	12+	2-	8=	5.0	43.5	15.0	7.0
11	GodWhale	19+	7+	2-	5-	20+	9-	4-	22+	17+	5.0	42.5	18.5	11.0
12	HoneyWaffle	2-	6-	19+	4-	22+	15+	10-	16+	14+	5.0	42.0	18.0	12.0
13	nozomi	20+	3-	18+	14-	17+	5-	16+	6-	15+	5.0	41.5	19.0	12.0
14	Apery	21+	22+	8-	13+	3-	6-	17+	5-	12-	4.0	42.5	14.0	7.0
15	Shueso	16+	9-	7-	19+	4-	12-	21+	18+	13-	4.0	42.0	15.0	8.0
16	taishogun	15-	8+	5-	10-	19+	18+	13-	12-	23+	4.0	39.0	14.0	8.0
17	dlshogi	1-	10+	23+	6-	13-	22+	14-	24+	11-	4.0	36.0	8.0	3.0
18	W@ndre	22+	21+	13-	1-	9-	16-	20+	15-	24+	4.0	34.0	8.0	5.0
19	Daigorilla	11-	5-	12-	15-	16-	23+	24+	21+	20+	4.0	31.0	7.0	4.0
20	Argo	13-	24+	22+	8-	11-	10-	18-	23+	19-	3.0	31.0	3.0	1.0
21	Ayame	14-	18-	9-	23+	10-	24+	15-	19-	22+	3.0	29.0	3.0	1.0
22	takotto	18-	14-	20-	24+	12-	17-	23+	11-	21-	2.0	29.0	1.0	0.0
23	CGP	6-	2-	17-	21-	24+	19-	22-	20-	18-	1.0	32.5	0.0	0.0
24	dainomaruDNNc	3-	20-	4-	22-	23-	21-	19-	17-	16-	0.0	34.0	0.0	0.0

*qualified for the final.

The top eight programs joined the second preliminary contest. Forty programs entered the first preliminary contest.

As shown in Table 2, three newcomers, YanauraO, with 8 wins and no losses, Suisho, with 7 wins and 1 loss, and Daigorilla, with 6 wins and 2 losses, proceeded to the second day. Other programs that qualified were CGP, NineDayFever, Ayame (6 wins and 2 losses), dainomaruDNNc, and dlshogi (5 wins and 3 losses).

Nanoha, Nene Shogi, Crazy Shogi, Aoba Zero (newcomer), Shibaura Shogi Softmax, and Kakinoki Shogi won five games but did not proceed to the second day because the SOSs of those programs were shorter.

1.2. Second Preliminary Contest

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

There were 16 seeded and 8 qualifying programs in the second preliminary contest. The candidates expected to proceed to the final were former finalists Kristallweizen (successor to former winner Hefeweizen), PAL, Apery, Meijin Cobra, Tanu-King (successor to the end of genesis T.N.K. evolution turbo type D), GodWhale, Qhapaq di molto (successor to Youkai Planet Qhapaq), and HoneyWaffle, together with elmo, winner of the 27th WCSC, and qualifying newcomers YaneuraO, Suisho, and Daigorilla.

After the eighth round, Kristallweizen, with 7 wins and 1 loss, and YaneuraO and PAL, each with 6 wins, one loss, and one draw, had qualified to proceed. The games in the ninth round were Kristallweizen vs. Qhapaq di molto, YaneuraO vs. Suisho, PAL vs. elmo, Tanu-King vs. NineDayFever, and Meijin Cobra vs. Novice (Table 3-1).

As shown in Table 3-2, Kristallweizen, Suisho, elmo, and Tanu-King won, while the Meijin Cobra and Novice game was a draw, so Kristallweizen (8 wins, 1 loss), YaneuraO, PAL, and elmo (each with 5 wins, 3 losses, 1 draw), Suisho and Tanu-King (each with 6 wins, 3 losses), Qhapaq di molto (4 wins, 2 losses, 3 draws), and Meijin Cobra (4 wins, 3 losses, 2 draws) proceeded to the final.

However, NineDayFever, GodWhale, HoneyWaffle, nozomi (5 wins 4 losses), and Novice (4 wins 3 losses 2 draws) did not proceed to the final because the SOSs of those programs were shorter. NineDayFever was 0.5 of an SOS shorter.

If the rules remain unchanged, the 16th program and those above it will all be seeded for the second preliminary contest. Otherwise, the number of seeded teams for the second preliminary contest can be decided shortly before the championship event begins (in, say, December 2019).

1.3. The Final

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

The candidates for victory were Kristallweizen and PAL, both second-time-entrants and the champion and the runner-up of the 28th WCSC, and YaneuraO, a newcomer. Those three programs had performed particularly well in the second preliminary contest.

After the sixth round, YaneuraO and Kristallweizen had won five times, and the other entrants had won three times or less, so the winner and the runner-up were these two programs. In the seventh round came the YaneuraO versus Kristallweizen game. The winner of this game was to be the championship winner. If the game turned out to be a draw, then YaneuraO would be the winner because of the SB (sum of beaten opponents' win points: win points are one for a win, zero for a loss, and a half for a draw.)

The YaneuraO versus Kristallweizen game was indeed a draw, so YaneuraO ended by winning the championship. Interestingly, the programmer of YaneuraO had prepared for this very situation, setting the value of a perpetual loop high, thereby encouraging a draw.

The results of the 29th World Computer Shogi Championship were YaneuraO as the winner and Kristallweizen as the runner-up (5.5 points each), Tanu-King third, elmo fourth, Qhapaq di molto fifth (4 points each), PAL sixth (2.5 points), Suisho seventh (1.5 points), and Meijin Cobra eighth (1 point). The finalists all performed at a very high level (Table 4)---8th-placed Meijin Cobra, for example, beat Suisho, which in turn had beaten the winner, YaneuraO.

There were cash prizes for this championship. They were awarded to YaneuraO, Kristallweizen, and Tanu-King.

YaneuraO, Kristallweizen, and Tanu-King used 52-, 240-, and 249-core PCs, respectively. Many programs used library modules. Nineteen programs used the Apery module, seventeen used the YaneuraO module, twelve used the tanuki module, ten used the elmo module, etc. Many programs used multiple modules---Kristallweizen, for example, used nine library modules.

All programs in the final used the YaneuraO module (including YaneuraO itself). The top five programs that did not use library modules were given awards (Novice, nozomi, Apery, Shueso and Ayame).

2. Accesses/watchers through the Internet

There were many observers who gained access through the Internet. Table 5 indicates the number of times access was made to the live top page, the number of unique IPs, the number of instances of blog access, the number of blog 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.

3. First player's winning ratio and drawing ratio, and average number of moves

The first player's winning ratio was usually over but close to 50%. The highest winning ratio for the first players was about 68% in 2002, 2013, and 2017. The lowest was about 32% in 2012. The ratio in 2019 was about 55%.

Table 6 and Figure 1 indicate the winning and drawing ratios for periods of five years. For the five-year-moving-average, the highest ratio for the 1st player was 58% (2013-2017), while the lowest was 44% (2008-2012). The highest drawing ratio

Table 4. The Results of the Final

No.	Program Name	1	2	3	4	5	6	7	Pt	SB	MD
1	YaneuraO	5+	8+	7-	3+	6+	4+	2=	5.5	15.5	10.5
2	Kristallweizen	8+	5+	3+	7+	4-	6+	1=	5.5	13.0	8.0
3	Tanu-King	6-	4+	2-	1-	5+	8+	7+	4.0	10.5	5.5
4	elmo	7+	3-	5-	8+	2+	1-	6+	4.0	10.5	4.0
5	Qhapaq di molto	1-	2-	4+	6+	3-	7+	8+	4.0	9.0	4.0
6	PAL	3+	7=	8+	5-	1-	2-	4-	2.5	5.0	0.0
7	Suisho	4-	6=	1+	2-	8-	5-	3-	1.5	5.5	0.0
8	Meijin Cobra	2-	1-	6-	4-	7+	3-	5-	1.0	1.5	0.0

Table 5 Access Information

No. of instances of live top page access			No. of unique IPs	
First Day	15,188	(10,343)	2,992	(2,363)
Second Day	19,366	(18,313)	3,755	(3,848)
Third Day	15,923	(13,556)	3,659	(3,769)
Next Day	1,343	(1,276)	1,038	(1,163)
No. of instances of blog access			**No. of blog visitors**	
First Day	11,895	(7,259)	3,099	(2,150)
Second Day	10,809	(10,163)	2,647	(3,074)
Third Day	11,813	(8,603)	3,307	(2,892)
Next Day	2,053	(2,046)	851	(1,007)
No. of instances of CSA top-page access			**No. of championship-page visitors**	
First Day	1,505	(2,202)	1,878	(1,960)
Second Day	1,860	(3,254)	1,591	(2,419)
Third Day	2,018	(3,039)	2,874	(1,732)
Next Day	634	(1,103)	537	(396)
No. of Niconico visitors [comments]			**No. of GodWhale visitors [comments]**	
Second Day	9,810 [2,162]	(77,728 [16,511])	8,651 [13,122]	(8,223 [16,055])
Third Day	67,074 [16,867]	(69.753 [12,430])	2,904 [5,114]	(7,361 [14,521])

In parentheses: instances of access during the 28th WCSC

was 4% (2015-2019), while the lowest was less than 1% (2013-2017, etc.). For the total (2002-2019, 8-team-finals), the first player won 316 times, the second player won 305 times, while draws occurred 12 times. The first player's winning ratio was about 51% and the drawing ratio about 2%.

Recently, the number of average moves has increased. Table 7 and Figure 2 indicate the number of average moves (finals, shogi-counting moves, or plies). The average moves through 2017 were around 140, but about 181 in 2018 and 190 moves in 2019.

We changed the rules for a draw on number of moves from 256 to 320 in 2019. There were four games where the moves exceeded 256 in 2019, but this change of rules does not appear to have had much effect.

4. Computer Shogi in the Near Future

Professional players who watched the 2019 WCSC declared that the top programs had already gone beyond top professional level. What is more, it seems highly likely that computer shogi will continue to grow even 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 seem to be at a stage that is close to solving shogi, but in truth it will still take a very long time to provide a complete solution.

5. Conclusion and Acknowledgments

Here, we have considered contemporary computer shogi, in particular how competitors performed at the 29th 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 computer shogi has now reached is able at last to show us a new world.

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Table 6 Five-year 1st player's winning ratio and drawing ratio

5 years through		2012	2013	2014	2015	2016	2017	2018	2019
games	A	140	140	140	140	140	140	140	140
#1st-p-wins	B	61	68	68	69	71	81	75	74
#2nd-p-wins	C	78	71	71	69	68	58	62	61
#draws	D	1	1	1	2	1	1	3	5
1sr-p w.r.	B/(B+C)	0.439	0.489	0.489	0.500	0.511	0.583	0.547	0.548
draw r.	D/A	0.007	0.007	0.007	0.014	0.007	0.007	0.021	0.036

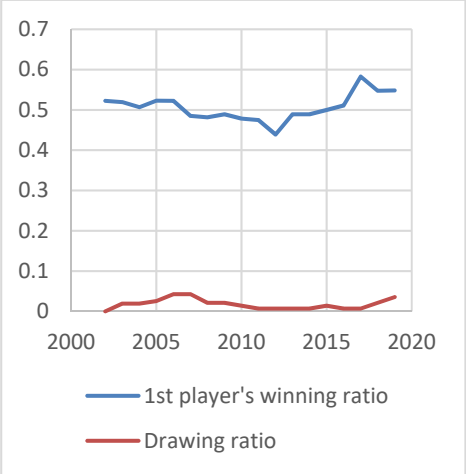

Figure 1 Five-year 1st player's winning ratio and drawing ratio

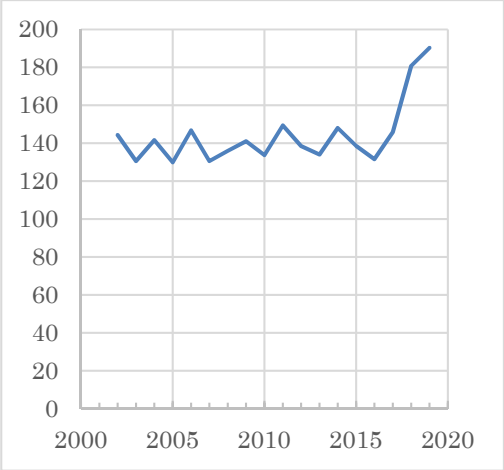

Figure 2 Average shogi-count moves

Table 7 Average shogi-count moves

year	average	std. dev.
2012	138.5	26.7
2013	134	31.3
2014	148	27.4
2015	138.6	31.6
2016	131.6	30.6
2017	145.8	32.2
2018	180.8	50.0
2019	190.3	58.0

References

[1] Computer Shogi Association: The Annals of CSA, vol. 1-30, Computer Shogi Association, 1987-2019.
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Appendix
Championship game record and some game positions

The game record of the final of the 29th WCSC (YaneuraO versus Kristallweizen), and some game positions are indicated here.

Final
5/5/2019
1st player: YaneuraO
2nd player: Kristallweizen

1.P-2f	2.P-8d	3.G-7h	4.P-8e
5.P-2e	6.G-3b	7.S-3h	8.S-7b
9.P-9f	10.P-1d	11.P-1f	12.P-8f
13.Px8f	14.Rx8f	15.P*8g	16.R-8b
17.P-7f	18.P-6d	19.P-3f	20.S-6c
21.P-3e	22.B-1c	23.S-3g	24.Bx3e
25.S-4f	26.B-4d	27.S-5e	28.B-3e
29.S-4f	30.B-4d	31.S-5e	32.B-3e
33.S-4f	34.B-4d	35.S-5e	36.B-3e

37.S-4f (Fig.3)
perpetual repetition, draw.

Fig.3 YaneuraO versus Kristallweizen 29th WCSC Final (37. S-4f)

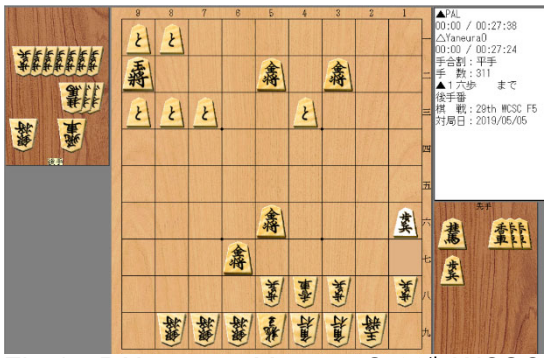

Fig.4 PAL versus YaneuraO 29th WCSC Final (311. P-1f). After the move, YaneuraO declared a win.

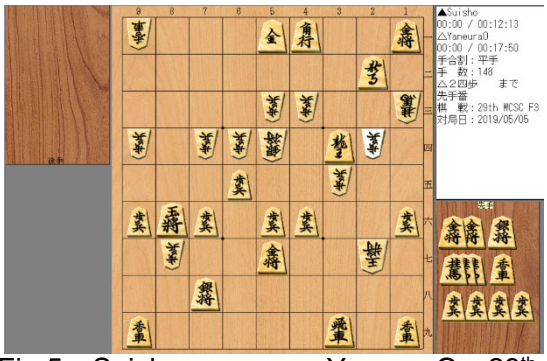

Fig.5 Suisho versus YaneuraO 29th WCSC final (148. P-2d). After this move, Suisho won by L*2i.

Picture 1 Watchers at the venue

Picture 2 Motohiro Isozaki after the draw and resulting victory in the championship

Picture 3 YaneuraO team members at the victory ceremony (All pictures are by Hirofumi Matsumoto, 2019.5.5)