MOCCOS WINS PHANTOM GO TOURNAMENT

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1. PHANTOM GO

Phantom Go (Borsboom *et al.*, 2007) is a very interesting game as it combines the challenges of Go with imperfect information. The games is played using the rules of Go but the players only know perfectly their own moves. A referee is used to tell a player when a suggested move is illegal or when a capture occurs.

The fourth Phantom Go tournament took place in Kanazawa in October 2010. Three competitors participated, *GoLois* by Tristan Cazenave, *Moccos* by Takuma Toyoda and *IcySoftwoodWine* by Yuji Abe. *GoLois* had been undefeated for the past three years, but the playing level has much improved and the three competitors of this year were of similar playing strength as shown by Table 1. Four matches were played between each program. *GoLois* won 2 games out of 4 against both *Moccos* and *IcySoftwoodWine* while *Moccos* won 3 games out of 4 against *IcySoftwoodWine* ensuring the gold medal.

2. DESCRIPTION OF THE PROGRAMS

Each artificial player was based on the Monte-Carlo method. *Moccos* and *GoLois* were both realization of the algorithm presented in Cazenave (2006) : for each possible move, random playouts are drawn. At the start of each playout, opponent pieces are put randomly on the board. The same number of playouts is made for each possible move and the move with highest win proportion is selected and played. *IcySoftwoodWine* also uses random playouts but the number of playouts drawn for each move is determined dynamically using the UCB algorithm (Auer, Cesa-Bianchi, and Fischer, 2002). *IcySoftwoodWine* also use pattern matching before running any playout : if any pattern is matched in a list of 12 3×3 handcrafted patterns or if a capture is possible, then no playout is run and the corresponding move is directly played.

The computational power was roughly equivalent between programs as *Moccos* and *GoLois* ran about 600,000 playouts per move while *IcySoftwoodWine* ran about 400,000 playouts per move.

Rank	Program	Origin	Score	Games	Title
1	*Moccos*	Japan	5	8	Gold medal
2	*GoLois*	France	4	8	Silver medal
3	*IcySoftwoodWine*	Japan	3	8	Bronze medal

Table 1: Results of the tournament

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(a) Position after move *52.*, Black to play   (b) Position after move *56.*, Black to play
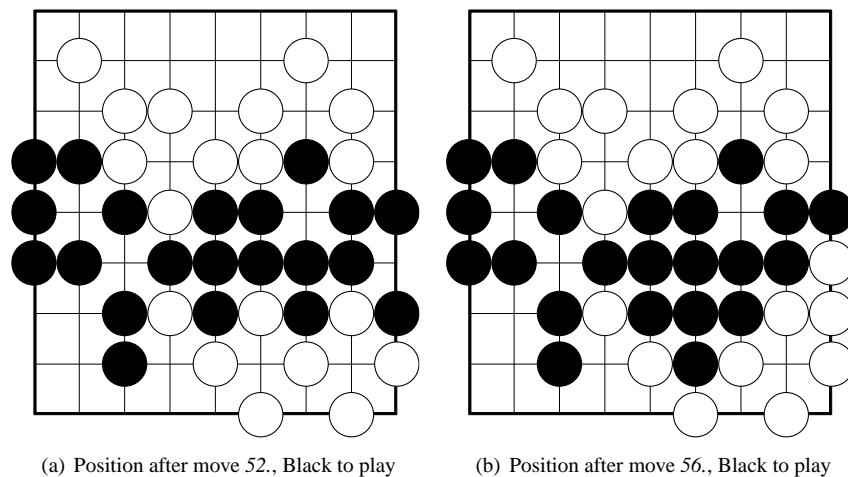
Figure 1: Positions from the second *GoLois* versus *Moccos* game, with *Moccos* playing White and winning at move *80.*

Move	*GoLois*	*Moccos*	Move	*GoLois*	*Moccos*
1	f5	e6	41	(g2) f2	(f2) f3
3	(e6) e5	(f5) f6	43	(b7) a6	(g4) e2
5	d6	(e5 d6) d5	45	a4	f1
7	(d5) c5	c6	47	h2	(h2) h1
9	d4	(d4) c4	49	i3	i2
11	g6	(d6) d7	51	e3	(h2) h3
13	(d7) g7	d5	53	(h2ko) f2	(f2 f3ko i3) i4
15	(d6ko c4) c3	(g6) d3	55	f3	(h4) i3
17	b4	(c4) g5	57	d2	(g6) g7
19	e4	(e4 g7) g4	59	c1	e8
21	b6	(c3) f7	61	c8	(c2) b8
23	(g5 f6) h5	g8	63	h9	d8
25	(g4) h4	h6	65	(c7 d8 b8) a9	i6
27	g3	h7	67	e9	f9
29	g6	(b6 g3) c7	69	i9	(a4) d9
31	f4	b5	71	c9	(c9 h9 c8) b3
33	(b5) a5	b7	73	a8	b9
35	i5	(b5 h5) g5	75	c9	c8
37	(g5) g4	(g5 c5 i5) g2	77	g9	d6
39	c2	h3	79	(g7) i7	g1

Table 2: Move list for the second game between *GoLois* and *Moccos*

3. PROBLEMATIC ILLEGAL MOVES

The programs always made the assumption that an illegal move resulted from an opponent piece already occupying the intersection. It is most often a safe assumption, but sometimes the move is illegal because the intersection has no liberty or because of the *ko* rule. This effect can be minimized when programs avoid to play intersections surrounded by opponent pieces as did *GoLois*. The problems with this approximation were known since the first tournament (Cazenave and Borsboom, 2007), and they decided several games this year in Kanazawa.

We present for illustration the second game between *GoLois* and *Moccos* in Table 2. *GoLois* was Black and had a promising position but lost as it failed to recognize that an intrusion by *Moccos* could live. Indeed, when *GoLois* is told at move *53.* that *h2* is not a legal move, it assumes it is illegal because of a white stone being present while the real reason is that *53. h2* is *ko* (see Figure 1(a)). From move *57.* on, *GoLois* thinks White does not have enough room to live and thinks it has a certain win (see Figure 1(b)).

4. REFERENCES

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