BACKGAMMON PROGRAM BEATS WORLD CHAMP

Report from Hans Berliner

On July 15,1979 in Monte Carlo world history was made as a computer program for the first time beat a recognized world champion at his own game. BKG 9.8, authored by Hans Berliner of the Computer Science Department, Carnegie-Mellon University, Pittsburgh, 15213, beat Luigi Villa, the newly crowned Backgammon World Champion in a seven point match 7-1. It should be noted that during the match both opponents palyed well; however, Villa played clearly better. However, as an examination of the game records below will confirm, on this occasion BKG 9.8 was the beneficiary of the element of luck in the game of backgammon, and this accounts for the lop-sided score.

Thus there should be no delusion that there now exists a world class backgammon program; only one that can give anyone a very good fight. For the occasion of the contest, the program operated through a terminal embedded in a mobile robot. The terminal was connected to a radio transmitter/receiver which communicated with another in a nearby room that was connected to a modem. This hooked into a telephone and then by trans-atlantic satellite we connected to dial-up lines at CMU Computer Science Department. The robot-connection was an unfortunate necessity, both because the sponsor insisted on it, and probably more realistically, because without this bit of window dressing, very little attention would have been paid to the whole contest. Because of this a number of stories that fall rather short of being responsible have appeared in the media. I enclose some first and second hand reports of these below.

The robot was, in fact, the theme of the tournament. Trophies had robots on them, and the robot itself was in evidence at all the social events, motoring around and saying witty things via its radio controller. This probably did not foster the image in anyone's mind that it was going to play a serious game of backgammon. However, during the week before the match, MYTB 9.8, operating from inside the robot, decimated the members of the press corps that had come to play it in order to wins free trips to various locations. This probably went unnoticed by most of the participants who were busy with their own matches.

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From Bay area television:

> News out of Italy has it that a robot named GAMMONOID has just defeated the world champion of Backgammon, an Italian, for $5000. Its style of play was described as "relentless and aggressive". The Italian champion and his compatriots stalked about the room in a rage before leaving, claiming that the robot was lucky.
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> And throughout this entire passage, a picture of some artist's conception of a mad robot gone wild, gawking out at the screen with stacks of money, coins and bills in its metalic claws, was displayed.

From Channel 2 television, Pittsburgh

> "Today a 3 1/2 foot Carnegie-Mellon robot is the new Backgamon Champion of the world. The human champion - I should say ex-champion - Mr. Villa of Italy said it was 'all luck, the dice were against me' The robot won by four games out of five - that sure doesn't seem like luck to me. Later, the robot sent an electronic message to a computer at Carnegie-Mellon saying 'I owe it all to my creator, Dr. Hans Berliner'. I hope that robot doesn't get into newscasting too - I bet he works cheap too..."

From the front page of the Tuesday, 17 July, San Francisco Chronicle:

> Robot Whips Backgammon Champ
>
> Monte Carlo
>
> A 3 1/2-foot robot has beaten the new world backgammon champion.
>
> "The machine was lucky," insisted the champion, Luigi Villa, a professional from Milan. "The dice were not rolling for me tonight," he complained and stamped his foot.
>
> Villa's disappointment was shared by several fellow Italians, who surrounded him in an indignant and gesticulating mass after the contest and hurled insults at the machine.
>
> The robot, termed a gammonoid, won four of its five games in a seven-point match and walked -- or rather rolled -- away with $5000 in prize money Sunday night.
>
> The machine confined its comments after the match to a long stream of electrical impulses, which were transmitted by telephone line and satellite to a computer at Carnegie Mellon University in Pittsburgh.
>
> "This was a fantastic victory for science," said tournament director Lewis Deyong.
>
> Earlier former world champion Paul Magriel was left gasping with excitement during his commentary on the robot's fifth game, which was broadcast on closed-circuit television to an audience of 200 in the Winter Sporting Club.
>
> "Look at this play," he enthused. "I didn't even consider this play...this is certainly not a human play. This machine is relentless. Oh,

it's aggressive. It's a really courageous machine."

The audience, lolling on plush, upholstered chairs and sipping champagne, broke into wild applause and laughter when the machine eventually won.

"They came to mock and they stayed to marvel," Magriel said. "This is certainly a great day for backgammon. This robot can really teach us something."

The robot's artificial intelligence was designed by a computer research scientist, Dr. Hans Berliner of Carnegie Mellon. The machine's computer program, nicknamed the "Mighty Bee" by scientists in Pittsburgh, represents a breakthrough in cybernetics--the science of computer language. The breakthrough will be explained to the world's computer science community in a long technical paper to be read by Berliner in Tokyo in August.

United Press

In addition a very nicely done article appeared in the July 17, Washington Post, and an article appeared in the overseas edition of the Herald-Tribune on Tuesday July 17.

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Let me try to clear up a few frequently asked questions. The money was put up 1/2 by MERIT cigarettes which sponsored the event, and 1/2 by Intelligence Systems, Ltd., which is planning to market a version of my program. The money went to ISL.

About the dice rolling. Clearly, no one would let the machine roll dice when they can't see what is happening. I had asked the tournament director to assign me an experienced player to help, particularly with rolling the dice, and watching for dice rolls for both sides that end up "cocked" in illegal position. It would have been too much for one person to roll the dice, enter them into the terminal, receive the move, make the move, look at the opponent's roll, enter it, look at his move, enter that, check doubling, and also note that no move is complete until the mover has picked up his dice.

A very nice man was assigned and seemed to enjoy his role very much. After a few plays, I found out he also spoke Italian. There was quite a bit of "calling" for rolls and the man was (incredibly enough) successful every time he called a roll (about 3 times during the match; which is about a 40,000 to 1 shot). Halfway through the first game, he asked Villa in Italian if there was any money riding on this "exhibition" match. His jaw dropped considerably when Villa answered solemnly "Cinquento Mille Dollares". Thereafter, he made only one more call, the final fateful double 6. Truly an incredible performance. Is ISP for real?

I have done a minimal analysis of the games, and this substantiates that Villa is certainly the better player. Villa played 80 non-forced moves during the match. In giving these games to BKG 9.8, and asking it to move in Villa's situation it 51 times chose the same move as he; this represents 64% of the action. Of the 29 times the program would have played differently, there was 1 occasion where it chose a clearly better move, and 7 times when it chose clearly inferior alternatives. The remaining 21 differences would require a cadre of better players than myself to adjudicate their merits. It would have played game 4 exactly as Villa did.

As to the program's own play, it made at least 8 plays ranging from doubtful to obviously bad. Most of the remaining moves were good, although we don't feel completely qualified to comment on their quality. There were several good to sensational things that the program did: In game one it played its 19th move very correctly (9-7, 9-5) leaving 13 shots but avoiding future problems which would have remained after the alternate (5-1,4-2) which only leaves 11 shots.

The double to end game two was quite good for a machine. This is considered a "pressure" double as the game is at a crisis point and could easily swing badly against the opponent. The consensus was that Villa should have accepted, but a good roll for BKG 9.8 at this point could have put him at a disadvantage from which it might have been impossible to recover.

The 12th play in the final game (3-2, 13-8) created quite a sensation. Humans usually don't think of creating two blots in their home board when the opponent has a man on the bar. However, here BKG 9.8 welcomed being hit as it would improve its timing for the already established backgame. It will require better players than myself to determine whether the play is correct in an absolute sense, but it certainly is not eminently incorrect, and is certainly imaginative.

Another good but unobtrusive move was its decision to give up the backgame on play 18 with (22-20,22-20,22-20,3-1). Only persons who have tried writing AI programs know how difficult it is to get a program to do this instead of the alternative of playing the 2's in its homeboard and amintaining the now useless "backgame".

As to the doubling, BKG 9.8 did a good job; however, its accept in the third game is suspect and it probably could have accepted in the fourth game.

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MATCH TO 7 POINTS

WHITE BLACK

LUIGI VILLA (World Champ) BKG 9.8

White 6,1 12-18,17-18
Black 4,4 24-20,24-20,13-9,13-9
(20-16,20-16,9-5,9-5) is better
White 4,2 12-16,19-21
Black 4,4 20-16,20-16,6-2,6-2
White 1,6 0-1,1-7
Black Doubles Double Accepted
Black 2,4 8-4,6-4
White 3,4 17-20,17-21
Black 2,5 16-11,9-7
White 1,4 0-1,12-16
Black 4,5 25-20,20-16
White 3,5 0-3,0-5
Black 1,2 7-5,5-4
White 3,3 0-3,18-21,19-22,19-22
Black 1,5 16-11,9-8
White 2,3 1-3,12-15
Black 2,2 13-11,11-9,11-9,11-9
White 2,6 3-5,5-11
Black 6,2 13-11,8-2
White 5,1 0-5,12-13
Black 3,3 No Legal Moves
White 3,3 13-16,15-18,16-19,19-22
Black 1,1 25-24,24-23,6-5,6-5
White 4,5 No Legal Moves
Black 1,3 23-20,11-10
White 3,4 0-3,3-7
Black 6,6 20-14,14-8,10-4,8-2
White 3,5 7-10,10-15
Black 6,4 8-4,8-2
White 5,1 15-20,18-19
Black 2,3 9-6,6-4
White 2,4 18-20,19-23
Black 6,2 4-2
White 5,4 1-6,6-10
Black 3,1 2-1,4-1
White 1,2 No Legal Moves
Black 6,6 No Legal Moves
White 3,5 0-3,10-15
Black 2,4 9-5,9-7
Good move.
White 5,6 3-8,8-14
Black 6,2 7-1,2-0
White 1,1 15-16,16-17,17-18,18-19
Black 1,2 2-0,1-0
White 6,1 14-20,22-23
This is senselessly risking a gammon.
(22-23,3-9) is correct as the second man is not needed there, and now double 2's, double 1's, and 2-1's all result in wasting pips in the race to avoid the gammon. BKG 9.8 plays it correctly.
Black 6,4 4-0,5-0
White 1,2 21-22,22-24
Black 6,5 5-0,5-0
White 5,5 3-8,8-13,13-18,18-23
Black 6,2 2-0,4-0
White 3,4 3-6,6-10
Black 3,2 2-0,4-1
White 2,2 10-12,12-14,14-16,16-18
Black 2,1 1-0,4-2
White 6,2 18-24,23-25
White resigns Black wins

The Score is now White - 0, Black - 2.

White 3,6 1-4,4-10
Black 6,3 13-10,24-18
White 2,5 0-2,2-7
Black 1,1 8-7,8-7,6-5,6-5
White 4,5 0-4,19-24
Black Doubles Double Refused
Black wins

The Score is now White - 0, Black - 3.

White 2,5 12-14,12-17
Black 1,4 13-9,6-5
White 6,3 14-20,17-20
Black 4,4 13-9,9-5,8-4,8-4
White 4,5 12-16,16-21
Black 6,4 6-2,8-2
White 1,2 19-20,19-21
Black 5,4 13-9,13-8
Senselessly leaving a blot.
White 1,4 12-13,17-21
Black 6,3 25-22,8-2
25-16 is correct, keeping men in play.
White Doubles Double Accepted
White 5,1 17-22,21-22
Black 4,3 No Legal Moves
White 6,3 17-23,20-23
Black 6,4 No Legal Moves
White 6,4 1-7,7-11
Black 5,4 No Legal Moves
White 6,1 1-7,7-8
Black 3,2 No Legal Moves
White 4,1 8-12,13-14
Black 4,3 No Legal Moves
White 2,2 11-13,12-14,12-14,14-16
Black 3,2 No Legal Moves
White 1,2 14-15,15-17
Black 5,4 No Legal Moves
White 2,3 13-15,17-20
Black 6,4 No Legal Moves
White 5,2 15-20,19-21
Black 5,4 No Legal Moves
White 5,3 14-19,16-19
Black 6,4 No Legal Moves
White 6,6 19-25,19-25,19-25,19-25
Black 2,6 25-19,19-17
White 5,2 20-25,20-22
Black 6,1 17-16,16-10
White 6,4 20-25,21-25
Black 3,1 10-9,9-6
White 6,1 20-25,22-23
Black 6,2 24-18,18-16
White 3,4 21-24,21-25
Black 4,1 25-24,16-12
White 4,1 0-1
Black 6,3 6-3,9-3
White 5,3 No Legal Moves
Black 3,1 2-1,12-9

White 6,4 No Legal Moves
Black 5,5 24-19,19-14,14-9,6-1
White 6,6 No Legal Moves
Black 2,1 9-8,9-7
White 6,6 No Legal Moves
Black 4,4 9-5,8-4,7-3,4-0
White 6,6 No Legal Moves
Black 5,3 3-0,5-0
White 6,6 No Legal Moves
Black 6,6 6-0,6-0,5-0,5-0
White 6,2 0-6,6-8
Black 1,4 4-0,1-0
White 1,2 8-9,9-11
Black Doubles Double Refused
Black wins
The Score is now White - 0, Black - 5.

White 4,5 12-16,12-17
Black 4,2 6-4,8-4
White 5,2 16-21,19-21
Black 4,2 13-11,13-9
White 4,4 1-5,1-5,5-9,5-9
Black 2,1 25-23,6-5
White Doubles Double Refused
White wins

The Score is now White - 1, Black - 5.

Black 2,1 6-5,13-11
White 1,2 1-2,12-14
Black 6,1 6-5,11-5
White 6,4 12-18,14-18
Black 2,1 5-4,6-4
White 1,6 2-3,12-18
Black 3,2 8-6,6-3
White 3,1 0-3,1-2
Black 4,2 25-23,13-9
White 6,2 3-9,9-11
Black 5,3 25-20,23-20
White 5,1 2-7,11-12
Black 6,3 13-10,13-7
White 3,4 0-3,3-7
Black 5,5 25-20,20-15,8-3,8-3
Good move; the blots don't matter.
White 6,3 7-13,12-15
Black 3,2 25-23,25-22
White 4,1 12-16,15-16
Black 3,2 24-22,23-20
White 4,2 17-21,19-21
Black 6,1 20-14,14-13
t is bad to hit; 20-14,10-9
is right.
White 2,6 0-2,12-18
Black 5,1 3-2,13-8
White Doubles Double Accepted
White 3,2 0-3,19-21
Black 4,2 25-23,10-6
White 2,1 21-23,23-24
Black 5,3 25-22,25-20
White 4,2 3-7,7-9
Black 5,5 20-15,15-10,10-5,8-3
White 1,3 9-10,18-21
Black 4,3 5-2,6-2
6-3,5-1 is better.
White 1,4 10-11,11-15
Black 4,2 5-3,5-1
5-1,22-20 is better.
White 2,1 21-23,23-24
Black 2,2 22-20,22-20,22-20,3-1
Good decision.
White 4,1 15-19,18-19
Black 5,5 20-15,20-15,15-10,15-10
The start of some fabulous rolls, but it would have been better to bring 3 men out instead of 2.
White 5,3 16-21,16-19
Black 3,3 10-7,10-7,7-4,7-4
White 5,1 17-22,17-18
Black 3,2 20-17,17-15
White 5,3 18-23,19-22
Black 5,3 20-17,20-15
White 3,3 18-21,18-21,22-25,22-25
Black 6,6 17-11,15-9,15-9,11-5
White 1,5 19-20,20-25
Black 6,4 9-5,9-3
White 1,5 19-20,20-25
Black 6,4 4-0,6-0
White 1,5 19-20,20-25
Black 4,2 2-0,4-0
White 6,2 23-25,19-25
Black 4,1 1-0,4-0
White 5,4 19-23,21-25
Black 4,1 1-0,4-0
White 1,1 23-24,24-25,24-25,24-25
Black 6,2 2-0,6-0
White 6,1 21-25,21-22
Black 1,2 2-0,5-4
White 1,3 21-22,22-25
Black 6,6 5-0,4-0,3-0,3-0
Black wins
Black wins Match.
Final Score White - 1, Black - 7.

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Professor Michael Brodie, Dept. of Computer Science, University of Maryland, College Park, Maryland 20742