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P7S CHECKERS

Abstract

This program allows the user to play a standard game of American checkers against the computer (or let the computer play itself). Moves and commands are entered via the teletype and if the user has a Digital-to-analog converter, the board can be displayed on an oscilloscope. Test positions can be inputted for analysis and the look-ahead depth can be varied. Computer's play is acceptable but poor by professional standards. Computer can also play music while waiting for input if hardware permits.

Minimum equipment needed: PDP-8, 8I, 8L, or 8E
Teletype

optional equipment: EAE option
Digital-to-analog converter, type AA01A
Oscilloscope
Music registers, type P7S-MR1 or P7S-MR2
Stereo amplifier and speakers



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Dedication

Dedicated to David Cohen.

In envy of Mac Hack VI.



PPS CHECKERS

Acknowledgement

I wish to thank Mario DeNobili for teaching me everything I know about the game of checkers and owe him a debt of gratitude for the 800 hours (approximately) he spent playing against the program while testing its strategy.

I also wish to thank David Cohen for his many theoretical discussions concerning the mathematical basis for checkers strategy. I enjoyed his metric.

I wish to console Guido Dionysus, who lost 55 consecutive games against the computer at depth level 2.

I wish to thank Bartholomew Drachma for the elaborate plans and progress which he has made on his board sensor and mechanical hand. Perhaps I should change the tune to "To Dream the Impossible Dream ...".

Music to "Love is Blue" is by André Popp; lyrics by Pierre Cour. The arrangement used is a condensed version of an arrangement by Halmy Kresa.



P7S CHECKERS

Preface

This document replaces but does not make obsolete the document labelled P7S-Ø8-√R/R-1.

This program was partially written as part of a laboratory course at the Polytechnic Institute of Brooklyn under the supervision of Prof. Shocman.

This program has not as yet been approved by the P7S protection committee but is nevertheless being distributed so that users can get some enjoyment out of it even though the author does not feel that he is through with it. The author has several plans for features he wishes to add to the program but can not get around to it at the present time because of other commitments. These features include:

- (i) incorporation of alpha-beta pruning
- (ii) a dynamic board evaluator which will give points to initial moves which locally increase the static board evaluation
- (iii) a tournament play mode
- (iv) a better static-board evaluator during endgame play.

The author doesn't mind other users modifying the program, but would appreciate hearing from them if they achieve any success.

A version of this program which runs on a PDP-12 is available and will shortly be submitted to DECUS.

A preliminary version which swapped songs off of DECTape is no longer available since it had to be scrapped to make room for a better static board evaluator.



1. Distribution: The source for P?S Checkers can be obtained on paper tape, cards, or DECTape. Because of the size of the program, it is segmented into four parts, the Body, Evaluator, Monitor, and I/O Routines. In addition, there is a common page 0 to each of these parts, called DATA0. The program should be built up on a DECTape containing the RL Monitor System, as follows: Assemble DATA0 and CH1 through CH5 in order to get the body; save in a binary file called BCH. Assemble DATA0 and KR1 and KR2 in order to get the Evaluator; save as a binary file called BKR. Assemble DATA0 and MON1 through MON5 in order to get the Monitor; save in a binary file called BMON. Assemble DATA0, IO1, IO2A, IO2B, IO3, IO4, IO5 in order to get the I/O Routines; save in a binary file called BIO. Ignore all error messages which you get while assembling; these are expected.

If the user has one or two music registers, type P?S-MR1 or P?S-MR2, he should include the device codes for these devices in the program in the file called DATA0. Details are given there in the source listing on how to do this. With this option in effect, the computer can play "Love is Blue" while it is waiting for the opponent to type in a move. The purpose of this is to distract the opponent. Details on how to build a music register are not yet available for distribution. The music is played in stereo. Users at installations without music registers are welcome to visit the Polytechnic Institute of Brooklyn for a demonstration.

2. Loading: P?S Checkers can be run from the RL Monitor by typing the command

RUN BIN=200,BCH,BKR,BMON,BIO .

Otherwise, the four binary paper tapes can be loaded into core using the DEC binary loader. The program's starting address is location 200. It is also restartable from there. All I/O devices not used by the program which could cause numerous or spurious interrupts must be disconnected before the program starts or the program's interrupt routines will halt.

location 200 (its starting address)

3. Playing notes: P?S CHECKERS plays a standard game of American checkers. In particular, the following rules are in affect:
- Jumps are mandatory. If you have a jump, you must make it; if you have a choice of jumps you must make one of them; you may choose any one; you need not choose the longest jump, but you can not prematurely terminate a multiple jump in the middle.
 - Black plays first.
 - Singles may not move or jump backwards.
 - Kings may move only one square at a time, but in any direction. Kings may jump both forwards and backwards.
 - A turn ends when you crown a piece. A single may not jump in and out of the king row, crowning as it jumps.
 - A player loses if he is stalemated (i.e. has no legal moves when it is his turn to move).
 - The standard method of numbering the board and the initial set-up of the board and men are shown in the following diagram, with notation as follows:
 - b - black single
 - r - red single
 - B - black king
 - R - red king



	1 b		2 b		3 b		4 b
5 b		6 b		7 b		8 b	
	9 b		10 b		11 b		12 b
13		14		15		16	
	17		18		19		20
21 r		22 r		23 r		24 r	
	25 r		26 r		27 r		28 r
29 r		30 r		31 r		32 r	

figure 1
initial
set-up

4. Equipment set-up:

- (a) The teletype should be on.
- (b) The D/A converter should be on. [The A/D converter should be off.] D/A output channel 1 should be hooked up to the negative x-input of an oscilloscope, and D/A output channel 2 should be hooked up to the negative y-input of this oscilloscope. The oscilloscope should be on with sweep disabled, and the size and position controls should be set so that the board which will be displayed just fills the screen.
- (c) Output from the music registers should be fed to two speakers through a stereo amplifier if music is desired. This option should not be used during tournament games.

5. Switch Register control:

- bit 0: down - display checkerboard grid as well as men
up - don't display checkerboard grid
- bit 1: down - normal position
up - freeze display (when c ; prohibit further play
- bit 2: down - don't play music while waiting for input
up - play music while displaying board, waiting for input



- bit 5: down - don't play notes while computer "thinking"
up - while computer is contemplating its move, notes will be played; the higher the pitch, the greater the current depth of analysis
- bit 6: down - normal position
up - used for diagnostic purposes only; types moves at all levels temporarily rejected by analysis
- bit 10:down - normal position
up - used for diagnostic purposes only; types mini-maxed evaluations at each level of the analysis
- bit 11:down - normal position
up - used for diagnostic and trace purposes only; prints entire analysis and static board evaluations

The general user should normally keep bits 6-11 down since the type-out produced by them is lengthy and meaningless to him. While these bits are up, the current board is no longer displayed; instead the board currently under consideration by the analysis is displayed.

6. Entering moves:

Black starts the game. Before each move, the computer types out the number of the move and the player whose turn it is to move (either black or red) followed by a colon. If the computer has been told to make moves for this player (see next section) it then types its move in the format described below. [Moves are numbered sequentially and are typed in octal.] If the player is to make a move, he types it in via the following format:

For a non-capturing single move, you type the number of the square containing the piece you desire to move, followed by a space or a hyphen followed by the number of the square you wish to move to. For example: 14 18

For a jump, you type the number of the square containing the piece you desire to move followed by each square, in order, which this piece will touch while performing the jump. This does not include the squares which are jumped over. These squares are entered separated by either a space or a hyphen. For example: 2 18 9 2 or 17-18

Square numbers are typed in decimal and correspond to the numbering system shown in figure 1. A square's number is one or two digits long. A one-digit number may be typed in with a preceding zero if desired, but this is not necessary. Typing errors can be corrected by using the back-arrow character. Typing a back-arrow (before hitting carriage return) erases the previously entered character and allows you to retype it. n characters can be erased by typing n back-arrows. Back-arrows have no effect if there are no more characters left to be erased.

After having typed your move, you must type a carriage return. If the move typed was syntactically incorrect, your input is ignored, and the computer repeats its request for input.



If an illegal move is typed in, either because the pieces don't move in the manner typed in or because a non-jump was entered when you had a jump on the board, the message

ILLEGAL MOVE or ILLEGAL JUMP

is typed out, depending on whether the computer was expecting you to enter a non-capturing move or a jump.

7. Entering commands:

At any time, instead of entering a move, you may enter a command to the program. Commands consist of two letters (or more) followed by a carriage return. The legal commands are listed and described below. If an illegal command is entered, the computer types WHAT? and then repeats its last request for input, at which point you may repeat your attempt to enter a command or you may make your next move. After the command is executed, play continues from where it was left off except if the command requested otherwise. The legal commands are:

- RE (resign) Indicates that the player wishes to resign
- PB (play black) Tells the computer to play for black
- PR (play red) Tells the computer to play for red
- PY (play yourself) Tells the computer to play for black and red
- PN (play neither) Lets the player(s) play for both black and red
- PA (pass) Lets the player pass (make no move)
- NE (new game) Starts up a new game
- EA (halt) The computer halts. Play may be resumed by hitting continue. Music is suspended.
- BD (board display) Prints current board on teletype.
- MO (monitor) Terminates game and bootstraps by branching to location 7600.
- EV (evaluation) For diagnostic purposes - prints static evaluation of current position.
- WH (what?) not currently implemented
- TB (take back) Take back last move. Not currently implemented.
- SMn (set maxply to n) where n is a non-zero octal digit. This command sets the minimum look-ahead to n. It is initially set to 2. It must not be set to zero and it is recommended that it not be set to more than 5. Example: SM3
- AN (analyse) Puts program into analysis mode which allows the user to specify an initial position from which play is to then start.

In analyse mode, the computer, in succession, types out the name of the piece to be placed on the board (BS-black single; BK-black king; RS-red single; RK-red king) at which point the user types in the squares (if any) which are to contain this piece separated by a space from each other and terminated by a carriage return.

Typing errors incurred while entering a command can be fixed by using the back-arrow character as explained before.



8. Miscellaneous:

- (a) A board type-out (via the ED command) can be abruptly terminated by striking any character on the keyboard.
- (b) Hitting about at any time restarts the program.
- (c) The program is completely restartable from location 200.
- (d) P7S CHECKERS will run on a machine without EAE. However, for users with EAE, the MQ is used as a bar graph (from the left) which indicates the dynamic depth of look-ahead. While the computer is "thinking", each light on in the MQ indicates two levels of look-ahead.
- (e) Hitting break while the computer is thinking tells it that at the completion of the move it is currently contemplating, it should stop playing for either player (as if the command BN were entered). Hitting control X has the same effect except that the computer does not finish determining the move it was then working on.
- (f) While the computer is not thinking, the current board is always displayed on the oscilloscope using the notation described in section 5(a). Unoccupied squares (which may legally be played upon) are partly shaded in.



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Appendix I

Words to L'amour est Bleu (Love is Blue)

Doux, doux, l'amour est doux
Douce est ma vie, ma vie dans tes bras
Doux, doux, l'amour est doux
Douce est ma vie, ma vie pres de toi ---

Bleu, bleu, l'amour est bleu
Berce mon coeur, mon coeur amoureux
Bleu, bleu, l'amour est bleu
Bleu comme le ciel qui joue dans tes yeux ---

Comme l'eau Comme l'eau qui court
Moi mon coeur Court apres ton amour.

Gris, gris, l'amour est gris
Pleure mon coeur lorsque tu t'en vas
Gris, gris, le ciel est gris
Tombe la pluie quand tu n'es plus la ---

Le vent, le vent gemit
Pleure le vent lorsque tu t'en vas
Le vent, le vent maudit
Pleure mon coeur quand tu n'es plus la ---

Comme l'eau Comme l'eau qui court
Moi mon coeur Court apres ton amour.

Bleu, bleu, l'amour est bleu
Le ciel est bleu lorsque tu reviens
Bleu, bleu, l'amour est bleu
L'amour est bleu quand tu prends ma main ---

Fou, fou*, l'amour est fou
Fou contre toi et fou comme moi
Bleu, bleu, l'amour est bleu
L'amour est bleu quand je suis a toi.

*no relation to FOO.