

Instant Software™

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PROGRAM DOCUMENTATION

TRS-80*
Model I, Level II
16K

MASTER REVERSI

0378RD

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Introduction

Reversi is a game for two players. The game is played on a 64-square (8 by 8) grid. The players use a supply of disks, each of which is white on one side and black on the other. Prior to the start of play, four disks are placed at the center of the board as shown in Figure 1. One player takes black and the other white. The object is to end the game with the majority of disks on the board having your color face up—the greater your majority, the more complete your victory.

The two players alternate in placing a disk, player's side up, on one of the board's empty squares. Black always goes first. Only certain squares are legal, as will be discussed shortly. If the player has no legal move, he must pass and let the other player take an extra turn. A player may not pass if a legal move is available, no matter how poor a move it may be. When neither player has a legal move, the game is over.

Once placed, a disk is never removed or moved to another square during the course of the game. However, a disk may be turned over, or flipped, reversing its color. Hence the name, "Reversi."

Only moves which result in at least one enemy disk being flipped are legal. You flip your opponent's disks by bracketing them with your own. All pieces thus bracketed, in ANY straight line, whether horizontal, vertical or diagonal, are then flipped over to reverse their color. See Figure 2. If it is Black's turn to play, he can place a disk on the square indicated by the asterisk. After this has been done, the line formed by the two white disks has a black disk on each end. The white disks have been bracketed and thus must both be turned over. The result is depicted in Figure 3. This was a vertical flip. For an example of a horizontal flip, see Figures 4 and 5. For an example of a diagonal flip, see Figures 6 and 7.

In Reversi, a single move may result in flips in more than one direction. In Figure 8, a move by Black to the starred square will flip two ways, vertically and diagonally. Figure 9 shows the result. Figure 10 shows a position in which Black can flip in 8 directions. Figure 11 shows the outcome. This is the maximum number of directions possible in Reversi. 8-way flips rarely occur in actual play, but are quite legal.

Figure 12 is presented to avert a common beginners' misunderstanding of the rules. If Black plays to the starred square, he flips the three white disks in row 5. Figure 13 shows the outcome. Note that, as a result of these flips, the two remaining white disks in column E are now bracketed by black disks. This does NOT mean that they too are to be flipped at this time. Only lines of disks which are directly bracketed by the disk just played may be flipped.

Loading Instructions

To run MASTER REVERSI, simply put your MASTER REVERSI disk in drive 0 and press the RESET button. The disk will boot and the program will load automatically. MASTER REVERSI's title page will appear in wide letters while the program loads. When the letters become narrow the program is loaded.

Getting Acquainted: Some Fundamental Commands and Features

After the program has been loaded and the title page has been displayed, press any key. The title page will be replaced by MASTER REVERSI's menu. Press <I>. As indicated on the menu, this means "I want to play against the computer." (Other options will be described in the Advanced Features section.) You will see a display similar to Figure 14.

The main part of the display is occupied by an 8 by 8 playing board. The four center squares are set up in the standard Reversi opening position. The solid squares stand for white disks and the 'X'-like markers stand for black disks.

There is some additional information to the right of the playing board. Near the top, a black disk and a white disk are depicted. Below the black disk is the word HUMAN, indicating that you have the color black. Beneath the white disk is the name ALDARON. Your computer opponent is named ALDARON because, in Tolkien mythology, Aldaron is the lord of the trees. Since this program uses state-of-the-art logic tree search algorithms to make itself the most formidable machine-Reversi opponent available, its name is apt.

There is a small arrow between ALDARON's disk and the human's disk pointing to the human's disk. The arrow always points to the player whose turn it is.

Below each name is the number 2. The number below a player's name shows the number of disks of his color currently on the board. Figure 14 shows the opening position and each player has two disks.

<I>

Below the two 2's, you will see IQ = 2. This indicates that the program is set to level 2. Levels 0 through 9 are available. To change the IQ level, press <D>. The computer will replace the 2 with all the digits from one to nine so rapidly that you can only see a flickering numeral. The cycling numerals continue until you press any key from 0 to 9, depending on which level you want. Select an IQ of 4 for a get-acquainted game. At level 4, ALDARON will respond promptly, yet play a strong enough game to defeat most humans. The IQ level may be changed at any stage of the game.

Later on, some additional information will appear on the screen in parentheses to the right of the IQ = message. You need not understand the parenthetical material in order to enjoy playing Reversi, and it will be explained in the Advanced Features section.

Above the black disk at the upper right there is a tournament clock. A similar clock will appear over the white disk after you make your first move. You may ignore these clocks for the present as they will have no effect on the flow of the game and will be fully explained in the Advanced Features section.

There is a zero near the upper right corner of the screen, just over the white square above the name ALDARON. The number in that location always shows the current move number. 0 (zero) is now displayed because move 1 (one) hasn't been made yet.

To the right of the 0 are the characters A1. This is the current position of the cursor in standard algebraic Reversi coordinates. (See Appendix 1 if you wish to acquaint yourself with this system of notation.)

<↑> <↓> <→> <←>

The cursor is represented in Figure 14 as a dot. On the screen, it will blink on and off. You may move it with the four arrow keys. The arrow keys automatically repeat. Try holding down the up-arrow and notice how the cursor immediately moves up one square, and then continues up the screen. Also, the cursor "wraps around." If you move it off the top of the screen, it reappears at the bottom. If you move it off the left, it reappears at the right.

NOTE: The following explanation assumes that you are already familiar with the rules of Reversi. If not reread the introduction before continuing.

<ENTER>

Note how the cursor coordinates at the upper-right of the screen change as the cursor moves. Move the cursor to the square where you would like to put your first disk, and enter your move by pressing <ENTER>. If you're not sure which squares you can legally move to, try any square. Attempts to make illegal moves available. ALDARON will display an asterisk in all the squares to which you can legally move. After studying the options, press any key to continue the game. Position the cursor to one of the available legal squares, and press <ENTER>. A black disk will appear on the screen at the cursor position and flash several times to make sure you notice it. After about a second, the new disk will stop flashing and the flip(s) engendered by your move will be carried out. The move count above ALDARON's name will be updated from zero to one to reflect the completion of the first move. Also, the disk counts below the two names will be adjusted to reflect the changes on the screen.

Almost immediately (perhaps even before you've had a chance to verify all the changes discussed above), ALDARON will respond with a move of his own. He will place a disk on the board, flash it to make sure you have noticed where he is moving, and then perform the necessary flip. (By the way, MASTER REVERSI's randomizing feature makes it unlikely that ALDARON will choose moves which result in two identical games in a row.)

<->

To see what the board looked like before ALDARON's move was made, press <-> ("minus" to go back). As long as you hold down the key, the previous position's display will be retained on the board. When you release the minus key, the current game display returns. If you are unfamiliar with Reversi, press and release the minus key and study the flip which has taken place, until you see just which disk flipped and why.

<BREAK>

At the higher IQ levels, ALDARON may take a substantial amount of time to move. If you get bored, you can force him to move quickly by holding down the break key. This will cause ALDARON to abort his search and make the best move he found up until the time you interrupted him.

<SPACE>

It is now your turn to make the third move of the game. Place the cursor on a legal move square BUT DON'T PRESS <ENTER> YET. Instead, acquaint yourself with another of MASTER REVERSI's features by pressing the <SPACE> bar. ALDARON will respond by showing you what the board would look like if you were to move to the selected square.

You may study the resulting position to decide whether or not you actually want to make that move. If you decide you like the new position, simply press <ENTER> and ALDARON will accept the move as played. Otherwise, press any key other than <ENTER>, and the board position will be restored so that you may continue your search for an acceptable move.

Since it is illegal to move to an occupied square, you can use <SPACE> to get ALDARON to show you all the places you may move to. Just place the cursor on an occupied square before pressing the <SPACE> bar.

<P>

Continue to play the game. If a situation arises in which you have no legal moves, ALDARON will inform you that you must pass, and ask you to press <P> to acknowledge this (see Figure 16). If you then press <P> for Pass, ALDARON will move again. If you press any key other than <P>, the message will disappear and you will be able to move the cursor around the screen. However, since there are no legal moves, eventually you will have to surrender, and press <P> to pass.

If you attempt to pass when you have one or more legal moves, ALDARON will display your legal moves and let you try again. The one exception to this occurs before the first move of the game. ALDARON always gives you black at the start of a game, and expects you to move first. If you would prefer ALDARON to play first, pass by pressing <P>. ALDARON will then switch colors with you and make the first move.

When ALDARON is thinking, a flickering line below the IQ = message will assure you that he is awake. The flickering pattern also imparts some other information which will be covered in the Advanced Features section.

As the game draws to a close, a plus sign (+) or some additional numbers may appear above the players' names. You don't need to be concerned with them to enjoy your game. Their meaning will be presented in the Advanced Features section.

When the game is over, ALDARON will let you know who won by blinking the victor's name on and off. In the case of a draw, ALDARON will blink the two names alternately.

After a game has been completed, ALDARON will display the following message:

SAVE GAME (Y/N)?

The meaning of this will be explained in the Advanced Features section. For now, just answer <N>. A copy of the game history in Reversi notation will be displayed (this notation is explained in Appendix 1). Pressing any key other than <ENTER> will switch the display back and forth between the game history and the final position. You may press <ENTER> to return to the start position and begin a new game. When the game history appears, you will be prompted:

PLAY AGAIN?

(Y/Q)

Press <Y> to start a new game or <Q> to reboot.

ADVANCED FEATURES

<&>

Any time you wish, you may have MASTER REVERSI display a list of its commands and their uses by pressing <?>. There are several screenfuls of instructions available in the help mode. To go from any page to the next, press <ENTER>. If you press <ENTER> while the last help-page is on the screen, MASTER REVERSI will cycle you back to the first page. When you have had enough help, press <BREAK> to return to the game.

<SHIFT><U>

In the previous section of this manual, you learned how to use <-> to view the board position of the previous move. If you want to take a move back, <SHIFT><U> (for "Undo") will do so. You may press <SHIFT><U> repeatedly if you like, and undo the game all the way back to move zero.

"Undo" is the first <SHIFT>ed command introduced thus far. In general, commands which are not destructive to the normal, orderly flow of a game do not require the use of <SHIFT>. Commands which may alter the game flow in an extra-legal fashion require the <SHIFT>. This is to prevent accidents from disrupting your game.

<M>

If you would like help selecting a move, press <M> (for Move). ALDARON will use his current IQ setting to search for your best move. Once found, the move will be displayed in the usual way. Press <ENTER> if you wish to make the move ALDARON has shown you. Press any other key to remove his recommendation from the board. If you are at a high IQ level and get tired of waiting for ALDARON's recommendation, simply hold down <BREAK> and ALDARON will return with the best move found so far.

<SHIFT><M>

If you would like to have ALDARON suggest a move without any wait at all, press <SHIFT><M>. ALDARON will display the best move he found for you during his previous search for his own move.

There are a couple of restrictions to be aware of when using <SHIFT><M>. If the game has just started and ALDARON is still in his "opening book" he will have no <SHIFT><M> recommendation because he will not yet have done a search. Also, if you have pressed <M> since ALDARON's last move, subsequently pressing <SHIFT><M> will not display a move for you. Instead, it will show ALDARON's most likely response to you if you should make the move suggested when you tried <M>.

There is one other factor to keep in mind about <SHIFT><M>: ALDARON's recommendation is based on a search done one move ago. Therefore, the search is effectively one ply (move) shallower than one starting from the current position would be, so <SHIFT><M> may suggest a slightly weaker move than <M> would. This is the price you pay for an instant answer.

<SHIFT><P>

You learned in the Getting Acquainted section that <P> allows you to pass, but only when it is legal to do so. If you would like to pass even when it is not legal, <SHIFT><P> (for Pass) will do the trick. Notice that the shift key is required because you are doing something illegal.

After you press <SHIFT><P>, the fact that it has become ALDARON's turn will be indicated by the player arrow at the top right section of the display. However, ALDARON won't move until you

tell him to because he isn't sure what you're trying to accomplish. If you want to choose a move for ALDARON, simply place the cursor on the selected square and press <ENTER>. If you want ALDARON to select his own move, tell him to do so by using the M option, waiting for ALDARON to display a move, and then pressing <ENTER>. Then proceed as usual.

<SHIFT><R>

A similar command to <SHIFT><P> is <SHIFT><R> (for Reverse). This allows you to switch sides with the computer. For example, if you were Black in a game against ALDARON and wanted to switch sides, you could press <SHIFT><R>. You would then be White and ALDARON would be Black. You will then see the new status on the right hand side of screen. After <SHIFT><R> has been pressed, it is still the same color's turn to play. Since it was Black's turn before the switch was made, it will still be Black's turn. Thus the turn becomes ALDARON's.

In this case, ALDARON will not move until you tell him to because you might have wanted to keep the turn as well as to reverse colors. ALDARON gives you a chance to do that now by pressing <SHIFT><P>, thus forcing him to pass. It will then be your move and you may proceed normally. If, on the other hand, you want ALDARON to move, either enter his move for him or use the <M> option to get him to select his own move. If you use the <M> option, don't forget to press <ENTER> after ALDARON selects a move.

<N> or <SHIFT><N>

If you get tired of seeing yourself referred to as HUMAN, simply press <N> (for "Name"). You will see a blinking cursor appear over the H of HUMAN. You now have an opportunity to change the name of either or both players.

You may type in a new name (up to 8 letters). At the end of the new name, press <ENTER> and the cursor will move to the beginning of the left-hand name. Keying in the second name is the same as keying in the first, except that after <ENTER> is pressed, you will leave the Rename Mode and return to the play mode. If you attempt to type in a name which is too long, ALDARON will automatically put in an <ENTER> for you after the eighth letter. To leave the old name unchanged, press <ENTER> while the cursor is still over the first letter of the old name.

<SHIFT><Q>

Another command which has been shifted because it is disruptive to normal play is <SHIFT><Q> (for Quit). In fact, this command is so disruptive that an extra level of protection has been included to prevent accidentally invoking it. After you press <SHIFT><Q>, ALDARON will ask YOU RANG? If you want to quit, press <Y> (for Yes) and you will be returned to the game initialization menu. Otherwise, press any other key and continue the game.

<SHIFT><F>

Some Reversi players may be disturbed by the flashing cursor which is present when it is the human's turn to move. To eliminate this inconvenience, simply press <SHIFT><F> (for Flash) and the offending flickering will cease. Pressing <SHIFT><F> again will restore the flashing.

CLOCKS

At the start of a new game, the two clocks are reset to 25 minutes. For those of you not familiar with chess clocks in general, and their application to tournament Reversi in particular, here is an explanation:

In a tournament Reversi game, each player is allowed a cumulative 25 minutes to complete all of his or her moves. Since this averages out to less than a minute a move, tournament games are pretty fast-paced. To enforce this speed limit, each player is provided with a clock which runs while it is his or her turn, and stops when it is the other player's turn. If a player uses more than 25 minutes, a flag on his or her clock changes position to indicate a forfeit has occurred.

ALDARON allows you to play by tournament rules. At the start of a game, each player has 25 minutes on the clock. During each player's think time, the clock counts down. Thus, the clock shows the player how much time he or she has left for his/her remaining moves. If a player's clock reaches zero, ALDARON will not declare a forfeit. Instead, he resets the clock to 25 minutes and starts counting up. Whether or not you call a forfeit in that situation is left up to you. Should you decide to continue the game, the clock of the player who "overstepped" will thereafter show total time consumed instead of time remaining.

<T>

<T> (for Think Mode) controls one of MASTER REVERSI's most novel features. Think Mode (or T-Mode) simply determines what is displayed while ALDARON is thinking. There are 4 T-Modes.

numbered 0 through 3. When you first boot up MASTER REVERSI, T-Mode 1 is automatically selected.

If you press T, you will notice a Think Mode prompt on the lower-right section of the screen. Like the IQ prompt, the T-Mode has a "cycling-digit" display to its right. Enter a number from 0 to 3 to select the corresponding T-Mode.

T-Mode 0 is the "quiet" or "nothing-special" mode. In this mode, when it is ALDARON's turn you will see an unchanging display of the board—only ALDARON's clock ticking down lets you know that the program is alive. This mode is for players who prefer a tournament atmosphere. It allows the human to contemplate the position without visual distraction, even when it's ALDARON's turn to play.

T-Mode 1 is the default mode. It is the same as mode 0 except that a flickering graphics bar appears near the lower right corner of the display when ALDARON is thinking. It is only intended as further reassurance that MASTER REVERSI has not hung up on those occasions when ALDARON takes longer than usual to choose his move.

The flickering bar also presents certain information about the state of ALDARON's tree-search. It is not really necessary to understand it, but if you're interested, here's what it means:

The bar is actually composed of a series of separate graphics blocks (they look like little squares) concatenated from left to right. The left-most block represents the lowest level of the tree (one ply deep). The next square to the right represents the second ply, etc. Whenever ALDARON thinks about a move at a specific ply, he reverses the state of that ply's block (if it's off he turns it on and if it's on he turns it off). Thus, to some extent, T-Mode 1 lets you follow the ins and outs of ALDARON's calculations.

Also, in T-Mode 1, Prediction is turned on. See the discussion of Prediction after the section on T-Mode 3.

T-Mode 2 displays everything displayed by mode 1 plus a dynamic revelation of ALDARON's move evaluation factors. To see what happens in this mode, select an IQ level which thinks for at least several seconds before moving. 5 or 6 would be good. Select T-Mode 2. Now play a few moves. You'll notice numbers appearing on some of the squares of the game board. They may be anywhere between 0 and 99 and only appear on squares to which ALDARON may play on the current move. They reflect ALDARON's evaluation of the consequences of moving to that square. 50 is neutral. Anything above 50 is favorable to ALDARON, and anything below 50 is unfavorable. (If ALDARON is looking for a move for YOU because you have pressed <M>, then above 50 is favorable for you, not ALDARON).

Usually, the numbers will change while you watch. This is because ALDARON's evaluation changes as he gets deeper into his search. The numbers disappear when ALDARON moves. This may make it difficult to observe. To see it clearly, hold down the <SPACE> bar while ALDARON is thinking. ALDARON will seek a move as usual, but when he finds it, he won't display it until you release <SPACE>. You'll know ALDARON is waiting when you see the graphics bar stop flickering. Now, while continuing to hold down <SPACE>, you may contemplate ALDARON's final evaluations. If one square is numbered higher than any other, you should see ALDARON move there when you release <SPACE>. If several squares are tied for first, ALDARON will select one of those squares.

If you are good at evaluating Reversi positions, you may notice that sometimes a relatively poor move appears to receive the same evaluation factor that a very good one receives. This is a consequence of the alpha-beta tree pruning technique. ALDARON will still choose the best of the moves which appeared for first place. Suppose that move A is better than move B. Move B may show the same evaluation factor on the screen. This merely indicates that at some stage of his decision procedure, ALDARON determined that move B, at best, was no better than move A, and therefore wisely decided not to evaluate it any further.

One of the most important uses of T-Mode 2 is in analysis. One can get a good idea of how ALDARON rates the various options available to him in a given situation by watching him think in T-Mode 2. To see how ALDARON rates the opponent's alternative, simply wait till it's the opponent's turn, leave T-Mode 2 on, and press <M>.

T-Mode 3 shows everything displayed by mode 1. In addition, the game board is updated to display every position evaluated by ALDARON in his search. Actually, the two deepest plies are not included because to do so would result in an impossibly fast display. (NOTE: This mode makes ALDARON take about twice as long to move.)

Predict

At any IQ level from 4 up, ALDARON handles time allocation by dividing the game up into two stages. At first he plays quickly by not looking very far ahead—a mere 6 ply at level 6. When Predict is on, the level ALDARON is investigating at any moment is shown in parentheses just to the right of the IQ display.

As the game continues, ALDARON gradually increases the extent of his look-ahead. During these early phases, ALDARON's main strategic objective is to maximize the flexibility of his position while decreasing that of yours.

At some point, a stage is reached where ALDARON is capable of foreseeing every eventuality that can occur during the game. At IQ 6, this happens when there are about 14 empty squares remaining on the board. When this "end game" stage is reached, ALDARON abandons his earlier strategy and concentrates on finishing with the highest disk count possible. At this point, ALDARON is certain to find a win, if one exists, so he is eager to reach that stage as early as possible. To further this goal, he will sometimes attempt to look to the end before he has time to complete the search. Let's call it the Pre-End Search, or PES. He can get away with this because, at that stage, he stops searching as soon as he finds a win. In other words, by settling for the first win found rather than the best win, ALDARON clinches his victory a move or two sooner than would otherwise be possible.

Once an end game search has been completed, ALDARON knows who will win and by how much if both players play perfectly from that point on, and he is capable of passing that information on to us. In the Prediction Mode, that's exactly what he does by placing a number above the name of the player who should win—assuming both players continue perfectly! The number is the disk count by which the winner should be ahead at the end of the game.

This number is posted just as ALDARON finishes moving. It disappears as soon as you press any key, so if you're interested in the prediction, look before you touch!

Now here's why we explained a little about the PES. Remember there's a point where ALDARON has searched to the end for a win, but hasn't yet found the best win? At that stage, ALDARON knows who should come out on top, but not by how much. Instead of a score, ALDARON places a plus sign (+) above the name of the projected winner. As soon as he knows more (usually after another move or two), ALDARON replaces the + with the projected margin of victory.

SCREEN EDITING (<W>, , and <0>)

You may use ALDARON's analytic abilities to analyze positions and solve problems. Set up a position by placing the cursor over the square you want to alter. Then press <SHIFT><W> to place a white disk on that square, <SHIFT> to place a black one there, or <SHIFT><0> (zero) to empty the square. You may also want to use the <N>, <SHIFT><P>, and <SHIFT><R> commands to tell ALDARON who has which color and whose move it is.

<S>

Once you have a position on the screen that warrants analysis, you can try out different move sequences, have ALDARON recommend moves (with <M> and <SHIFT><M>), and refer to ALDARON's evaluation of a position (as displayed in T-Mode 2). After following a given line of play, you may want to return to the original position (or some crucial intermediate one) to examine alternate continuations.

In such cases, it would be desirable to have some means of restoring a setup without having to re-enter it square by square. MASTER REVERSI allows you to do just that. In fact, the program sets up 5 board-buffers (numbered 1 through 5) so you can have up to 5 separate positions in memory at any one time.

To save a position so you can return to it later, press <S> (for Save). A prompt at the top of the screen will invite you to key in a number from 1 to 5. Do so and the current position will then be saved in the buffer of that number. If you enter an incorrect number (or make any other illegal response), ALDARON will give you a "bad number" message and wait for you to acknowledge it by pressing any key. Then you may type <S> and try again.

NOTE: Saving a position doesn't result in any illegality, so the <SHIFT> key is not used. You should be aware that whichever buffer you select to receive the new position will have its old contents erased. Select your buffer with care! If, after pressing <S>, you change your mind about saving the position, press <BREAK>.

Saved positions will remain in memory only as long as MASTER REVERSI is kept running. You can retain positions even after the computer has been turned off by saving games to disk. This will be discussed later.

<SHIFT><L>

To reload a position previously saved, use **<SHIFT><L>** (for Load). Answer the prompt which appears at the top of the screen with a number from 1 to 5. If you make an illegal response at this stage, ALDARON will give you a "bad number" message and wait for you to acknowledge by pressing any key. You may then press **<SHIFT><L>** and try again.

NOTE: Since loading a saved position will erase the current one and disrupt the game flow, the **<SHIFT>** key is required. Since the current position will be written over, save it in another buffer if you want to return to it.

<=>

While playing a game, you may want to review the moves leading up to the current situation. Pressing **<=>** will display the current game history in standard Reversi notation (described in Appendix 1).

<SHIFT><H>

<SHIFT><H> (for number of Humans) allows you to change the number of players mid-game. After pressing **<SHIFT><H>**, you will be prompted to key in **<0>** (zero), **<1>**, or **<2>**. This choice is similar to that offered in MASTER REVERSI's sign-on menu except that the **<T>** (Tournament) option is not available at this stage.

Entering **<1>** after **<SHIFT><H>** selects the normal (one human versus the computer) mode. If you would like to use MASTER REVERSI as a playing board for a game between two humans, press **<2>** after **<SHIFT><H>**. The two of you may now play against each other using ALDARON to do all the flipping, disk counting, kibitzing, etc. You may ask him to recommend moves (with your opponent's permission, of course!), or to store positions to return to later. And don't forget to use the **<N>** command to place the names of the two human competitors in their proper places! As detailed under "ANALYSIS," the two-human mode is also useful for analyzing completed games.

If you prefer spectator sports, you may enter **<SHIFT><H><0>** (zero), telling ALDARON that no humans will be involved in the game. ALDARON will then play a game against himself.

You may be wondering why someone would want to use the **<SHIFT><H>** feature to change the number of players mid-game. There are actually several situations where this is useful, especially if you like to use ALDARON's superb move selection algorithms to analyze Reversi positions. A few examples will be given in the next section of this booklet which deals with ALDARON's game review features.

GAME REVIEW

At the end of a game, you will be offered the following prompt:

SAVE GAME (Y/N)?

If you type **<Y>** the game you just finished will be stored in a special game-review buffer. Any game previously stored will be lost. If you type **<N>**, the previous contents of the buffer will remain intact, but the game that was just played will not be available for review. If you finish a game you'll want to review later, it can be saved to disk. (This will be explained in detail further on.)

In either case, the game history and the prompt **PLAY AGAIN (Y/N)?** will be displayed. If you respond to the **PLAY AGAIN?** prompt by pressing any key other than **<Y>**, **<Q>**, or **<ENTER>**, the display will switch back and forth between the game history and final position. Pressing **<Y>** returns you to the sign-on menu. Pressing **<Q>** reboots the system—it's the equivalent of pressing the reset button. Pressing **<ENTER>** starts a new game with the same number of humans as the game just completed.

Before going further with these instructions, it would be a good idea to load MASTER REVERSI and play a quick game (use an IQ of 1 or 2 and don't worry about whether you win or lose). Answer **SAVE GAME** with **<Y>**. You will then have a game stored in the review buffer and will be able to follow the examples in the ensuing paragraphs.

Once a game has been saved by answering the **SAVE GAME (Y/N)** question with **<Y>**, you may use **<SHIFT><J>** (for Jump) to jump to any point in the game you choose. If you have a game in the review buffer, try the following:

Type **<SHIFT><H>** and then **<2>** to get into the two-human mode. This will simplify our exploration by preventing ALDARON from making a move whenever he thinks it's his turn. Now type **<SHIFT><J>** and you will be prompted to enter a number. Type in 35 and then press

<ENTER>. The screen should show you the position just after move 35 was made. The cursor should be at the location of the 35th move and the cursor coordinates shown near the upper right hand corner of the display should reflect the algebraic coordinates of the new cursor location. The move counter to the left of the algebraic coordinates should indicate that move 35 was made. The disk counts beneath the names should reflect the new score, and the arrow between the two players should show whose turn it is to move.

You may now use ALDARON's other features to explore the position. For example, <-> will show you what the board looked like before move 35 was made. The arrows will let you move the cursor around and <SPACE> will show the immediate results of any move you might be curious about. <ENTER> will let you make a move. Trying an illegal move will result in a display of legal alternatives. <M> will have ALDARON recommend a move using his current IQ level, and <SHIFT><U> will let you backspace a move at a time starting from the current position (in this example, move 35).

Try using <SHIFT><J> to jump to several different positions in your game. You may want to jump forward to the final position. This will often be move 60. However, if any passes occurred during the game, the final move number might be higher than 60. To be safe, jump to 70. Trying to jump to a move numbered higher than the last move of the game will get you to the final position.

You have another feature available. Use <SHIFT><J> to get a mid-game position (move 35 would be good). Now press <@>. ALDARON will display the next move made in the game. <@> shows a move in the same way that <SPACE> does—that is, after pressing <@>, pressing any key other than <ENTER> cancels the displayed move; pressing <ENTER> actually enters the move. When analyzing a game, you may use <@> to remind yourself of what was played in a given position, and then use ALDARON's other facilities to investigate alternative lines of play.

If you attempt to use <@> in a position in which a pass occurred, ALDARON will bring this to your attention by giving you the standard PASS prompt. After pressing <P> to enable the pass, you may continue using <@>.

Notice that <@> is, in effect, a single-stepping key that lets you advance, move by move, through a stored game. If you would like to be able to step through the game without having to press <ENTER> after every <@>, use <SHIFT><@> instead. <SHIFT><@> performs much the same function as does <@> except that <SHIFT><@> enters the move for you as well. Combined with <SHIFT><U> which steps backward, you can step back and forth through the game from one position to another.

Another aspect of <SHIFT><@> is its automatic repeat feature. Get the starting position of the game (using <SHIFT><J><O><ENTER>). Then hold down <SHIFT><@> and watch the miracle of time-lapse photography bring you the Reader's Digest version of the game.

Now that you know how to use the game review features (<SHIFT><J>, <@> and <SHIFT><@>), you no longer have to use the save <S> and load <SHIFT><L> features to save any positions which occur during a game. All positions occurring during a game will automatically be made available when the game is completed if you answer the SAVE (Y/N)? prompt with <Y>. You may reserve the 5 <S> buffers for storing the interesting positions you come across while analyzing side lines bypassed during the game itself.

Analysis

If you do much game analysis, you'll like the way the review features work in concert with the <SHIFT><H> options. You can begin a typical analysis session at the end of a game by answering the SAVE (Y/N)? prompt with <Y/N> and pressing <ENTER> to go back to the game's starting position. Next, use <SHIFT><H> to select the two-human mode, and use <I> to set ALDARON's IQ to a good level for analysis (anywhere from 4 to 7, depending upon how serious you are). Now step through the game using <SHIFT><@>, or use <SHIFT><J> to jump right to the most interesting part of the game. Use <@> to remind yourself what move was played in that position. Move the cursor to other squares and use the space bar to see the results of alternate moves. When you find one that looks interesting, <ENTER> it, and play a move for the other side. Explore this variation as deeply as you like. If you play through to the end of the game, answer the SAVE <Y/N>? question

with <N> (otherwise, the sideline will replace the real game in the game review buffer.) If you come across any positions worth studying more deeply later, use the <S> command to save them.

Whenever you're ready, use <SHIFT><J> and an appropriate move number to return to the main line of the game. Step to a position in which it was your turn to move. Then press <M> to see what ALDARON would have done in your place. Next, after pressing any key (other than <ENTER>) to remove ALDARON's recommendation from the display, press <SHIFT><M> to see how ALDARON might have replied to the move he suggested for you. Explore any interesting avenues of play opened up by those moves. Then use the <SHIFT><L> command to reload the interesting sideline position you saved earlier, and use the <SHIFT><H> to change from the two-player mode to the one-player mode. Use <T><2> to turn on think-mode 2 and play a few moves against ALDARON and see what he thinks of the position! Then use <SHIFT><J> to return to the real game position and use <SHIFT><H> to switch to the zero-player mode. Sit back and watch ALDARON as he shows you how he thinks each player should have handled the position.

If you're not a tournament Reversi player, you'll probably never need to pursue your investigations as thoroughly as outlined above. But if you are a serious competitor, you will find ALDARON's analytic gifts a remarkable boon.

Tournament Mode

Serious Reversi players may use the Tournament Mode. To enter this mode, press <T> at the sign-on menu (to get to the sign-on menu, simply Quit the game you are in). This is a special version of the one-human mode. It has been altered to simulate tournament conditions as closely as possible and afford the most formidable competition ALDARON is capable of.

In the Tournament Mode, MASTER REVERSI accomplishes the above by 1) turning off the flickering cursor, 2) using an opening book, 3) thinking on the opponent's time, and 4) making the fullest possible use of the allotted 25 minutes. Let's take a brief look at each of these measures.

1) Turning off the flashing cursor: ALDARON does this so that the playing board will be as free from distracting motion as possible. If, as a result, you're not sure whether it's your turn to move or ALDARON's, look at the indicator arrow near the upper right of the display or check to see whose clock is running. If it's your turn in the Tournament Mode and you can't tell where the cursor is, simply press one of the arrow keys. The cursor is quite visible while moving.

2) Using an opening book: In the normal playing mode ALDARON calculates his opening moves in the same way that he chooses his other moves. As a result, he plays excellent openings (at the higher IQ levels) at the cost of precious time. In the Tournament Mode, ALDARON will conserve time by playing "memorized" or "book" openings. You will know when ALDARON is making memorized moves because he will make them instantly, regardless of the IQ level.

In the Tournament Mode, ALDARON's propensity toward playing canned openings will reduce the variety of opening lines your game may take. If you like, you may prevent ALDARON from using his opening book without having to give up the Tournament Mode. To do so, play a few moves in the Tournament Mode until ALDARON is out of his book. You will know this has happened when he starts to think about a move. Then, wait till it's your turn again (you may hasten this by pressing <BREAK> if you like), and restart the game by jumping to move zero (<SHIFT><J><0>). Now ALDARON will play the opening without referring to his book.

3) Thinking on the opponent's time: As soon as ALDARON is out of his opening book, he will try to conserve time on his clock by thinking while yours is running. Here's how he goes about it. When ALDARON chooses a move, he also determines as best as he can what your reply should be. After displaying his own move, ALDARON assumes that you will make the projected reply and immediately starts thinking about his next move on that basis. If he is wrong and you pick a move other than the one he expected, he is no worse off than if he hadn't tried. If, however, you select the move he prepared for, he will have gained whatever time you consumed in selecting it. Often, if you make the projected move, ALDARON will respond instantly. To find out what move ALDARON is expecting, press <SHIFT><M> before you move.

4) Making the fullest possible use of the allotted 25 minutes: Since ALDARON is saving time by using the opening book and by thinking while it's your turn, he tries to use that extra time to his advantage. He does so by investigating the possibilities of a position more thoroughly than usual.

Entry Mode

Suppose you wanted to use MASTER REVERSI to examine a game played at an earlier time. You have a copy of the game in Reversi game history notation (see the notation section for an explanation of game history diagrams). One way you could get the game into the computer is to enter MASTER REVERSI's two player mode and use the normal move-entry procedure to type it in move by move. That might prove slightly awkward because of the necessity of searching the game history diagram for the next move each turn. An easier way to enter the game would be to enter MASTER REVERSI's Entry Mode by pressing <SHIFT><E>. Notice how ALDARON's blinking dot cursor has been replaced by a blinking underscore character (). This tells you that the game board now displayed is the Entry page. The Entry page looks like the playing board but you can't play a game on it. Instead, you can enter whole games at a time, either from a disk or through the keyboard.

You are now ready to enter a game. You can practice with the sample game in Figure 17, also used in the notation section in Appendix 1.

<SHIFT><Z> (in the Entry Mode)

It's a good idea to type <SHIFT><Z> before entering a game. This zeroes anything which might have been in the Entry page previously. Then type in the numbers as they appear in the game history diagram, going from left to right, top to bottom. After each number, press <ENTER> to advance the cursor to the next square. Check your work as you go along.

ALDARON will help catch mistakes by warning you if you try to enter the same move number on two different squares. He will do so by replacing the first occurrence of a given move number with a Reversi disk as soon as you enter the second occurrence. If you discover any errors, just use the arrow keys to bring the cursor back to the square containing the mistake and enter the correct value (the four arrows work in the Entry Mode in much the same way as in the Playing Mode, except that the cursor will not go to the 4 central squares). When you're finished entering the game, press <BREAK> and you will be returned to the Playing Mode.

WARNING: Whenever you return to the Playing Mode from the Entry Mode, any new position you typed into the Entry page will automatically be transferred into the game-review buffer. That buffer's previous contents will be lost. If you want to preserve the previous contents of the review buffer, press <SHIFT><G> just before returning to the Playing Mode. This will copy the game in the review buffer into the Entry page (see below for a full description of the <SHIFT><G> command). If you want to go from the Entry Mode to the Playing Mode while preserving both the game in the Entry page and the game in the review buffer, save the game in the Entry page on disk (as described below). Next copy the game in the review buffer to the Entry page with <SHIFT><G>. Then return to the Playing Mode with <BREAK>.

Once you are back in Playing Mode, use <SHIFT><J> 70 to get to the end of the game. If you have entered the moves in the Entry Mode correctly, you will see a display of the final position of the game. Otherwise, the game will be displayed at the point where the next move, as you entered it in the Entry Mode, is illegal. If this occurs, note the position of the cursor which shows you the location of the last legal move you entered. Then type <SHIFT><E> to return to the Entry Mode, and look for an error in the next move. After correcting any errors, press <BREAK> to return to the Playing Mode, and try again.

When you have succeeded in getting <J> 70 to jump to the end position, use <J><0> to return to the start. Now all of ALDARON's game review and analysis features may be used to examine the game. An interesting way to begin is with a quick time-lapse trip through the game (hold down <SHIFT><@>).

<N> or <SHIFT><N> (in the Entry Mode)

When you are through looking at the sample game, you may want to save it on disk so you can reexamine it in the future without retyping it. If you decide to do so, start by reentering the Entry Mode (<SHIFT><E>). Then, since the names of the players get saved along with the game, enter the players' names. The method for name changes is the same in the Entry Mode as in the Playing (use <N> or <SHIFT><N>) Mode.

<SHIFT><C> (in the Entry Mode)

Next, use the Catalog feature (<SHIFT><C>) to find a vacant disk slot. After pressing <SHIFT><C>, you will be presented with a full catalog of the games saved in MASTER REVERSI's disk library. Up to 100 games, numbered from 0 to 99, may be stored. When MASTER REVERSI

has filled the screen with catalog information, the display pauses. You may press <ENTER> to continue to the next screenful, or single-step the display with <SPACE>. After all the occupied disk slots have been displayed, you will be returned to the Entry Mode. You may also return to the Entry Mode at any time during the catalog display by holding down <BREAK>.

<SHIFT><D> (in the Entry Mode)

Once you have selected a vacant slot in which to save the game you typed in, press <SHIFT><D> (for Dump). Then answer the prompt with the number of the disk slot you selected, and press <ENTER>. Your game will be saved on the disk. If you enter an illegal slot number, MASTER REVERSI will let you know and you may then repeat the command.

NOTE: The video field, which in the Playing Mode shows the move number, is used in the Entry Mode to show the last disk slot accessed by a Dump or Load command.

<SHIFT><L> (in the Entry Mode)

At a later time, you may want to reload a game from the game library. Go to the Entry Mode and press <SHIFT><L>. Key in the slot number of the game you want to load and press <ENTER>. The game will be loaded into the Entry page.

When you looked at the catalog, you probably noticed that MASTER REVERSI comes with several pre-saved games. The first ten of these are from the Santa Cruz Open Machine Reversi tournament, in which a primitive version of MASTER REVERSI competed. The game that ALDARON played against the Rosenbloom program has the last two moves omitted. This is because in that game, a bug caused ALDARON (playing against a DEC-10) to make a mistake in a won position on his very last move. This lost the game and cost first prize in the tournament. ALDARON is too embarrassed to show you the end of that game, but it's there up to the point where he flubbed. Needless to say, the offending bug has long since been corrected.

Also in the library are some games which earlier versions of MASTER REVERSI lost to human Reversi players, including world champion Jonathan Cerf. ALDARON has enjoyed more than his share of victories against high caliber opponents as well, but we have chosen games for the library which exhibit the creativity and brilliance of human players.

Finally, the library includes some games played entirely by humans. Studying these games will allow you to learn from experienced Reversi tournament players.

<SHIFT><<> (less than) (in the Entry Mode)

The Entry Mode offers a few additional features. Suppose you are playing a game with the computer and don't have time to finish. Before turning off your computer, go into the Entry Mode (<SHIFT><E>) and press <SHIFT><H> (indicating less than a whole game). The interrupted game will then be transferred to the Entry page and you may save it on a disk to continue later.

<SHIFT><G> (in the Entry Mode)

Sometimes you will want to put a game you have just finished on disk. Get the game into the game-review buffer (answer the SAVE (Y/N)? prompt with <Y>). Then go to the Entry page and press <SHIFT><G> (for Game). The finished game will be copied from the review buffer to the Entry page and may then be dumped to disk.

RECOVERING FROM COMPUTER MALFUNCTIONS <BREAK>

If you accidentally reset your TRS-80 during a MASTER REVERSI session, or if a computer malfunction results in a hangup, reboot the MASTER REVERSI disk. When the letters on the title page have become small, press <BREAK>. MASTER REVERSI will enter the two-player mode, preserving as much of the prior game status as possible.

PRINT COMMAND <I> and <">

At any time during a MASTER REVERSI session, you may send the contents of the screen to your printer. You can use this to record positions, game histories, and information on the help pages. To do a screen dump press <I> or <">. <I> is for use with a graphics printer such as the EPSON MX-80. The MX-80's TRS-80 mode switch must be in the TRS-80 position. Use <"> for other printers.

REVERSI NOTATION

There are two common forms of Reversi notation: algebraic notation and game history notation. MASTER REVERSI makes use of both. Algebraic notation is generally used for identifying squares on the Reversi board and describing individual Reversi moves. Game history notation is used for recording sequences of moves (including whole games) in a concise and easily understood manner.

APPENDIX 1

Algebraic notation uses an X, Y coordinate system to identify each square. The eight columns, from left to right, are labeled with the letters "A", "B", "C", "D", "E", "F", "G" and "H" respectively. The eight rows, from top to bottom, are numbered 1, 2, 3, 4, 5, 6, 7, and 8 respectively. Each square may be identified by its column-letter and row-number (see Figure 15). The convention is to place the letter before the number, e.g., A1, B5, etc.

Those of you familiar with algebraic chess notation have probably noticed that the schemes are identical except that in chess, row 1 is on the bottom and row 8 is at the top. Since most contemporary Reversi literature is in Japanese, Reversi players keep the one at the top to retain compatibility with the Japanese system. Recording an entire game in algebraic notation would entail creating a list of about 60 coordinates representing the moves of the game (see Figure 16).

The same information could also be represented by starting with a diagram of the board and writing the number of each move in the corresponding square of the diagram (see Figure 17). This is a game history notation. Notice how little space is required to record an entire game.

APPENDIX 2

Alphabetic Command List Unshifted Commands

<I> (followed by a number from 0 to 8)

Play Mode: Change IQ level to selected number

<M>

Play Mode: do search and recommend move

<N> (or <SHIFT><N>)

Play and Entry modes: change player names

<P>

Play Mode: pass if legal, otherwise display permitted moves

<S> (followed by a number from 1 to 5)

Play Mode: save current position in buffer number

<T> (followed by a number from 0 to 3)

Play Mode: select Think Mode

Shifted Commands

<SHIFT>

Play Mode: place black disk at cursor position

<SHIFT><D> (followed by a number from 0 to 99)

Entry Mode: copy game from Entry page to disk-library slot number

<SHIFT><E>

Play Mode: go to Entry Mode

<SHIFT><F>

Play Mode: turn cursor-flash off or on

<SHIFT><G>

Entry Mode: copy game from review buffer to Entry page

<SHIFT><H>

Play Mode: set the number of humans

<SHIFT><J> (followed by a number and <ENTER>)

Play Mode: jump to move number

<SHIFT><L> (followed by a number from 0 to 99 and <ENTER>)

Entry Mode: copy game from disk-library slot number to Entry page

<SHIFT><L> (followed by a number from 1 to 5)

Play Mode: copy position from buffer number to playing board

<SHIFT><M>

Play Mode: recommend move using results of last search

<SHIFT><N> (or <N>)

Entry and Play Modes: change player names

<SHIFT><P>	Play Mode: force pass (change player on the move) even if illegal
<SHIFT><Q> (followed by <Y>)	Play Mode: quit game and return to sign on page
<SHIFT><R>	Play Mode: swap sides (same color still moves)
<SHIFT><U>	Play Mode: go back a move (go to position displayed by <->)
<SHIFT><W>	Play Mode: place white disk at cursor position
<SHIFT><Z>	Entry Mode: clear Entry page

Non-Alphabetic Commands

<SHIFT><Ø>	Play Mode: empty square at cursor
<<>	Entry Mode: copy incomplete game from playing board
<@>	Play Mode: show the next move in the review game without committing yourself
<SHIFT><@>	Play Mode: step the review game forward one move
<↑>, <↓>, <←>, <→>	Entry and Play Modes: move cursor as indicated
<BREAK>	Entry and Help Modes: go to Play Mode. Play Mode: interrupt ALDARON's search and use best move found so far
<ENTER>	Entry and Play Modes: used to enter moves and various commands. Help Mode: go to next page
<SPACE>	Play Mode: try a move without committing yourself
<.>	Play Mode: display position as it was prior to last move
<=>	Play Mode: display current game history
<!>	All modes: dump screen to graphics printer
<">	All modes: dump screen to non-graphics printer
<?>	Play Mode: go to Help Mode

APPENDIX 3

Command List By Function

Playing Mode, Playing Commands

<↑>, <↓>, <←>, <→>	Move the cursor as indicated
<ENTER>	Enter a move
<SPACE>	Try a move without committing yourself
<P>	Pass if legal, otherwise display permitted moves
<I> (followed by a number from 0 to 8)	Change IQ level to selected number
<->	Display position as it was prior to the last move
<=>	Display current game history
<SHIFT><U>	Go back a move (go to position displayed by <->)
<M>	Do a search and recommend a move

Mode Selection Commands

<?>	Go from Play Mode to Help Mode
<SHIFT><E>	Go from Play Mode to Entry Mode
<BREAK>	Go from Help Mode or Entry Mode to Play Mode
<SHIFT><H>	In Play Mode, set the number of humans
<T>	In Play Mode, set Think Mode (T-Mode)

Print Commands (All Modes)

<!>	Dump screen to graphics printer
<''>	Dump screen to non-graphics printer
<SHIFT><M>	Recommend a move using the results of the last search
<BREAK>	Interrupt ALDARON's search and use the best move found so far
<SHIFT><Q> (followed by <Y>)	Quit the game and return to the sign-on-page

Playing Mode, Editing Commands

<N> (or <SHIFT><N>)	Change player names
<SHIFT>	Place black disk at cursor position
<SHIFT><W>	Place white disk at cursor position
<SHIFT><O>	Empty square at cursor position
<SHIFT><P>	Pass on current turn: even if legal, turn passes to other player
<SHIFT><R>	Swap sides (same color still moves)

Playing Mode, Board Memory Commands

<S> (followed by a number from 1 to 5)	Save current position in buffer number
<SHIFT><L> (followed by a number from 1 to 5)	Copy position from buffer number to playing board

Playing Mode, Game Review Commands

<@>	Show the next move in the review game without committing yourself
<SHIFT><@>	Step the review game forward one move
<SHIFT><U>	Step backward one move
<SHIFT><J> (followed by a number and <ENTER>	Jump to move number

Playing Mode, Sub-Mode Selection Commands

<?>	Go to Help Mode
<SHIFT><H>	Set number of humans
<T> (followed by a number from 0 to 3)	Select Think Mode

Playing Mode, Miscellaneous Commands

<SHIFT><F>	Turn cursor-flash on or off
<SHIFT><E>	Go to Entry Mode

Entry Mode Commands

<↑>, <↓>, <→>, <←>	Move cursor as indicated
<ENTER>	Enter move into Entry page and advance cursor
<SHIFT><Z>	Clear Entry page
<SHIFT><N> (or <N>)	Change player names
<SHIFT><G>	Copy game from review buffer to Entry page
<<>	Copy incomplete game from playing board to Entry page
<SHIFT><L> (followed by a number from 0 to 99)	Copy game from disk-library slot number to Entry page
<BREAK>	Go to Play Mode
<SHIFT><D> (followed by a number from 0 to 99 and <ENTER>)	Copy game from Entry page to disk-library slot number

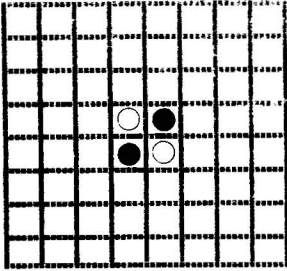


Figure 1

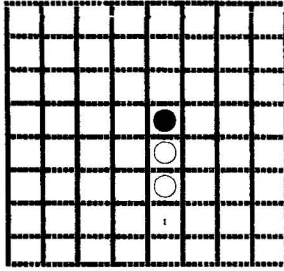


Figure 2

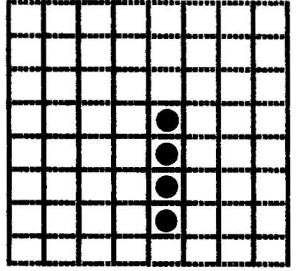


Figure 3

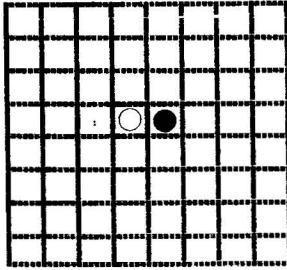


Figure 4

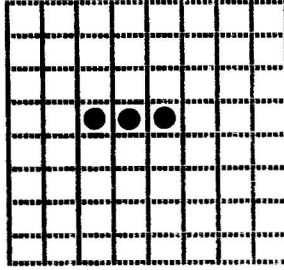


Figure 5

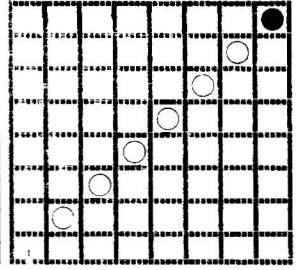


Figure 6

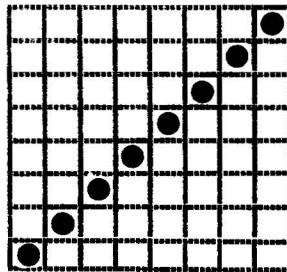


Figure 7

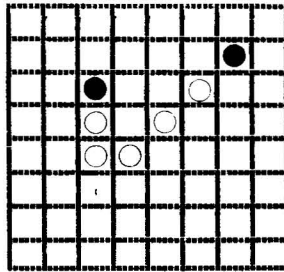


Figure 8

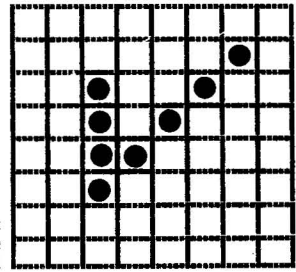


Figure 9

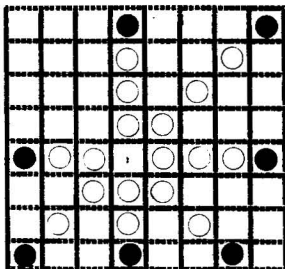


Figure 10

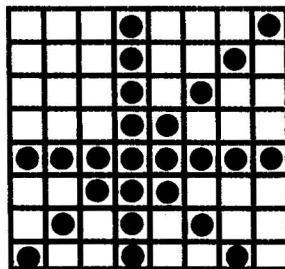


Figure 11

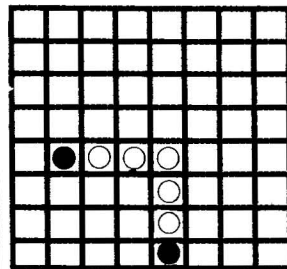


Figure 12

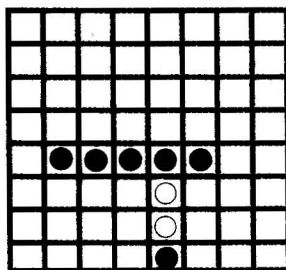


Figure 13

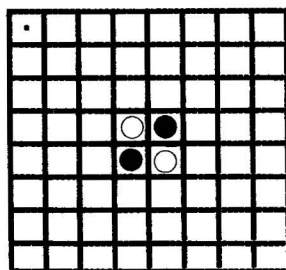
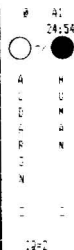


Figure 14



	A	B	C	D	E	F	G	H
1	A1	B1	C1	D1	E1	F1	G1	H1
2	A2	B2	C2	D2	E2	F2	G2	H2
3	A3	B3	C3	D3	E3	F3	G3	H3
4	A4	B4	C4	D4	E4	F4	G4	H4
5	A5	B5	C5	D5	E5	F5	G5	H5
6	A6	B6	C6	D6	E6	F6	G6	H6
7	A7	B7	C7	D7	E7	F7	G7	H7
8	A8	B8	C8	D8	E8	F8	G8	H8

Figure 15

1	F5	22	F1	43	G6
2	D6	23	B3	44	H5
3	C5	24	H3	45	G2
4	F4	25	H4	46	B2
5	E3	26	D7	47	F7
6	D3	27	D1	48	F8
7	E6	28	E1	49	E8
8	G5	29	C1	50	H1
9	C6	30	B1	51	G1
10	F3	31	C7	52	G7
11	G4	32	B4	53	A1
12	F6	33	A4	54	H7
13	C4	34	A5	55	A8
14	C3	35	A6	56	PASS
15	D2	36	B6	57	B7
16	C2	37	B5	58	PASS
17	F2	38	D8	59	C8
18	E2	39	H2	60	B8
19	G3	40	A2	61	G8
20	E7	41	A3	62	H8
21	H6	42	A7		

Figure 16

52	28	29	27	28	22	51	50
48	46	16	15	18	17	45	39
41	23	14	6	5	10	19	24
33	32	12			4	11	25
24	37	2			1	8	44
25	36	9	2	7	12	43	21
42	56	31	26	20	47	52	54
55	58	57	38	49	48	59	60

Figure 17

Copyright

This program is protected by copyright. This means that it is illegal to make a copy of the disk or of a listing of the program. Any copy. We feel strongly enough about this to offer a \$10,000 reward for the conviction of anyone copying this program. This means that when your life-long friend and bosom buddy asks you to run off a copy for him, you have, at that moment, to decide whether he wants the program or the ten thou. If you do decide to make the copy, you'd better be very nice to said friend from then on.

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Improvements

There are very few programs which cannot be improved. If you work out some improvements to this program, it could be worth your while to send them in for possible use in an updated version of the program. Those who contribute to an updated program will share in the royalties, which result. Instant Software Inc., Peterborough, NH 03458.

Disclaimer

Nothing in this world is completely perfect, including this program. I say this despite the yeoman efforts of the programmer who originally wrote and debugged it and the people in the Instant Software lab who worked far into the New Hampshire nights, all toward providing you with the best possible program.

Please enjoy it. If you come up with any improvements, you should let me know so I can pass along your ideas to other users.

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Wayne Green

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