

Leiserchess 2014

A Laser-Chess Game

Charles E. Leiserson

November 9, 2014

Leiserchess (pronounced “LYE-sir-chess”) **2014** is a two-player laser-chess game similar to [Laser Chess](#), [Khet](#), and previous versions of Leiserchess. Leiserchess 2014 was developed by the teaching staff of the MIT class 6.172 *Performance Engineering of Software Systems* for the term final project in Fall 2014, where the students are given a working implementation of a program to play Leiserchess 2014, and their job is to make it run as fast as possible and otherwise improve it.

On the surface, Leiserchess 2104 is much simpler than Laser Chess or Khet in that there are only two kinds of pieces — Kings and Pawns — and all pieces move the same way. A deeper complexity arises from the dynamics of how pieces interact, however, because the Kings carry their own lasers to shoot at each other and at each other’s Pawns. The result is an entertaining and challenging game that involves both tactics and strategy.

Pieces and Board

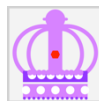
Leiserchess 2014 is played on an 8x8 square board. Each player has one King and six Pawns:



Tangerine
King



Tangerine
Pawn



Lavender
King

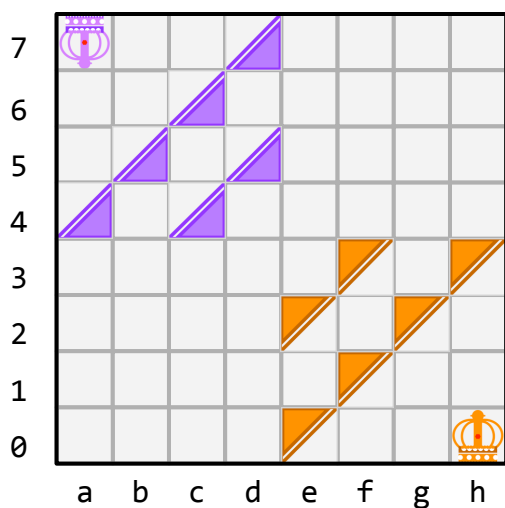


Lavender
Pawn

The King contains a laser that can be activated to shoot out of its front. Each Pawn contains a mirror oriented at a 45-degree angle to the ranks and files of the board, which can reflect the beam of the laser from rank to file or vice versa.

Opening Position

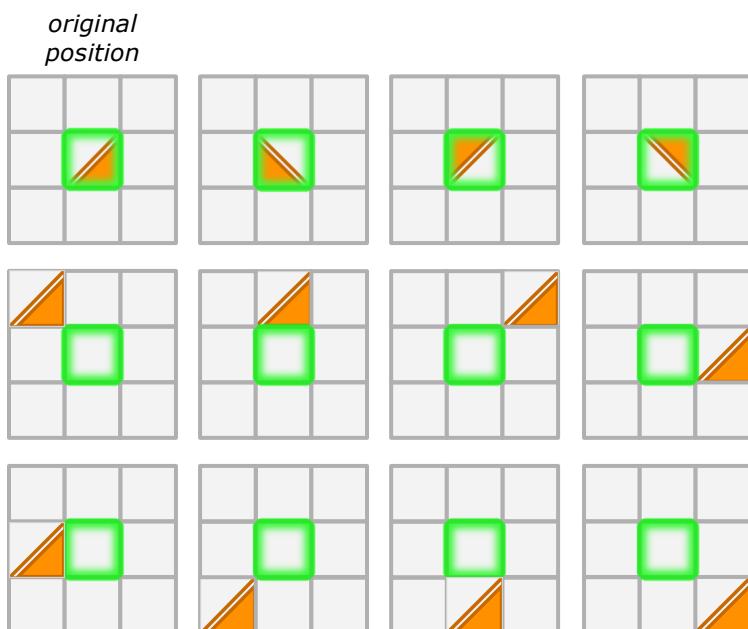
Play begins with the following opening position:



Rules

Tangerine moves first, and then play alternates between the two players. A player can only move his or her own pieces, not the opponent's. All pieces in Leiserchess 2014 move the same, whether King or Pawn. A turn has two parts: moving and firing the laser.

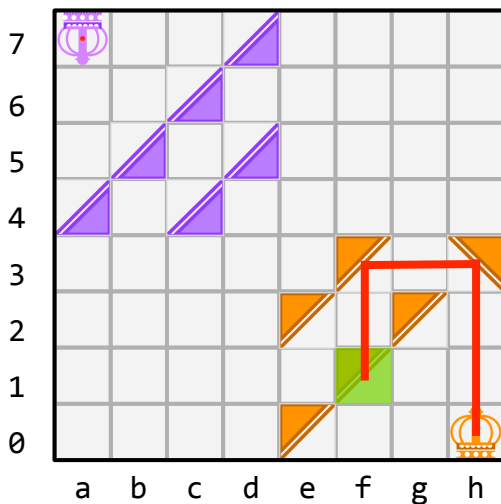
Moving. For the first part of a turn, a player on move chooses a piece and either rotates it or moves it to an adjacent square in any of the eight compass directions while maintaining its orientation. You can rotate a piece by 90, 180, or 270 degrees. You cannot both rotate a piece and move it in the same turn. The following diagram shows a Pawn on a square and its 11 possible moves:



Stomping. If a player moves a Pawn to a destination square occupied by the opponent's Pawn, the opponent's Pawn is **stomped** and removed from the board. Kings cannot stomp, and they cannot be stomped, and a Pawn cannot stomp another Pawn of the same color. If a destination square is occupied by a piece that cannot be stomped, the player cannot move to that square.

The null move. A player can make a "null" move, in which no piece is actually moved, as long as firing the laser zaps a piece (of either side). If no piece is zapped, the null move is illegal.

Zapping. For the second part of a turn, the player fires his or her laser, which shoots out of the top of the King. The beam may safely bounce off the mirrored surfaces of Pawns, but if the laser zaps an opaque (nonmirrored) side of a piece, the zapped piece is removed from the board, no matter which player owns it. (Yes, you can zap your own Pawns and even commit suicide!) If a player's King is zapped, the game is over, and the player loses. After a player moves, whether making a normal move or a null move, he or she must *always* fire the laser, even if it is self-destructive. For example, if Tangerine rotates its Pawn on h3 right for its first move from the opening position, it zaps its own Pawn on f1:



Thus, two pieces can be captured on a single move, one by stomping and one by zapping.

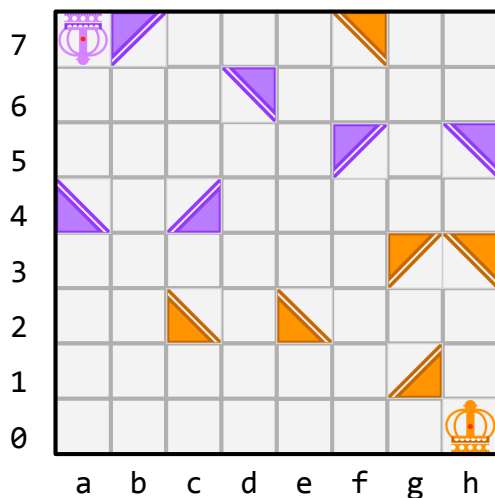
Draws. A draw occurs (1) if there have been 50 moves by each side without a piece being zapped or stomped; (2) if the same position repeats itself three times with the same side on move and the player on move requests a draw; or (3) if the two players agree to a draw.

Time control. As players become skilled, they tend to think longer. A chess clock (see http://en.wikipedia.org/wiki/Time_control) can be used to keep the pace up. Ideally, use a "delay" clock, such as a Fischer clock. Free chess-clocks applications are available for many smart phones.

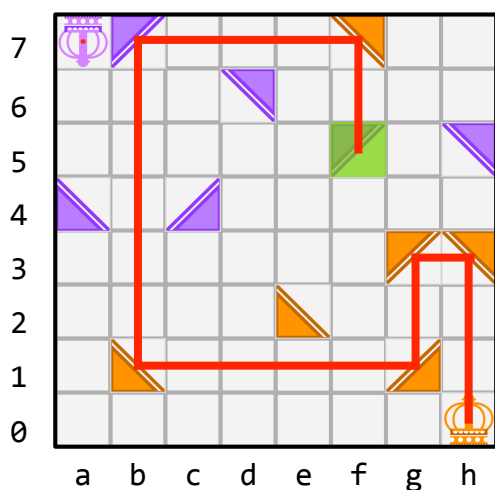
Learning Leiserchess 2014

To learn the game, start by clearing the board of all Pawns, and play with just the two Kings, one in each corner of the board. You will discover that this endgame situation can always be won by one of the two players, who can force the opponent's King to the edge and zap it. Playing this endgame will give you a feeling for the power of the laser-slinging Kings. Afterwards, go on to play normal games.

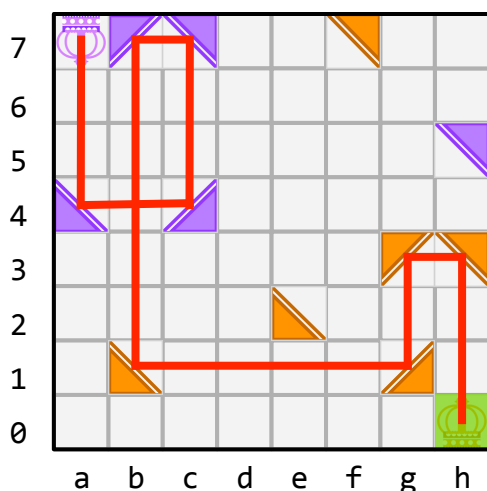
Tactics. Despite the simplicity of the rules, Leiserchess 2014 has remarkably interesting tactics. For one King to zap the other, it risks opening itself up to counterattack, and so shots must be artfully composed. For example, consider the following position with Tangerine to move:



Tangerine can zap the Lavender Pawn at f5 by moving its Pawn on c2 to b1:



Doing so results in immediate disaster, however, as Lavender counters by moving its Lavender Pawn on d6 to c7, zapping the Tangerine King, and winning the game:



The Pawns at b7, b1, g1, g3, and h3, which Tangerine used to reflect the laser to zap the Lavender Pawn at f5, are now used by Lavender in the reverse direction to zap the Tangerine King. Watch out for poison Pawns!

This kind of tactic illustrates the “emergent complexity” inherent in Leiserchess 2014, where the interaction of simple pieces engenders complex behavior. The “reverse-path” nature of mirrors — “If you can see me, I can see you!” — produces a wealth of tactical issues.

Strategy. Strategy is required for a player with a dominant position to prevail over the opponent. Without a thoughtful plan, the dominant player may not be able to engineer a zap. Although Leiserchess 2014 is a young game, some strategic elements have begun to emerge from games played so far:

- Keep some Pawns in the neighborhood of your own King. A “naked” King is generally easy to zap.
- Watch out for pinned pieces. It may be helpful to interpose your own Pawn between your opponent’s King and one of his or her Pawns to prevent your own King from being zapped, but your Pawn’s mobility may then be limited.
- Pawns toward the edges of the board can easily find themselves unable to “cooperate” with other pieces, rendering them next to useless.
- If your opponent “hunkers down” its King by surrounding it with Pawns, you can invade with your Pawns to disrupt the positions of your opponent’s pieces.

Recording Board Positions and Games

Board positions can be recorded using a modified Forsyth-Edwards notation (FEN). From Tangerine’s point of view, we list the pieces rank by rank, starting with rank 7 and ending with rank 0. Within each rank, we describe the contents of each square from a to h. Each piece is identified by a two-letter sequence describing the way it is facing, where upper case letters stand for Tangerine, and lower-case letters stand for Lavender. The Tangerine King is identified by NN, EE, SS, and WW, depending on whether it is facing north (toward the higher-numbered ranks), east (toward higher

lettered files), south, or west. The Lavender King is similar, except lower-case letters are used. A Tangerine Pawn is identified by NE, SE, SW, and NW, depending on whether its mirror is facing northeast, southeast, southwest, or northwest, and similarly, using lower case, for the Lavender pawns. The numbers 1 through 8 indicate consecutive empty squares, and a forward slash separates ranks. After the board description, the letter W or B (for White and Black, the traditional chess colors), depending on whether Tangerine has the next move in the position, or Lavender, respectively. For example, the opening position can be described with the following FEN string:

ss2nw4/2nw5/1nw1nw4/nw1nw5/5SE1SE/4SE1SE1/5SE2/4SE2NN W

Games can be recorded using the following simple notation:

- If a piece is rotated, write down the square holding the piece followed by either "L" for counterclockwise, "R" for a clockwise, or "U" for a 180-degree rotation, e.g., "g2R".
- If a piece is moved to an adjacent square, write down the source square followed by the destination square, e.g., "h3g4".
- A null move is denoted by "moving" the king to its own square, e.g., "h0h0".
- Record the outcome of the game as 1-0 (Tangerine wins), 0-1 (Lavender wins), or 1/2-1/2 (draw).

Here is an example of a recorded game:

	<i>Tangerine</i>	<i>Lavender</i>
1.	d3c4	a4R
2.	e3U	d7c7
3.	h0g1	e4e3
4.	h3R	e3d3
5.	c4d5	d4c3
6.	e0U	d3d2
7.	d5e6	c6U
8.	f1U	c3b2
9.	g2f3	b2c1
10.	e4d5	b5c4
11.	h3g3xc1	d2e1xg1
	0-1	

Feedback

Please email questions or comments to leiserchess@gmail.com. Thank you, and I hope you will enjoy Leiserchess 2014!