

Leiserchess 2018

A Laser-Chess Game

Charles E. Leiserson and the MIT 6.172 Staff

Leiserchess (pronounced “LYE-sir-chess”) **2018** is a two-player laser-chess game similar to [Laser Chess](#), [Khet](#), and previous versions of Leiserchess. The teaching staff of the MIT class 6.172 *Performance Engineering of Software Systems* developed Leiserchess 2018 (henceforth just Leiserchess) for the term final project in Fall 2018. The students are given a working implementation of a program to play Leiserchess, and their job is to make it run as fast as possible and otherwise improve its playing ability.

On the surface, Leiserchess 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 is played on an 8x8 square board. Each player has one King and seven Pawns:



Tangerine
King



Tangerine
Pawn



Lavender
King

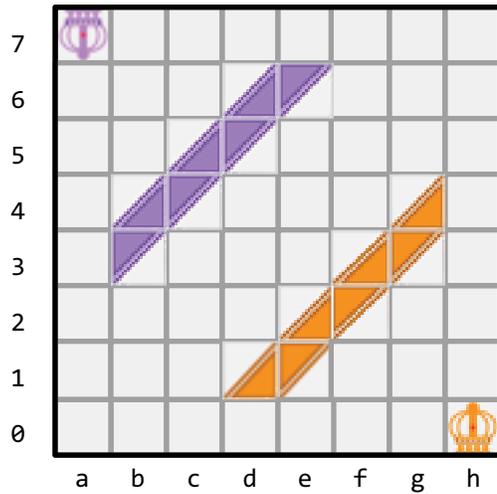


Lavender
Pawn

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 deflect the beam of the laser from rank to file or vice versa.

Opening Position

Play begins with the following starting position:

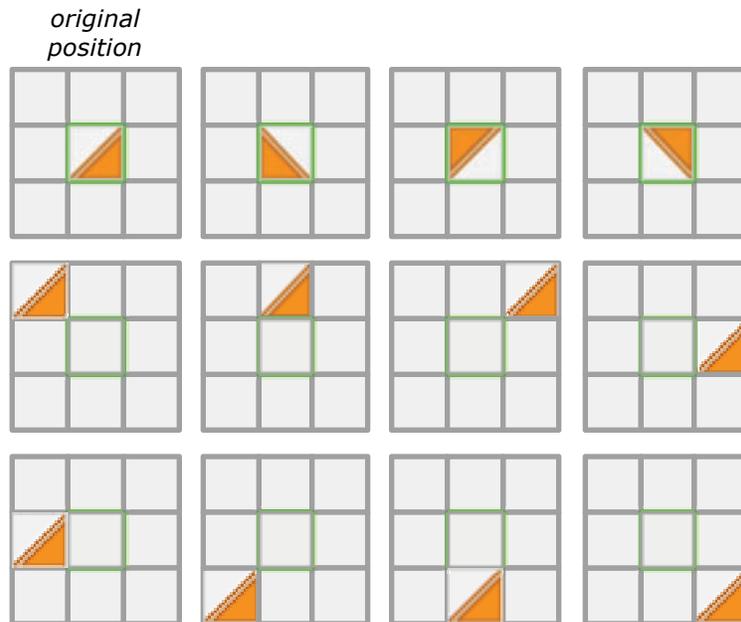


The starting position.

Rules

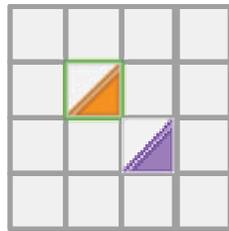
Tangerine moves first, and then play alternates between the two players. A player can only move his or her own pieces. All pieces in Leiserchess move the same, whether King or Pawn. A turn has two parts: moving, and firing the laser. A move is either a basic move or a swap move.

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

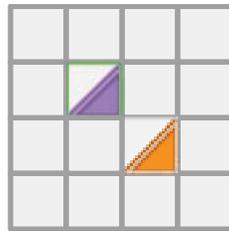


The 11 basic moves.

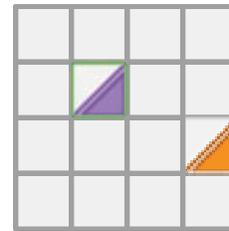
Swap moves. If an enemy piece occupies a square adjacent to the player's piece, the two pieces swap positions, maintaining their orientations, and then the player's piece can make an extra basic move. Here is an example:



Initial position with Tangerine to move.



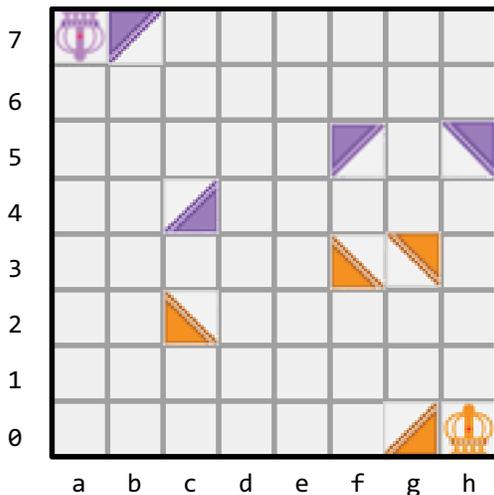
Intermediate position after swap.



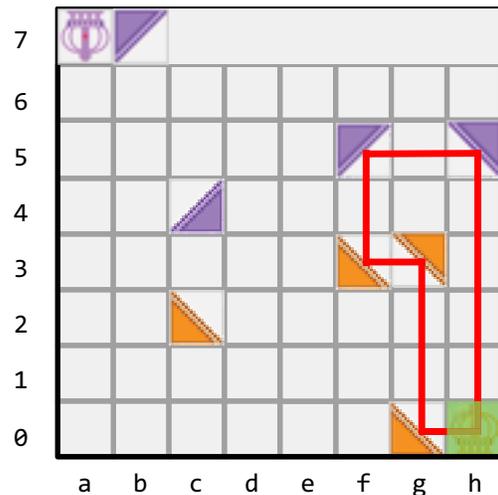
Final position after extra basic move.

Firing the laser. For the second part of a turn, the player fires the laser, which shoots out of the top of the King. The beam can 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 King is zapped, the game is over, and the player who owns the zapped King loses.

After a player moves, he or she must *always* fire the laser, even if it is self-destructive. For example, in the position shown below on the left, if Tangerine unwisely rotates the Pawn on g0 clockwise 90 degrees, as shown in the position on the right, it zaps its own King on h0:



Tangerine to move.



Suicide!

The Ko rule. To help ensure that the game makes progress, Leiserchess has a "Ko" rule similar to the Ko rule in the game of Go. The Leiserchess Ko rule says that a move is illegal if it "undoes" the opponent's most recent move by returning the position to the position immediately prior to the current position.

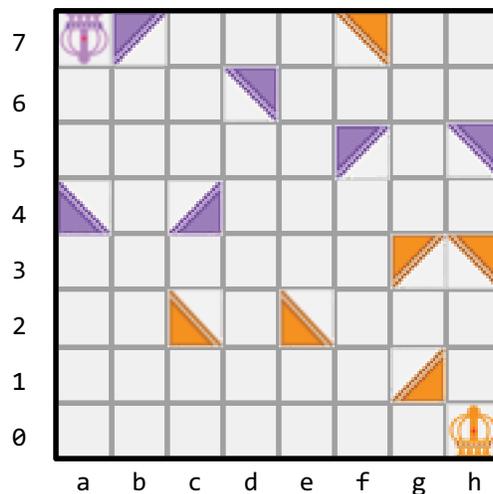
Draws. A draw occurs (1) if there have been 50 moves by each side without a Pawn being zapped; (2) if the same position repeats itself three times with the same side on move; or (3) if the two players agree to a draw.

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-clock applications are available for many smart phones.

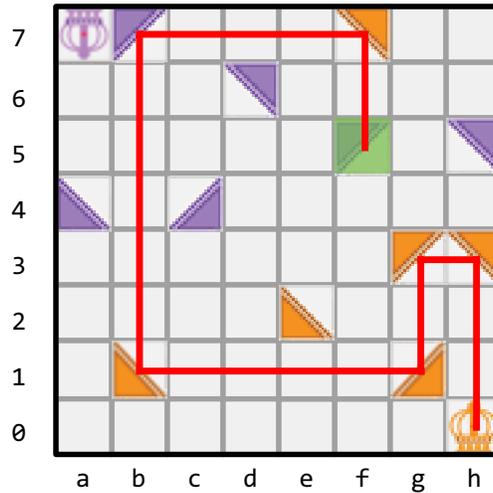
Learning Leiserchess

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 enemy 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 has remarkably interesting tactics. For a King to zap the enemy King, it risks opening itself up to counterattack, and so shots must be artfully composed. For example, consider the following position with Tangerine to move:

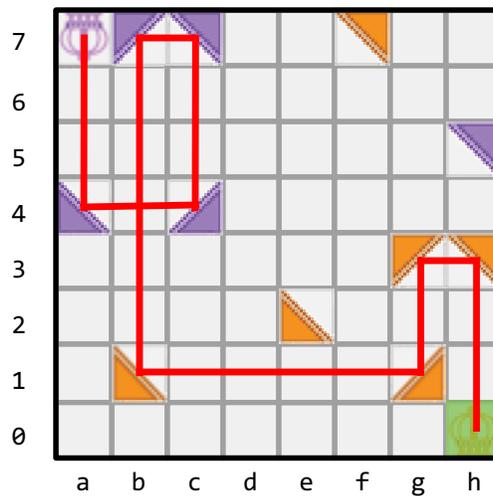


Tangerine can zap the Lavender Pawn at f5 by moving its Pawn on c2 to b1:



Tangerine's move zaps Lavender's piece on f5.

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:



Lavender counterattacks and wins 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, 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 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.
- Try to limit the mobility of the enemy King by threatening to attack the squares next to it. That is, be in a position to attack the enemy King should it move to an adjacent square.
- As the Kings move toward the center, a Pawn on the edge of the board can easily find itself unable to "cooperate" with other pieces in directing the path of the laser, rendering the Pawn next to useless.
- If the enemy King tries to "hunker down" by surrounding itself with its Pawns, you can invade with your Pawns to disrupt the enemy King's defensive position.

Recording Board Positions and Games

Board positions can be recorded using a modified [Forsyth-Edwards notation \(FEN\)](#). From Tangerine's point of view, list the pieces rank by rank, starting with rank 7 and ending with rank 0. Within each rank, describe the contents of each square from a to h as follows. 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:

```
ss7/3nwse3/2nwse4/1nwse3NW1/1se3NWSE1/4NWSE2/3NWSE3/7NN 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 empty square, write down the source square followed by the destination square, e.g., **h3g4**.
- If a piece swaps with an enemy piece, the two squares involved are recorded followed by the notation for the additional basic move taken by the piece: **L**, **R**, **U**, or the destination square.
- 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:

1. g4g5	e6e7	18. g2g3	f3g3g2	35. e5e6	c3c2
2. g5g4	e7e6	19. f3e4	d7L	36. a1b1	c1L
3. g4L	b3L	20. e4d3c4	a7b7	37. b1R	d0R
4. g4h5	b4R	21. c4b5	e4d5d6	38. e0L	c1b2
5. f3e4	d5e4f5	22. h4g5	g2f3	39. b1b2c1	b1a1
6. f2e3	f5g5	23. e4f3e2	e4f3	40. c1b2	a1b2a3
7. h5g6	g5h4	24. e2f3g3	b7a7	41. e6U	a3R
8. h0g0	c4R	25. b5a4	b4a4b5	42. e6d5	a7R
9. e3e4	b3b2	26. b4b5a6	d7e7f6	43. f5e6	c2U
10. g0f0	d6d7	27. g5f6e5	a7L	44. a1b1	c7U
11. d5c5b5	h4g3f2	28. g6g5f5	d6d7L	45. e0f0	c2d2
12. e2f2g2	c4b3	29. f0e1	d7c7	46. b1c1	c7b7
13. e4d5R	d7L	30. e1e0	b4c3	47. d5L	d2e3
14. d5e6e7	b2b1	31. f5g6f6	b3c2	48. f0g1	e3f3
15. e1d0	e4d3	32. f6f5	c2d1c0	49. g1h1	f3g3
16. b5c4	d5c4c3	33. c2b2	b1a1	50. e6f5	g3h3
17. d5R	e2f3	34. d0c0R	a1b2c1		0-1

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