# LINES OF ACTION

Claude Soucie (1969)

The game is played on a chessboard with 12 black and white pieces. For setup, the black pieces go to the top and bottom rows and the white pieces to the first and last columns; corner squares are empty.

A *clump* is a maximal set of pieces of one colour, connected through orthodiagonal steps. A player wins by unifying all pieces into a single clump.
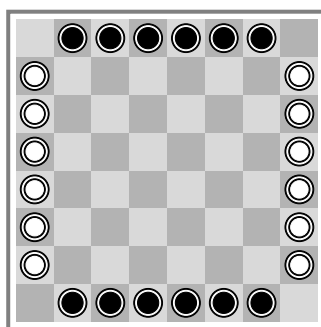
initial position

Black begins. The turn of a player consists of **moving** an own-piece of, where
- movement is along a straight line, vertical or horizontal or diagonal;
- the movement range in a direction is the number of *all* pieces on that line;
- the moving piece may jump over, but not land on, pieces of that colour;
- the moving piece may end on, but not jump over, pieces of the other colour;
- ending on a square with an opposing piece **captures** that piece.

Win and loss conditions are checked in this order:
1. Loss: a player is unable to move.
2. Loss: a player's move causes a repeated position.
3. **Win by unification:** the player's move creates a single clump.

———————⊶❧⊷———————

Remarks about the rules

- If a piece is alone on a line, it can move to an adjacent square in that direction.
- Claude Soucie reflected his dislike of draws this by declaring stalemates and repeated positions as losses, and simultaneous unification as win for the moving player.
- A player wins by having a single, movable piece. In particular, capturing the opponent's penultimate piece without forming a single clump oneself gives the win away.
- Almost all games end with one side forming a single clump. Stalemate and simultaneous unification come up rarely.
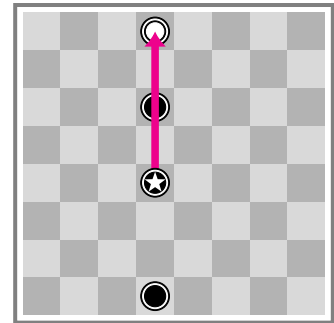
Diagrams explaining the rules
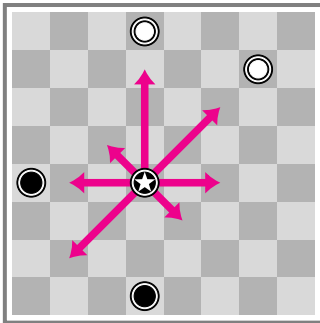
All movement options for ⊛.

Pieces can move in any direction, by exactly the number of pieces on that line.
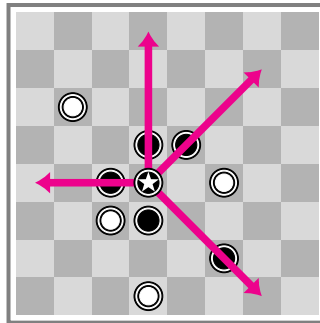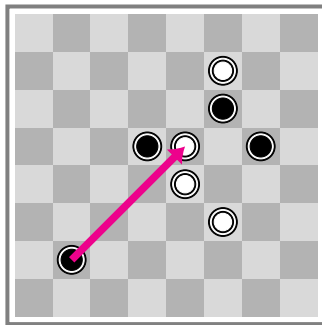
All movement options for ⊛.

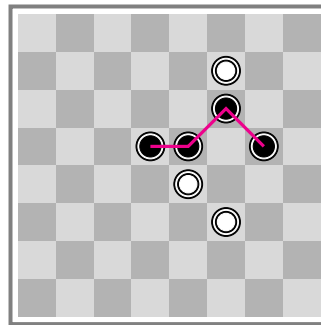A piece can jump over pieces of the same colour but not over opposing pieces.

A capturing move of ⊛.

A piece can jump on and capture opposing pieces, but cannot jump on pieces of the same colour.

before

after

Black wins: this move unifies all black pieces into a single clump.

If a capturing move simultaneously unifies the pieces of both colours, this is a win for the active player.

Three easy endgame problems.
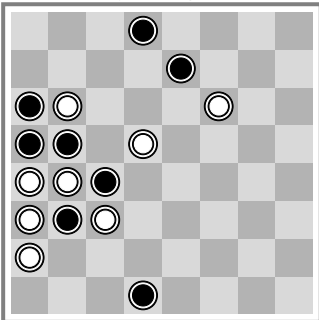
Problem 1. White to play
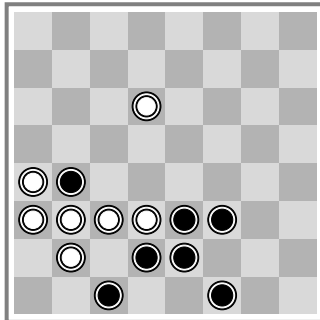
Problem 2. White to play

Problem 3. Black to play

Two fundamental principles

In traditional parlance of LINES OF ACTION, maximal sets of connected pieces of one colour are called *clumps*. So each side has two clumps initially, and the game is won by achieving a single

clump. Players shouldn't shy away from breaking up their clumps. The two basic lessons are: (1) Capturing opposing pieces is often a good idea. (2) The initial lines of pieces are very weak.

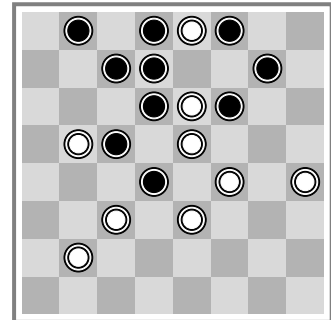**Material advantage is valuable.** The following train of thought is natural, but misleading: as it is seemingly easier to unify a smaller number of pieces, don't capture and instead rejoice when your own pieces are captured. However, this is almost completely wrong! While there are cases when a capturing move is bad, material superiority is desirable in general: with more pieces, you have higher mobility (more pieces to move), better defence (more pieces to block with) and greater flexibility (more ways to connect those pieces).

Capturing and the benefits of material superiority.
In Problem 5, Black can unify right away. The goal is to demonstrate the flexibility from having many more pieces by getting three pieces in the lower left quadrant first. You can create variants of this problems yourself.
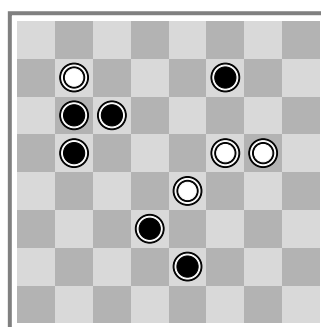In Problem 6, White only needs to catch up with one last straggler. But Black's material superiority can prevent this.
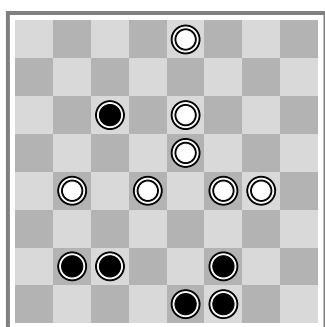
Problem 4. Black to capture
Choose the best move.
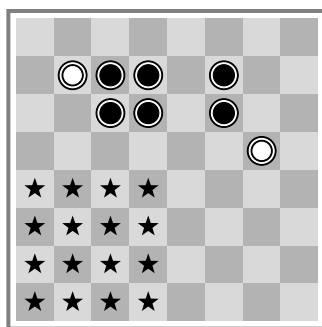
Problem 5. Black to unify with at
least three pieces on ★ squares

Problem 6. Black to play

Weakness of the starting position. Because the pieces are initially already nicely lined up, it is tempting to leave one side be, and only move pieces from the other half. This strategy occurs naturally to anyone starting to play LINES OF ACTION, and is called the *cross-rush*. It is warned against already in Ralph Betza's 1979 article [A]. Besides sacrificing a lot of flexibility— by refusing to move half of the player's force—this strategy suffers from the weaknesses of the pieces in their initial position:

1. They are susceptible to blocks, and can at worst get walled in.
2. They are susceptible to cuts which hurt most if a piece in the middle is captured.
3. These pieces have low mobility, with few available directions.

If pieces in their starting position get walled off, this may require painful moves along the edge, just to obtain minimal mobility.

Tactical concepts

Built-in asymmetry and blocks. The peculiar movement rule in this game may feel mechanical. You may worry having to count all the time. However, the board is small enough that you quickly get a good feeling for movement ranges. A curious feature are the four different options to prevent a threatened piece from being captured:

1. capture the attacking piece;
2. move the attacked piece;
3. move another piece anywhere onto the line of attack
4. move another piece off the line of attack.

In LINES OF ACTION, asymmetric positions occur because a piece can jump over pieces of the same colour whereas opposing pieces *block* movement.

symmetric: ❶ and ② can capture each other   asymmetric: ❶ can capture ② but not vice versa

In this game, pieces can be *pinned* from afar. This refers to a piece whose movement incurs an immediate loss, such as a strong cut or outright defeat.

⊛ is pinned: if relocated, Black
wins by moving Ⓐ to *a*.

Walls. Several blocking pieces side by side can constitute a *wall*. In the following position, the three Ⓐ pieces form a wall. They have the greatest effect on the two © pieces which are unable to move whatsoever. Moreover, the wall also has some effect on the two Ⓑ pieces which are restricted to a single available direction.

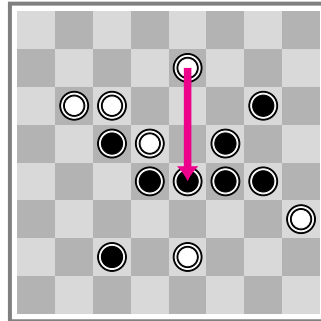Black's wall also helps in unifying the upper and lower parts of the black starting position. Observe how Black has moved pieces from both sides whereas White has only moved pieces from the right-hand column yet—an ill-fated cross-rush attempt.

Finally, Black can attempt to attack White's feeble file because pieces jump over pieces of the same colour. Especially © are interesting targets: capturing one of them splits the left-hand line. This maneuver will be discussed below.

Building walls is particularly easy against pieces which are still at the border. This is one of the reasons why the initial position is so weak.

Black, as the starting player, has an advantage in setting up walls. As usual in board games, the best reply when faced with a threat is often not to react locally. Here, when faced with a wall, ponder forming your own wall. Quite frequently, both sides create walls. This leads to longer games, and White is by no means relegated to a worse experience in this tug-of-war. Another valid option is to attack the wall. When and how to evacuate stragglers from behind a wall is a subtle matter.

Cuts and wedges. A *cut* is a capture that increases the opponent's clump count. Not all cuts are effective. A cut usually becomes better with each of these properties:
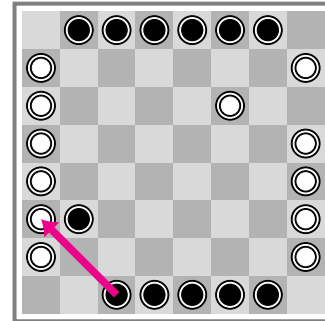
1. *Multiple cut:* The opposing clump is now split into three or more clumps.
2. *Strong cut:* The remaining clumps are not just single pieces.
3. *Wedge:* Some pieces of the remaining clumps are blocked.
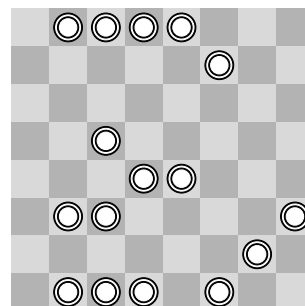

multiple cut   strong cut   wedge

Thickness. Sometimes, a clump, or part of it, is so well-connected that it cannot be cut. Such a clump is called *thick* or, for example in [C], *compact*. The evaluation function of the computer program MIA [F] uses a simplified version, by searching for 2×2 boxes of pieces of the same colour, called a *quad*.

The opposite is, naturally, a *thin* clump. As will be explained below, a thin clump does not spell doom but it does make matters more delicate. Thickness is a relative measure, and a move may make a clump thicker even though it is can still be cut elsewhere.
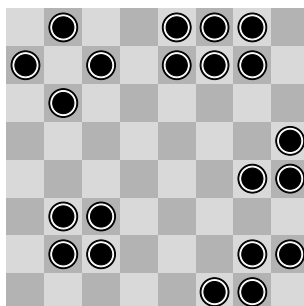

Examples of thick clumps   Examples of thin clumps

Thick clumps have fantastic resiliency against being split. However, it is impossible to play without thin clumps. A pragmatic approach is this: when deciding between two reasonable moves, put heigher weight on the one improving thickness.

An indirect benefit of many thick shapes is additional mobility. Pieces in a larger thick clump can often move and still be connected to that clump. Moreover, along various lines of movement, there will be several pieces in the clump, and this often enables strong attacks. Finally, a thick shape can make it easier to lead straggling pieces towards unification.

On the other hand, a thin clump with the same number of pieces will cover a lot of area. Hence thin formations may enable very fast unification, and this can be decisive. Altogether, the choice between thickness or thinness depends subtly on circumstances, and I couldn't give general recommendations. As a crude rule of thumb, I'll say that, strategically speaking, the player with the inferior position is more likely to play riskily and with thinner clumps.

Three harder endgame problems *Black to move and win!*

Problem 7.

Problem 8.

Problem missing!

Strategic concepts

Centre of mass. This high level notion has been defined and explained by Ralph Betza [A], independently picked up by Kerry Handscomb [C] as 'focal group', and codified for the MIA program [F] in a computationally expensive function.

The black centre of mass is the
quite thick size six clump.
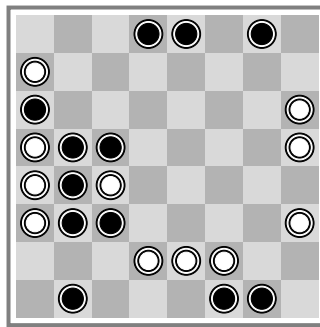
The centre of mass is the area where pieces of a player gravitate to. Thus the concept expresses the extra efficiency of moving the minority towards the majority rather than the other way around. The centre of mass is fluid: during play, it centre can grow, shrink, shift or dissolve.

Wall openings tend to create pronounced centres right away. On the other hand, a position may have no clearly visible centre of mass. This happens more often with thin, diagonal structures.

Often, but not always, the centres for both players are close to each other. As is common in games of skill, a natural instinct should be resisting the opponent's plans. An instance in LINES OF ACTION is building your own wall rather than immediately escaping from the wall your opponent is building. Another one is to create your own centre of mass rather than going with the one of the opponent.

Algorithmically speaking, the centres of mass, computed geometrically by averaging over all coordinates of pieces of each colour, is only the first step. Next one wants to know strongly concentrated pieces are around this centre. See [F] for details where they also mention the empirical fact that it is detrimental if early centres of mass are in the geometric middle of the board—it is better placed closer to the edge. (This way, pieces can be attacked from fewer directions.)

Ideas for problems on centre of mass very welcome!

Flexibility. In the sources, this notion is used with several meanings, and I will take it to refer to two ideas: (1) how many pieces can usefully move?, and (2) how many different relevant squares can be reached? Often, inflexibility is felt painfully when no piece can move to an important rank, file or square. In this sense, fewer pieces generally mean lesser flexibility.

As one aspect, this recovers Ralph Betza's *balance*, by which he refers to something seemingly unrelated: in the beginning, try to move pieces from both initial clumps. Put as a proverb: Avoid moving only pieves from one side! However, trying this in practice quickly shows that the pieces will be more active in a balanced position. As an added bonus, a balanced opening prevents any allusions to the cross-rush.

A position with scattered pieces, having a high clump count, can be very flexible! By contrast, here is a common tactical source of inflexibility. A quiet move of just a single step can often improve a situation considerably.

Pieces blocking each other: none of these black pieces can move horizontally.

Distance, circumference, connection speed. These are not pressing issues in the early game, but will come up later in the game. *Distance* refers to how many stragglers there are, i.e. isolated pieces, and how far they are from the centre of mass. Similarly, if a player has a position without a clear centre of mass, e.g. two distant sizeable clumps, then this handicap may be referred to as *diameter*.

In these, and other late-game, situations, the focus is on how fast a unified clump can be established. I emphasise again that LINES OF ACTION tends to become a race only—if at all—in the final stage.

Todo 1: board centre initially to avoid
Todo 2: order of moves (a heuristic)

Opening. In principle, an opening library for LINES OF ACTION might exist, especially with good computer programs available. However, I am not aware of any, and thus I have to be brief. The next diagram shows all first moves (up to symmetry) which (1) cannot be captured right away and (2) are not along the boundary:
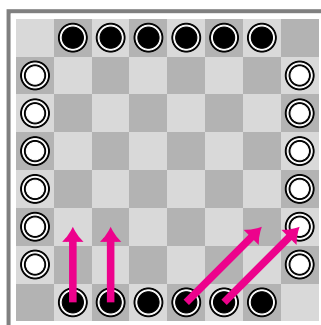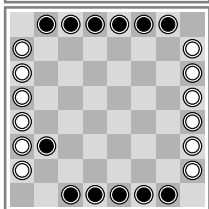

A short look at each of these moves:
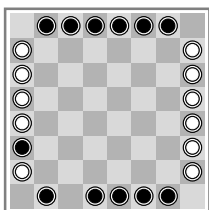
The cross-corner capture. Many players seem to think this is the weakest of the four moves. It does capture a piece, which is generally beneficial. On the other hand, the single piece **a2** is not blocked at all, and the capturing piece is at the boundary.

Later on, cross-corner captures become important tactical options.

This move is often the beginning of a wall strategy. Natural follow-up moves are the captures **c1-a3** and **d1-a4**. A good reply for White is the symmetric **a2-c2** which prevents both the long capture on **a4** and makes the short capture on **a3** meaningless.

Another interesting follow-up for Black is **c1-c3**, enabling another pressing diagonal move, **e1-b4**.
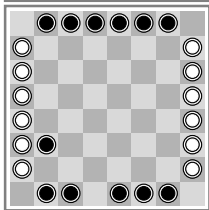
A very popular move, going even more strongly for a wall. It has natural continuations **b1-b4** and **b8-b5**. If not prevented, Black can pile up pieces on **b3, b4, b5, b6, c4, c5** in this fashion, creating a thick wall.

A very typical reaction is the symmetric **a5-c7**: it gets one piece off the first column and prepares to build a wall on the upper side (naturally, because it is still complete).
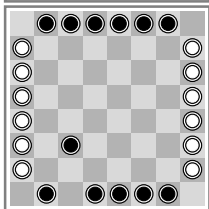
The most centre-oriented move. It has nice subsequent moves **e1-b4**, **b1-b3** and **c8-c6**.

Open vs. closed positions. The number of legal moves generally depends on the number of pieces left on the board. However, there are positions in which both sides are so tightly intertwined that there are particularly few available moves. I call those *closed positions* and contrast them against *open positions*. The left-hand position below has Black to move, with nine pieces and only 18 available moves. In the right-hand position, Black can choose between opening the position or going for a closed game.
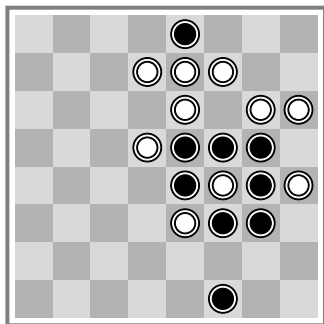
A closed position.
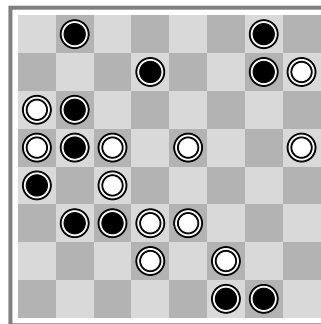
A choice: **a4:c4** opens; **b8-b4** closes.

In a closed position, both sides are restrained in moving. This can sometimes be used by the player with the weaker position, for example from having fewer pieces. In general when behind, it is necessary to attack the opposing position even if that entails losses in the short term. In other words, the player with the weaker position may go for a longer game with reduced

branching (smaller move numbers, i.e. a closed position) because that may enable a tricky upset. Rephrasing, the reduced flexibility can hurt the opponent even more.

History

LINES OF ACTION was invented by Claude Soucie in the early 1960s in New York; the precise year is not known. The game first appeared to a larger audience in Sid Sackson's book *A Gamut of Games*. Its edition from 1969, declared simultaneous unification as a draw. In the preface to the second edition, Sid Sackson writes: "Claude Soucie and I are all that remain of the N.Y.G.A. At his request, I have corrected an error in the rules for LINES OF ACTION, eliminating possible draws." (N.Y.G.A. = New York Gaming Association).

David Parlett seems to be the unique source changing the title to 'Action Lines'. I have no idea what kind of syntactic possession made him do this.

The game soon drew some attraction, including tournaments and play by mail, and in his 1979 article series [A], Ralph Betza already speaks of the "old school". At the latest by the 1990s, it had secured the status of a modern mind sport among board games.

LINES OF ACTION has an interesting computer play history. Someone at the Stanford university wrote a computer program playing LINES OF ACTION, around 1975. There are several programs that play stronger than humans, and they compete in computer championships. Rules for computer tournaments slightly differ by declaring simultanous unification as a win for the moving player and by declaring stalemate as a forced pass (but not loss). Infinitely repeated positions came up in one game. Computer tournament rules declare threefold repetition to be draw.

There are a number of variants. Here is an alternate starting position, suggested by the author himself:
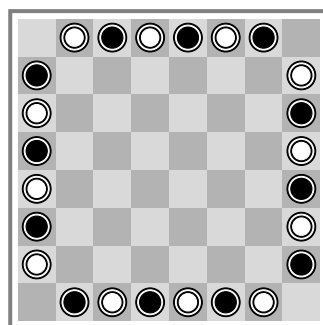
Alternative initial position
'scrambled eggs'

Claude Soucie did not invent many games but his LINES OF ACTION is clearly a master piece. He later came up with a more elaborate variant, ZEN L'INITIE (Claude Soucie, 1997), sharing goal and movement with LINES OF ACTION but adding a neutral piece that can be moved (and used to connect) by either side.

Solutions to the problems

1. *b6-c5+*. Threatens **f6-e6++** and **f6-d4++**, and Black can't prevent both. If White makes any other move, then Black **e7:b4**.
2. *a4-c2*. Black threatens to connect with either **b4-d4** or **c1-c3**, and the solution is the only way to prevent this.
3. *b8:b5*.
4. *c6:e6*. This move prevents White **e8-e4+** and enables Black **e1:e5**.
   Going quickly through the other capturing moves in the problem position: **e1:e5** looks attractive because it cuts at

the vital point; however, it is refuted by **e8:e4**. The captures **b2:b4** and **c6-e8** are horrible moves, for they enable a white win in the next turn. There are two more captures, but **f2:d4** loses to **e8-e4**, and **f1:f4** is counteracted by **b4:f4**.

5.

6. *f7-e6*

7. *e4-d5*. Problem from a training match Mona vs. YL (2000).
   1 ... a2-a3. 2 d4-c5; e5-d4. 3 d1-c2; b5-d3. 4 c2-b3; d4-b4. 5 b3-a4; d3-b5. 6 a4-a6; f5-f6. 7 a6-b7; f6-d8. 8 e6-d7; a3-a4. 9 b7-a6; d6-b6. 10 d5-c6; b4-b7. 11 d7:b7 ++ 1-0.

8. *b4-d4*. Problem and solution by Phil Cohen; from the reprint of Ralph Betza's *New Ideas in LOA* (NOSTalgia 1978) in 'Anything but Chess' by Tracy Cobbs.
   There are three moves that prevent Black's winning move **b8-b7**. Of these, two are easy to handle: **1. ... a6:c8. 2. b8-b7++** and **... e5:b8. 2. c3:a5+, a7-c7; 3. d8-e7+, c7-f4; 4. c8-g8++**. The most forceful, though outwardly least promising, is **1. ... a3-b2**. Many replies should work (**b8-b6: 2. c8:a6, c5:f8. 3. e6-d7++; 2. c3:a5** but the most straightforward seems to be **2. e8:e5+**, to which there are two replies:
   2. ... f7-e8; 3. f8-f7+++, a6:c8; 4. f7-d7++.
   2. ... a6:c8; 3. e5-e7++, a5:d5; 4. b8:d6 threatening **d6-e5+++++** which wins at once against all but seven moves:
   4. ... c8:e6 or **f7-g6** or **b2-a3: 5. d4-b4++**.
   4. ... c8-b7; 5. d4-g7+, d5-any; 6. c4:f7++.
   4. ... a7:d4; 5. c3-b4+.
   4. ... a7-d7; 5. c4-b5+.
   4. ... a7-b8; 5. e7-e5+, f7-e7; 6. d8-c7++.

Literature

[A] Ralph Betza: *New ideas on LOA*, NOSTalgia 221–225 (1979?), 5 pages.
[B] Kerry Handscomb: *Lines of Action: strategic ideas I*, Abstract Games Magazine 1 (2000), 3 pages.
[C] Kerry Handscomb: *Lines of Action: strategic ideas II*, Abstract Games Magazine 2 (2000), 2 pages.
[D] Kerry Handscomb: *Lines of Action: strategic ideas III*, Abstract Games Magazine 3 (2000), 2 pages.
[E] Claude Chaunier: *Lines of Action: strategic ideas IV*, Abstract Games Magazine 5 (2001), 3 pages.
[F] M.H.M. Winands, H.J. van den Herik, J.W.H.M. Uiterwijk: *An evaluation function for Lines of Action*, Advances in Computer Games (2004), 12 pages.
[G] Mark H.M. Winands, Yngvi Björnsson, Jahn-Takeshi Saito: *Monte-Carlo tree search in Lines of Action*, (), 12 pages.

Interesting positions, perhaps for problems:
1. https://www.littlegolem.net/jsp/game/game.jsp?gid=2145423&nmove=43
   Black to prevent draw.

Commented games:
1. Fabio Dulcich comments: Paul Yearout vs Fabio Dulcich (1993):
   https://boardgamegeek.com/blogpost/74680/lines-action-paul-yearout-vs-fabio-dulcich-1993
2. Walter Sandsquish comments: Walt Roessner vs Ralph Betza:
   https://boardgamegeek.com/blogpost/74995/lines-action-walt-roessner-vs-ralph-betza
3. Fred Kok comments: Ragnar Wikman vs Fred Kok (1997):
   https://boardgamegeek.com/blogpost/75750/lines-action-ragnar-wikman-vs-fred-kok-london-1997
4. Fred Kok comments: Fred Kok vs Patrick Mouchet:
   https://boardgamegeek.com/blogpost/75581/lines-action-fred-kok-vs-patrick-mouchet

Mark Winand's LOA page: https://dke.maastrichtuniversity.nl/m.winands/loa/