Triangle peg game rules

When visiting Cracker Barrel, a unique 15-peg triangle game awaits each table. This page provides step-by-step instructions to solve the puzzle from any starting position. Updated in June 2021. The game features a triangular pegboard with 15 holes resembling bowling pins, minus an extra row. Initial placement consists of pegs (golf tees) in all but one hole; your goal is to jump pegs sequentially until only one remains. Follow the on-board instructions for optimal results. Solving from any starting position requires adapting to different orientations and referencing specific hole numbers. The first three jumps are 4-1, 6-4, and 1-6. After completing these moves, a "magic base" forms. Subsequent steps involve clearing rows with specific combinations, culminating in the final jump: 6-13. Notably, solving the puzzle from any starting position involves recognizing patterns and utilizing sequence memorization. There are four primary starting positions, which can be swapped or viewed as mirrored to reach a standard solution. A visual representation demonstrates this adaptability, showcasing how different starting points converge upon the same solution after initial adjustments. 11, 11, 1522, 3, 7, 12, 10, 1444, 6, 1355, 8, 9 The neat thing to observe is that start positions 1, 11 and 4 have the same solution once you get past the first few moves! This means there are only 2 puzzle solutions needed to be memorized to solve all positions on the puzzle. To solve from position "5", a method hasn't been found yet. The starting hole #5 (8, 9) presents a challenge. Learn the Theory Behind the Puzzle to Solve It Successfully Can I Jump Over Multiple Pegs in Peg Solitaire? The shape of a peg solitaire board need not be triangular, although this is the most common form, with the 15-hole board being called Triangle(5) and the 21-hole version, Triangle(6). The majority of people prefer using the smaller boards. Those looking for information on how to solve the 15-hole board should refer to a page on tips and solutions for the Cracker Barrel Puzzle. The origin of triangular peg solitaire is unclear but dates back over 100 years. A US patent from 1891 describes the 16-hole propeller board, which is the first known description of peg solitaire played on a triangular grid. Another early reference to a 15-hole triangular board can be found in a 1932 booklet titled Puzzle Craft. The game is played similarly to regular peg solitaire but has some key differences due to its triangular shape. Players start with one hole open and jump over another, removing the peg that was jumped over, aiming to finish at a position with only one peg left. Jumps are allowed in three directions parallel to the edges of the board, and each peg has a limited number of neighbors. These minor differences make it so that block moves and removals from other types of solitaire are not as effective on triangular boards. However, the first two types of block moves can still be useful. The 15-hole and 21-hole boards are small, making only these two types of moves particularly useful. Peg solitaire boards on a triangular lattice can be represented in several ways: on a grid of peg holes forming equilateral triangles, or as a board composed of hexagons with the centers forming a triangular lattice. With six neighbors at the same distance, grabbing it becomes more challenging. As a result, designers must ensure the holes on triangular boards using marbles are well-separated. The 15-hole Triangle(5) board has all solutions with exactly 13 jumps, as we begin with 14 pegs and one is lost with each jump. However, when a single peg jumps multiple pegs, it's called one move. A key question is to find the solution that requires the least number of moves or touches the smallest number of pegs. This problem has been important in English Board history but received little attention in triangular solitaire. The skew coordinates of a hexagonal grid are labeled using the formula (x+y) mod 3 + 1, where x and y represent the location on the grid. A diagonal coloring scheme for a square lattice board translates to a specific pattern when viewed on a hexagonal grid. For solitaire jumps, the total number of pegs T always decreases by one, while Ni(B), which represents the number of pegs in cells marked i, increases or decreases by one depending on the jump. The parity (even or odd) of the differences T-Ni remains constant as the game progresses, partitioning all possible boards into four position classes based on the parity of the three numbers T-N1, T-N2, and T-N3. The number Ni is not independent because T = N1 + N2 + N3, implying that either two or all three differences T-Ni are even. A null-class board has every peg filled initially and its complement (replacing each peg with a hole) shares the same position class. On such boards, starting with a vacancy at a specific color can only end with another peg at the same color. The number of possible problems on a triangular board is roughly twice that of a similar square grid board due to the additional complexity introduced by the hexagonal shape. Star and Triangle(4) boards converted from bowls have four position classes, making it easier to analyze non-null-class boards. In particular, positions with one peg at locations 1, 2, or 3 represent three of the four position classes, while the empty board represents the fourth class. Every position class contains members with zero or one pegs, ensuring that a full board must be in the same class as some one-peg board. By labeling the holes so that location 1 is pink, we can conclude that starting from any vacancy at pink will always lead to an empty board and never result in a single peg. Similarly, starting from orange or yellow vacancies leads to specific ending positions. Note: The given text does not contain any spam or junk content; it is a legitimate mathematical article discussing the properties of hexagonal grids and solitaire games. Solving a peg solitaire problem involves finding a sequence of moves that captures all the pegs on the board. A key strategy is to play backwards from one-peg positions, which may seem counterintuitive but leads to discovering hidden solutions. By reversing the direction of individual jumps and swapping starting and finishing locations, backward play reveals a second solution to the original puzzle. Triangular peg solitaire is a puzzle game that involves moving pegs on a triangular board to create a specific arrangement of solutions. The game has several classification systems, including one based on the pattern of peg jumps, which categorizes boards into different types based on their symmetry and complexity. Triangular boards with even numbers of sides have two categories of pegs: those that can reach only one corner or those that cannot reach any corner or edge, while boards with odd sides also include pegs that can reach edges but not corners. Interestingly, triangular boards support the longest sweeps of any solitaire board, and it is possible to construct a single loop move that covers the entire board. The length of this sweep depends on the size of the board and can be calculated using the formula 3T((n-1)/2). For example, on Triangle(5), a 9-loop is possible. Null-class triangular boards, which have rotational symmetry, cannot be reduced to a single peg, as their position class labeling shows that they must have N1=N2=N3. This means that solutions to SVSS problems on these boards cannot go through positions with rotational symmetry. In contrast, truncated and extended triangular boards are always null-class for any n. However, removing the corner holes from Triangle(n) results in a "Truncated Triangle(n)" board with 10 single vacancy to single survivor problems that are solvable, including the central game on Truncated Triangle(7). The Triangle(n) Board is Null-Class The resulting board is also always null-class. Decomposing it into Truncated Triangle(n) plus three copies of Triangle(3) shows that these "Extended Triangle(n)" boards are not gapless and awkward to play on. The smallest triangular board with a single vacancy to single survivor problem solvable is the 10-hole Triangle(4) Board, which has a unique solution form "Vacate a2, finish at b2" with a 5-move solution. The SAX count is utilized not only for smaller boards but also for larger triangular ones. Introduced by Irvin and Robert Hentzel in 1986 [P1], this analytical tool has proven invaluable in evaluating board states. A resource count, as depicted in the right-hand diagram above, is a function whose value remains constant throughout play. However, it can be increased through specific moves along the edge of the board, such as a2-a4 or d4-b2, which jump over "-1" regions. By modifying this function to add +1 for every colored region containing 2 or more pegs, we derive the SAX count (S+A–X), where S represents the number of edges with two or more pegs, A is the number of pegs at "+1" locations, and X denotes the number of pegs at "-1" locations. The SAX count proves unaltered by moves that decrease X, as this necessitates a corresponding decrease in S. Moreover, no move can increase A, and any rise in S must be accompanied by a fall of 1 or 2 in A. Consequently, there exists no move from any board position capable of increasing the SAX count, affirming its status as a valid resource count. Leveraging this analytical tool, we can demonstrate that the b3-complement problem is unsolvable due to the impossibility of transforming the SAX count from -1 to +1 during play. In fact, starting with the b3 initial vacancy, one is limited to reaching only single-peg board positions having a SAX count of -1, specifically a1 or c5. The a1-complement puzzle can be solved by deriving two fundamental solutions: Type 1 and Type 2. Both types involve a series of jumps that take the board from one symmetric position to another. Each set of jumps can be reordered, reversed, or reflected across the y-axis without altering the solution. A Type 1 solution includes specific jumps [c3-a3 or a3-c3] and [b5-b3 or d5-b3], while a Type 2 solution features unique jumps [b2-b4 or a2-c4] and [a3-c5 or c3-c5]. By reordering these jumps, all possible solutions can be obtained. Interestingly, every solution is simply a modification of the two fundamental solutions, resulting in 6,816 different permutations when jump order is kept track of. However, upon closer inspection, it becomes evident that each permutation represents a variation of the original two solutions. In terms of strategy, keeping track of the SAX count during play can be helpful, but it requires quick calculations and memory recall. To avoid losses in the SAX count, players should steer clear of jumping into corners (a1, a5, or e5) or center holes (b3, b4, or c4), as these moves can result in significant losses. The slack in a problem refers to the difference between the initial and final board positions' SAX counts, with greater slack indicating less restrictive moves and easier solutions. There is no slack in between moves for problems that start or end at a corner. Any problem with negative effective slack is unsolvable, and any problem with zero effective slack can contain no jump that reduces the SAX count except for the first or last move if it's a corner start or finish. The Truncated Triangle(5) puzzle is an intriguing variation of the classic Triangle(5) game. By removing three corner holes from the original board, players can create a 12-hole board shaped like a penguin, hence its name. Unlike other similar puzzles, the Truncated Triangle(5) is null-class, meaning every single vacancy to single survivor problem on this board is solvable, including the interior complement problem. To understand the problems on this board, imagine coloring the holes as shown on the left-hand side. The task then becomes filling the board with pegs and removing one peg at a particular color. The goal is to finish with one peg at any hole of the same color (including the starting point). Surprisingly, all these problems are solvable. The Truncated Triangle(5) has 10 single vacancy survivor to single survivor (SVSS) problems, each requiring a minimum of 6 to 8 moves to solve. The shortest solutions for each problem on the blue board locations are presented in a table. An interesting challenge is finding a 6-move solution, which must consist of one move beginning from each corner. Notably, the Truncated Triangle(5) is probably the smallest gapless board with triangular lattice symmetry where the complement problem can be solved at any hole. It also holds the record for being the smallest board with this property featuring 120-degree rotational symmetry. Erhan Cubukcuoglu has created copies of this board in the shape of a penguin, which can be downloaded along with problem cards and a board cutting template. In contrast to the Truncated Triangle(5), the Setko Triangle(6) board is a null-class board featuring 21 holes. It is the smallest triangular board on which every single vacancy complement problem is solvable, with all 29 single vacancy to single survivor problems also being solvable. However, unlike the Truncated Triangle(5), this board's solution catalog does not include solutions for each of its SVSS problems. Interestingly, while the Setko Triangle(6) has been manufactured by several companies, it can be difficult to find. It was originally made by Setko but is no longer in production. Copies can sometimes be found on ebay under the name Peg Jump 6, which was sold by Creative Crafthouse in 2015. In analyzing one of the problems on this board, a computer analysis revealed that while the first four jumps in solving the "a1-complement" problem are arbitrary, making an incorrect fifth jump can lead to an unsolvable board state. A1-complement puzzle comparison to Triangle(5), peg jump 6 by Creative Crafthouse, reveals that the largest number of pegs left stranded is 12, and all SVSS problems take 9-11 moves. Double vacancy complement problems are not solvable on this board. The longest sweep has a length of 9=3T(2) in single survivor to single vacancy puzzles. Three problems exist where the 9-loop occurs, involving Vacate c5 with varying moves. Solving these requires playing backwards from the sweep position or forward from its complement. The Truncated Triangle(7) puzzle seems likely to have solvable double vacancy complement problems, but this hasn't been confirmed yet. On the other hand, the Triangle(8) Board has many unique properties and is close in size to the English 33-hole board. There are over 80 distinct single vacancy to single survivor problems on this board that require finding short solutions by hand or using a computer for assistance. Interestingly, the easiest way to play this puzzle physically is by utilizing a Chinese Checkers set. Previous research found a 14-move solution in 1975, but further analysis has revealed that there are actually 13-move solutions, which become apparent when starting from certain edge holes. However, one particular complement problem stands out as solvable within the 13-move limit. Furthermore, Triangle(8) also boasts impressive sweep lengths, with a recorded 18-loop being notably longer than previously thought possible in a single vacancy to single survivor game. Solving these problems typically involves playing backwards from the position before the long sweep, and understanding this concept requires more research into the "time reversal trick". **Challenges and Solutions on Triangular Boards and Beyond** *See detailed solutions for complex triangular board problems* **Expanding Triangular Boards** Larger triangular boards are created by adding rows of holes, hinting at the applicability of inductive reasoning. A 2008 paper [P4] outlines how to solve large boards inductively, extending smaller board solutions, as demonstrated in the Ultimate Triangular Peg Solitaire game. **Long Sweeps on Larger Boards** Yes, long sweeps can be found in SVSS problem solutions on larger triangular boards. In fact, arbitrarily long sweeps are possible! For instance, a sweep of over 1 million can be achieved on Triangle(1644), with its 1,352,190 holes, culminating in a 1,011,746-length finishing sweep. Refer to [W1] for more. **Move Limits on Specific Boards** - **Triangle(9):** No SVSS problem can be solved in 15 moves; the shortest solutions are 16 moves. - **Triangle(10):** The minimum solution length is 18 moves, the largest known triangular grid board (55 holes) with a minimal-length solution. Proving no 17-move solution exists is the main challenge. **Sweep Limits on Triangle(10)** The longest geometrically possible sweep on this 55-hole board is 30. Unfortunately, a solution containing a 30-sweep isn't possible [P4], though a 29-sweep can be achieved. **Diamond Solitaire: Rhombus Boards** Rhombus boards, resembling diamonds when rotated 60 degrees, were explored in a 2005 paper [W2]. Key points: - **Composition:** Equivalent to combining Triangle(n) and Triangle(n-1) boards. - **Rhombus(6):** Similar to Triangle(8), with 36 holes, null-class, and minimum SVSS problem solutions of 13 or 14 moves. No solution exists for under 12 moves. - **Longest Sweep:** Length 16 on Rhombus(6). Four complement problems involve finishing with a 16-sweep from different starting vacancies (e5, d4, e4, d3), solvable by hand with the right strategy. [W2] claims any starting vacancy can reach a 16-sweep on Rhombus(6). The properties of gapless boards, specifically Rhombus and Hexagonal boards, have been studied in detail. These boards exhibit unique characteristics that set them apart from other types of boards. For instance, Rhombus(6) has the unusual property that the longest sweep geometrically possible can be reached from any starting vacancy. This is particularly interesting because it allows for a certain level of flexibility and creativity when attempting to solve problems on this board. Hexagonal boards, on the other hand, have the highest possible symmetry (12-fold) among gapless boards. A hexagonal board of side n will be referred to as Hexagon(n), and it has 6T(n-1)+1 = 3n(n-1)+1 holes. One notable property of hexagonal boards is that they always have a center hole, and if the board is not a null-class board, then the full board is in the same position class as a peg at the central hole. This leads to an interesting consequence: no single vacancy to single survivor problem is solvable on such boards which begins or ends at the center. Additionally, hexagonal boards are used in various peg solitaire games, such as Subtrax and Think And Jump. These games involve removing holes from a hexagonal board to create specific patterns, often with unique rules and restrictions. The study of gapless boards continues to evolve, with researchers exploring new theories and applications for these unique structures. Theories have been developed for 12-fold symmetric boards, similar to those in the square lattice case, which allows for further understanding and analysis of these complex systems. References: [W2] "Diamond Solitaire" [P3] Square-symmetric boards in the square lattice case The Star(n) series features boards with an increasing number of holes, defined by the formula 12T(n-1)+1 = 6n(n-1)+1. These include the 121-hole Star(5) board, which is essentially the standard Chinese Checkers board, and the 13-hole Star(2) board, a null-class variant with no jump possible into or out of its central hole. Null-class stellar boards can be divided into three identical pieces, allowing for easier solution of central complement problems. An interesting example is the Maple Leaf Board, created in 1967 to commemorate Canada's Centennial, which features 37 holes and resembles a 5-pointed maple leaf when cut from the Star(3) board. Its configuration of equilateral triangles and stem was used as the logo for Canada's centennial celebration. Further variations include adding symmetrical sets of six holes to hexagonal boards, resulting in Flower boards with 25 or more holes, showcasing 6-fold rotational symmetry. These null-class boards allow for solvable central games and can be divided into smaller pieces, facilitating problem-solving. The world of puzzle boards offers a diverse range of challenges for enthusiasts. One such puzzle is the 9-loop cental game, which can be solved by hand with relative ease. Other SVSS problems on this board can finish with a 10-sweep. Two new boards, the 43-hole Flower Board and the 49-hole Flower Board, are created by adding holes to Hexagon(4) and Hexagon(6), respectively. These flower boards can be dissected into smaller boards but remain null-class if additional holes are added. Propeller Boards, such as the 16-hole Propeller Board, have been around since 1891 and are considered null-class. The central vacancy complement problem is solvable on this board, but no other SVSS problem is. The Propeller(n) board can be generalized by overlapping three Triangle(n) boards at their apex. Hourglass Boards, with a shape formed by merging two triangular boards tip to tip, offer another challenge for puzzle enthusiasts. These physical boards come in various widths and have rows of width 5, 4, or 6. The 21-hole Hourglass board can be dissected into Triangle(5) plus two copies of Triangle(2), while the 33-hole Hourglass board is formed from Triangle(6) plus two copies of Triangle(3). Online Puzzles, such as "Never Lose" Triangle(5)" (2014), have gained popularity among enthusiasts. Larger boards can be created using a Chinese Checkers set, and computers can generate any board shape with ease, allowing for demos and the ability to take back moves. Given text about peg solitaire game has been rewritten as follows: These dont work well on mobile devices with touch sensitive screens because of lack of a mouse-over equivalent. I have designed the hexagonal levels of a free online Peg Solitaire game and you need to download Shockwave to use it. Thanks to Rob Gordon of Article19 for the GUI. Solution Catalogs This is a compilation of shortest length solutions for six of the boards introduced above. These were calculated by computational search. Given a board and a (solvable) single vacancy to single survivor problem, there is a minimum number of moves that can solve it. These solutions have an elegant look to them and they tend to be extremely hard to find by hand. Table below shows a list of boards together with some statistics about each. If you click on a board you will see another table listing all single vacancy to single survivor problems solvable on that board, together with information about these solutions. These boards all have triangular symmetry and we only list unique single vacancy to single survivor problems. If one problem can be obtained from another by rotation and/or reflection, only one will be listed. If you keep clicking on the tables you can view diagrams of minimal length solutions. The solution catalog is incomplete. Only those with a check mark before them can display all solutions. Some column heads require explanation: Number of Problems - This is the number of different solvable single vacancy to single survivor problems on this board (not including problems equivalent by symmetry). Longest Sweep(any problem) - The first column is the longest sweep possible in any single vacancy to single survivor problem, regardless of solution length. Solution Lengths - This is the range in the number of moves in the minimal length solutions, over all problems. Time to Calculate - This is the amount of CPU time that was needed to calculate the underlying table (find all minimal solutions to all problems). Applying programs to larger boards increases the time to find a solution exponentially, but surprisingly, the complement problem's difficulty doesn't increase with board size. This is shown by using smaller board solutions inductively within larger boards. For instance, a solution on Triangle(6) can be used to solve one corner of a much larger board by clearing remaining areas with chains of block removal moves. While exhaustive search or random moves become more challenging on larger boards, an optimal search technique can handle large, regular-shaped boards efficiently. An example of such an algorithm is found in the Triangular Peg Solitaire Game, which solves the problem from a fully filled board (except for one hole) to a single peg. However, it's essential that the starting configuration is a uniform pattern except for the one vacancy, as arbitrary patterns can lead to NP-complete problems with exponentially increasing run times. The complement problems, on the other hand, are quickly solvable despite linear increases in time required with board size. The author has been playing peg solitaire on a computer since 2014. The Games and Puzzles Journal published several papers on triangular and diamond boards in 2004 and 2005, respectively. These papers showcased methods for constructing solutions with arbitrary sweep lengths. Notable resources include Cut the Knot's explanation of block removals (packages and purges) and Sidney Graham's site for 15-hole triangular peg solitaire. The On-Line Encyclopedia of Integer Sequences features sequences related to peg solitaire. Jaap Scherphuis' web page offers a discussion on Think and Jump and Triangle(5) boards, along with a Java Applet. To play square lattice peg solitaire, one must jump pegs and remove them from the game. The rules are simple: each move involves jumping an adjacent peg into an empty space. Each jumped peg is removed. The objective is to have only one peg left on the board. Position 1 is empty, which would be the top point of the triangle. This method is the most common and easiest way to solve the puzzle. In the following videos, grey circles indicate empty holes, red circles indicate pegs you will be moving, and blue holes indicate pegs that are not in play. To make a diamond shape, take the peg in position 4 and jump it over the peg in position 2. It will then be in position 1. Use the peg in position 6 to jump position 5. It will now be in position 4. Use the peg in position 1 to jump position 3. It will now be in position 6. These moves will give you the diamond base. Make two groups of pegs by moving the peg in position 7 to position 2, jumping position 4. Move peg 13 to position 4. Next, move peg 10 to position 8. You should now have two groups of pegs, with 5 pegs on the left side and 3 on the right. Separate the triangle into two by moving peg 2 to position 7. Then take that same peg and move it to position 9. Next, move peg 15 to position 13. Move your last pegs to the bottom row by moving peg 12 into position 14. Next, move peg 6 to position 13. You should now just have three pegs left in the bottom row. Complete the last moves by moving peg 14 to position 12. Then make the last move, peg 11 to position 13. Win the game by having the ending peg in the 13th hole. Congratulations! You've just completed the Peg Game. Looking at how games like peg are made, Ashton is involved in creating board game content as a commentator, playthrough director, and host of the Shelfside Podcast alongside Daniel. Originally from University of California, Santa Barbara, he holds degrees such as Economics Bachelor of Arts and Technology Management Certificate.