PENCIL AND PAPER 12

Print ‘n’ Play Collection

Of the 12 Pencil 'n' Paper Puzzles

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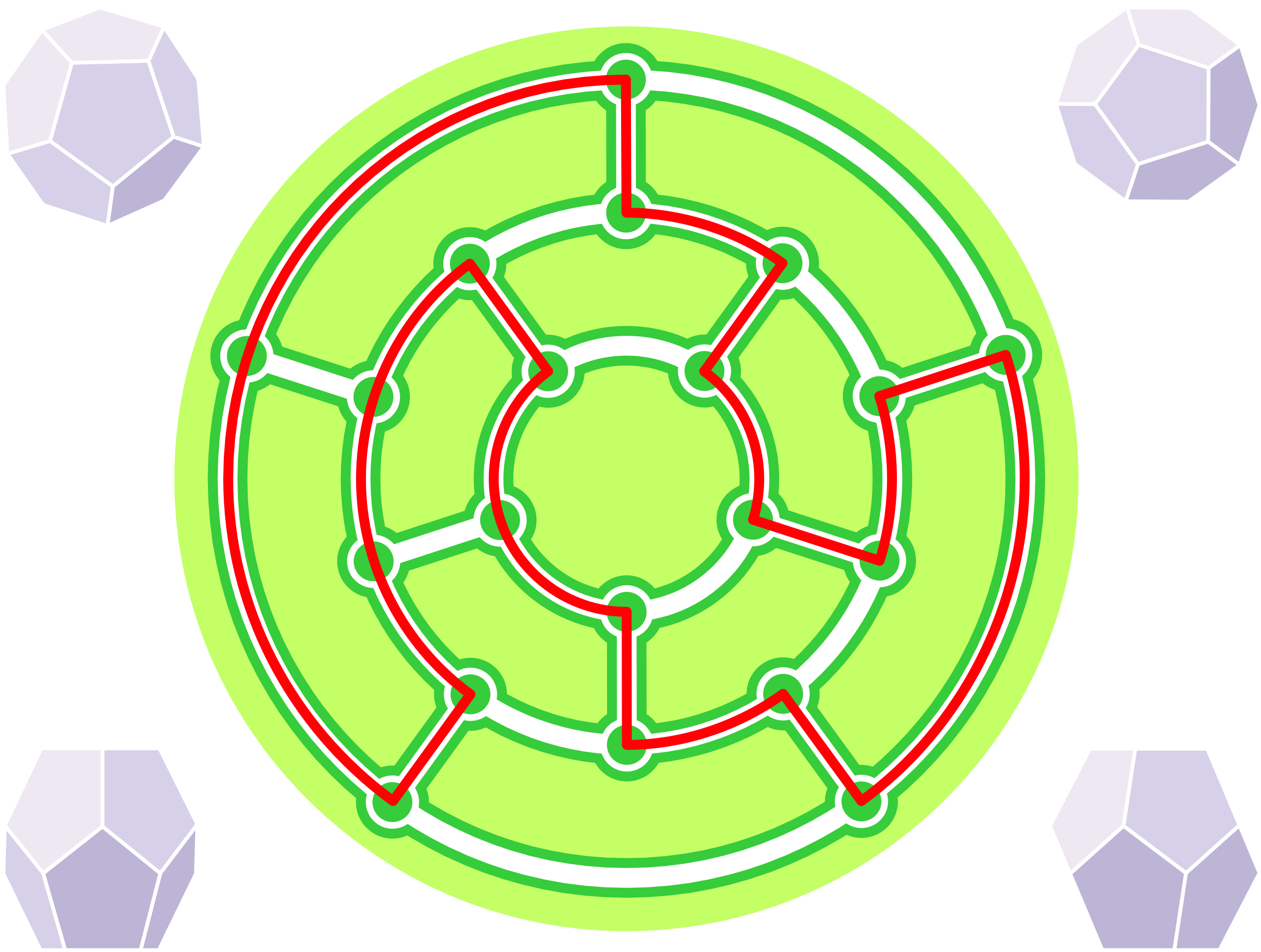
Around Dodecahedron In 20 Points* by W. R. Hamilton



The graph in the circle above is a two-dimensional projection on the plane of a dodecahedron (a three-dimensional solid with twelve pentagonal faces). Each green point on the graph represents the respective vertex of the dodecahedron, and each white line between any two points - the respective edge. Such graphs, which project some three-dimensional problems and puzzles onto the two-dimensioanl plane are called Schlegel diagrams.

The object of this puzzle is to visit all the 20 green points on the graph. You can start at any point but you may visit each point only once. Moving from point to point you have to travel along the white lines (alleys) only. You have to finish at the point where you've started your journey from.

*This puzzle is an Icosian game which was invented by the mathematician W. R. Hamilton in 1859. Hamilton devised a branch of mathematics to solve similar path-tracing problems on two-dimensional solids. He called it Icosian calculus.

The Quarrelsome Neighbors after Sam Loyd

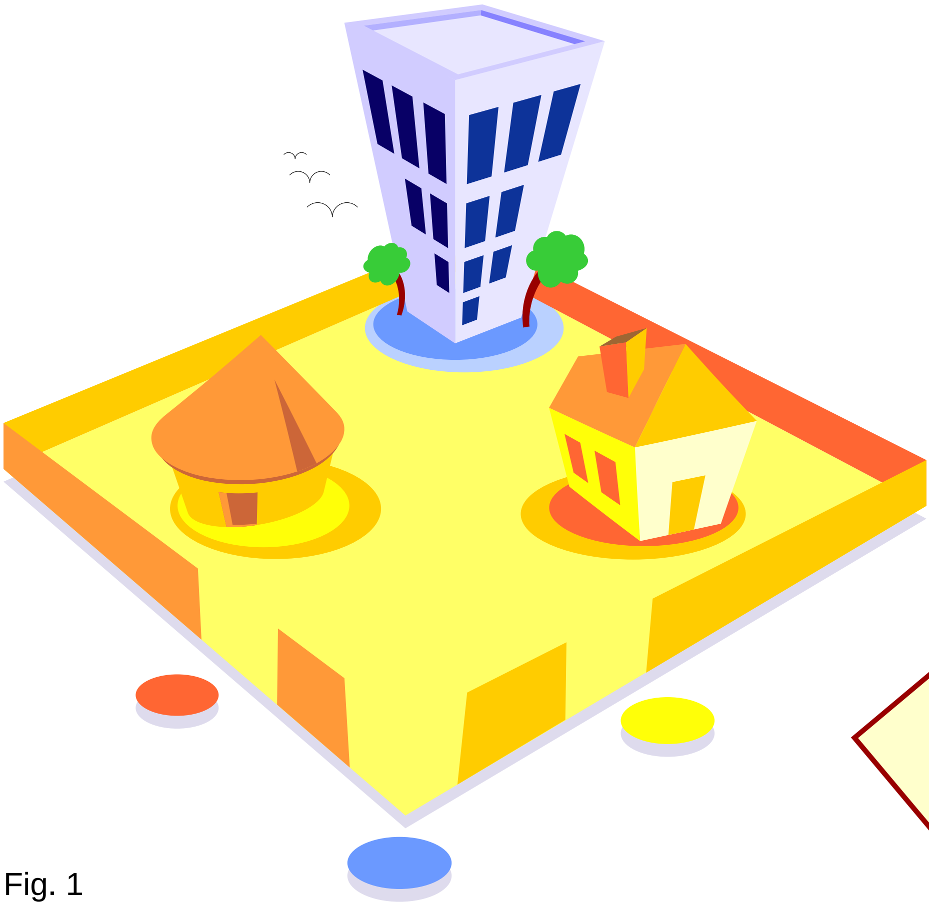


Fig. 1

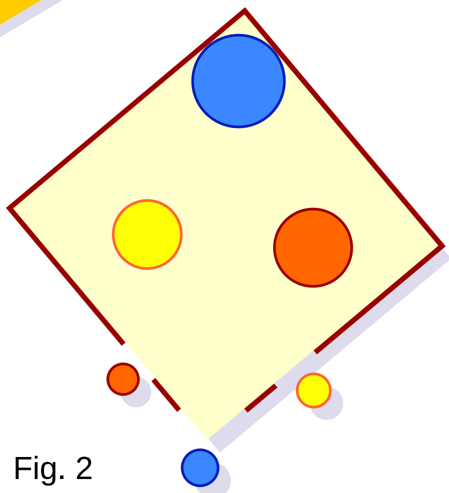


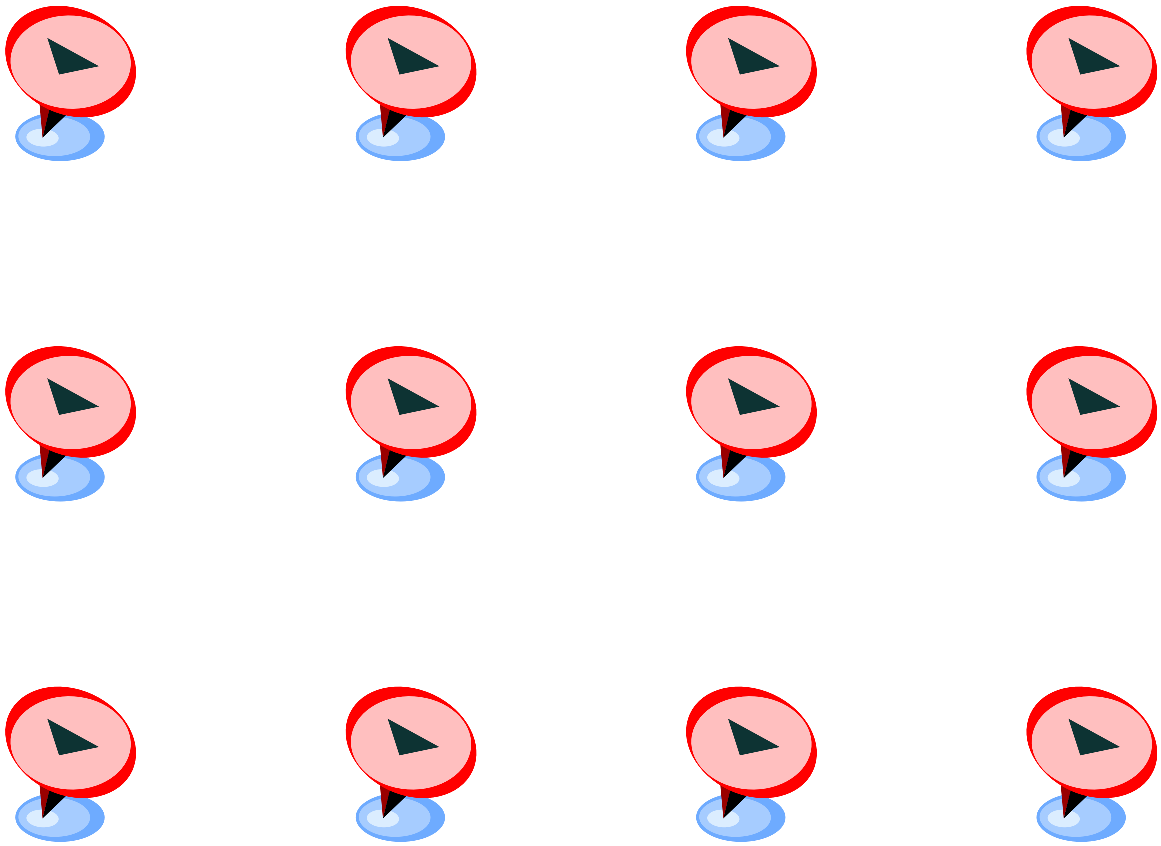
Fig. 2

Three neighbors - the owners of the skyscraper, the bungalow and the cottage - who share the small park, as shown in Figure 1, have a falling out. This led them to the decision to build three pathways from their houses to the gates of the park (every path to another gate), so that none of the paths cross each other!

The owner of the skyscraper wants to build the path to the central gate. The owner of the bungalow (on the left) wants to make the path to the gate on the right, and the owner of the cottage (on the right) wants to have his path to the left gate. The colors of the lawns around the houses and the respective spots next to the gates will help you to understand their plan. Please, notice that none of the path can go behind the skyscraper (Figure 2)

How do the quarrelsome neighbors have to build their pathways?

Twelve Points*

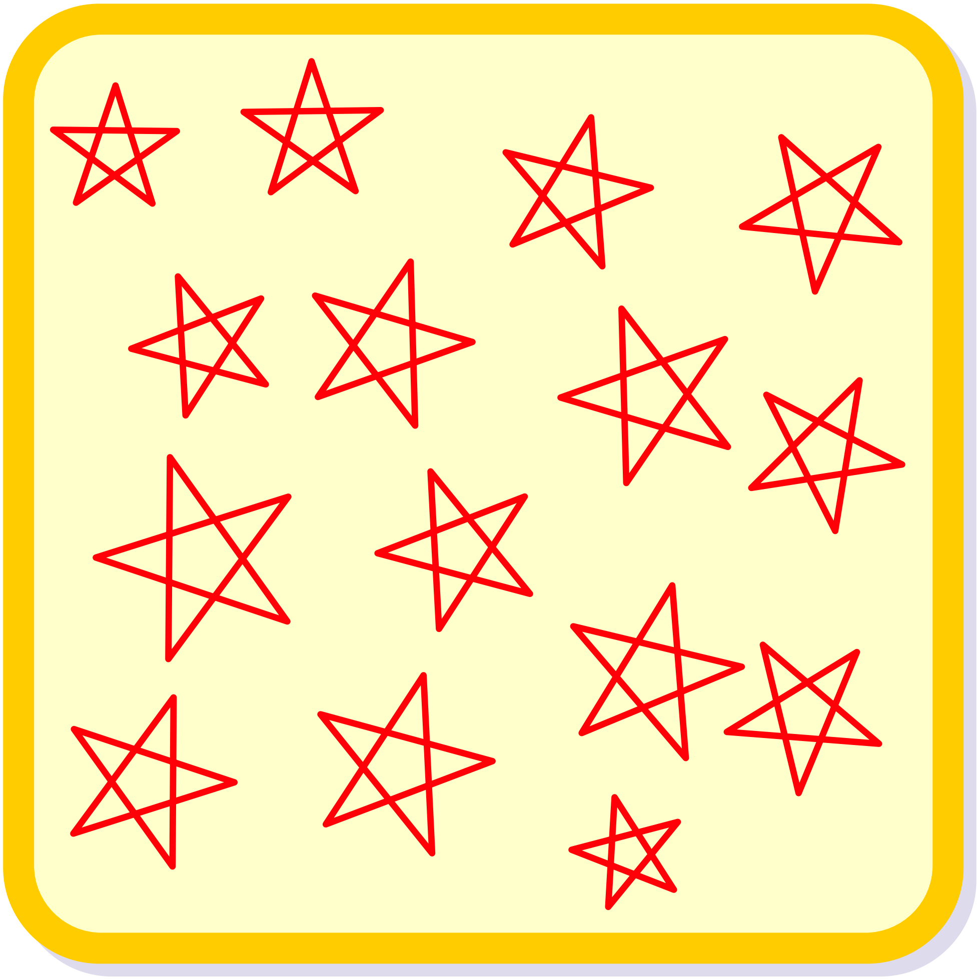


Connect all the twelve points with exactly 5 connected straight lines without lifting your pencil off the paper.

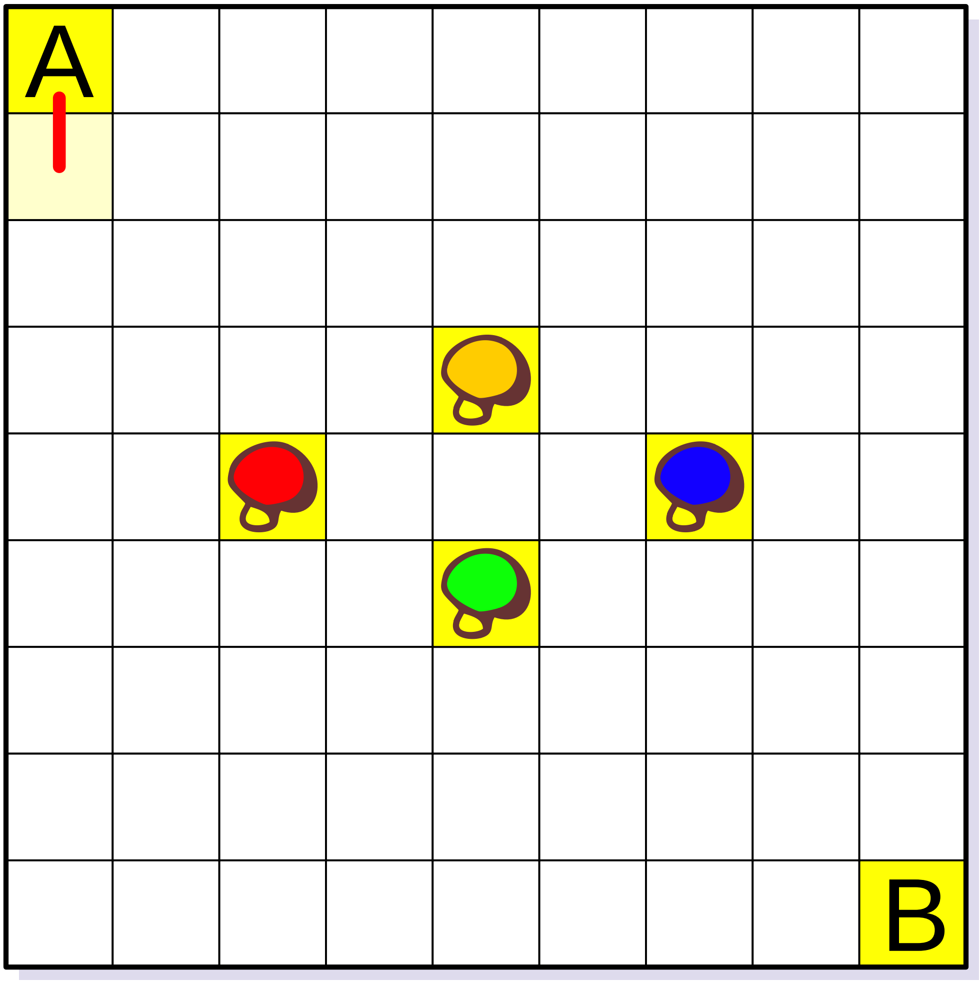
*This puzzle was inspired to the publication on our site by the message from Meeki L.

The New Star Puzzle

by Sam Loyd



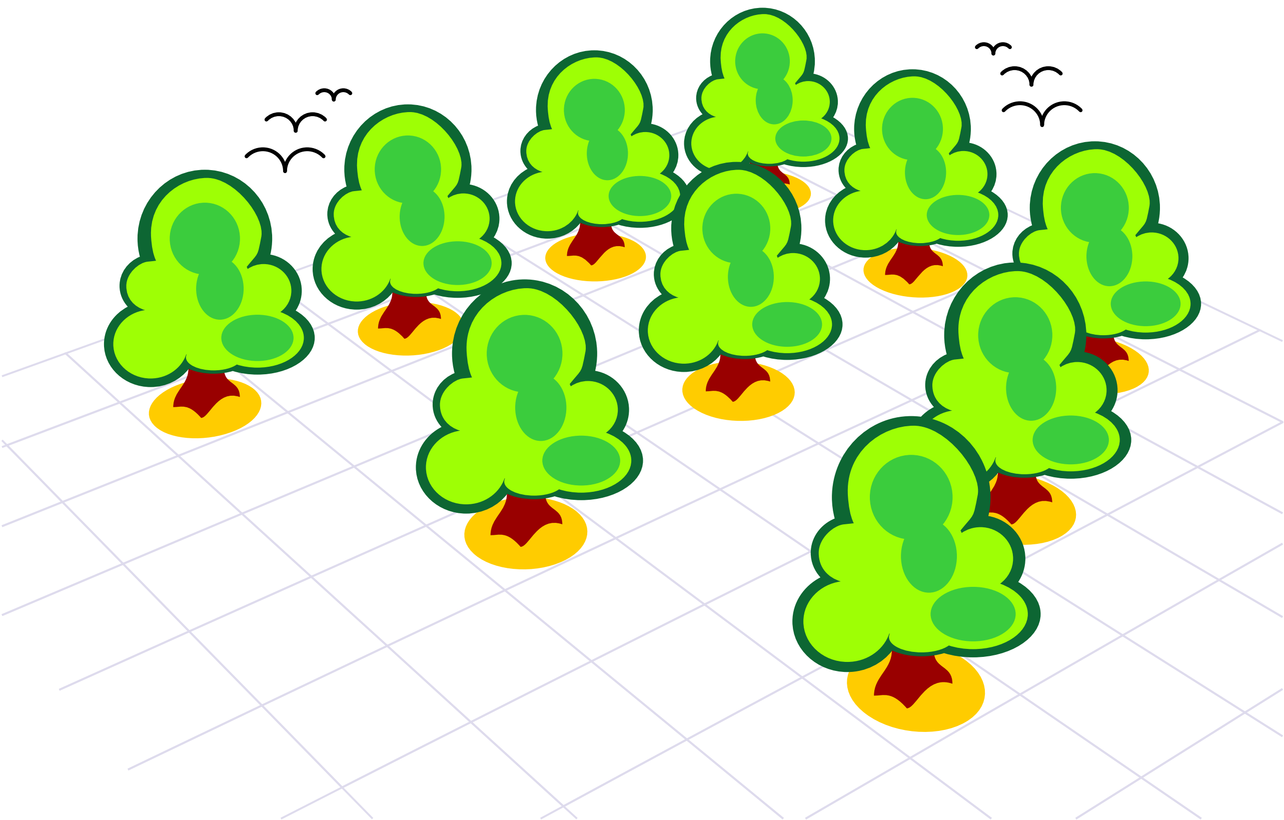
Can you add to the diagram shown in the illustration one more perfect five-point star - looking exactly like any of those in the diagram - that will be larger of any of them, but at the same time will touch none of them?



The goal of this puzzle is to draw a path from A to B so that it goes through each empty square of the board only once and has no self-crossings. Your path must go horizontally and vertically (never diagonally), and it has to avoid the four squares with the mushrooms in them.

There is an additional condition: the second square of the path must be exactly under the A square as shown in the illustration.

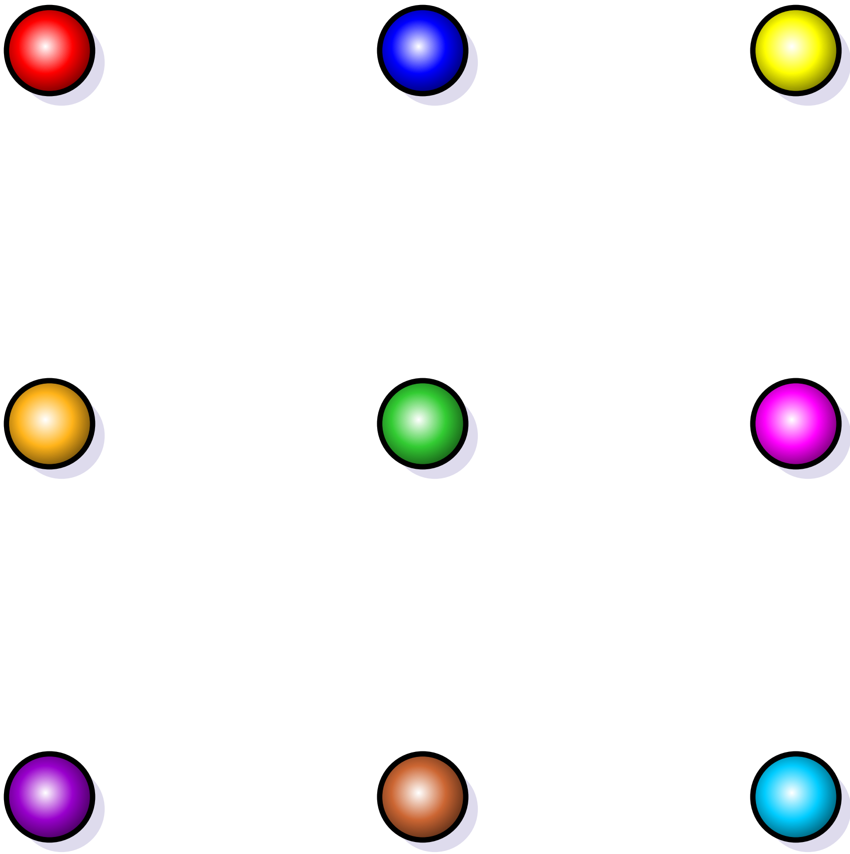
10-in-5-Rows*



Imagine you have ten trees to plant. You have to get an orchard which must consist of five straight rows of trees and each row must contain four trees. One straight line of ten trees cannot be used. Thus the question is: what template could be used for the planting?

*This puzzle was inspired to the publication on our site by messages from Sundaresan.K.R and Dan E.

Dots & Squares*

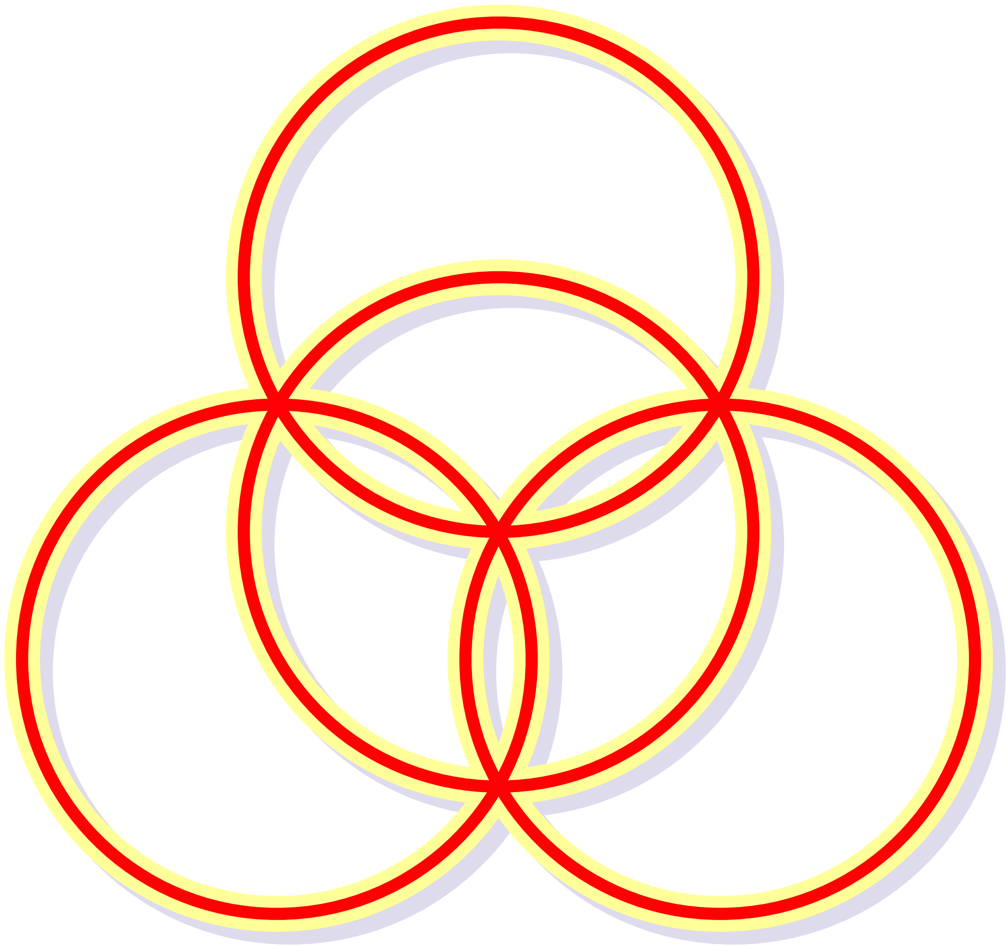


Can you draw three squares in such a way that each of the nine dots shown in the illustration is enclosed in only one region?

*This puzzle was inspired to the publication on our site by a message from our visitor K.

Four Circles

by Thomas H. O'Beirne

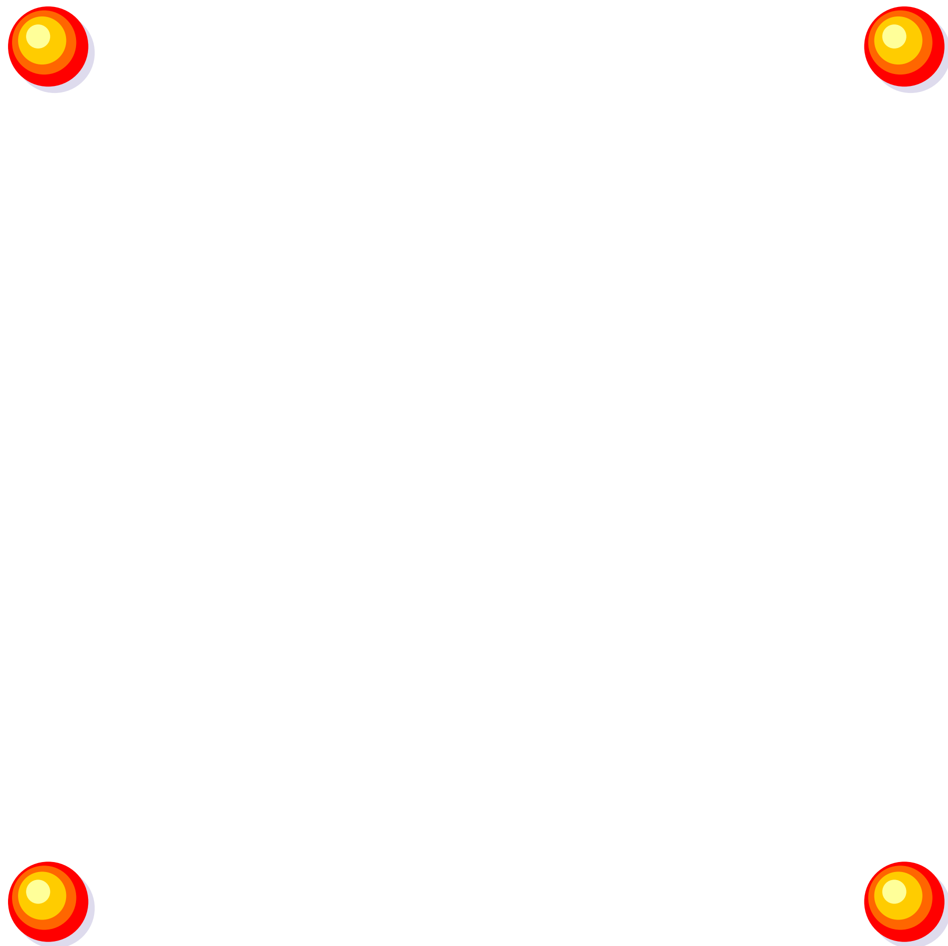


Draw this pattern of four crossing circles with pencil in one continuous line so that you don't take the pencil point off the paper.

You aren't allowed to go over any part of the line twice, or cross it.

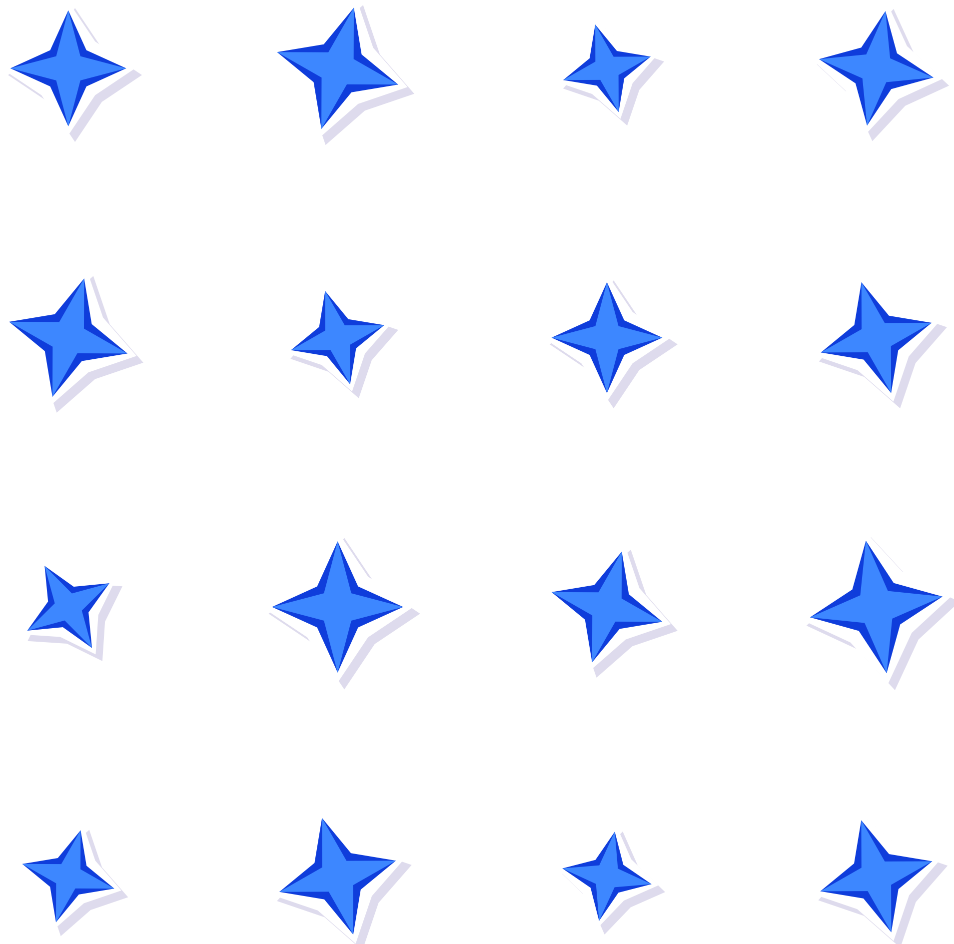
Shortest Connection

after Martin Gardner

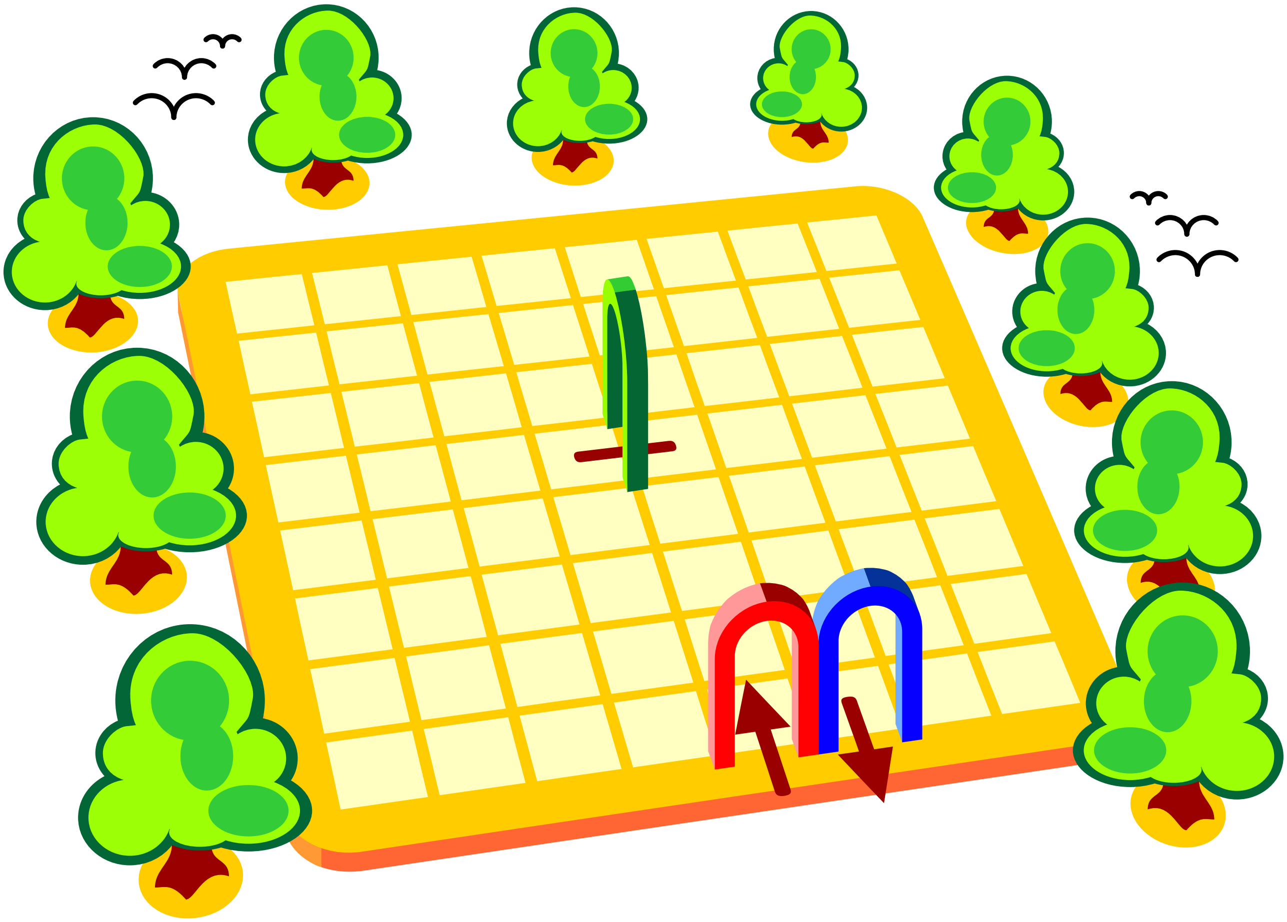


Draw four dots that mark the corners of a perfect square as shown in the illustration.

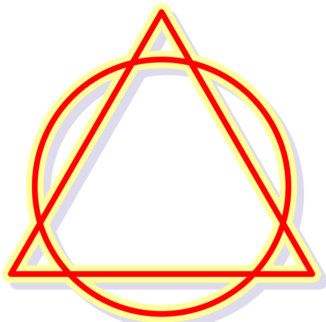
The object is to draw a minimal network spanning them. The parts of it may intersect, and you're allowed to use additional dots while drawing the network.



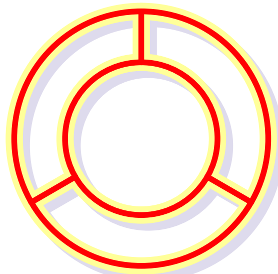
The object of this puzzle is to connect all the sixteen stars above with exactly 6 connected straight lines without lifting your pencil off the paper. The lines must go through the centers of the stars.

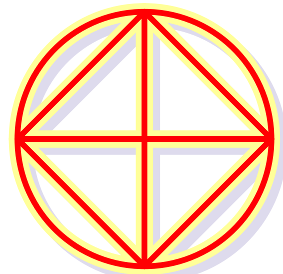


The goal is to draw a path that goes through each of the 64 cells of the board only once. The path must enter the board at the red gate, pass under the green gate in the center of the board and leave it at the blue gate. Your path must go horizontally and vertically (never diagonally).


1


2


3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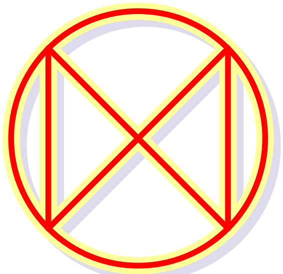
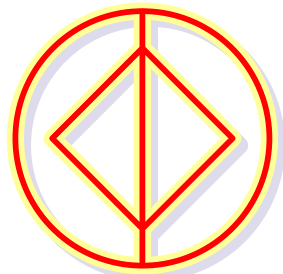

5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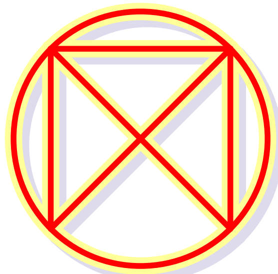
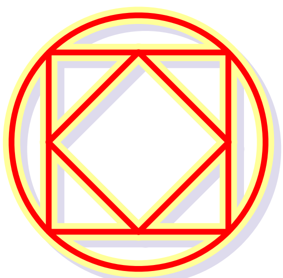

7


8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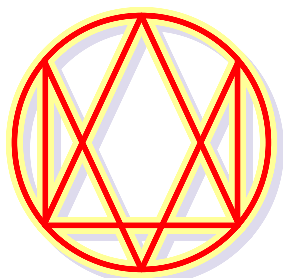
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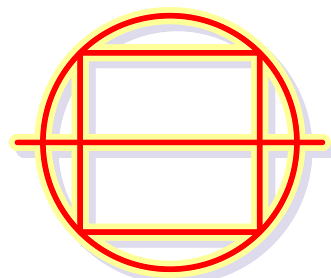
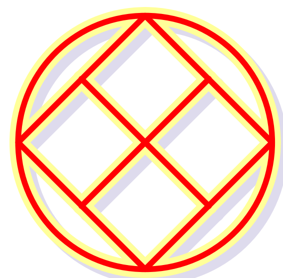

11


12

The object of this puzzle is to figure out which of the 12 patterns above can't be drawn with pencil in one continuous line so that you don't take the pencil point off the paper.

You are not allowed to go over any part of the line twice, or cross it.

PENCIL AND PAPER 12

Solutions

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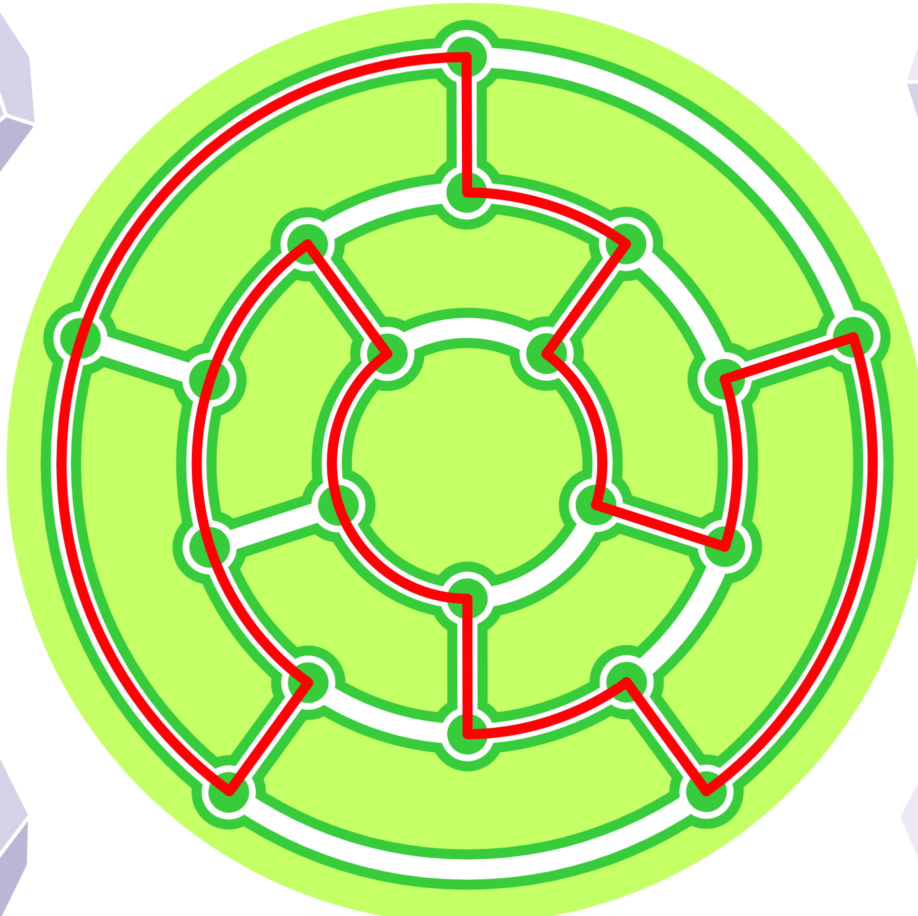
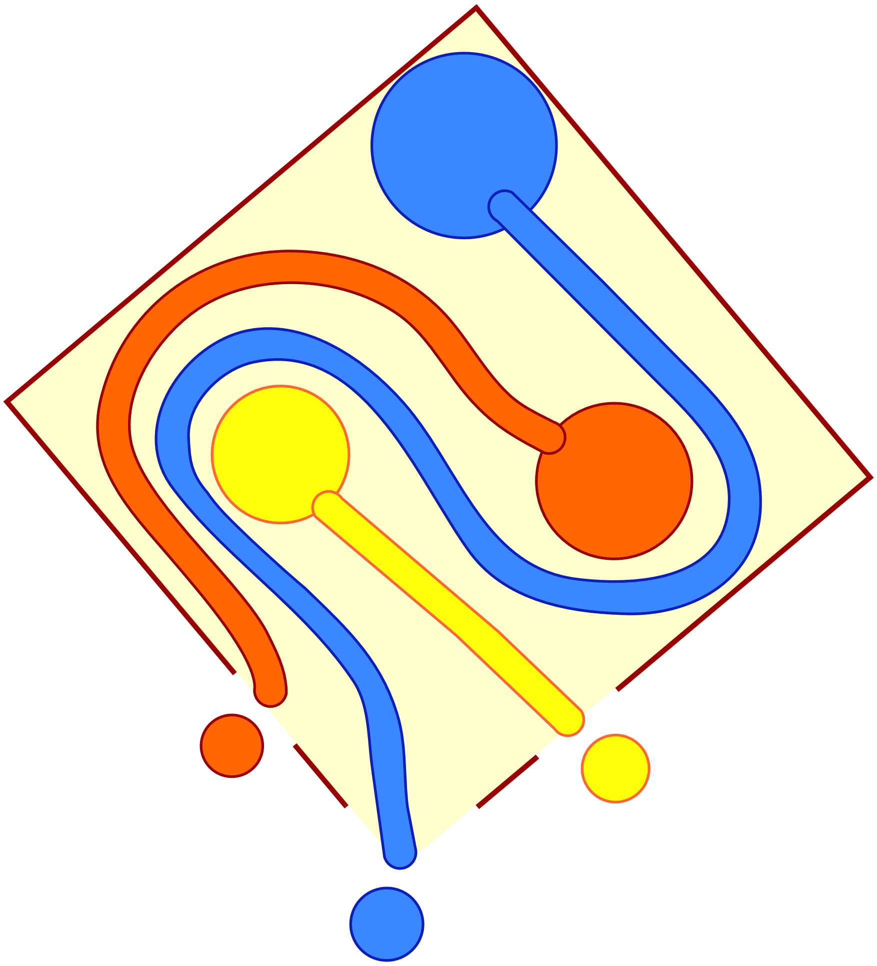
Around Dodecahedron In 20 Points (Solution)



One of the possible paths to this puzzle is shown in the illustration.

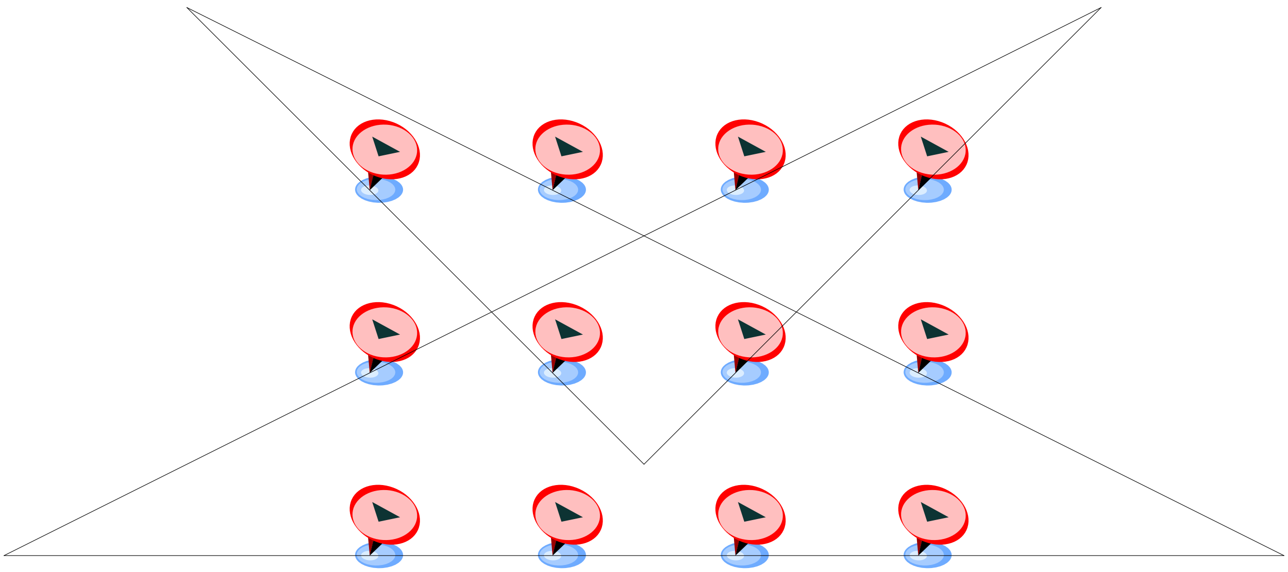
The Quarrelsome Neighbors (Solution)



The quarrelsome neighbors have to build their paths as shown in the illustration or in a symmetric way.

Twelve Points

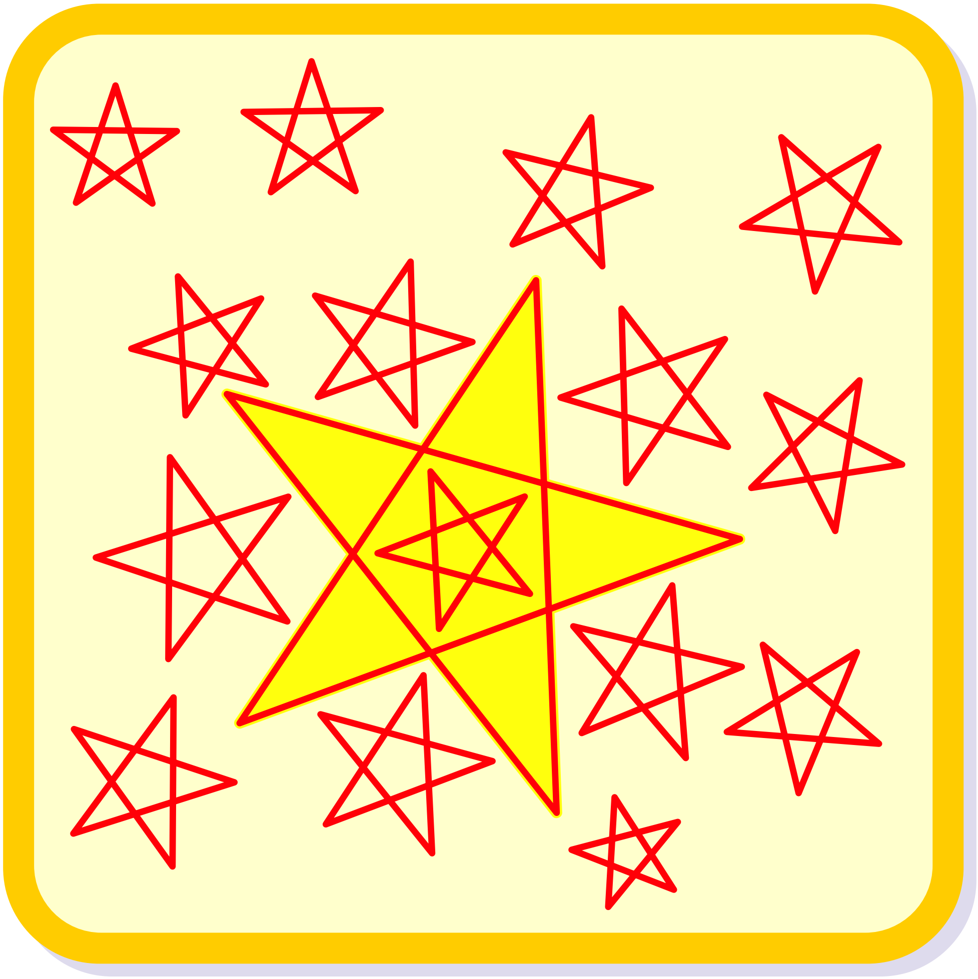
(Solution)



The solution is shown in the illustration.

The New Star Puzzle

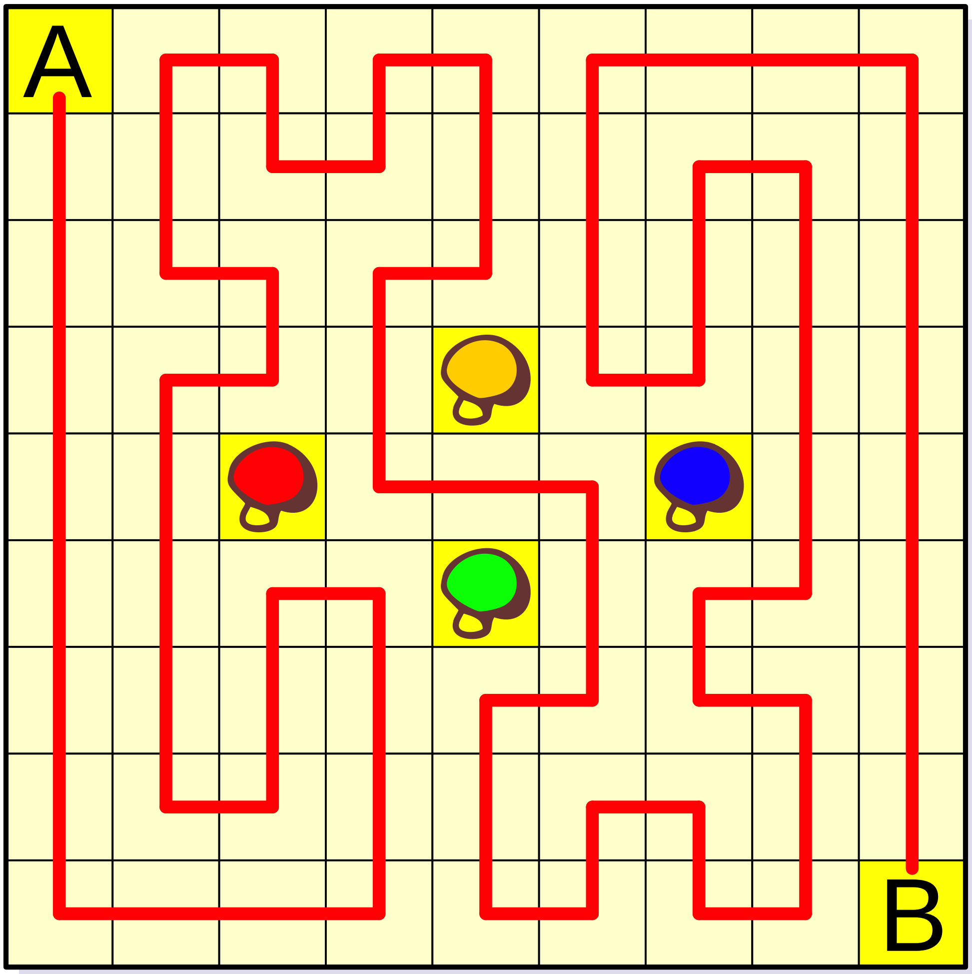
(Solution)



How to add a new, bigger star to the existing ones is shown in the illustration.

Puzzling Journey

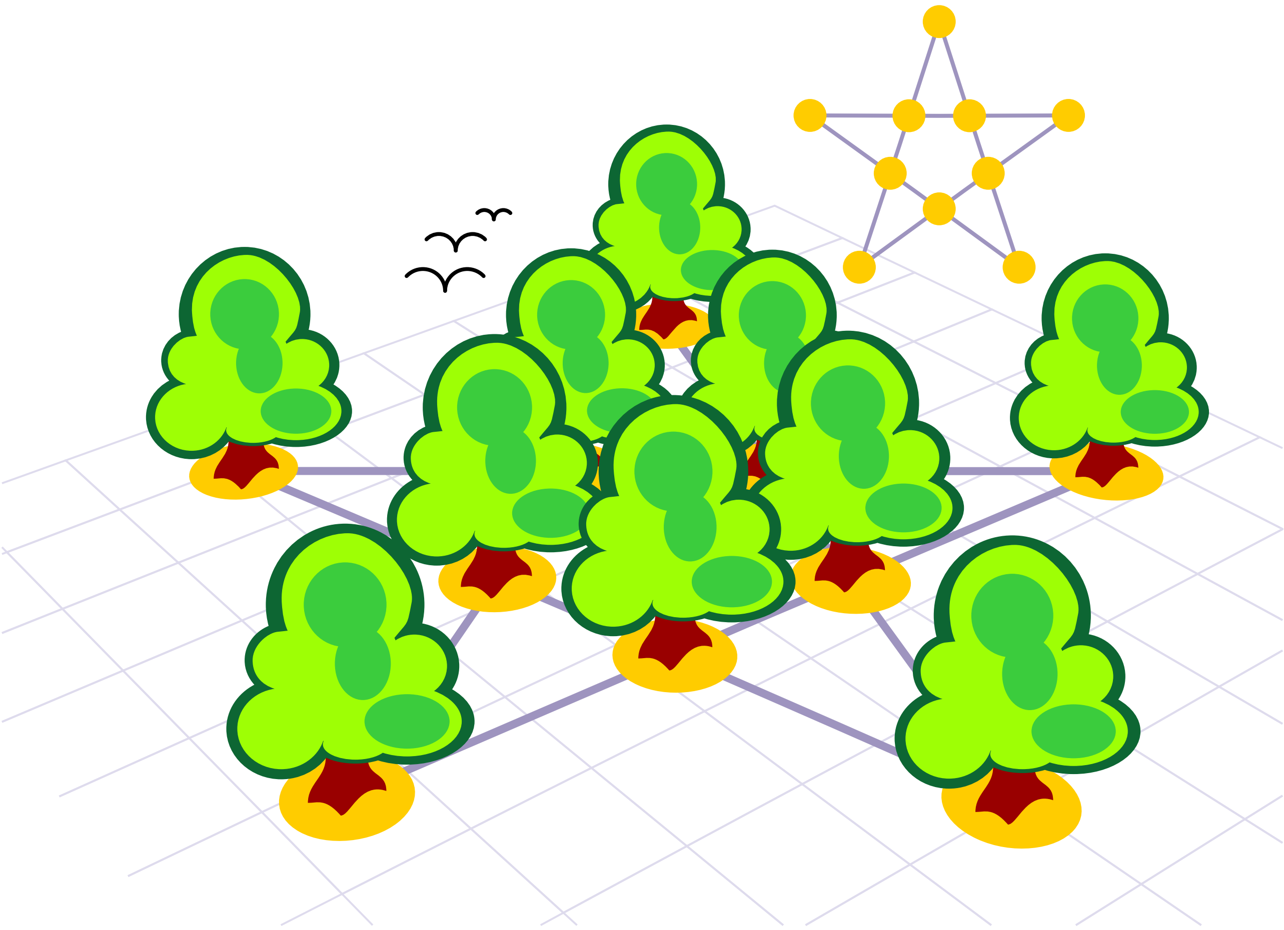
(Solution)



One of the paths is shown in the illustration.

10-in-5-Rows

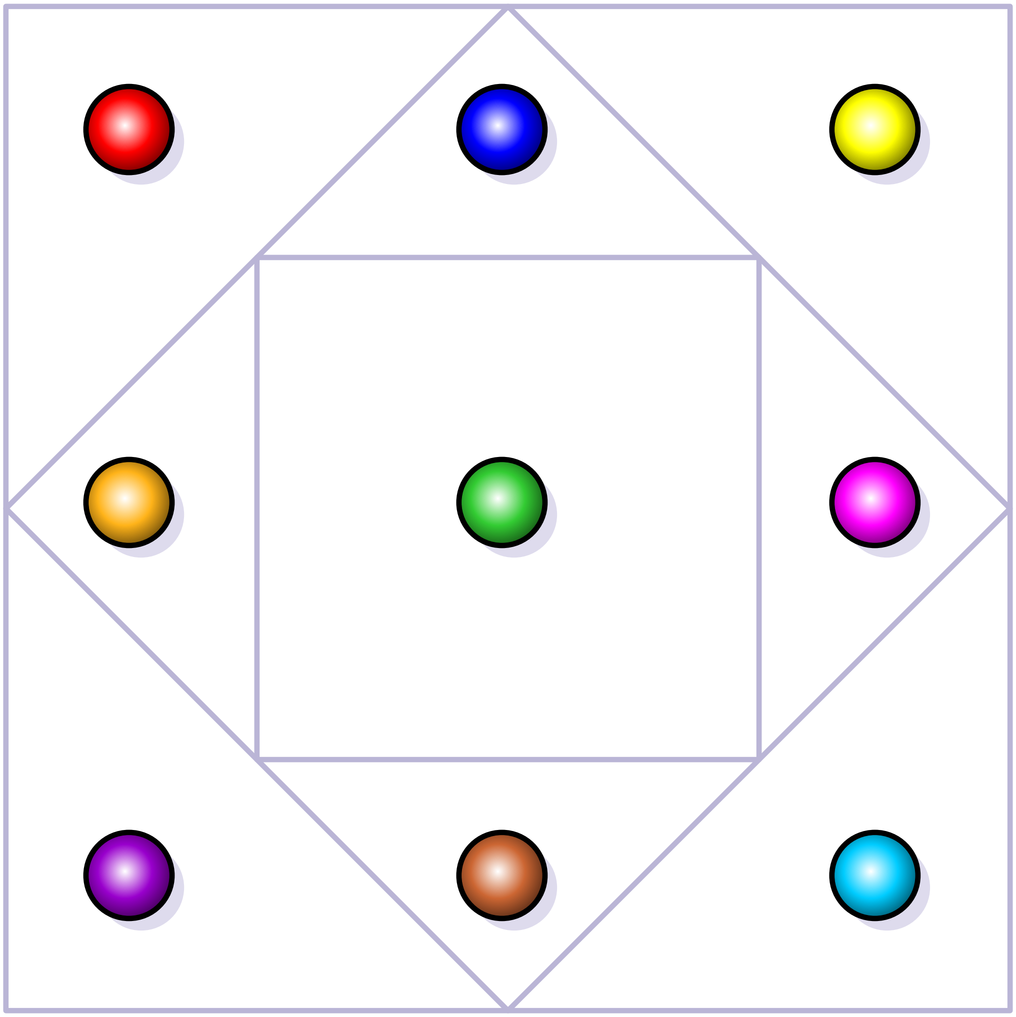
(Solution)



One of the solutions to this puzzle is shown in the illustration.

To plant an orchard of five rows of four trees each you could use a five-point star template as shown in the illustration.

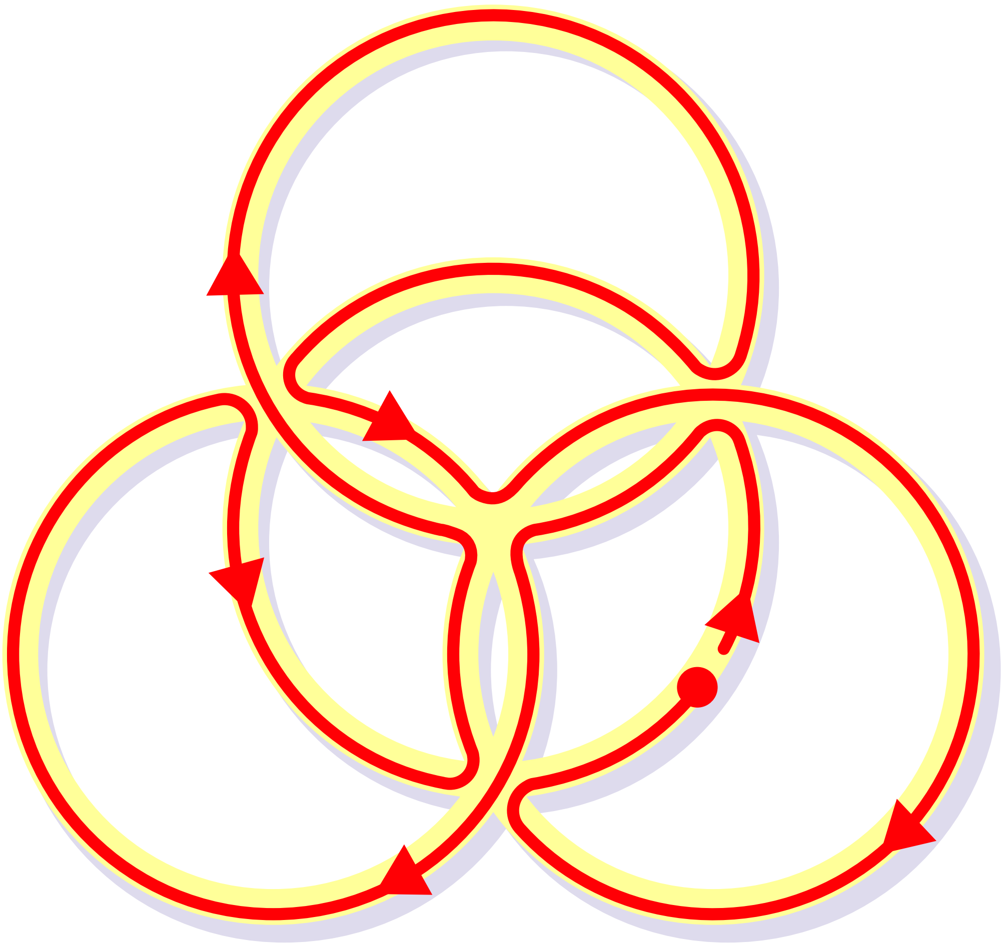
This classic puzzle has a long story behind it. Such puzzle grands as Sam Loyd and Henry E. Dudeney contributed to the development of the puzzle.



The solution is shown in the illustration.

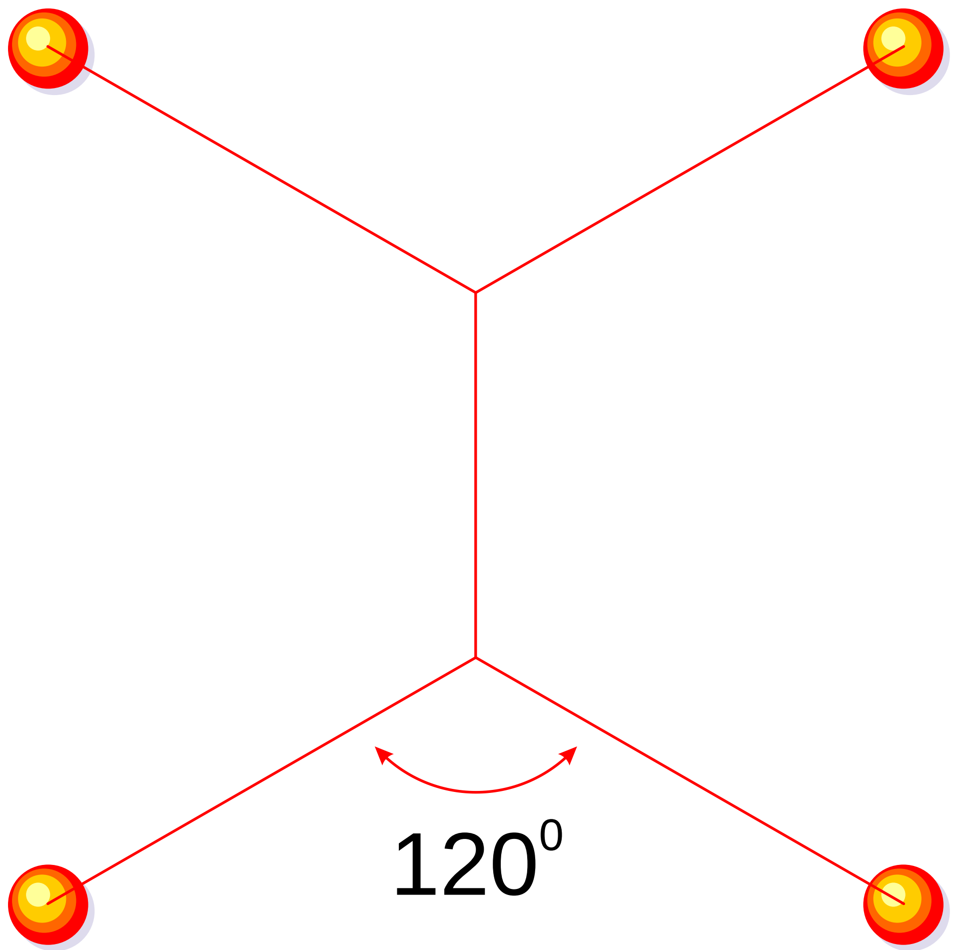
Four Circles

(Solution)



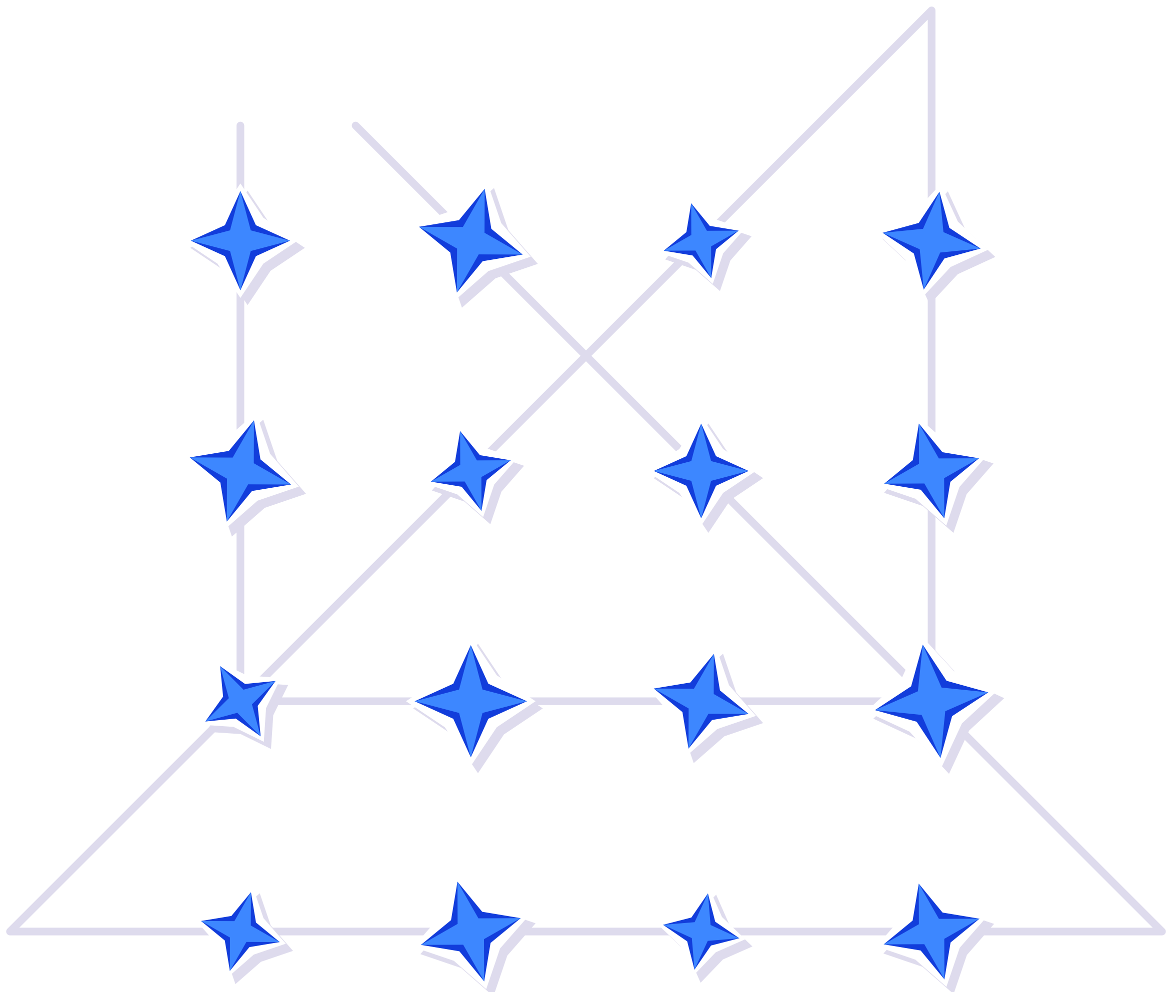
A pretty symmetrical solution to this puzzle is shown in the illustration.

More solutions can be found at:
http://www.puzzles.com/PuzzlePlayground/FourCircles/FourCirclesSol.htm.



At first sight it seems that the cross of the two diagonals with one additional point makes the minimal network. But, in fact, it isn't. If the side of the square is 1 then the total length of the cross is 2sqrt2, or about 2.828. With the same side of the square total length of the network (with two points of intersections) shown in the illustration on the left is only (1 + sqrt3), or about 2.732, that makes it the minimal possible network to span the four corners of a square.

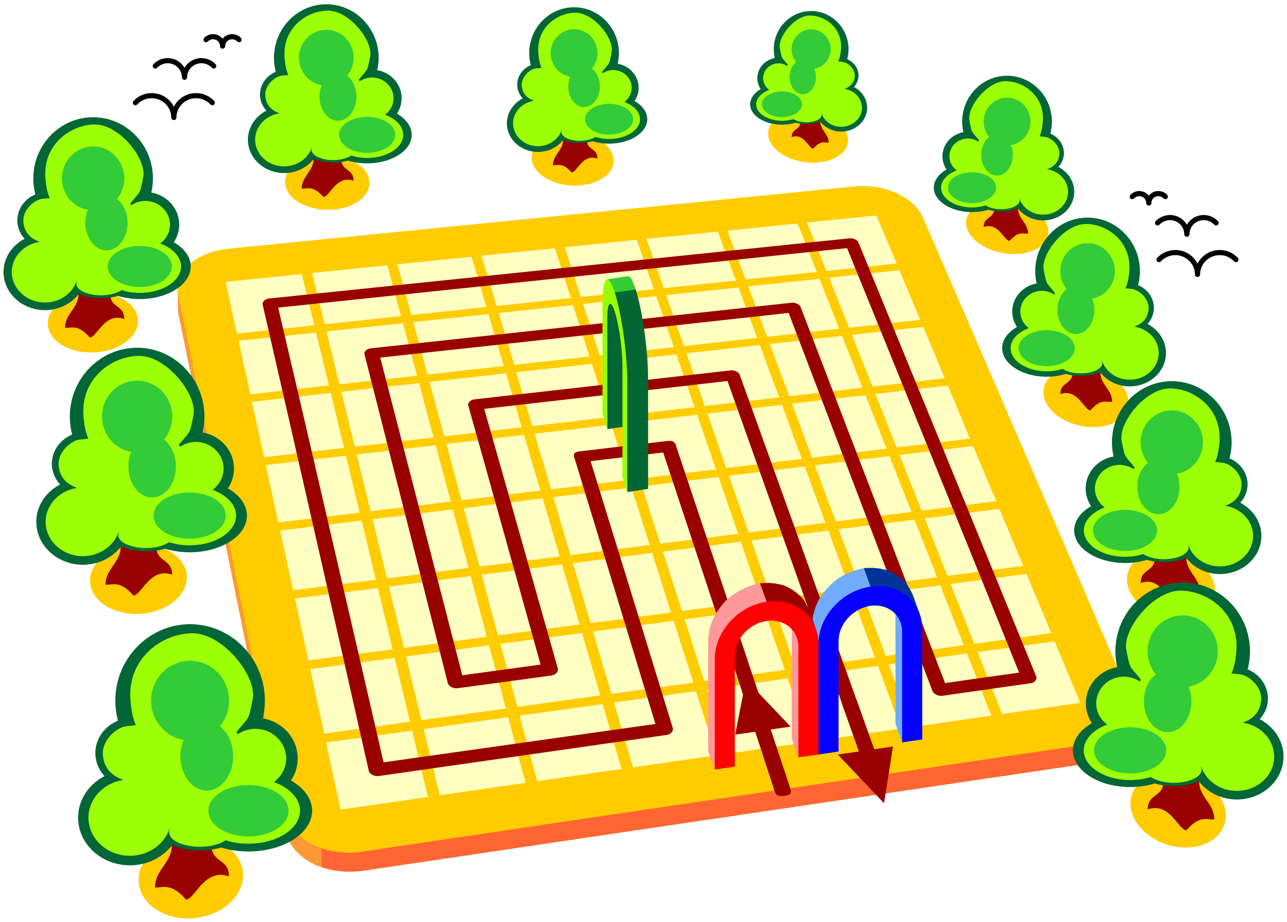
Starry Sky
(Solution)



One of the solutions is shown in the illustration.

Puzzling Journey 2

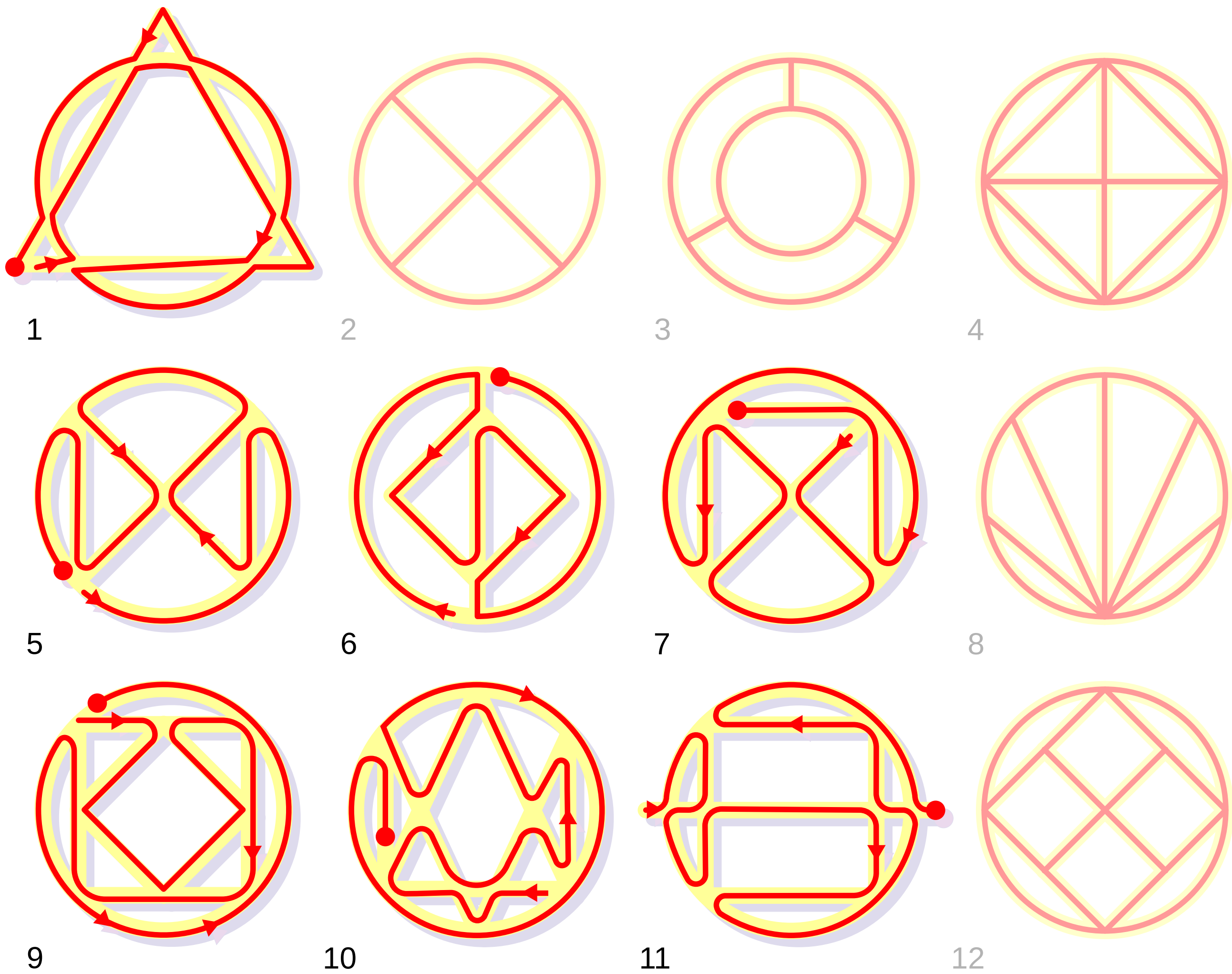
(Solution)



One of the solutions is shown in the illustration.

More solutions can be found at
http://www.puzzles.com/PuzzlePlayground/PuzzlingJourney/PuzzlingJourneySol.htm.

The Unicursal Marathon
(Solution)



The only patterns which can't be drawn with pencil in one continuous line so that you don't take the pencil point off the paper are as follows: 2, 3, 4, 8, 12.

Possible solutions to the remaining patterns are shown in the illustration above.

Now using Figure 4 we'd like to explain why it's impossible to draw it with pencil in one continuous line so that you don't take the pencil point off the paper, or why it isn't unicursal.

Figure 4 has exactly four points (nodes) where an odd number of lines are branching out (5 at each), and one node in the center of the pattern with an even number of branches (4).

Every time you go through a node not stopping at it you must of necessity use a pair of its branches. Therefore at each of the four nodes on the periphery of the pattern one branch in any case will be alone. When we use this alone branch this means that our line either starts from this node or just finishes at it. Thus we have FOUR points (nodes) where the line has to start (or finish) doesn't matter how to draw it. But a continuous line has only TWO ends, so the puzzle can't be solved.

Same proof is true and for the rest of "impossible" figures in our set - 2, 3, 8 and 12.

ANY figure that has only TWO points (nodes) where an odd number of lines are branching out, and ANY number of its nodes with an even number of branches, CAN BE DRAWN in one continuous line. You just have to start at one "odd" point and finish at the other. See Figures 6, 7, 10 and 11 (figure 11 has two "free" ends which are "odd" nodes too, but just with one branch each).

And finally an excellent thing about all unicursal figures is that you ALWAYS can draw in one continuous (and even closed in loop!) line ANY pattern if ALL its nodes are "even." See Figures 1, 5 and 9.