Double Dissections:
Visual Geometry with Origami Squares*

by Puzzlium

Sets & Shapes

Origami paper squares, colored on one of their sides and white on the other, are traditionally used for creating various 3-D shapes: flowers, animals, different objects, and much more. There are even Origami puzzles proposing geometric patterns to be created with folding an Origami square, and some of them are quite challenging.

Also, Origami squares can be used to create very simple modules to a newly devised type of visual geometry puzzles. For each challenge we will use a pair of Origami squares cut equally into the same sets of pieces. As a result, for each puzzle we will have a double set of pieces in which every piece has its twin.

The first double sets use the lines of two main diagonals, which we can easily pre-crease or mark on each Origami square, while for other sets we use orthogonal or combined cuts. Accordingly, the first sets mainly contain just isosceles triangles, and for the next sets their pieces get different forms up to quite unusual ones.

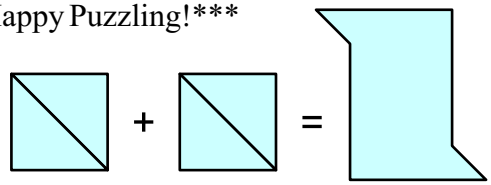
Using each double set of pieces, we can create different shapes like polygons, stars, diaphragms, crosses, and so on. Note that in all puzzles described below you can rotate their pieces but not overlap or flip them over. An example of the shape created with one of the simplest double sets is shown on the right.

In the next two pages you can find a selection of double sets (A thru P) and shapes created of them (1 thru 16). Your challenge is to pair all sets and shapes into sixteen corresponding pairs. For this you should figure out and show from which set and how each shape is assembled. You will discover that some sets allow assembling not just one but several shapes and vice versa. But finally, each one of the sixteen sets should have its own respective shape.

Among the shapes proposed in page 3 there are several shapes with quite interesting properties. First, it is a big square (Shape 6) assembled of two initial, smaller ones. This is a nice illustration and proof of Pythagoras' theorem. Then, an interesting fact about an iris diaphragm (Shape 10) is that being inscribed into a unit circle, it has the biggest possible pieces.**

Also, a four-pointed, fully symmetric star (Shape 16) is another unusual geometric find. This is a very unexpected shape considering pieces from which it is assembled, and it has a nice proof of its full symmetry. Can you find this proof? This star and the set of pieces for it inspired a puzzle mosaic shown in Page 4. Can you find this symmetric star in the mosaic?

Happy Puzzling!***



Double Dissections: Example
Two Origami squares divided into two isosceles triangles each and the shape created from them.

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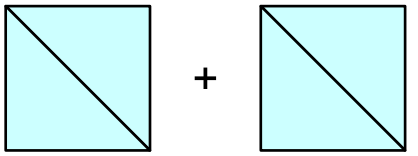
*) Prepared specially for the Geometry Party, San Francisco, CA, USA, April 27, 2014 by Serhiy Grabarchuk, a puzzle creator, solver, writer, and co-founder of Puzzlium Inc., www.puzzlium.com.

**) Found by Serhiy Grabarchuk in April 2005, and first published at Erich Friedman' Packing Center in the Tans in Circles collection, www2.stetson.edu/~efriedma/tanincir/.

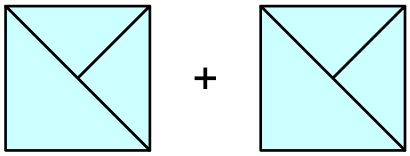
***) Solution to all puzzles will be posted at www.ageofpuzzles.com.

Double Dissections: Sets

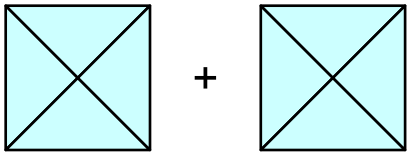
Pair all double sets (A thru P) with shapes (1 thru 16) shown in the opposite page into sixteen corresponding pairs and show from which set and how each shape is assembled. Note that finally each set should be used just for one shape.



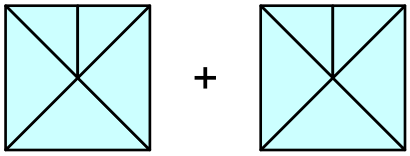
Set A =
Shape [ ]



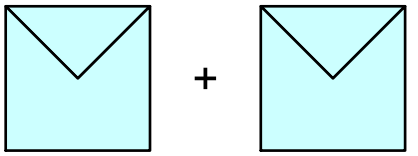
Set B =
Shape [ ]



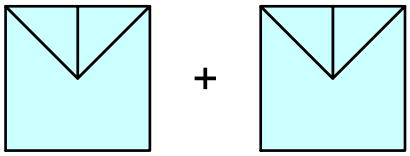
Set C =
Shape [ ]



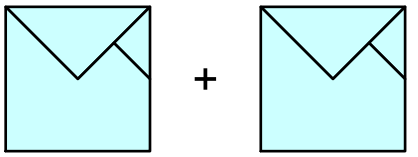
Set D =
Shape [ ]



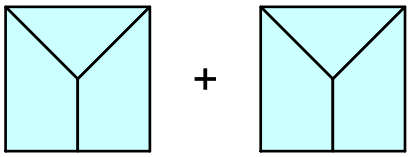
Set E =
Shape [ ]



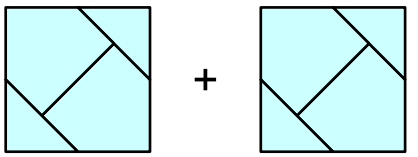
Set F =
Shape [ ]



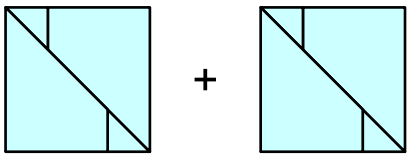
Set G =
Shape [ ]



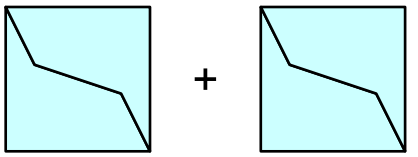
Set H =
Shape [ ]



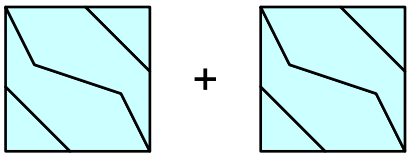
Set I =
Shape [ ]



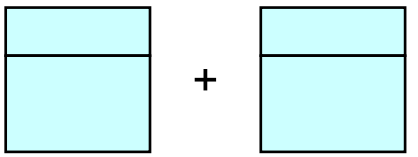
Set J =
Shape [ ]



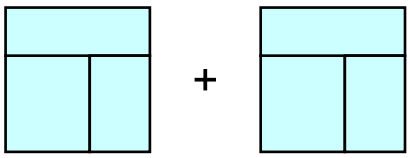
Set K =
Shape [ ]



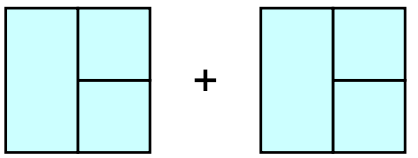
Set L =
Shape [ ]



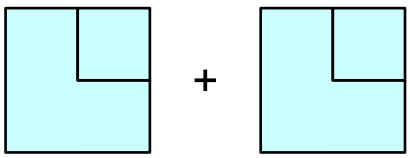
Set M =
Shape [ ]



Set N =
Shape [ ]



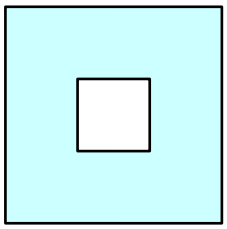
Set O =
Shape [ ]



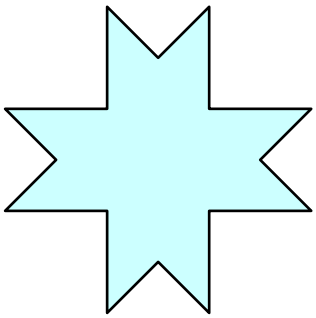
Set P =
Shape [ ]

Double Dissections: Shapes

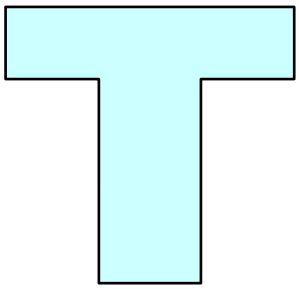
Pair all shapes (1 thru 16) with their respective double sets (A thru P) shown in the opposite page into sixteen corresponding pairs and show from which set and how each shape is assembled. Note that finally each shape should be formed by one set only.



Shape 1 = Set [ ]



Shape 2 = Set [ ]



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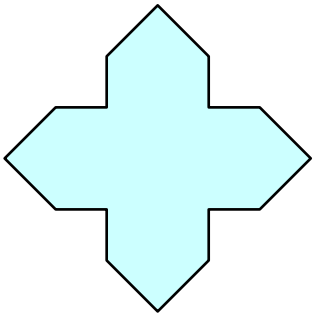
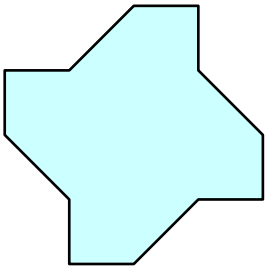
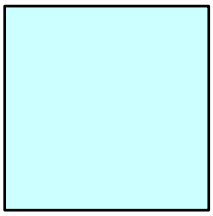


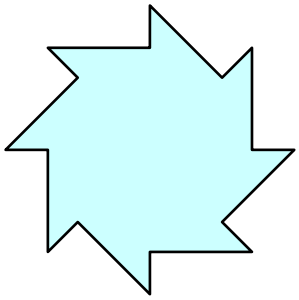
Shape 4 = Set [ ]



Shape 5 = Set [ ]



Shape 6 = Set [ ]



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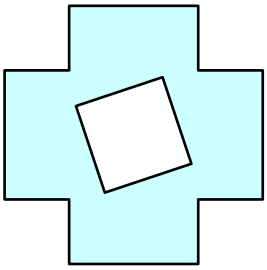

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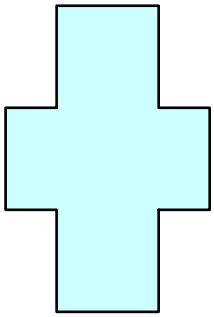

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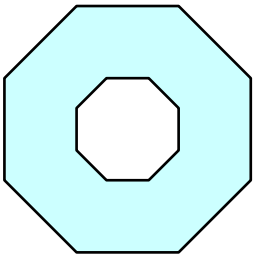
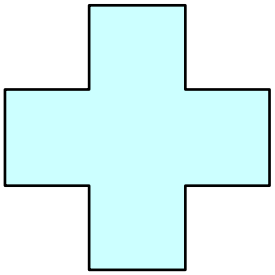
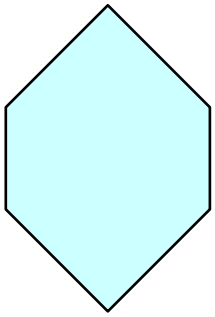


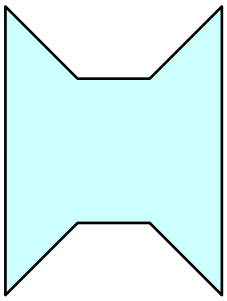
Shape 10 = Set [ ]



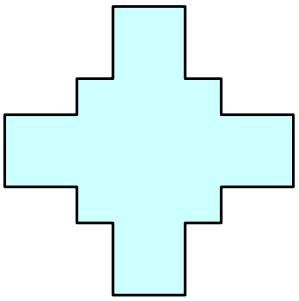
Shape 11 = Set [ ]



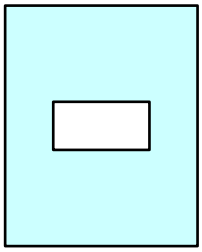
Shape 12 = Set [ ]



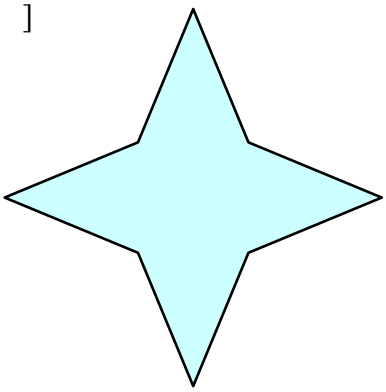
Shape 13 = Set [ ]



Shape 14 = Set [ ]



Shape 15 = Set [ ]



Shape 16 = Set [ ]

Double Dissections: Mosaic

In the inlay, find a perfect, four-pointed star exactly similar to that shown just above it. The star can differ in size and orientation, but its outline must be full and uninterrupted.