

Islamic Geometric Puzzles

Math in Games

2018- 2019

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- 1) **Game Name:** Islamic Geometric Puzzles
- 2) **Objects:** Expanding the Creativity and Geometric understanding, working with concepts such as symmetry, rotation, dilation, reflection and transforming some shapes to others. For example, transforming star type (8- point) to a square. Additional objective includes familiarity with some artistic idea throughout Islamic tiling.
- 3) **Designer:** Narges Assarzadegan
- 4) **City:** Isfahan, Iran
- 5) **Time:** 20 minutes

Rules:

Participant: students' grade 10- 11 (Each group include 4-6 students)

Instruction: The cards will be distributed to the groups; the students will then attempt to construct the desired figures with puzzles pieces, which is provided in each package.

School: Rahmat, Dolat Abad, Isfahan, Iran (girls), students of 10, 11 grade.

Game box:

- 16 cards
- 7 packages
- Game board
- Instruction

Instruction:

Game box includes 7 packages and 15 cards. Each package include pieces of puzzles that players should make by the following instruction. For example, designs on the cards 1 and 2 should be built by putting contents of package1 (puzzles pieces) together. Therefore, for example by using package 1 contents, we can make two presented designs on the cards 1 and 2. Other designs can also be make based on the following instruction:

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Cards 1, 2 -> Package 1

Cards 3, 4, 5 -> Package 2

Cards 6, 7 -> Package 3

Cards 8, 9 -> Package 4

Cards 10, 11 -> Package 5

Cards 12, 13 -> Package 6

Cards 14, 15 -> Package 7

Package contents are the same on the cards. They are separate, cut plastic forms with different colors. Each package can include at least two collection of puzzles pieces related to the cards. For example, for package 2, there should be at least eight collections of puzzles pieces where the players can tile the plane.

It was attempt for the designs to go from simple to difficult. In this game, the players will learn that for example at package 3, designs 6 and 7 are transformable to each other; therefore, two designs have the same area. Why this two design had same area, is a question that the players might ask. Players can research this at other times.

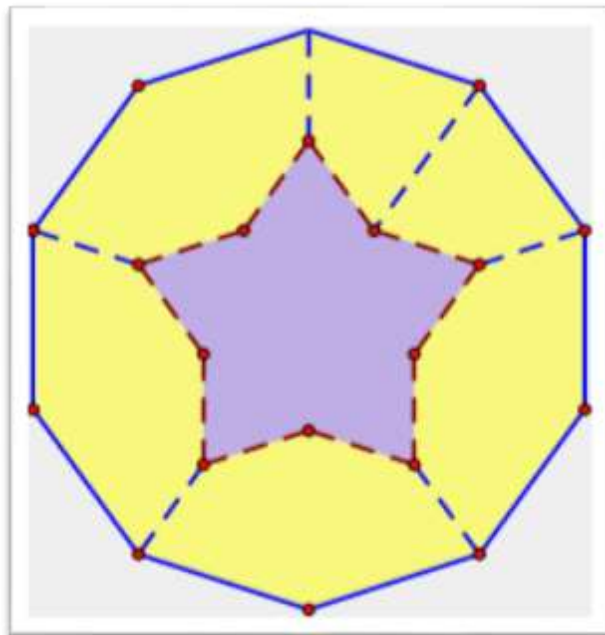
The actual tiling designs that are based on the represented designs on the cards will be printed in the back of the cards. This way, players can see the actual application of these geometrical transformations and can understand the relationship between art and mathematics.

Throughout the game, the players can notice each geometrical transformations such as rotation, reflection, dilation and transforming some shapes to others.

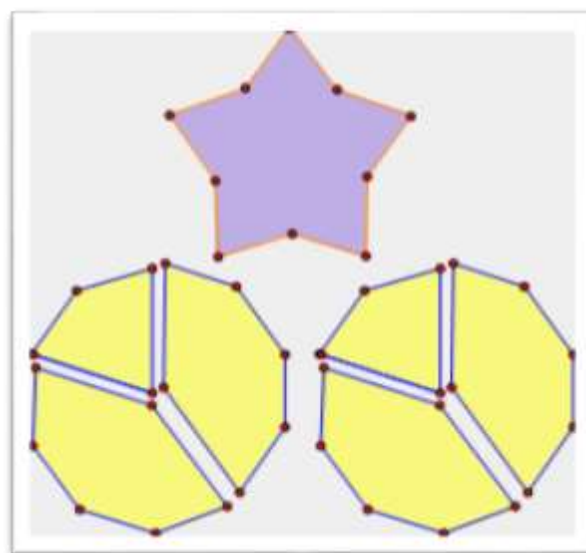
I have provided this puzzle with a perspective to Persian math history. I have chosne some patterns from the following references:

- Anonymous. Interlocks of Similar or Complementary Figures. Paris: Biblioth eque Nationale, ancient fonds. Persan 169, ff. 180r- 199v.
- Broug, Eric. Islamic Geometric design, Thames & Hudson, London, 2013.
- Jazbi, S. A. (translator and editor), Applied Geometry, Soroush Press, ISBN 964 435 2017, Tehran 1997.
- Maher- al- Naghsh, M., Design and Execution in Persian Ceramics, Reza Abbasi Museum Press, Tehran, 1984, Vol 1-5.
- Sarhangi, Reza. The Geometric studies of some Mosaic Design Compositions and Puzzles Presented in a Thirteenth Century Treatise. Proceedings of Bridges 2015.

All designs provided with Geometer's Sketchpad Software by Author.



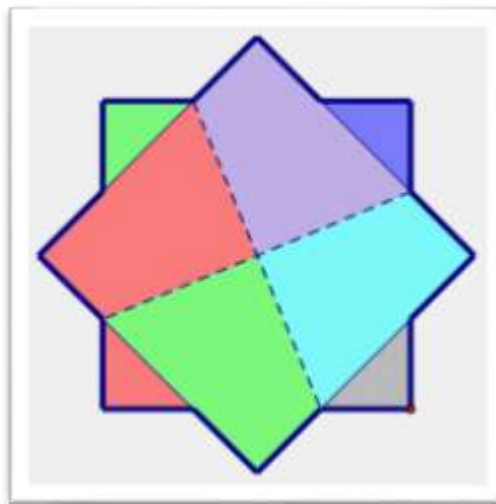
Card1: constructing a decagon



Card2: Constructing a star type (5 point) and 2 decagon



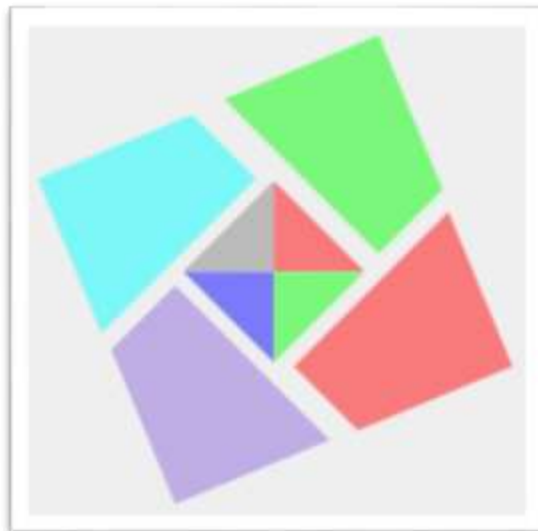
Back of Card1, 2: Kasegaran Madrasa Isfahan, Iran



Card3: Constructing a star type (8-point)



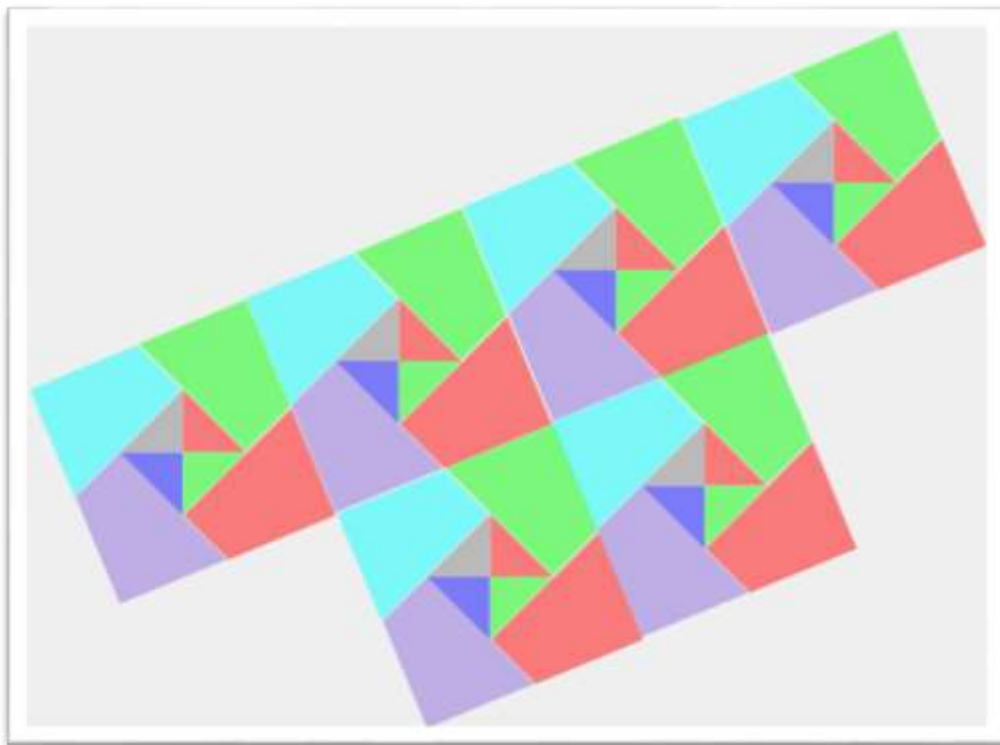
Back of card3: From Eric Broug book



Card4: Constructing a square



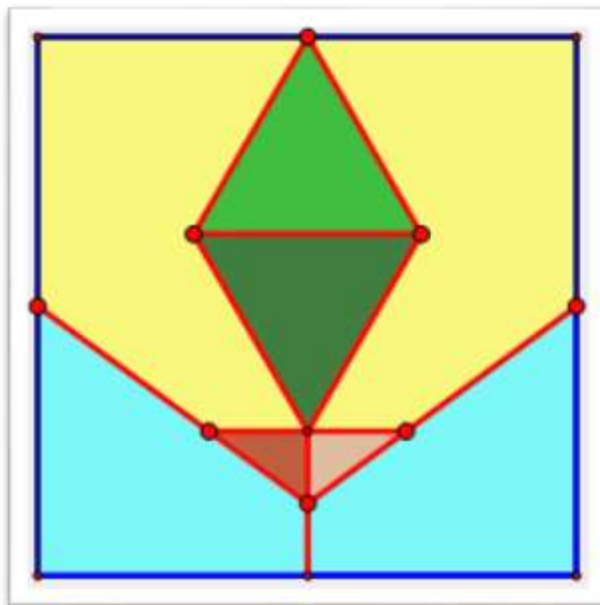
Back of card 4: Jame Mosque Isfahan, Iran. Photo by N. Assarzadegan



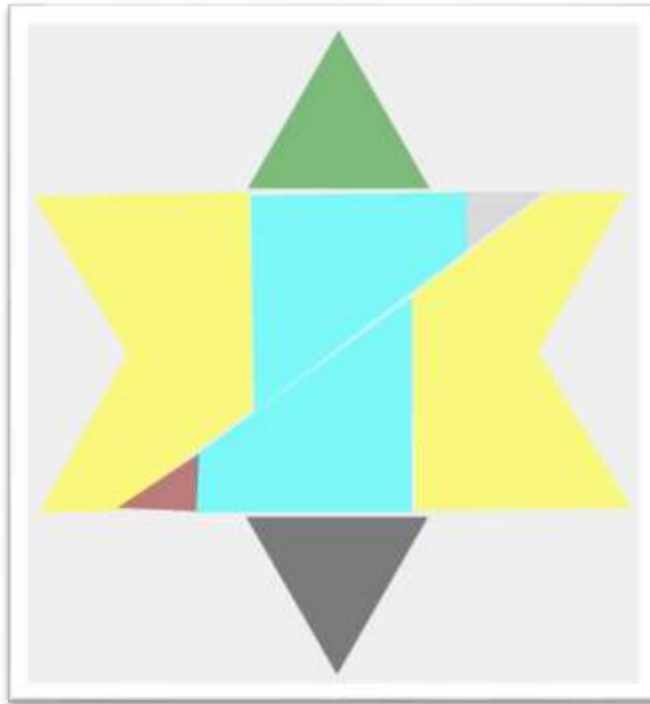
Card5: Tiling the plane



Back of card 5: Sheikh lotf o Allah mosque. Photo by N. Assarzadegan



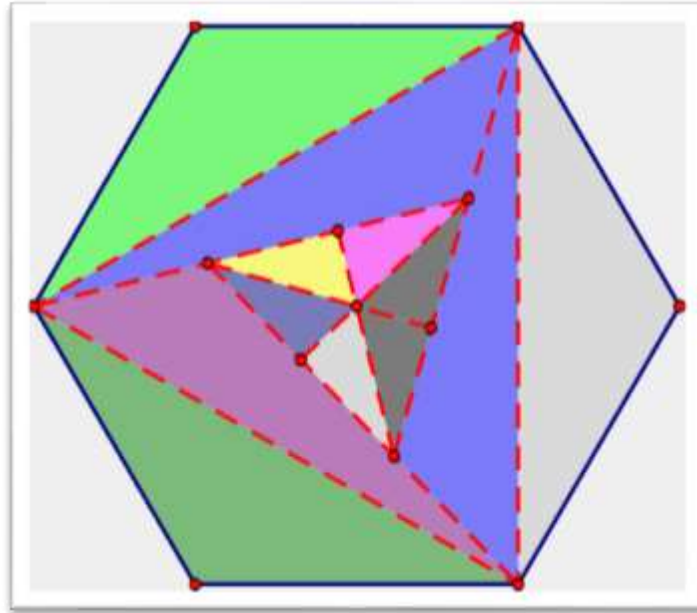
Card6: Constructing a square



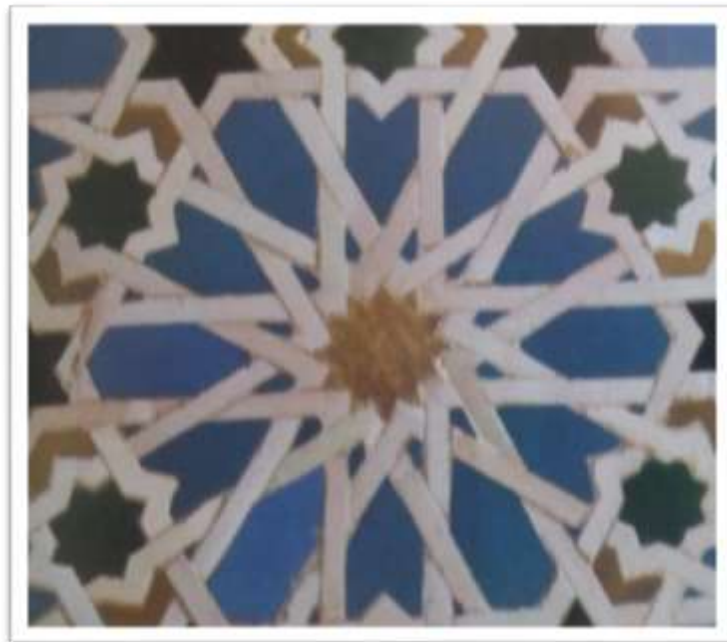
Card7: Constructing Star type (6- point)



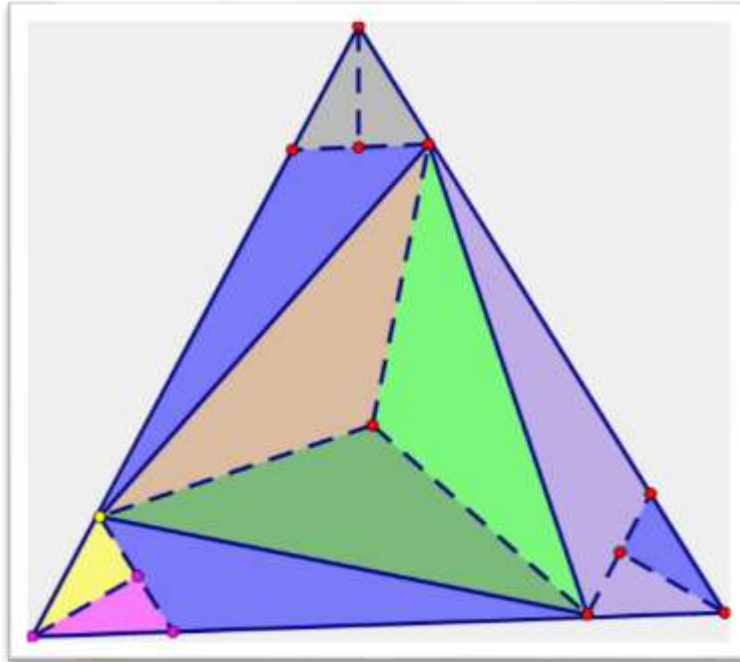
Back of cards 6, 7: from Eric Broug Book.



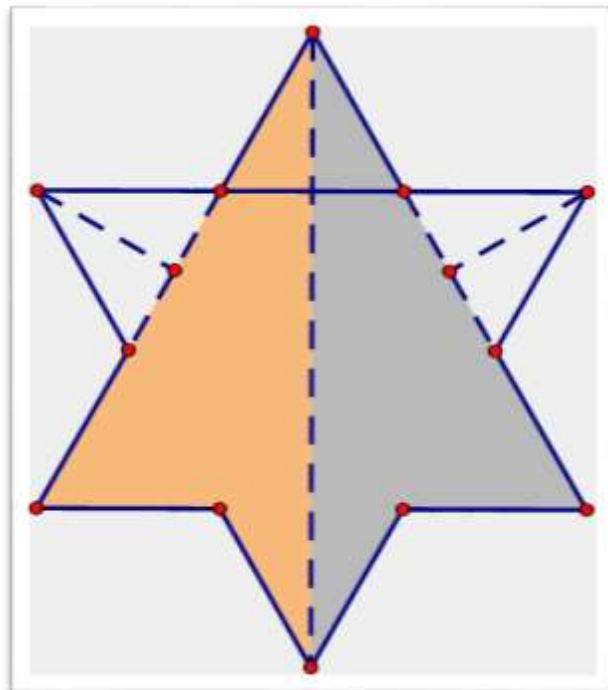
Card8: Constructing a hexagon



Back of Cards 8, 9: From Eric Broug Book



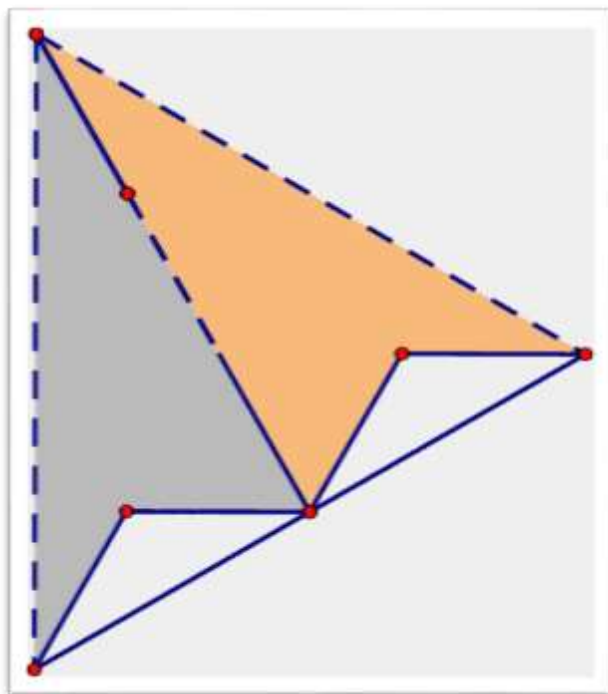
Card 9: Constructing a equilateral triangle



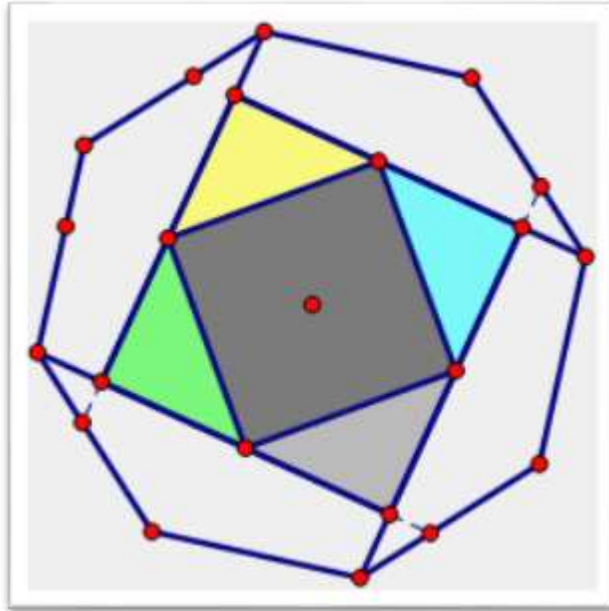
Card10: Constructing a Star type (6- point)



Back of Cards 10, 11: From Eric Broug Book



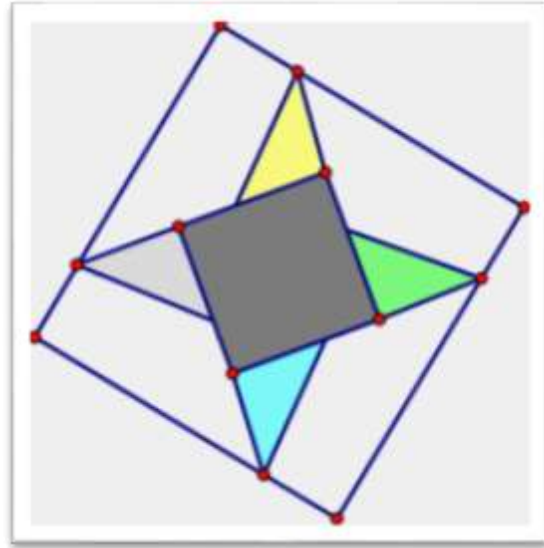
Card11: constructing equilateral triangle



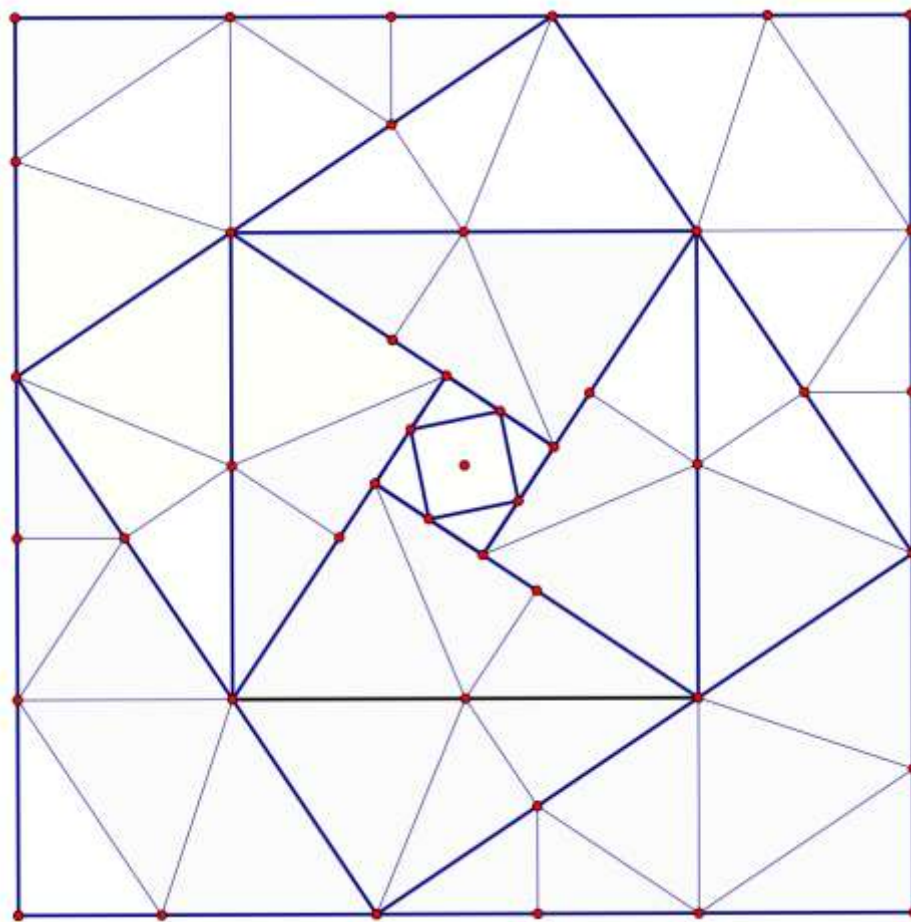
Card12: Constructing an octagon



Back of Cards 12, 13: from Eric Broug book



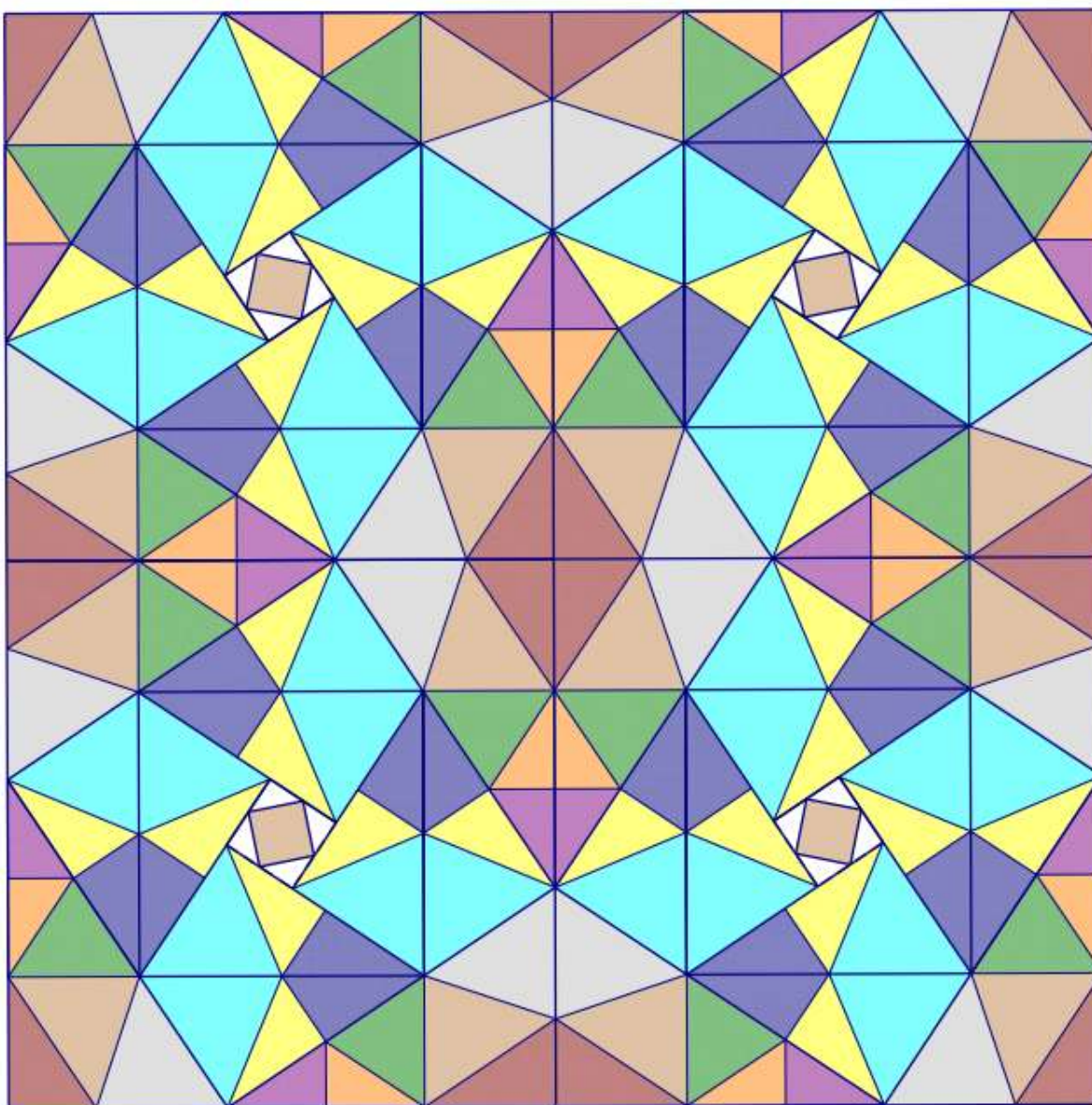
Card13: Constructing a square



Card14: a complex Islamic design



Back of card 14: Jame Mosque, Isfahan, Iran. Photo by N. Assarzagdegan



Card 15: a sample tiling constructed up on card 14.



Back of card 15: Chahar bagh Madrasa, Isfahan, Iran. Photo by N. Assarzadegan