MATH/FA 1020 – Math in Art

Summer 2016

Worksheet 2

Deadline:

If you are submitting this for bonus (Summer 2016 - A01 *only*), it is due on May 18th, 2016.

Objective:

The objectives of this worksheet is to investigate the golden ratio and the objects associated with it and to develop skills related to symmetries and symmetrical objects. The construction lines should still be visible on the page, but should be fainter that the objects you are drawing. You are encouraged to use (translucent) colour to accentuate the objects.

1. Draw a long line on the page and perform the golden cut of this line. You must do this step very carefully, as the measurements will be used in later pages.

2. Use the pair of line lengths constructed in page 1 to construct further smaller pairs of lengths in golden ratio. Pick one kind of golden triangle (either the acute golden triangle or the obtuse golden triangle) and create several copies of the object at various sizes. In class it was shown how to divide up a golden triangle into further golden triangles; this page should contain other (non-embedded) triangles.

3. Using the same lengths as has been previously constructed, create an assemblage of golden objects. There should be at least one inclusion of each of the -Golden Acute triangle -Golden Obtuse triangle -Golden rectangle -Regular pentagon. The various objects should interact, overlap.

4. Draw a long line along the short side of the page. Construct a golden rectangle using that line as a short side. Construct a golden spiral inside the rectangle. Creatively accentuate the spiral on the page.

5. Use a previous pair of lengths to create a (large) regular pentagon. Join the corners to form a star shape in side the pentagon. Repeat this with the smaller pentagon in the middle of the star. Repeat this a second time. (You may continue to repeat this if you are interested; three stars is simply the minimum) Use colour to distinguish a variety of golden obtuse triangles. You will be able to find golden obtuse triangles of six distinct sizes.

6. Construct a square that fills most of the page. Construct the golden cut of one side of the square, and draw a line through the square that divides it into two rectangles. Using the previous measurements, construct the line perpendicular to the last, which will divide the original square into four sections, two of which are squares and two of which are (golden) rectangles. One of the diagonals of the original large square will pass through the two smaller squares. Draw some design in the squares and rectangles that will have this diagonal as a line of reflection.

7. Form isosceles triangles having adjacent Fibonacci numbers. Use the smaller Fibonacci number to be the base, and the larger one as the two equal sides. You could start with cm's, and switch to mm's once the numbers get larger; or you could make your own scale. Draw (construct) a golden acute triangle in the corner for comparison. (Label the sides of the triangles with the Fibonacci numbers used.)

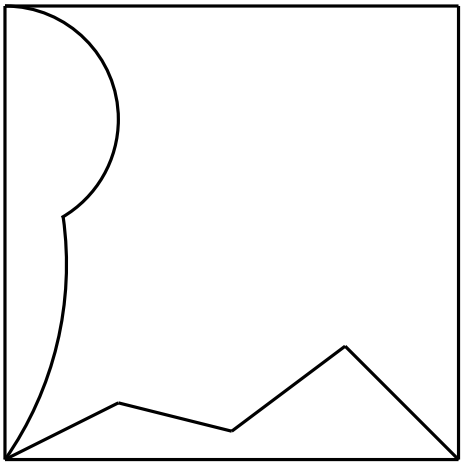
8. Draw some small figure on a page about 3cm $\times$ 5cm. It does not need to be a realistic figure, and it should have not symmetries. By using constructions on 2 or 3 points of the figure, make 5 more copies of it on the same page. There should be at least one example of a copy made by rotation, one by reflection, and one by translation. You do not need to always copy the original, you can make copies of copies.

9. Start by drawing two lines which are perpendicular to each other in the middle of the page. Draw a large circle which is centred where these two line meet. Create the division of the circle into 8 or 12 equal segments. To create 8 segments, bisect each of the angles to achieve and angle of 45°. To create 12 segments, use equilateral triangles to create angles of 60° (which will leave angles of 30°). Use these circle divisions to create an object that has rotational symmetry (which may or may not have reflections as symmetries.)

10. Find (make) a square out of thin cardboard or card stock (construction paper can also be used). This square should have a side length of about 5 cm. Pick two adjacent (touching) sides; these sides will be cut from corner to corner, and then pieces will be attached to the remaining two sides. Each of the two cuts should be distinct, non-symmetrical, and not interfere with each other. Once the square is cut and reassembled, trace it on a piece of paper. Then line it up (so a cut side would line up with the corresponding attached side) and trace again. Attempt to fill the page in this manner.

    Reform the tile that you made for page 10 by either flipping or swapping the attached sides. (You can flip either, or both, or flip AND swap; the tile simply needs to be

different.) Repeat the exercise of attempting to fill the page with the tile form using a different colour and different orientation than the original.



Example square cuts
(Not to scale)