MATH/FA 1020 – Math in Art

Summer 2016

Worksheet 5

Deadline:

If you are submitting this for bonus (Summer 2016 - A01 *only*), it is due on June 17th, 2016. *NOTE:* Since this has come out later than I had hoped, I will take a relaxed attitude towards substituting old exam questions for some of the required pages. I will put the possible exchanges with each page description. Exams mentioned will either appear on the department website with old exams (linked from my webpage) or linked directly on my website for the course. F - indicates Fall, W - indicates Winter, and S - indicates summer.

Objective:

There are three objectives of this worksheet. One objective is to continue our consideration of the hyperbolic geometry (disk model). The second objective is to develop out ideas regarding homotopies. The third objective is to review some of the (knowledge) material, and consider ways to visualize it. You are encouraged to use (translucent) colour to accentuate the objects.

1. Create a hyperbolic plane (circle) with centre O. Pick three random points, A, B, and C which are points of the geometry. (Be careful, if you pick points too close to O, parts of the construction may run off the page.) Construct the hyperbolic triangle ABC. (Note: this should require the construction of the centre line for at least two of the points. If you accidentally pick three points all on a single hyperbolic line, move one of them.)

   Potential exam exchanges: F07 - Q8; F08 - Q7; F09 - Q7; W05 - Q8; W06 - Q7; W09 - Q7; W14 - Q8; S14 - Q7

2. Create a hyperbolic plane (circle) with centre O. Pick 3 to 6 equally spaced points in the plane, which are also equally spaced from O. (You may start with an equilateral triangle, square, regular pentagon or regular hexagon. Then find the centre of your object use that as O. Draw the plane further than the corners of the object.) Construct the hyperbolic lines regular shape. (Use symmetry to simplify things.)

   Potential exam exchanges: W07 - Q8; W08 - Q3

3. Sort all (upper case) letters and digits into homotopic classes. (If you happen to know an alternate language that uses a different alphabet, throw in a few of those letters too.)

   Potential exam exchanges (The exam questions are mostly lighter than this question, substitute at your own risk): F08 - Q8(a); F09 - Q8(a); W09 - Q8(a)

4. Figure out which letters have the lower case version of the letter homotopic to the upper case, and which do not. When I tried it, I found 6 examples of upper case and lower case that were *not* homotopic. Individuals may get different results based on style of writing.

   Potential exam exchanges (The exam questions are mostly lighter than this question, substitute at your own risk. Do not use the same substitution for two pages.): F08 - Q8(a); F09 - Q8(a); W09 - Q8(a)

5. Draw 3 – 5 intermediate stages of a continuous deformation (homotopy) between two objects (flat - 2 dimensional).

   Potential exam exchanges: F06 - Q6; F08 - Q8(b); W05 - Q9(c); W08 - Q2; W09 - Q8(b); W14 - Q9(a); S14 - Q8(a)

6. Draw (if you feel you can) 3 – 5 intermediate stages of a continuous deformation between two 3-dimensional objects . (If you cannot, do another pair of objects, but NOT homotopic to the last pair.)

   Potential exam exchanges: F06 - Q6; F08 - Q8(b); W05 - Q9(c); W08 - Q2; W09 - Q8(b); W14 - Q9(a); S14 - Q8(a)

7. – 10.

   Create 4 pages of review. These pages can be mostly words, a mixture of words and pictures, or mostly pictures. The following are questions regarding some material that was covered during the class. The expectation is the think about some of the topics, not to redo constructions. Your review pages should respond to these, but are not limited to these:

   - What is a Fractal?
   - What are the Fibonacci numbers?
   - What are the basic symmetries?
   - What is the classification of symmetries?
   - What is the classification of similarities?
   - What are the conics?
   - What is the classification of 2-manifolds?
   - What are 4 rules of (linear) perspective?

- What is the difference between a Euclidean geometry and a hyperbolic geometry?
- Describe the icosahedron and the dodecahedron; explain how various numbers in this description are related.
- What is the (precise) value of the golden ratio?
- How are the following related to the golden ratio: golden rectangle, golden acute triangle, golden obtuse triangle, regular pentagon, Fibonacci numbers?