Worksheet 5

Deadline:

If you are submitting this for bonus (Summer 2016 - A01 *only*), it is due on June 17th, 2016.

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.)

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.)

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.)

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.

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

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.)

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?