Math 812T – Geometry for Geometry Teachers
Summer, 2012
Final Assignment (due by Wednesday, July 9, 2014)

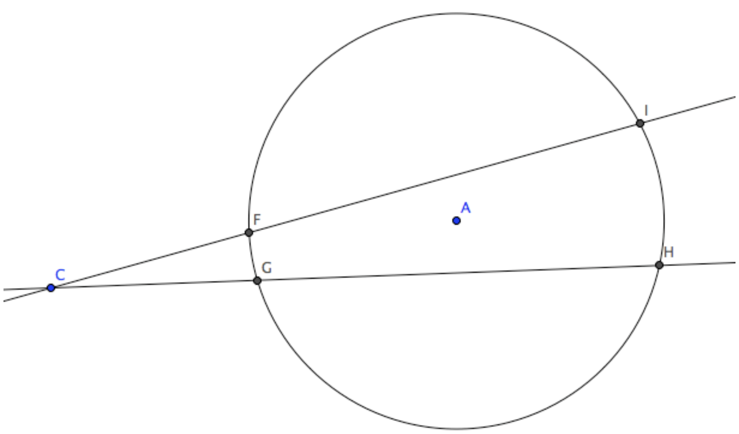
Your Fabulous 5: Because this is a fairly large class, we're using two days for presentations, so there will be fewer days with homework than when we've taught this before, which means fewer options for choosing homework problems to write up carefully. Thus it makes sense to reduce the Sample 6 to a Fabulous 5. So instead of 6, you will select 5 homework problems, no more than three from each week, whose solutions you are proud of and which demonstrate what you have been able to accomplish. For these problems you will be expected to submit solutions of high quality, that demonstrate sound reasoning, an appropriate approach, sufficient justification, proper mathematical notation, good organization, and expositional clarity.

Problem Reflections Assignment: You will select two problems from your Fabulous 5 that stand out to you for some reason and write about your experience as a learner of mathematics. For each problem, explain why you chose it and reflect on what mathematical ideas you learned and what you are learning about yourself as a learner of mathematics. Each reflection should be one-half to one page in length.

End-of-course Reflection: This is a written assignment on which you reflect on what you have learned. Are there things that you found particularly interesting, surprising or meaningful? Has your perception of mathematics changed? If so, in what ways? Will what you have learned have any effect on your teaching? In particular, are there any discrete math topics that you could introduce at your grade level and explain how these topics would be integrated into your current curriculum? Your final reflection should be approximately one page in length.

End-of-course Problem Assignment: Do any 3 of the following 5 problems.

Problem 1: Consider the following figure:



Given a circle with center A as shown in the figure above, prove that $2m(\angle GCF) = m(\angle IAH) - m(\angle GAF)$.

Problem 2: The geographic coordinates of New York are 41° N latitude and 74° W longitude. The geographic coordinates of Los Angeles are 34° N latitude and 118° W longitude. The geographic coordinates of Austin, Texas are 30° N latitude and 97° W longitude. If someone in Austin faces Los Angeles, and then turns clockwise to face New York, what is the angle through which the person turned? Explain how you found your answer.

Problem 3: Let C be the unit circle in the plane. The point of this problem is to create a Geogebra file as part of your answer, which you will need to email us (at bharbourne1@unl.edu, hartke@unl.edu).

(a) In Geogebra, given points P and Q on the unit circle C, construct the circle $C_{P,Q}$ that goes through P and Q such that C and $C_{P,Q}$ cross each other at right angles (i.e., $C_{P,Q}$ is the hyperbolic line through P and Q in the Poincare disk model of the hyperbolic plane). As you drag P and Q, the circle $C_{P,Q}$ should follow them, always meeting C at two right angles. Explain conceptually your strategy for how you constructed $C_{P,Q}$.

(b) Also add a point R to the interior of the unit disk and construct the circular arc $L_{R,Q}$ (i.e., the hyperbolic line through Q and R) through R and Q that meets C at right angles. As R or Q is moved, $L_{R,Q}$ should move too. Explain conceptually your strategy for how you constructed $L_{R,Q}$.

Problem 4: There is an acute triangle. At each vertex there is a spider. A fly lands on the triangle. Where should it land so that its distance to the nearest spider is as far as possible? Justify your answer.

Problem 5: A student is trying to prove that if the incenter and centroid of a triangle are the same point, then the triangle is equilateral. The student shows you the following proof:
Given $\triangle ABC$. Let P be the incenter of $\triangle ABC$; assume P is also the centroid. I will show that any two sides of $\triangle ABC$ are congruent; without loss of generality, it is enough to show that $\overline{AB} \cong \overline{AC}$. Let D be the midpoint of side $\overline{BC}$. Then $P \in \overline{AD}$ since $\overline{AD}$ is a median and P is the centroid, but P is also the incenter so $\overline{AD}$ bisects $\angle BAC$. Since D is a midpoint of $\overline{BC}$, we know $\overline{BD} \cong \overline{DC}$. We also know $\angle BAD \cong \angle DAC$ since $\overline{AD}$ is bisects $\angle BAC$. Finally we know $\overline{DA} \cong \overline{DA}$ by reflexivity. Thus $\triangle BAD \cong \triangle CAD$ by SAS, so $\overline{AB} \cong \overline{AC}$. Explain what is wrong with the student's proof. How would you explain the error to a peer? How would you explain it to the student?