Exploring Hyperbolic Geometry Using Geometer's Sketchpad

1. INTRODUCTION

These notes provide a very brief introduction to the use of Geometer's Sketchpad on the computers in Weniger 226, and should also work in the MLC computer lab in Kidder 108.

2. GETTING STARTED

- Add the network place `\\poole\ClassFolders` .

  One way to do this is to double-click on `My Network Places` , then on `Add a network place` , which will open a wizard. You can browse for `poole` , or enter the above share name by hand. You may need to enter the fully qualified name `poole.scf.oregonstate.edu` rather than `poole` .

- Browse to `\\poole\ClassFolders\Math-Dray` .

  This directory contains class files and shortcuts you may need for some of the activities.

- Double-click on `Map Onid Drive` .

  This should mount your ONID home directory, so that you can save your work between sessions. There are several other ways to do this, which may depend on which lab (and which computer) you are using. ***When saving your work, make sure you navigate to your ONID directory.*** Files saved to `My Documents` will ***not*** be visible from any other computers on campus.

- Start Geometer's Sketchpad by double-clicking on `GSP 4.06` .

  Geometer's Sketchpad does not automatically have an icon on the desktop or in the Program Menu. Feel free to add one — Geometer's Sketchpad should live in `C:\Program Files\Sketchpad` . But realize that these shortcuts will only be available when you login to this computer.

3. USING GEOMETER'S SKETCHPAD

Most of the controls are straightforward. The icons along the left control the action of the mouse. The four icons in the middle allow you to insert points, circles, line segments, and text, respectively. For some of these choices, you may need to click and drag to construct the object.

Right-clicking on a single object allows you to set additional properties, such as color, thickness, and label. Selecting the text icon allows you to toggle whether and where a label is shown, or to insert text by double-clicking.

The power of Geometer's Sketchpad lies in its ability to make geometric constructions. After selecting some points and/or lines, open the `Construct` or `Measure` menus to see what the possibilities are.

You must have the appropriate number of objects selected in order to perform a given construction or measurement. Select the pointer icon and click on any object to toggle whether it is selected, or on empty space to deselect everything and start over (a good idea before starting any construction, especially at the beginning).

- Construct a triangle by hand. Now do it again, but this time use the `Construct` menu as much as possible. Measure all the sides and angles in either triangle.

4. HYPERBOLIC GEOMETRY

- Copy `\\poole\ClassFolders\Math-Dray\Hyperbolic.gsp` to your ONID directory, then open the copy from inside Geometer's Sketchpad.

  Double-clicking on a sketch does ***not*** seem to work. Opening my copy of this file may prevent others in the class from accessing it. You can also start with the similar file on your local machine, which is at `C:\Program Files\Sketchpad\Samples\Sketches\Investigations\Poincare Disk.gsp` .

This sketch not only shows the Poincaré disk, but also adds custom tools to the last icon on the left, below the text icon. To access one of these tools the first time, click on the icon, then select the tool you want. To access the same tool again, after having selected another tool, simply click on the icon again. ***To get the list of tools back, click on the icon and hold the mouse button down until the list reappears.***

- Construct a hyperbolic triangle. Use the custom tools (not the `Measure` menu!) to measure all of its sides and angles.

  Recall that some hyperbolic lines are diameters of the unit circle. You can construct such lines easily in Geometer's Sketchpad, but there are no hyperbolic tools with which to measure their lengths, nor can you easily measure the angles where such lines intersect other hyperbolic lines. (Feel free to construct such tools yourself...)

5. ASSIGNMENT

(Instructions will be given during class on how to submit your work.)

- Construct a hyperbolic triangle. Measure all of its sides and angles.
- Construct another triangle such that two corresponding sides as well as the included angle are congruent.
- Check whether SAS congruence holds in this case by measuring the remaining sides and angles.
- (Optional) Use a similar construction to check whether SSS congruence holds.
- Write a paragraph describing your construction, and what conclusions you reached.

  You can in principle complete this assignment "by eye", using the measurement tools to get the sides and angles approximately correct. Geometer's Sketchpad will help you by, for instance, assuming you want to put a point on a line if you are close enough. You can improve the accuracy of your measurements, thus checking for roundoff error, by changing the precision in the `Edit -> Preferences` menu.

  However, it is better to let Geometer's Sketchpad do the work where possible. Can you come up with a process for duplicating triangles? For example, right angles can be drawn accurately by constructing perpendicular (hyperbolic) lines. And hyperbolic circles turn out to be Euclidean circles as well (but not with the same center!), which provides an accurate way to duplicate lengths. (There are two custom tools for constructing hyperbolic circles.)