Math 361 Rough Draft

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1 Hyperbolic geometry as explained to my mother

1.1 Euclid's Postulates

1.2 Statements equivalent to the fifth postulate

1.3 Gaussian curvature

2 Models of the hyperbolic plane

2.1 Poincaré disc model

2.2 Klein model (projective disc model)

2.3 Poincaré half-plane model

2.4 Lorentz model (hyperboloid model)

3 Constructing the hyperbolic plane

"Isometric constructions of the hyperbolic plane (or approximations of the hyperbolic plane) as surfaces in 3-space." [4]

3.1 The annular hyperbolic plane

The standard paper-and-tape construction using identical annular strips.

3.2 basic crochet version

3.3 polyhedral annular hyperbolic plane (paper)

3.4 hyperbolic soccer ball (paper)

3.5 defining the radius (curvature) of hyperbolic planes

3.6 crochet a pseudosphere

4 Proof that the constructions produce a hyperbolic plane

The construction satisfies these major descriptions of hyperbolic planes

4.1 Euclid's Postulates

The first four postulates hold, while the fifth postulate does not.

4.2 Pseudosphere

Same intrinsic geometry as the pseudosphere

4.3 Riemannian manifold with constant negative Gaussian curvature

4.4 upper half-plane model

5 historical/philosophical content: other combinations of fiber arts and non-euclidean geometry

5.1 Crocheting the Lorenz Manifold [5]

5.2 Knitting non-Euclidean Pants [1]

5.3 Scarves and other Möbius Knitting [2][3]

6 appendix: basic crochet info

Instructions on standard crochet stitches, particularly those used for constructing hyperbolic planes. [6]

References

[1] Sarah-Marie Belcastro and Carolyn Yackel (eds.), *Making mathematics with needlework*, A K Peters, 2008.

[2] Cat Bordhi, *A treasury of magical knitting*, Passing Paws Press, 2004.

[3] ———, *A second treasury of magical knitting*, Passing Paws Press, 2005.

[4] David W Henderson and Daina Taimina, *Crocheting the hyperbolic plane*, The Mathematical Intelligencer **23** (2001), no. 2, 17–28.

[5] Hinke M Osinga and Bernd Krauskopf, *Crocheting the lorenz manifold*, The Mathematical Intelligencer **26** (2004), no. 4, 25–37.

[6] Debbie Stoller, *Stitch 'n bitch crochet: The happy hooker*, Workman Publishing, 2006.