Formalizing Hyperbolic Geometry in LEAN

The goal of this project is to introduce the student to interactive theorem proving and formalization of mathematics using the LEAN proof assistant, with a concrete focus on basic hyperbolic geometry.

The student will:

- Learn the basics of LEAN and its mathematical library (mathlib), with an emphasis on how standard notions from analysis and geometry are represented formally.
- Learn how to use AI assisted tools for auto-formalization and proof search, and how to critically check and refine AI generated LEAN code.
- Develop a formalization plan for a small but meaningful piece of hyperbolic geometry (for example, models of the hyperbolic plane, geodesics and distance, or basic comparison inequalities).
- Implement this plan in LEAN, including precise definitions and fully verified proofs of a selected collection of lemmas and theorems in hyperbolic geometry.

By the end of the project, the student should have a working LEAN file (or small library) that formalizes a coherent portion of introductory hyperbolic geometry.

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