

Mathematics 133 — Geometry

Topics in the Course Notes — Fall 2020 Version

Note: “(*)” means that there is no corresponding section in the notes, but there is such a section in the exercises for the course.

- 0. Preface

- I. **Topics from linear algebra**
 - 0. Background material (*)
 - 1. Dot products
 - 2. Cross products
 - 3. Linear varieties
 - 4. Barycentric coordinates
 - 5. Some examples

- II. **Vector algebra and Euclidean geometry**
 - 1. Approaches to Euclidean geometry
 - 2. Synthetic axioms of order and separation
 - Appendix. The isosceles triangle fallacy
 - 3. Measurement axioms
 - 4. Congruence, superposition and isometries
 - Appendix. Logical independence of the congruence axioms
 - 5. Euclidean parallelism
 - Appendix. Coordinate affine spaces

- III. **Basic Euclidean concepts and theorems**
 - 1. Perpendicular lines and planes
 - 2. Basic theorems on triangles
 - 3. Convex polygons
 - 4. Concurrence theorems
 - 5. Similarity
 - 6. Circles and constructions
 - Appendix A. Further topics in Euclidean geometry
 - Appendix B. Euclidean geometry and modern mathematics
 - 7. Areas and volumes
 - 8. Rectangular coordinate systems

- IV. *Not needed for this course*

- V. **Introduction to non-Euclidean geometry**
 - 1. Facts from spherical geometry
 - 2. Attempts to prove Euclid’s Fifth Postulate
 - 3. Neutral geometry
 - 4. Angle defects and related phenomena
 - Appendix. Solved exercises
 - 5. Further topics in hyperbolic geometry
 - 6. Subsequent developments
 - 7. Non-Euclidean geometry in modern mathematics
 - 8. Summarizing the impact of hyperbolic geometry