

Math 335: Differential Geometry
Final Exam Preparation: Overview Questions

These questions are designed to help you solidify your high-level understanding of the material from the second half of our course. This list is not necessarily exhaustive, but should hopefully get you thinking about the bigger picture. It's a good idea to combine these questions with the review questions for the midterm!

- What is the Gauss map? Why do we care about it?
- For a vector $v \in T_p S$, what does $dN_p(v)$ measure?
- What is the significance of the fact that dN_p is a self-adjoint linear map?
- What are $\kappa, \kappa_n, \kappa_g, K$, principal curvatures, and mean curvature? How are they all related? How do curves and surfaces play into the definition of each?
- When considering the quantities above, why are charts important?
- What are Christoffel symbols? Why are they important?
- What is the significance of Gauss' Theorema Egregium? What are the main steps in the proof of this theorem?
- Over the course of the semester, we have encountered a number of different bases for either $T_p S$ or $T_p \mathbb{R}^3$ (i.e. the set of vectors based at p in \mathbb{R}^3). Which bases have been important for which objectives?
- What is a geodesic? What properties do geodesics have?
- In what sense is the Euler-Poincaré characteristic a topological, as opposed to a geometric, invariant of a surface S ?

- What does the local Gauss-Bonnet theorem say? What does it say about geodesic triangles?
- What does the global Gauss-Bonnet theorem for surfaces without boundary say? What is the significance of this theorem?