Mat 180 Special Topics
2021-2022 Academic Year

Fall 2021: Curves on Surfaces (Professor Kapovich)

Prerequisites: MAT 147 is required. Students are also strongly recommended to have taken MAT 141.

Course Description:

In this course we will discuss several topics related to topology and geometry of surfaces, including: Quotient topology, examples of surfaces, triangulations of surfaces, topological invariants of surfaces, classification of surfaces, Jordan curve theorem. We will also relate topology of surfaces to Euclidean and hyperbolic geometry.

Winter 2022: Introduction to Computer-Assisted Theorem Proving (Professor Koeppe)

Prerequisites: Programming language; MAT 67 or 108 or equivalent; at least one upper division course with a focus on writing mathematical proofs; at least one upper division course with a focus on algorithms or computation.

Course Description:

We will learn to use computer-assisted theorem proving software, in particular the system Lean 4 (https://leanprover.github.io/theorem_proving_in_lean/index.html) in combination with mathlib (https://github.com/leanprover-community/mathlib). Final projects will contribute to the library of theorems with formalized proofs in one of several areas of mathematics. Grading will consist of homework projects and a final project.

Spring 2022: Information Theory with Applications to Biology, Physics, and Machine Learning (Professor Chaudhuri)

Prerequisites: MAT 22A or 27A and MAT 107 or 135A

Course Description: Information theory has a rich mathematical structure with deep connections to multiple areas of pure and applied mathematics. Its applications have grown far beyond initial work in compression and communication to provide new perspectives on problems across the physical and biological sciences. This course will provide an introduction to the mathematics of information theory followed by an exploration of applications. Applications will include animal foraging, the organization of perceptual and memory systems in the brain, interpretations of statistical physics, and machine learning algorithms. The course will include a project component, where students apply information theoretic perspectives to a mathematical or scientific area of their choosing.