AB Geometrie und Topologie
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Differentiable manifolds (and Lie groups)

WiSem 2024/2025

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Differential geometry started out in the 19th century as the study of curved spaces (Gauß, Riemann). In its modern form, it provides a flexible language which allows to capture a wide variety of geometric settings as they arise in many branches of mathematics and physics. To name a few, there is a close interaction of differentiable geometry with topology, (complex) algebraic geometry and geometric analysis, and in physics it is used in mechanics, gauge theory, relativity and string theory.

We will discuss basic notions regarding differentiable manifolds and Lie groups including

- differentiable manifolds and maps
- flows and distributions
- Lie groups and their Lie algebras, smooth actions
- (recap of) differentiable forms and Stokes' theorem
- de Rham cohomology

As a starting point serves the Implicit Function Theorem and the notion of submanifold motivated by it, as discussed in calculus of several variables (Analysis II).

The course will be continued in the summer term with an introduction to Riemannian geometry.

For students of mathematics/physics, third year or later (bachelor, master, TMP).

Prerequisites: *Linear Algebra I+II* and *Analysis I-III* (calculus of one and several real variables, measure and integration, basics on manifolds and differential forms). The course will be independent of the course *Geometrie* of the previous semester.

References: L.W. Tu, *An Introduction to manifolds*, Springer, 2008

J.M. Lee, *Introduction to smooth manifolds*, Springer, 2003

Th. Bröcker, K. Jänich, *Einführung in die Differentialtopologie*, Springer, 1973

F. Warner, *Foundations of differentiable manifolds and Lie groups*, Springer, 1983

S. Kobayashi, K. Nomizu, *Foundations of differential geometry*, Wiley, 1963