The Algebra and Geometry of Modern Physics
Spring semester 2013/2014: Bundles

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(1) Fibre bundles (definitions and examples, constructions, maps, equivalence, gluing, associated sheaves and Čech cohomology)

(2) Vector bundles (definitions and examples, vector bundles associated with a manifold, vector space constructions applied to bundles, sections, elements of K-theory).

(3) Bundles with a group action (definitions and examples, structure group, principal bundles, associated bundles, instantons, spinor fields)

(4) Connections on fibre bundles (the connection one-form, gauge potential and gauge transformation, parallel transport, holonomy, covariant derivative and curvature, Bianchi identity, connection compatible with metric, holomorphic bundles, Hermitian bundles, Hodge structure);

(5) Relation to physics (gauge theories, Maxwell action, Dirac magnetic monopole, Dirac's geometric quantisation, the Aharonov-Bohm effect, Yang-Mills theory, instantons, Berry's phase, gauge anomalies).

(6) Wess-Zumino-Witten σ-model, the Chern-Simons TFT.

(7) T-duality/Mirror symmetry (topological aspects, gerbe-theoretic aspects, categorial aspects including the Fourier-Mukai transform).

Literature:

M. Nakahara, "Geometry, Topology and Physics", 2003

T. Frankel, "The Geometry of Physics: An Introduction", 2011