

PMATH 965 -- Topics in Geometry and Topology -- Geometric Invariant Theory, Symplectic Reduction and Moduli Spaces.

*Course description:* Many important examples of topological spaces, manifolds and varieties are constructed as quotients. Geometric invariant theory (GIT) and symplectic reduction provide methods for constructing quotients by groups actions in algebraic and symplectic geometry, respectively. In particular, moduli spaces of bundles or varieties are often obtained this way. This course will be an introduction to GIT and symplectic reduction with an application of these techniques to certain moduli problems. It will cover material that any graduate student interested in geometry will find useful (such as groups actions; symplectic structures and Hamiltonian actions; coarse and fine moduli spaces; bundles, connections, sheaves, sheaf cohomology; (semi)stability). The course should be accessible to students who have taken PMATH 465 or PMATH 764 or an equivalent course. Topics will include: Algebraic groups and Lie groups; group actions and quotients; examples of affine and projective GIT quotients; criteria for (semi)stability; moduli of projective hypersurfaces; overview of sheaf cohomology; line bundles and divisors on curves; vector bundles and locally free sheaves; moduli of vector bundles on curves; symplectic structures; Hamiltonian actions, moment maps, and symplectic quotients; examples; GIT vs symplectic quotients; moduli spaces of bundles/connections as symplectic quotients (time permitting).