

MATH 552: LIE GROUPS AND ALGEBRAS

SUGGESTED PROJECT TOPICS

Each student enrolled in the course is expected to give a presentation during the last few classes. I will need to know ahead of time what you want to talk about so that this can be scheduled properly. You are free to talk on anything generally related to Lie groups, Lie algebras, and representation theory. Below is a list of possible suggestions, but you do not need to choose from this list and are encouraged to choose something that interests you. If you have trouble deciding, try looking through another text book and finding something that we didn't cover but you would like to learn.

- (1) Spin groups, representations of $\text{Spin}(n)$ vs. $\text{SO}(n)$
- (2) Canonical commutation relations in quantum mechanics and the Stone–von Neumann theorem
- (3) Exceptional groups and algebras, i.e. G_2, F_4, E_6, E_7, E_8
- (4) Representations of finite groups (e.g. permutation groups) [FH]
- (5) The Laplace operator on S^2 and the hydrogen atom ([K] 4.9)
- (6) The Casimir element/operator ([K] 6.3)
- (7) Lie algebra cohomology (Chevalley–Eilenberg)
- (8) Cohomology of $BU(n)$ and characteristic classes
- (9) Characteristic class computations and representation theory (Borel–Hirzebruch)
- (10) Borel–Weil theorem (highest weight representations as equivariant sections of vector bundles)
- (11) BCG resolution ([K] 8.4)
- (12) Weyl character formula ([K] 8.5)
- (13) Young diagrams and representations of $sl(n; \mathbb{C})$ ([K] 8.7, [FH])
- (14) Weyl integration formula
- (15) Differential geometry of Lie groups
- (16) Principal G -bundles and connections/curvature

[K]=Kirillov, [FH]=Fulton–Harris.