

# Basics of representation theory (28 lectures, 56 hours)

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1. Symmetry
2. Linear algebra
3. Finite groups
4. Representation of group
5. Representations of Abelian groups
6. Symmetric group  $S_n$
7. Representations of  $S_3$
8. Characters
9. Representations vs characters
10. Representations of  $S_4$
11. The number of irreps is equal to the number of conjugacy classes
12. Irreducible representations of  $S_n$  groups and Frobenius formula for characters
13. Young symmetrizers and irreps of  $GL(n)$ ,  $SL(n)$ . Schur-Weyl duality
14. Lie groups and Lie algebras
15. Subgroups, product, semiproduct of groups
16. Representations of  $sl(2)$ . Cartan-Killing metric
17. Structure of simple Lie algebras
18. Examples, isomorphisms in low dimensions
19. Root systems. Classification of simple Lie algebras.
20. Highest-weight representations of simple Lie algebras
21. Weights of irreps, multiplicity, Freudenthal formula
22. Clebsh-Gordon problem
23. Weyl formula for characters
24. Induced representations
25. Representations of Poincare group - particles
26. (All) objects in group theory as invariant tensors
27. Quantum dimensions
28. Universal formulae in simple Lie algebras.