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## Varieties of four-dimensional gauge theories

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Given a gauge Lie algebra, it is natural to seek representations for four-dimensional spacetime fermions that are anomaly-free and complex. Even for irreducible representations, where the problem reduces to studying  $\mathfrak{su}_n$  for  $n \geq 3$ , solutions seem to be few and far between: a trial-and-error scan by Eichten, Kang and Koh found only three for  $\mathfrak{su}_5$ , for example. In this talk, I will explain how concepts and constructs in algebraic geometry show that there are in fact infinitely many such representations and yield them all. In particular, I will show that the problem is nearly identical to finding chiral solutions to the  $U(1)$  anomaly cancellation equations for  $n$  Weyl fermions in four spacetime dimensions.

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