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The multiplicity of a weight in a finite-dimensional irreducible representation of the rank 2 Lie algebras can be computed via Kostant's weight multiplicity formula. This formula consists of an alternating sum over a finite group and involves Kostant's partition function. Our main result describes the terms that contribute nontrivially to Kostant's weight multiplicity formula. By taking a geometric and combinatorial approach, we provide concrete visualizations of these sets for all pairs of integral weights λ and μ of all rank 2 Lie algebras and show that the diagrams associated to our main result present new and surprising symmetry. This research was conducted during the 2019 Mathematical Sciences Research Institute Undergraduate Program in Berkeley, CA under the direction of Dr. Pamela E. Harris. (Received July 28, 2020)