Instead of ordering by discriminant, one may list all real quadratic fields as $F_n = \mathbb{Q}(\sqrt{n^2-4})$, with sparse repetitions. This family contains unit-generated orders $\mathcal{O}_n = \mathbb{Z}\big[\frac{1}{2}(n+\sqrt{n^2-4})\big]$; indeed, the unit-generated orders in real quadratic fields fit into two natural families, one of which is the $\mathcal{O}_n$. We prove that the class numbers of the orders $\mathcal{O}_n$ grow like class numbers of imaginary quadratic fields; the other family behaves similarly. The ordering of quadratic fields F_n has several other nice features, such as a straightforward description of those with a unit of negative norm and a straightforward description of those with a unit of odd trace. In density, exactly 50% of the F_n have a unit of odd trace; in contrast, in the standard ordering by discriminant, between 7.4% and 33.4% of real quadratic fields have a unit of odd trace.

In the second part of the talk, we describe a framework of conjectures under which the class numbers of $\mathcal{O}_n$ and its superorders count isometry classes of maximal configurations of complex equiangular lines in dimension $d = n+1$. These configurations are known in quantum information theory as SICs (short for SIC-POVMs, or symmetric, informationally complete, positive operator-valued measures) and can be generalized to subspace configurations called r-SICs. Under our framework of conjectures, certain invariants of r-SICs are algebraic numbers that, for n odd, generate all abelian Galois extensions of F_n.

The results presented in this talk include joint work with Jeffrey Lagarias and joint work with Marcus Appleby and Steven Flammia.