Hadamard Matrices

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Hadamard matrices are square matrices with entries $+1$ and -1 with determinant achieving an upper bound due to Hadamard. They have a rich theory, including that of two sub-types, symmetric and skew (apart from the diagonal) with many applications. A related class of matrices are the conference matrices which have zero diagonal and other entries $+1$ and -1 and meet a similar determinant bound. Recently Dennis Lin asked some interesting questions about a class of matrices which resemble Hadamard or conference matrices and are required to have large determinant; I have called these "hot" and "cold" matrices. There are some conjectures about the structure of these matrices which so far defy attempts at proof. I will explain all these things.