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I will present the Rice condition number of the best rank- $r$  matrix approximation problem, i.e., of computing the rank- $r$  truncated singular value decomposition. This condition number measures, in the Frobenius norm, how much an infinitesimal perturbation to an arbitrary input matrix is amplified in the perturbation of the best rank- $r$  approximation. I also present a Rice condition number of the problem of taking a matrix to a selected left or right singular subspace, or, equivalently, to a projector thereon. This condition number measures the input error in the Frobenius norm and the output error in the chordal, Grassmann, and Procrustes distances on the Grassmannian manifold of linear subspaces, rigorizing and extending prior, classic results in numerical linear algebra. We are able to derive explicit closed-form formulas of these condition numbers in terms of the singular values of the input matrix for both of these classic numerical linear algebra problems through an interesting voyage in Riemannian geometry.

*Joint work with Paul Breiding (University of Osnabruck, Germany) in the first part.*