Computing Accurate Eigenvalues and Singular Values

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In some cases, the singular values and the eigenvalues of positive definite matrices can be computed to high relative accuracy, with the guaranteed number of correct digits even in the smallest singular and eigenvalues. The challenging task is then to determine classes of matrices that determine its spectra to high relative accuracy under entry–wise small perturbations, and then to construct numerical algorithms capable of achieving that level of accuracy in standard floating point arithmetic. For the singular values of certain classes of matrices and for the eigenvalues of positive definite matrices, a variant of the Jacobi algorithm is shown to be capable of delivering results to the accuracy determined as feasible by the perturbation theory. We will describe the details of that development and show how to implement a version of the Jacobi algorithm.