Gauss-like quadrature through manipulations with Jacobi matrices

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We discuss a construction of several types of Gauss and *rational* Gauss quadrature rules through manipulations with Jacobi or Jacobi-like matrices. We pay particular attention to the rational anti-Gauss, simplified Gauss and Gauss-Radau rules. The interest in these rules stems from the need to approximate the matrix functionals of the form $v^T f(A)v$ arising in many applications, where v is a vector, A is a large symmetric positive matrix, and f is a function defined on the spectrum of A. Although a distribution function in the functional $v^T f(A)v$ is not explicitly known, we can compute the corresponding Jacobi or Jacobi-like matrix (and therefore the Gauss or rational Gauss quadrature for the mentioned functional) by several steps of Lanczos or rational Lanczos method with input v and A. By modifying such a matrix we can compute some other quadrature that enables us to estimate the error in the Gauss or rational Gauss quadrature.

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