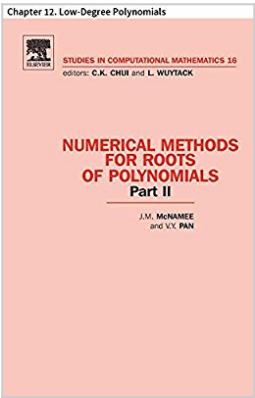

Numerical Methods for Roots of Polynomials - Part II: Chapter 12. Low-Degree Polynomials (Studies in Computational Mathematics)

By J.M. McNamee, V.Y. Pan

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We deal here with low-degree polynomials, mostly closed-form solutions. We describe early and modern solutions of the quadratic, and potential errors in these. Again we give the early history of the cubic, and details of Cardan's solution and Vieta's trigonometric approach. We consider the discriminant, which decides what type of roots the cubic has. Then we describe several ways (both old and new) of solving the quartic, most of which involve first solving a "resolvent" cubic. The quintic cannot in general be solved by radicals, but can be solved in terms of elliptic or related functions. We describe an algorithm due to Kiepert, which transforms the quintic into a form having no or term; then into a form where the coefficients depend on a single parameter; and later another similar form. This last form can be solved in terms of Weierstrass elliptic and theta functions, and finally the various transformations reversed.

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