The role of storage recurs throughout the book; what different "levels" of memory are available, how are they related, how can each hierarchy be best exploited?

The work of Gustavson and his colleagues is described here. They began in 1966 with the clever idea of a program whose output is not the solution to $Ax = b$ but instead a loop-free machine language code to compute x taking explicit advantage of the sparseness structure of A. This is dramatically efficient for the common case in which many problems are to be solved but all sharing the same sparseness structure. The personalized compiler has arrived.

B. N. P.

22 [5, 13.20].—F. BAUER, P. GARABEDIAN & D. KORN, *Supercritical Wing Sections*, Springer-Verlag, Berlin, Heidelberg, New York, 1972, v + 211 pp., 26 cm. Price $6.40.

When aircraft fly at high subsonic velocities, an increasing aerodynamic resistance or drag is experienced as the speed of sound is approached. Initially, it was thought that the drag was unbounded at Mach 1 and, hence, that a "sonic barrier" had been discovered. Now we know that the barrier is only a local maximum, that supersonic flight is possible on one side, and that supercritical subsonic flight is possible on the other side. In the latter region, local regions of supersonic flow appear on wings and bodies, and special designs are required to avoid strong shock waves and accompanying adverse effects. As stated in the preface of *Supercritical Wing Sections* "The purpose of this report is to make available to the engineering public mathematical methods for the design of supercritical wings." These are the methods which have been used by the authors to design and analyze two-dimensional shock free supercritical airfoils. The publication, written in the style of a technical report, is divided into three parts giving the mathematical theory, a users' manual for the listed computer programs, and calculated results and examples.

Part I reviews the theoretical formulations with primary emphasis on the airfoil design techniques using the method of complex characteristics. In this ingenious method, the mixed elliptic-hyperbolic partial differential equation is made linear by a hodograph transformation, and, then, all variables are analytically continued from real 2-space to complex 4-space. The resulting equation is purely hyperbolic with distinct eigenvalues except at the sonic locus. The problem posed is of the inverse variety, that is, to find suitable initial data which yield a solution with a desirable body shape and pressure distribution, with the correct flow at infinity and which is shock free (no external limit lines). Selecting the proper initial data is complicated, and a general form is deduced based on knowledge of the incompressible flow past an ellipse and on experience. The singular part of the solution may be written as an integral formula, and the remainder is obtained by numerical integration of linear nonhomogeneous characteristic equations.

Two other theoretical methods which are used are briefly discussed in Part I. An integral boundary layer theory due to Nash and MacDonald is incorporated in the design method to predict the separation point and to make a displacement thickness correction for the airfoil shape. Solutions for off-design conditions are

obtained from the analysis program which uses relaxation methods to solve the mixed elliptic-hyperbolic partial differential equation for flow about a specified shape (direct problem). It is assumed that embedded shock waves will be weak enough to introduce negligible vorticity and, hence, a potential flow model is used. The solution procedure is quite efficient, but numerical instabilities may be encountered for large regions of supersonic flow. In addition, the shock wave jump may be in error since the difference equations are not in conservative form.

Part II of the report is a users' manual describing the input procedures and execution of the program. Program listings and an example case are given. It is intended that the programs may be implemented without understanding the theory of Part I, and experience will tell if this is realizable. There are several aspects of the design program which require "individual skill and ingenuity" for "success." The programs are written in ANSI Fortran IV and designed for a teletype time-sharing system. Several computed outputs are given in Part III to illustrate the versatility of the techniques.

In general, the publication is a laudable effort to implement theoretical research into the design process. One weakness in this respect could be that only sparse information is provided on the experience with other users of the programs or with the limitations of the methods. Future improvements in this regard and in the boundary layer and analysis methods will undoubtedly be forthcoming.

EARLL M. MURMAN

NASA-Ames Research Center
Moffett Field, California

23 [7].—D. S. MITRINOVIC, *Uvod u Specijalne Funkcije* (*Introduction to the Special Functions*) (in Serbo-Croatian), Izdavacko Preduzeće Gradevinska Knjiga, Beograd, 1972, xi + 188 pp., 24 cm.

At a first glance of the volume under consideration, it would appear difficult to render a faithful review since the book is written in a totally unfamiliar language. By the same token, it would seem that the volume would be of little use to potential readers not acquainted with this language. On closer examination, the language barrier is considerably softened because there is little text, and what little there is is such that the meaning can usually be identified by the closeness of the words to their English counterparts and by the mathematical equations and notation surrounding the text.

The volume, which is divided into eight chapters, is essentially in the form of a handbook, though some proofs are given in sketchy form. On the other hand, numerous results are stated without proof in the principal part of the text or are given at the end of each chapter as a problem. Thus, the tome is ideally suited for self-study or as a pedagogical aid for classroom instruction. The results given are fundamental to the subject and are those which one would normally expect in an introductory text on the subject. A wealth of material is covered. The chapter titles are (1) Gamma Function and Beta Function, (2) Legendre Polynomials, (3) Laguerre Polynomials, (4) Hermite Polynomials, (5) Chebyshev Polynomials, (6) Bessel Functions, (7)