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"a great Russian scholar," Kantorovich is "an eminent Soviet mathematician," but Darboux is only "a French mathematician."

10. What's NOT to Like? I found the excessive use of logical notation to be severe in spots. For example, the proof of DeMorgan's law (Vol. I, p. 9) contains practically no words at all, just symbols. This is easy for a trained mathematician to read, but I wonder what a beginning student would make of it. Even some definitions are given in this style; e.g., the "definition" of the *image* of a set X under a function f (Vol. I, p. 12) is stated as

$$f(X) := \{y \in Y \mid \exists x\,((x \in X) \wedge (y = f(x)))\},$$

and that of *infimum* (Vol. I, p. 45) as

$$i = \inf X := \forall x \in X((i \leq x) \wedge (\forall i' > i\, \exists x' \in X(x' < i'))).$$

Granted, this happens only occasionally after the first chapter, so it's easy to ignore. Moreover, this habit practically disappears by the middle of Volume II.

I also found the differences between Russian and American nomenclature annoying after a while. We find Borel–Lebesgue for Heine–Borel, Schwarz–Bunyakovsky for Cauchy–Schwarz, generalized functions for distributions, fundamental sequence for Cauchy sequence, the Lagrange finite-increment theorem for the mean value theorem (at least "Cauchy's finite-increment theorem" is called the generalized mean value theorem in a footnote), the Gauss–Ostrogradskii theorem for the divergence theorem, and rapidly decreasing functions for Schwartz functions. Before you hand this two-volume set to one of your students, you might consider explaining that standard American usage is different, and provide a dictionary so that the student can learn our terminology (hence, be able to communicate with the rest of us).

11. Misprints. I read nearly every page of both volumes and found very few misprints.

1. Exercise 3a in Vol. I (p. 11) asks for a proof of the same version of DeMorgan's law which was proved in the text on p. 9.
2. The M is missing from the Weierstrass M-Test (Vol. I, p. 99).
3. The set $\{x \in X : d(a,x) \geq r\}$ is supposedly open (Vol. II, p. 5).
4. The function $\chi_{E_1 \cap E_2}$ should be multiplied by f (Vol. II, p. 123, line 11).
5. The symbol $\int \text{limits} Y\, dy$ should be $\int_Y dy$ (Vol. II, p. 127, line -3).
6. "Orhogan" (Vol. II, p. 522) should be "orthogonal."

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Solving Nonlinear Equations with Newton's Method. *By C. T. Kelley.* SIAM, Philadelphia, 2003. $39.00. xiv+104 pp., softcover. ISBN 0-89871-546-6.

This excellent short book is a practical guide to the solution of nonlinear equations by Newton's method, where "Newton's method" is to be understood in a rather broad sense. The subject matter is a class of iterative methods that solve a system of linear equations at each iteration to determine a correction. For safety, a simple line search is used to determine whether or not to take a "full" step. At each iteration the norm of the residual should be reduced. The matrix in the linear system to be solved is the Jacobian or an approximation to the Jacobian, and the system may be solved "exactly" by a direct method or approximately by an iterative method.

The book has four chapters. The first is an introduction and overview. Chapter 2 discusses direct methods (Gaussian elimination) for solving the linear equations exactly. In this situation there is pressure to avoid frequent updates of the Jacobian, since each update requires a new LU factorization. When an update is made, the Jacobian can be computed exactly or approximately. Chapter 3 covers iterative (Krylov subspace) methods for solving the linear systems. Here we have iterations within iterations; that is, we have "inner" and "outer" iterations. On each outer iteration we hope to obtain a sufficiently good approximation in only a few inner iterations, so preconditioners play a big role. The final chapter discusses Broyden's method, which builds increasingly good approximations to the Jacobian by making a rank-one update at each (outer) iteration. Here, too, preconditioners are important. The objective is to precondition the nonlinear system in such a way that the identity matrix is a good initial approximation to the Jacobian.

Each chapter includes a brief discussion of theory and practice, advice about which methods can be expected to work well in which situations, and a list of things that can go wrong. Each of the methods is illustrated by a variety of examples coded in MATLAB. The largest examples are from discretizations of nonlinear partial differential equations, both steady state and time dependent. All of the MATLAB codes can be downloaded from the SIAM web site (http://www.siam.org/books/fa01/) so readers can try them out, play with them, modify them, and use them as templates for solving their own problems.

In the preface the author states that he assumes the reader has a good understanding of numerical analysis at the level of Atkinson's *An Introduction to Numerical Analysis* and of numerical linear algebra at the level of Demmel or Trefethen and Bau. Although these prerequisites are technically correct, I hope that students will not be intimidated by them. Whether they have the prerequisites or not, I would encourage them to dive right in and learn something.

This book promises to be a useful supplement to a variety of numerical analysis courses and a helpful guide for practitioners who need to solve nonlinear systems in their research.

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