

Errata for Classical and Modern Numerical Analysis: Theory, Methods, and Practice

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Chapter 1

p. 2, in the proof of Theorem 1.2: There is an implicit assumption that $\int_a^b w(x)dx \neq 0$, and the case $\int_a^b w(x)dx = 0$ is not considered. To have the proof be complete, we need to observe that, if $\int_a^b w(x)dx = 0$, $w(x)$ must be identically equal to zero except on a set of measure zero. Thus, $\int_a^b f(x)w(x)dx = 0$, and Theorem 1.2 is also true in this special case.

p. 15, second line of Example 1.12: It should be fl instead of $f\ell$.

p. 19, Table 1.1: Although only 23 bits are used for single precision and 52 bits are used for double precision, $t = 24$ for single precision and $t = 53$ for double precision, because the first digit is assumed to be 1.

p. 66, (2.27): Instead of

$$\frac{\hat{x}_k - x}{x_k - \alpha} \rightarrow 0 \text{ as } k \rightarrow \infty,$$

it should be

$$\frac{\hat{x}_k - \alpha}{x_k - \alpha} \rightarrow 0 \text{ as } k \rightarrow \infty.$$

Chapter 3

p. 141, in (3.32): There is an extra “.”.

p. 143, line above (3.39): There should be no closing parentheses.

p. 154, line -8: It should be “ $i = 1, 2, \dots, n$ ”, rather than “ $1 = 1, 2, \dots, n$ ”.

- p. 182, problem 23: Since an “operation” could mean a fused multiply-add, the phrasing of this question may cause some confusion. Also, it is unclear how to achieve n^3 multiplications. (See the analysis in the instructor’s answer guide.) Here is a suggested replacement for the problem:

Compute the number of multiplications it takes to compute the inverse of a matrix according to the note on page 110 as $cn^3 + \mathcal{O}(n^2)$. (That is, determine c .)

Hint: c will be smaller if you take advantage of the fact that the right-hand-sides of the systems you are trying to solve are the unit vectors e_j .

- p. 188, problem 55(b): For consistency of notation with the rest of the text, it should be “find k ” and “ X_k ” rather than “find t ” and “ x_t ”.
- p. 188, problem 56(b): Add the following sentence before the parenthetical note: “Here, $y_0 = b$ and the x_i are computed according to the Full Orthogonalization Method described on page 173.”
- p. 201, line 2: There should not be a parenthesis after $(1, 0, 0)^T$.

Chapter 4

- p. 220, in (4.19): It should be $f^{(2n)}(\xi)$ instead of $f^{2n}(\xi)$.
- p. 243: There should be a comma after the $(x - x_{j-2})^3$ in the second to the last line of (4.29).
- p. 256: In Remark 4.43, it should be “Euler’s formula” instead of “Euler’s identity”.
- p. 284, problem 1(d): it should be “ $\varphi_3 \equiv t^3$ ”, rather than “ $\varphi_3 \equiv x^3$ ”.
- p. 286, problem 13: Since the $L_k(x)$ in this problem are the same as the $\ell_k(x)$ in (4.8) on page 212, L_k should be changed to ℓ_k , for consistency. Similarly, in problem 15 on the same page, l_i should be ℓ_i for consistency.
- p. 287, problem 18: The polynomial should be of degree 3, so it should be referenced as $P_3(x)$, not as $P_2(x)$.
- p. 289, problem 32: As printed, f is not uniquely defined at $x = \pi$. Replace “ $0 \leq x \leq \pi$ ” by “ $0 \leq x < \pi$ ”.
- p. 290, problem 38: Part (a) is assumed. Thus, part (a) should be absent, and the problem should be to prove that φ is constant on $[0, 1)$. It is also helpful to assume some kind of continuity, such as $\lim_{x \rightarrow 0^+} \varphi(x) = \varphi(0)$. (Otherwise, φ could be set to an arbitrary value at a countable number of points, and still satisfy the recursion relation and orthogonality conditions with respect to Lebesgue measure.)

Chapter 5

- p. 101, lines 1 to 4 of the proof:** The sentence should read: "The proof rests on the result in linear algebra that any square matrix is similar to an upper triangular matrix, i.e., given any n by n matrix A , there exists a unitary matrix P such that $PAP^{-1} = \Lambda + U$, where Λ is diagonal and U is upper triangular with zeros on the diagonal.
- p. 321, problem 16:** It should be

$$x_{k+1} = -(A - 3I)^{-1}(A - 5I)^{-1}x_k,$$

instead of

$$x_{k+1} = -(A + 3I)^{-1}(A - 5I)^{-1}x_k,$$

Chapter 6

- p. 377, problem 7:** The authors do not know a general closed-form formula for the n -th component in (6.14). A suggested rewriting of problem 7 is:

Compute the fourth and fifth components in (6.14), assuming order 4 Taylor arithmetic is to be used. Can a general formula be derived? Can a recursive routine be devised to compute the n -th term, without explicitly computing it by hand first?

Instructors can consult the solutions manual for an answer to this modified question.

- p. 377, problem 8:** There is a similar difficulty with this problem as with problem 7. It is suggested that the problem be replaced by:

Compute the components of the degree-4 Taylor object for $(u_{\nabla})^n$.

Project: Write a program that recursively computes a general coefficient for a degree N Taylor object for $(u_{\nabla})^n$.

- p. 378, problem 15:** This problem is erroneously stated. As a counterexample to part (a), take $f(x) = x^{10}$, and $a = 10$. Then, $f(-a) + f(a) = 2 \cdot 10^{10}$, while $\int_{-1}^1 f(x)dx = 2/11$, and the error bound is only $(10^3 - 10^2 + \frac{1}{3}) \cdot 90$.
- p. 379, line 1:** For consistency with the rest of the text, "Trapezoid rule" should be "trapezoidal rule".

Chapter 7

- p. 433, line 4 of problem 16:** It should be "determine β " instead of "determine β ".

p. 435, problem 24: (i) Method (i) Should read

$$y_{j+2} - 2y_{j+1} + y_j = 2h(f(t_{j+1}, y_{j+1}) - f(t_j, y_j)).$$

(iii) Method (iii) should read

$$y_{j+1} - y_j = hf(t_{j+1}, y_{j+1}).$$

Finally, the precise problem being solved is irrelevant to consistency and stability of the method, so the first sentence of the problem should be deleted.

Chapter 8

p. 383, line 10: Instead of “on page 482 in Section 8.1,” it should be “on page 482 in Section 8.7.”

Chapter 9

p. 517: The numbers on top of the nodes in Figure 9.6 are not correct.

p. 526, line 7: “Since $\bar{\varphi} \in [0, 181]$ ” should be “Since $\bar{\varphi} \in [0, 116]$ ”

p. 526, line 16: Remove the “=” from “ $\bar{\varphi} = \in [0, 41]$ ”

p. 526, line 17: It should be “Since $\bar{\varphi} \in [0, 116]$ ” instead of “Since $\bar{\varphi} \in [16, 106]$ ”

Chapter 10

pp. 543–544, and also Exercise 4 on page 567: The claim that Formula (10.21) is second order when $\alpha = \beta = 0$ is false. A counterexample is given in the Instructor’s Solution Manual for Exercise 4.

p. 544, last line: There is a misplaced comma. That is, “(10.25,)” should be “(10.25),”.

p. 548, beginning of line 8: “since” should be “Since”.

p. 557, line 7: “we are obtain” should be “we obtain”.

pp. 567–568, Exercise 5: The reader is requested to prove

$$\|Y - y\|_F^2 = \frac{1}{2} \int_0^1 (y'(x) - Y'(x))^2 dx \leq ch \max_{0 \leq x \leq 1} |y''(x)|.$$

Instead, the reader should be requested to prove

$$\|Y - y\|_F^2 = \frac{1}{2} \int_0^1 (y'(x) - Y'(x))^2 dx$$

and

$$\|Y - y\|_F \leq ch \max_{0 \leq x \leq 1} |y''(x)|.$$

- p. 569, Exercise 11:** The reader should assume, as in Theorem 10.8 and Lemma 10.2, that $|K| \leq M < 1$, and should also assume that K is symmetric, i.e. that $K(s, t) = K(t, s)$. Additional clarification is given in the Instructor's Solution Manual.

Appendix A

- p. 571, second line of 1(c):** An $f(x)$ is missing at the end. That line should read:

$$\min_{x \in [a, b]} f(x) \leq f(x_j) \leq \max_{x \in [a, b]} f(x)$$

- p. 574, first two lines of 7(b):** There are two closing parentheses missing. That is, instead of

$$\begin{aligned} \|(A + B)^{-1} - A^{-1}\| &= \|(A + B)^{-1}(I - (A + B)A^{-1})\| \\ &= \|(A + B)^{-1}(I - AA^{-1} - BA^{-1})\| \end{aligned}$$

it should be

$$\begin{aligned} \|(A + B)^{-1} - A^{-1}\| &= \|(A + B)^{-1} (I - (A + B)A^{-1}) \| \\ &= \|(A + B)^{-1} (I - AA^{-1} - BA^{-1}) \| \end{aligned}$$