ERRATA 1.1
for
Introduction to Algorithms
by Cormen, Leiserson, and Rivest
January 15, 1993

This list describes the known bugs in the first printing of the first edition of *Introduction to Algorithms*. These bugs were fixed in the second printing. An errata sheet for the second and subsequent printings is available separately.

Typically, page and line numbers are given to localize the error. A negative line number indicates numbering from the bottom up. The finder of each bug is credited on the right margin. Actual text from the book is surrounded by ⦅ ⦆. Replacement text, where provided, is surrounded by ⟪ ⟫.

A PostScript version of this errata sheet is available via an Internet electronic mail server. To receive instructions on how to use this service, send electronic mail to `algorithms@theory.lcs.mit.edu` with "`Subject: help`" in the message header. The instructions also describe how to submit bug reports by email and how to obtain errata for the second printing. We regret that we cannot personally respond to all mail.

Page xv, line -8 *Charles E. Leiserson*

The text ⟪Ray Hirschfeld, ⟫ *should be inserted after* ⦅Bemus, ⦆.

Pages xv, line -1 and page xvi line 1, page xvi, line 22 *Alan Sherman*

Raymond Johnson should be listed with other students, not with colleagues who have used this text in courses.

Page xvi, line 21 *John Keen*

The name ⦅John Keene⦆ *should be spelled* ⟪John Keen⟫.

Page 7, line 20 *Michael Ernst*

The word ⟪is⟫ *should be added to the end of the line.*

Page 124, Theorem 6.6 *Tom Cormen and Charles Leiserson*

The theorem is wrong as stated. The bound should read as follows: ⟪ Then for $r > \mu$,

$$\Pr\{X - \mu \geq r\} \leq \left(\frac{\mu e}{r}\right)^r .$$

⟫ *The proof of the theorem must be changed as well.*

Page 125, Corollary 6.7 *Tom Cormen and Charles Leiserson*

The corollary is wrong as stated. The bound should read as follows: ⟪Then for $r \geq np$,

$$\begin{aligned}\Pr\{X - np \geq r\} &= \sum_{k=\lceil np+r \rceil}^{n} b(k; n, p) \\ &\leq \left(\frac{npe}{r}\right)^r .\end{aligned}$$

⟫

Page 126, Exercise 6.5-4 *Tom Cormen and Charles Leiserson*

The exercise should read as follows: ⟪Show that the conditions of Theorem 6.6 imply that

$$\Pr\{\mu - X \geq r\} \leq \left(\frac{(n-\mu)e}{r}\right)^r .$$

Similarly, show that the conditions of Corollary 6.7 imply that

$$\Pr\{np - X \geq r\} \leq \left(\frac{nqe}{r}\right)^r .$$

⟫

Page 126, Exercise 6.5-5 *Tom Cormen and Charles Leiserson*

The exercise should read as follows: ⟪ Consider a sequence of n Bernoulli trials, where in the ith trial, for $i = 1, 2, \ldots, n$, success occurs with probability p_i and failure occurs with probability $q_i = 1 - p_i$. Let X be the random variable describing the total number of successes, and let $\mu = \mathrm{E}[X]$. Show that for $r \geq 0$,

$$\Pr\{X - \mu \geq r\} \leq e^{-r^2/2n} .$$

(*Hint:* Prove that $p_i e^{\alpha q_i} + q_i e^{-\alpha p_i} \leq e^{-\alpha^2/2}$. Then follow the outline of the proof of Theorem 6.6, using this inequality in place of inequality (6.44).) ⟫

Page 126, Exercise 6.5-6 *Tom Cormen and Charles Leiserson*

The exercise should read as follows: ⟪ Show that choosing $\alpha = \ln(r/\mu)$ minimizes the right-hand side of inequality (6.45). ⟫

Page 131, line 21 *Jon Freeman*

The expression ⟪$1 - n^{r-1}$⟫ *should be replaced by* ⟪$1 - 1/n^{r-1}$⟫.

Page 182, line 21 (first line of second display) *Jeff Shallit*

The superscript ⟪ i ⟫ *in the last term should be a subscript.*

Page 187, Exercise 10.1-2 *Jeff Shallit*

The number of comparisons should be ⟪ $\lceil 3n/2 \rceil - 2$ ⟫ .

Pages 256-259, Lemma 13.5 and Theorem 13.6 *Tom Cormen and Charles Leiserson*

The error in Theorem 6.6 affects the statement of Lemma 13.5 and the proofs of both Lemma 13.5 and Theorem 13.6. Only constant factors are affected. See the second printing for full details.

Page 363, line 3 of Section 18.3 *Jeff Shallit*

Insert the word ⟪ as ⟫ *after* ⟪ prepaid work ⟫ .

Page 377, line 10 *Sam Bent*

It seemed insufficiently clear that the condition $\alpha > 1/2$ applies to the remainder of the problem. The sentence ⟪ Assume that α is strictly greater than $1/2$. ⟫ *should be amended to read* ⟪ Assume that α is strictly greater than $1/2$ in the rest of this problem. ⟫

Page 451, following definition of $\lg^{(i)}$ *Tom Cormen*

Insert the equation ⟪

$$\lg^* n = \min \left\{ i \geq 0 : \lg^{(i)} n \leq 1 \right\} .$$

⟫

Page 460, line 2 *Sam Bent*

The phrase ⟪ sequence of m Find-Depth and Graft operations ⟫ *should read* ⟪ sequence of m Make-Tree, Find-Depth, and Graft operations ⟫ .

Page 482, lines 11–21 *Michael Fredman*

The $\Leftarrow$ portion of the proof is buggy. Here is Fredman's note:

> *"The situation assumes that a white path from u to v exists at the time of u's discovery, that w immediately precedes v along the path and w is a descendant of u, but that v is not a descendant of u. It is then claimed that the call to* DFS-VISIT(w) *guarantees that v is finished before w is finished. This is false, since the call to v may take place before that of w via edges deviating from that particular white path."*

The last four lines of the proof should be replaced by the following lines. ⟪ Note that v must be discovered after u is discovered, but before w is finished.

Therefore, $d[u] < d[v] < f[w] \leq f[u]$. Theorem 23.6 then implies that the interval $[d[v], f[v]]$ is contained entirely within the interval $[d[u], f[u]]$. By Corollary 23.7, v must after all be a descendant of u. ⟫

Page 608, equation (27.9) *Robert D. Blumofe*

The second case ⟪ $-c(u,v)$ if $v = s$ ⟫ *should be replaced by* ⟪ $-c(v,u)$ if $v = s$ ⟫ .

Page 627, Problem 27-3(b) *Sam Bent*

This problem part should be changed to read ⟪Show that the maximum net revenue can be easily computed from the capacity of the minimum cut of G and the given p_j values.⟫

Page 691, line 1 *Arthur F. Lent*

The words ⟪and commutative⟫ *should be inserted after* ⟪ associative ⟫.

Page 706, line 5 *Arthur F. Lent*

The phrase ⟪ look at which elements "know" that they are not the maximum. ⟫ *should be replaced by* ⟪consider how many elements "think" that they might possibly be the maximum.⟫.

Page 766, line -7 *Ronald L. Rivest*

The phrase ⟪ exists a vector x ⟫ *should be replaced by* ⟪exists a nonzero vector x⟫.

Page 786, line 10 *David B. Wilson*

The expression ⟪ w_n^k ⟫ *should read* ⟪ ω_n^k ⟫.

Page 788, line 19 *David B. Wilson*

The expression ⟪ $a_0 w_1^0$ ⟫ *should read* ⟪ $a_0 \omega_1^0$ ⟫.

Page 788, line -8 *David B. Wilson*

The expression ⟪ w_n^{2k} ⟫ *should read* ⟪ ω_n^{2k} ⟫.

Page 798, first line of part d of Problem 32-3 *Charles E. Leiserson*

The expression ⟪ w_n^k ⟫ *should read* ⟪ ω_n^k ⟫.

Page 943, first sentence of proof of Thm. 36.10 *Lance Fortnow*

This sentence should read: ⟪The argument we used in the proof of Theorem 36.9 to show that $SAT \in NP$ applies equally well here to show that $3-CNF-SAT \in NP$.⟫

Page 992, reference 120 *Sam Bent*

The source of the Kirkpatrick and Seidel article should be changed to ⟪SIAM Journal on Computing, 15(2):287-299, 1986⟫.