Cumulative corrections through June 30, 2002 for
***Computer Algorithms: Introduction to Design and Analysis*, third edition**
by Sara Baase and Allen Van Gelder

1. Corrections made in second printing

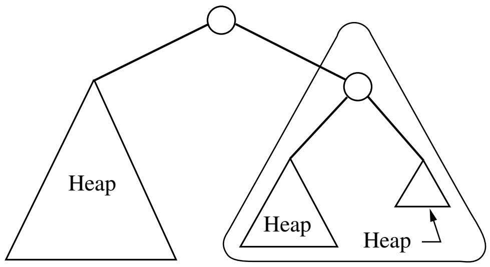
The copyright page of the second printing says "*Reprinted with corrections, April 2000*." Corrections listed in this section have already been made in that printing.

Errata

(*Jan. 28, 2000*) Pg. 171, line –10. Change "is less than" to "$\leq$".

(*Jan. 28, 2000*) Pg. 172, line 14. Change "$<$" to "$\leq$".

(*Jan. 12, 2000*) Pg. 187. The rightmost diagram on the second row of Fig. 4.19 should be changed to look like the diagram below.



(*Jan. 28, 2000*) Pg. 216, line –8. Change "Accelerated Heapsort." to "Mergesort."

(*Jan. 12, 2000*) Pg. 327, Fig. 7.11. Change "3" to "4" in the adjacency list of node 6 (just before "32.0").

(*Jan. 12, 2000*) Pg. 353, line 9. Change n to $n+1$.

(*Jan. 12, 2000*) Pg. 357, line 5. Change the $>$ symbol to the $\geq$ symbol.

(*Jan. 28, 2000*) Pg. 416, line –16. Change "running time of" to "number of weight comparisons done by".

Other clarifications

(*Jan. 12, 2000*) Pg. 97. Append "(Pseudocode is okay; exact Java would require Appendix A.6.)" to each of Exercise 2.8 and 2.9.

(*Jan. 12, 2000*) Pg. 163.
Line 17: Change the comment "Assume failure"; to "In case no key $<$ pivot."
Line 21: Delete the comment "// Succeed."
Line 29: Change the comment "Assume failure"; to "In case no key $\geq$ pivot."
Line 33: Delete the comment "// Succeed."

(*Jan. 12, 2000*) Pg. 335, line 7. Change the word "sweep" to "wrapper".

(*Jan. 28, 2000*) Pg. 383, 2nd line in 7.43(a). The phrase "there is an edge *vs*, and there are no edges of the form *sv*." may be replaced by "there is an edge *vs* and there is no edge of the form *sv*."

(*Jan. 12, 2000*) Pg. 600, Exercise 13.4, part d. Just before the right paren, insert "in Section 13.3.2".

Index corrections

These corrections are motivated by actual problems students had in finding things.

(*Jan. 12, 2000*) Pg. 682. Insert page numbers 16, 27 before page number 126 in the entry for "factorial function".

(*Jan. 12, 2000*) Pg. 684. Insert a new entry "longest path problem, 354–357, 568" after the entry for "Lomuto, N.".

(*Jan. 12, 2000*) Pg. 685. Insert page number 607 after page number 479 in the entry for "partition problem".

(*Jan. 12, 2000*) Pg. 688. Insert a new entry "wrapper, 108" before the entry for "write conflict".

Misplaced stars

In the table of contents several sections were "starred" in error. Only section 12.4 should be "starred." Sections 5.5 and 6.7 and all Exercise sections should not be "starred." Similarly, on "chapter opening" pages only section 12.4 should be "starred"; no stars should appear on pp. 149, 223, 249, or 451.

2. Recent corrections, not in second printing

Some of these might be corrected in the third printing.

Errata

(*Jan. 20, 2001*) Pg. 24, l. –10. Change "(and is possible to prove) that"
to "that on the interval $(-\infty, \infty)$".

(*Dec. 10, 2000*) Pg. 25, l. –5 (end of second line of Eq. 1.15). Change "n^{k+1}."
to "$\left(n^{k+1}-1\right)$.".

(*Jan. 20, 2001*) Pg. 55, l. –2. The lower-case "k" should be capital "K".

(*Jan. 20, 2001*) Pg. 57, l. 17. Change "$< x <$" to "$< K <$" about in the center of the line.

(*Jan. 20, 2001*) Pg. 58, l. –7 (displayed eq.). Change "$t\,2^{k-1}$" to "$t\,2^{t-1}$". (In the exponent k becomes t.)

(*Dec. 10, 2000*) Pg. 138, l. –7 (item 2 of Theorem 3.16). Change "$\Theta(f(n)\log(n))$."
to "$\Theta(f(n)\log(n)) = \Theta\left(n^E\log(n)\right)$.".

(*June 6, 2000*) Pg. 139, lines 8 and 12. Change "any positive ε" to "some positive ε" in two places.
See text below that includes all changes on lines 8–12 of p. 139.

(*Dec. 10, 2000*) Pg. 139, l. 10. Change $\Theta(f(n)\log(n))$ to $\Theta\left(n^E\log(n)\right)$.

(*Dec. 10, 2000*) Pg. 139, l. 12. Change "and $f(n) \in O(n^{E+\delta})$ for some $\delta \geq \varepsilon$,"
to "and $b\,f(n/c) \leq r\,f(n)$ for some $r < 1$ and large enough n,".

[*Note to readers*: Both the erroneous and corrected versions of this condition hold in practical cases; the condition immediately following "If" is the important one.]

After the above changes in **Theorem 3.17**, the three cases should read as follows:

1. If $f(n) \in O\left(n^{E-\varepsilon}\right)$ for some positive ε, then $T(n) \in \Theta\left(n^E\right)$, which is proportional to the number of leaves in the recursion tree.
2. If $f(n) \in \Theta\left(n^E\right)$, then $T(n) \in \Theta\left(n^E\log(n)\right)$, as all node depths contribute about equally.
3. If $f(n) \in \Omega\left(n^{E+\varepsilon}\right)$ for some positive ε, and $b\,f(n/c) \leq r\,f(n)$ for some $r < 1$ and large enough n, then $T(n) \in \Theta(f(n))$, which is proportional to the nonrecursive cost at the root of the recursion tree.

(*Dec. 10, 2000*) Pg. 167, l. 1. Append "$+\frac{1}{4}$".

Pg. 167, l. 3. Change "$-\frac{1}{4}n^2\Big)$"

to "$-\frac{1}{4}n^2+\frac{1}{4}\Big)$".

Pg. 167, l. 4. Change "$-1.$"

to "$-\left(1-\frac{c}{2n}\right).$".

(*June 6, 2000*) Pg. 169, l. 2 of the pseudocode. Change "$>$" to "$\geq$".

(*June 6, 2000*) Pg. 170, change the pseudocode in three places.
Line 4: Change "$>$" to "$\geq$".
Line 5: Change "first" to "first2".
Line 9: Change "$<$" to "$\leq$".

(*Feb. 13, 2001*) Pg. 190, l. 3 (not counting caption). Change "constructHeap(E, n);"
to "constructHeap(E, n, 1);".

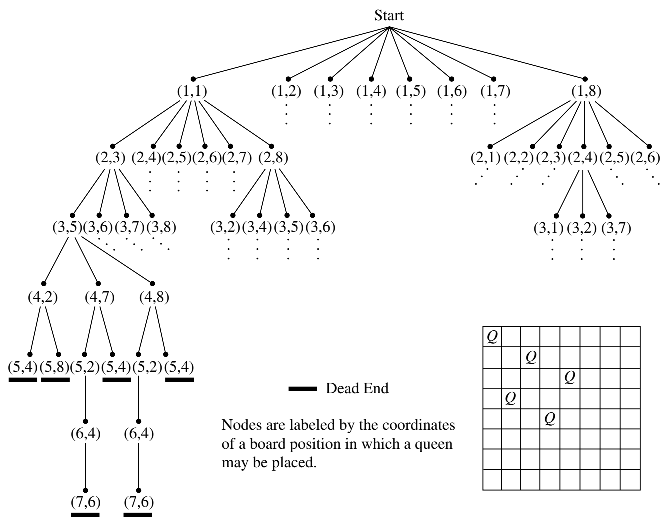
(*Dec. 10, 2000*) Pg. 191, l. –8. Change "$-n) = 2(n\lg(n) - 1.443n)$."
to "$-n+1) = 2(n\lg(n) - 1.443n + 1.443)$.".

(*Jan. 20, 2001*) Pg. 199, l. –9. Change "xLoc = 0; *// Assume failure.*"
to "xLoc = (xindex $\bmod h$); *// Assume failure.*".

(*Jan. 20, 2001*) Pg. 268, l. -2 (not counting caption). Change "ok;" to "rbr;".

(*Feb. 5, 2001*) Pg. 277, l. –3. Change "$(L_i+1)/2$" to "$L_i(L_i+1)/2$".

(*Feb. 5, 2001*) Pg. 339, Figure 7.14.
In the third row of pairs of numbers, the 5th pair should be "(3,2)" not "(3,1)".
In the fifth row of pairs of numbers, the 5th pair should be "(5,2)" not "(5,3)".



Corrected Figure 7.14.

(*Feb. 5, 2001*) Pg. 367.
Line 18: Change "subgraph, that is" to "subgraph (that is".
Line 19: Change "biconnected subgraph." to "biconnected subgraph) with at least one edge."

After these changes lines, the paragraph on lines 17–19 reads:

A *biconnected component* (*bicomponent* for short) of an undirected graph is a maximal biconnected subgraph (that is, a biconnected subgraph not contained in any larger biconnected subgraph) with at least one edge. ■

Note to readers: By the corrected definition, a graph with one vertex is biconnected and has zero biconnected components! Also, as seen in Figure 7.22, a graph with two vertices and one edge is biconnected and has one biconnected component. Although these cases seem unintuitive, the given definitions lead to the elegant properties of biconnectivity and Algorithm 7.9.

(*Feb. 12, 2000*) Pg. 383, l. 7 and 8. Change "graph" to "graph with three or more vertices" in both parts (a) and (b).

(*Feb. 12, 2000*) Pg. 419, l. –15 (Exercise 8.18). Append the sentence "Assume all edge weights are positive."

(*Mar. 30, 2001*) Pg. 462, l. –14. Replace the last "1" by "0" (zero), so the expression reads "low ≥ 0;".

(*Feb. 12, 2000*) Pg. 463, l. 16. Replace the last "1" by "0" (zero), so the expression reads "low ≥ 0;".

(*Nov. 16, 2005*) Pg. 465, l. –10. Replace "0" by "1".

(*Oct. 31, 2001*) Pg. 486, 494, 503, scan procedures. All three scan procedures have the same bug: If a suffix of the text string is the first match to the pattern, then the match goes undetected, because the tests for end of text and end of pattern occur in the wrong order; e.g., text, *acab*, pattern *ab*. The correction is similar in all three procedures: (1) Change "while (endText(T,j) == false)" to "while (true)" and (2) after the existing "if ... break;", insert the new conditional statement, "if (endText(T,j)) break;".

(*Feb. 22, 2000*) Pg. 600, l. –10, in 13.4(e). The word "prime" should be "nonprime".

Other clarifications

(*Dec. 10, 2000*) Pg. xiii, l. –2. A simpler URL is "**`http://www.cse.ucsc.edu/~avg`**".

(*Jan. 20, 2001*) Pg. 2, l. –17. (This clarification probably will not be incorporated until a new edition.) The phrase "several thousand years to run" is a gross understatement. Interested readers should estimate how long it would take a million computers evaluating 10^9 states per second each, in parallel, to evaluate 10^{50} states.

(*June 30, 2002*) Pg. 14, ll. 15, 19, 20. Change "antisymmetric" to "asymmetric" three places.

(*Jan. 20, 2001*) Pg. 28, l. –14. Change "connective" to "operator".

(*Jan. 20, 2001*) Pg. 28, l. –12. Change "connectives" to "quantifiers".

(*Jan. 20, 2001*) Pg. 38, l. 6. Append a semi-colon after "b_{kj}".

(*May 1, 2003*) Pg. 40, l. –13. Change "E, n " to "**int[]** E, **int** n".

(*Jan. 20, 2001*) Pg. 41, l. -4. Change "available whether or not the"
to "supplied above whether the".

(*Dec. 10, 2000*) Pg. 45, l. 7 (not counting the caption). Add this parenthesized sentence to the end of Definition 1.14: "(Or $f(m,n) \leq c\,g(m,n)$ for all $m,n \geq n_0$, if f and g are functions of two variables that both go to infinity, etc.)"

(*Jan. 20, 2001*) Pg. 45, Def. 1.14 and pg. 47, Def. 1.15. (This clarification probably will not be incorporated until a new edition.) Although the functions f and g are described as being "into the positive real numbers" for simplicity, it is sufficient if the n_0 mentioned in the definitions can be chosen so that $f(n)$ and $g(n)$ are positive for $n \geq n_0$.

(*May 1, 2003*) Pg. ???. Append "such that $g' \geq 0$ for sufficiently large n and"

(*Jan. 20, 2001*) Pg. 45, l. –4. Change "A function $f \in O(g)$"
to "Function f is in $O(g)$".

(*Jan. 20, 2001*) Pg. 46, 4th line of Example 1.13. Change "1 $f(n)$" to "$1 \cdot f(n)$"

(*Jan. 20, 2001*) Pg. 48, l. 1. Change "Function $f \in \Omega(g)$"
to "Function f is in $\Omega(g)$".

(*June 6, 2000*) Pg. 63, l. –3. Insert "in the worst case" at the end of the sentence. The phrase "at most" may be deleted.

(*Feb. 5, 2001*) Pg. 76.
Line –10. Change "List newL" to "IntList newL".
End of figure, above caption: There should be one more "}" to end the class.

(*Jan. 20, 2001*) Pg. 85, l. 2. Change "remainSubs;" to "remainSubtrees;".

(*June 6, 2000*) Pg. 94, l. 5. Insert "**int**" before the word "e".

(*Jan. 20, 2001*) Pg. 120, l. 10. Extend the sentence by changing "form." to "form (but also consider Section 3.5.6).".

(*Oct. 31, 2001*) Pg. 132, l. 15. Change ")))" to "))))".

(*Jan. 20, 2001*) Pg. 144, l. –7. Change "3.16" to "3.15".

(*May 1, 2003*) Pg. 155, l. 1. Figure 4.5, top line, leftmost entry should be "i+1".

(*May 1, 2003*) Pg. 156, l. 1. Change "(1.16)" to "(1.11)".

(*June 6, 2000*) Pg. 190, l. 5. Remove ";" before ")".

(*May 1, 2003*) Pg. 191, l. 3–4. (not counting Figure 4.22): Replace "...so the total for all the deletions..." with "...so the total number of comparisons..."

(*May 1, 2003*) Pg. 192, l. ???. A return statement is missing in Algorithm 4.10.

(*May 1, 2003*) Pg. 195, l. 13. Change "due to incomplete" to "due to an incomplete".

(*May 1, 2003*) Pg. 196, l. ???. A return statement is missing in fixHeapFast (Figure 4.25).

(*Oct. 31, 2001*) Pg. 199, l. 16. Delete the ";" at the end of the line for the function header.

(*May 1, 2003*) Pg. 209, l. 18. Change "3.10" to "3.9".

(*Feb. 5, 2001*) Pg. 212, l. 4. Change "list of integers" to "lists of integers".

(*Oct. 31, 2001*) Pg. 214, l. –11. Delete the last ";", before the right parenthesis.

(*Oct. 31, 2001*) Pg. 226, last line. A clearer phrase is "each win and each loss".

(*Jan. 20, 2001*) Pg. 237, l. –9. Change "1.10" to "1.9".

(*Jan. 20, 2001*) Pg. 245, l. 7. Change "$i > M$" to "$i \geq M$".

(*Jan. 20, 2001*) Pg. 245, all of Exercise 5.17. (This clarification probably will not be incorporated until a new edition.) The cost should have been for accessing the array E, rather than for comparisons. In part (a) show that three array accesses are necessary and sufficient. Part (c) should ask how many array accesses. Part (d) should say "with k array accesses" instead of "with $k-1$ comparisons". Part (e) should say "$\lg n + 3$ array accesses" instead of "$\lg n + 2$ comparisons".

(*May 1, 2003*) Pg. ???. The problem attributed to Pohl was published in *CACM*, 1972. Knuth published an extensive sorting bibliography in *Computing Reviews*, Vol. 13, pp. 283–289, 1972.

(*Dec. 10, 2000*) Pg. 277–280. In eight places the number 1055 should be 1215. The eight places are p. 277, l. 1 and in the table; p. 279, l. 9, l. 10, in the table, and l. –7; p. 280, second line of Example 6.12 and in the table.

(*Feb. 5, 2001*) Pg. 280, l. 13. Change "approach $\sqrt{n}$" to "be $\Theta(\sqrt{n})$".

(*Feb. 5, 2001*) Pg. 284, l. –7. Change "is" to "in".

(*Feb. 5, 2001*) Pg. 286.

Line 1 (not counting caption): Change "(We are assuming"
to "(We know that".

Line 2 (not counting caption): Change "It is not hard to show that no such program does"
to "We can show that no program of length m does".

(*Feb. 5, 2001*) Pg. 287, l. 1 (not counting caption): Change "only $2m+2n-1$" to "about $2m+3n$".

(*Feb. 5, 2001*) Pg. 288. l. –2. Change "does twice as many link"
to "may do twice as many link".

(*Feb. 5, 2001*) Pg. 289, line beginning "7.": Delete the right parenthesis before the semi-colon.

(*Feb. 5, 2001*) Pg. 291, l. –2. (This clarification probably will not be incorporated until a new edition.) Interested readers may verify that $\lg^*(n)$ can also be defined recursively by

$$\begin{aligned} \lg^*(1) &= 0 \\ \lg^*(n) &= 1+\lg^*(\lceil \lg n \rceil) \qquad \text{for } n > 1. \end{aligned}$$

(*Feb. 5, 2001*) Pg. 296, l. 21 (displayed code line): Change "Key K)" to "**float** K)".

(*Feb. 5, 2001*) Pg. 298–301. Five changes for consistency with Section 2.3.4.

Pg. 298, l. 11: Change "children" to "subtrees".
Pg. 298, l. 22: Change "children" to "subtrees".
Pg. 298, l. 24: Change "children" to "subtrees".
Pg. 299, l. -10. Change "children" to "subtrees".
Pg. 301, l. 7 (not counting caption). Change "children" to "subtrees".

(*Oct. 31, 2001*) Pg. 304, Exercise 6.23. *Note to readers*: In other words, let $m = n$ for the program you construct. Does this establish the claim on p. 288 that a lower bound of $\Omega(n + m \log n)$ can be achieved?

(*Feb. 5, 2001*) Pg. 319, l. 6. Change "it is also required that $E' \subseteq V' \times V'$."
to "each edge in E' must involve only vertices in V'.".

(*Feb. 5, 2001*) Pg. 319, l. 12. Change "vertices."
to "vertices. A subgraph of G is *proper* if it is not equal to G.".

(*Feb. 5, 2001*) Pg. 319, l. –6. Change "all distinct."
to "all distinct. A path of length zero is called an *empty path*.".

(*Feb. 5, 2001*) Pg. 334, l. 15, in "Remarks". (This clarification probably will not be incorporated until a new edition.) The variant of Queue.create that takes an argument is discussed in Exercise 2.16.

(*Feb. 5, 2001*) Pg. 335, l. 10. Change "of all G" to "all of G".

(*Oct. 31, 2001*) Pg. 345, l. numbered 12 in the procedure. Append ";".

(*Feb. 5, 2001*) Pg. 351, l. 5. Change "If there is any directed path"
to "If there is any nonempty path".

(*Oct. 31, 2001*) Pg. 353, l. 14. Insert ";" between "topoNum" and the square.

(*Feb. 5, 2001*) Pg. 361, l. –12, in "Remarks". (This clarification probably will not be incorporated until a new edition.) The variant of Stack.create that takes an argument is discussed in Exercise 2.15.

(*Feb. 5, 2001*) Pg. 364, l. 3. Change "then there is no problem."
to "then there is no problem. (How does Lemma 7.10 tell us v_i is white?)".

(*Feb. 5, 2001*) Pg. 374, Figure 7.26 has several typos.
Line 1: Change "n)" to "**int** n)".
Line 3: Change "IntStack" to "Stack".
Line 12: Change "p)" to "**int** p)".

(*Feb. 5, 2001*) Pg. 381, lines –4 and –3 (not counting caption, this is in Exercise 7.33).
Line –4: Change "necessary and sufficient" to "a necessary condition".
Line –3: Change "be biconnected?" to "be biconnected? Is it a sufficient condition?".
Line –3: Change "answer" to answers".

After these changes, Exercise 7.33 should begin as follows:

> **7.33** Is the following property on a graph $G = (V,E)$ a necessary condition for G to be biconnected? Is it a sufficient condition? Prove your answers.

(*May 1, 2003*) Pg. ???, l. ???. It seems to me that your proof of Lemma 8.1 fails to mention, let alone prove, a nontrivial fact that it tacitly relies on, namely, that swapping edges in the first tree does not destroy the MST property.

(*Mar. 10, 2001*) Pg. 402, l. 2. Change "numPQ" to "pq.numPQ".

(*Feb. 26, 2000*) Pg. 419, l. 1 of Exercise 8.18. Change "(V,E)" to "(V,E,W)" and insert "weighted" before "graph".

(*June 6, 2000*) Pg. 477, in Exercise 10.14a, delete "the" before "DP(lineBreak)".

(*June 6, 2000*) Pg. 448, l. –2. Change "of a graph" to "of an undirected graph".

(*May 1, 2003*) Pg. 501, l. 4. Remove "r," since the variable r is not used anywhere.

(*Oct. 31, 2001*) Pg. 507, l. 19. Change "four values:" to "three applicable values:".

(*Feb. 12, 2000*) Pg. 553, l. 3. Before the slug, insert the sentence
"For this chapter, all edge weights are integers or rational numbers."

(*Oct. 31, 2001*) Pg. 575, l. 4 (in displayed equation). Change "b_i" to "b_j" in two places and change "t_i" to "t_j" in two places.

(*Feb. 12, 2000*) Pg. 589, l. 14. Append this sentence to the end of the paragraph:
"For this section, all edge weights are integers or rational numbers."

(*Feb. 22, 2000*) Pg. 596, l. –4. Change "Now" to "Now, after stripping off the vertex strands,".

(*Feb. 12, 2000*) Pg. 607, l. 13. Change "CNF" to "SAT".

(*Feb. 26, 2000*) Pg. 656 l. 5. Append "*// or extends RuntimeException*".

(*Feb. 26, 2000*) Pg. 658. Append this paragraph at the end of Section A.3:

> **RuntimeException** may be used instead of **Error**.

Acknowledgments

We thank the following people for finding several errors: Prof. Robert Roos of Allegheny College, Molly McGuckin, a student at Allegheny College, Prof. David Helmbold of UCSC, Tom Raffill and Feng Wang, graduate students at UCSC, Prof. Jonathan Goldstine of Penn State, Prof. Philip Machanick of University of the Witwatersrand, South Africa, Dr. Ted Krovetz of UC Davis, Pannaga Shivaswamy of Cisco Systems, Prof. Loren Schwiebert of Wayne State University, Prof. Eric Bach of University of Wisconsin, Vladimir G. Ivanovic of California State University, Hayward, David Ilstrup, student at UCSC.

Bucks for bugs

Allen Van Gelder offers to pay $5.00 to the first student to report any previously unknown error in the text. Typographical errors, like misspellings, do not count. Most of the errors listed under errata above would have counted and some of these were reported by students, who received rewards. In case of duplicate reports the earliest prevails. Visit the web page where you found this document, or one of the web pages listed below, to find known errors.

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The authors' decision about whether something is or is not an error is final, and we cannot promise to carry on extended discussions.