

Errata for *Elements of Programming*

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Third printing, June 2010

Page xi, second paragraph: Append this sentence just before the final footnote mark: We thank Shinji Dosaka, Ryan Ernst, Steven Gratton, Volker Lukas, Qiu Zongyan, Abraham Sebastian, and Sean Silva for finding errors in the third printing.

Page 14: Change line 6 to:

$$n \mapsto (|n| \neq 1) \wedge (\forall u, v \in \mathbf{N}) uv = n \Rightarrow (|u| = 1 \vee |v| = 1)$$

(Reported by Steven Gratton.)

Page 29, line 4: Change “1979” to “1982”.

Page 76, footnote 5: Insert “Volume 3,” before “pages 14–22”.

Page 105, Lemma 6.8: Insert a right parenthesis after each of the two occurrences of “ $(\forall m \in [f, l])$ ” and change the typeface of all occurrences of m , f , l , j , and p in these two formulas to match the p , f , and l in the first line.

Page 127, requirements for `bifurcate_equivalent_nonempty`: Change `ValueType(I0)` to `ValueType(C0)`. (Reported by Sean Silva.)

Page 128, requirements for `bifurcate_equivalent`: Change `ValueType(C)` to `ValueType(C0)`. (Reported by Sean Silva.)

Page 131, requirements for `bifurcate_compare`: Change `ValueType(C)` to `ValueType(C0)`. (Reported by Sean Silva.)

Page 133, first line of section 8.1: Change “interator” to “iterator”. (Reported by Abraham Sebastian.)

Page 174, Exercise 10.4: Change “representive” to “representative”. (Reported by Qiu Zongyan.)

Page 182, Lemma 10.24: Change “and $3(n - 2)$ otherwise” to “and $3(n - 1)$ otherwise”. (Reported by Volker Lukas.)

Page 183, line 5: Change “If $p.m0 = m \wedge p.m0 = l$ ” to “If $p.m0 = m \wedge p.m1 = l$ ”. (Reported by Ryan Ernst.)

Page 203, `sort_n_with_buffer` precondition: $n/2$ should be $\lceil n/2 \rceil$. (Reported by

Ryan Ernst.)

Page 204, sentence before `merge_n_step_0`: Change “Rotating the ranges r_2 and r_3 ” to “Rotating the ranges r_1 and r_2 ”. (Reported by Shinji Dosaka.)

Page 213, line 19: Change “ $0 \leq i \leq \text{size}(w)$ ” to “ $0 \leq i < \text{size}(w)$ ”. (Reported by Sean Silva.)

Page 217, line 17: Change “ $n - k$ values in the open interval $[0, n - k)$ ” to “ $n - k + 1$ values in the closed interval $[0, n - k]$ ” (Reported by Qiu Zongyan.)

Page 218, line 12 from bottom: Change “The cost of insert before or after an erase at an arbitrary iterator is constant.” to “The cost of insert (both before or after an iterator) or erase is always constant.” (Reported by Qiu Zongyan.)

Page 246, entry for Sedgewick et al.: Change 1979 to 1982 and change “In *Proc. 11th SIGACT Meeting*, ed. Michael J. Fischer, pages 376–390” to “*SIAM Journal on Computing* 11(2): 376–390”.

Page 251, second column: Insert “*Mutable*, 150” after “*MultiplicativeSemigroup*, 66”, “*Readable*, 90” after “*RandomAccessIterator*, 113” and “*Writable*, 149” after “weakening, 11”.

Page 255, second column: Insert “*Mutable*, 150” after “Musser, David, 13”.

Page 257, second column: Change “properly partial object state” to “properly partial object type”. (Reported by Qiu Zongyan.)

Page 258, second column: Insert “*Readable*, 90” after “reachable algorithm, 121”.

Page 260, second column: Change “total object state” to “total object type”. (Reported by Qiu Zongyan.)

Page 262, second column: Insert “*Writable*, 149” after “words in memory, 4”.

Second printing, October 2009

Page xi, second paragraph: Append these two sentences (including footnote mark): We thank John Banning, Bob English, Steven Gratton, Max Hailperin, Eugene Kirpichov, Alexei Nekrassov, Mark Ruzon, and Hao Song for finding errors in the first printing. We thank Foster Brereton, Gabriel Dos Reis, Ryan Ernst, Abraham Sebastian, Mike Spertus, Henning Thielemann, and Carla Villoria Burgazzi for finding errors in the second printing.⁶

Page xi, bottom of page: Add this footnote:

6. See www.elementsofprogramming.com for the up-to-date errata.

page xiii, first paragraph: Change “and, since 2002, Adobe” to “and Adobe”.

page xiii, second paragraph: Change “and, since 2003, Adobe” to “and Adobe”.

Page 12, line 21: Change $x \mapsto \mathcal{F}(x)$ to $x \mapsto \mathcal{F}(x)$. (Reported by Abraham Sebastian.)

Page 12, concept *UnaryFunction*: Add a definition of *Domain* similar to the one in *HomogeneousFunction* later on the same page:

$$\wedge \text{Domain} : \text{UnaryFunction} \rightarrow \text{Regular} \\ \text{F} \mapsto \text{InputType}(\text{F}, 0)$$

(Reported by Carla Villoria Burgazzi, who detected the problem using her Liz interpreter.)

Page 25, *convergent_point*: Add this precondition:

$$// \text{Precondition: } (\exists n \in \text{DistanceType}(\text{F})) n \geq 0 \wedge f^n(x_0) = f^n(x_1)$$

Page 26: Change Exercise 2.3 to:

The precondition of *convergent_point* ensures termination. Implement an algorithm *convergent_point_guarded* for use when that precondition is not known to hold, but there is an element in common to the orbits of both x_0 and x_1 .

(Reported by Abraham Sebastian.)

Page 33, bottom of page: Change the case for n odd from $(a^2)^{n/2}a$ to $(a^2)^{\lfloor n/2 \rfloor}a$. (Reported by Ryan Ernst.)

Page 44, line 5: Change x_{x-k+1} to x_{n-k+1} . (Reported by Foster Brereton.)

Page 49, the *Relation* concept should be:

$$\text{Relation}(\text{Op}) \triangleq \\ \text{HomogeneousPredicate}(\text{Op}) \\ \wedge \text{Arity}(\text{Op}) = 2$$

(Reported by Foster Brereton.)

Page 54, line 12: Change “jth largest of k arguments” to “jth element from k arguments according to the given ordering.” (Reported by Abraham Sebastian.)

Page 66: Change the first sentence to: “A transformation is called an *inverse operation* of a binary operation with respect to a given element (usually the identity element of the binary operation) if it satisfies the following:”. (Reported by Mike Spertus.)

Page 71, first sentence of section 5.3: Change “an integer” to “a non-negative integer”. (Reported by Abraham Sebastian.)

Page 74, line 13: Change the final colon to a period. (Reported by Ryan Ernst.)

Page 87, *quotient_remainder_extended*: change the signature to:

$$\text{quotient_remainder_extended} : \mathbb{U}_n \times \mathbb{U}_n \rightarrow \mathbb{U}_n \times \mathbb{U}_n$$

(Reported by Henning Thielemann.)

Page 101, `find_n`: The precondition should be `readable_weak_range(f, n)` rather than `weak_range(f, n)`.

Page 121, `reachable`: The requirement should be *BidirectionalBifurcateCoordinate* rather than *BifurcateCoordinate*, and the precondition should be `tree(x)` rather than `tree(c)`. (The requirement error was reported by the GHC compiler when the concepts and functions in this chapter were translated to Haskell type classes and functions.)

Page 178: Change the sentence beginning “Since `m` is the smallest” to “Since `m` is the smallest positive number such that `mk mod n = 0`, `lcm(k, n) = mk`, where `lcm(a, b)` is the *least common multiple* of `a` and `b`.”

Page 235, paragraph beginning “Prefix `const`”: Append this sentence: “When applied to a reference type, the resulting type is a reference to a constant version of the reference base type.” (Reported by Gabriel Dos Reis.)

Page 237: Replace the production for `control_statement` with:

```
control_statement = return | conditional | switch | while | do
                  | compound | break | goto.
```

(Reported by Carla Villoria Burgazzi.)

First printing, June 2009

Page 14, `regular_unary_function`: The `f` to the left of `↦` should be `f`. (Reported by Mark Ruzon.)

Page 18, `power_unary` precondition: The superscript should be `i` rather than `n`:

```
// Precondition: n ≥ 0 ∧ (∀i ∈ N) 0 < i ≤ n ⇒ fi(x) is defined
```

(Reported by Alexei Nekrassov.)

Page 24, fourth line: Change “`q ≥ 0`” to “`q > 0`” and “when `slow` enters the cycle” to “when it collides with `slow`”. (Reported by Bob English and John Banning.)

Page 52: The `weak_ordering` property should be:

```
property(R : Relation, E : Relation) requires(Domain(R) = Domain(E))
weak_ordering : R
  r ↦ transitive(r) ∧ (∃e ∈ E) equivalence(e) ∧
    (∀a, b ∈ Domain(R)) exactly one of the following holds:
      r(a, b), r(b, a), or e(a, b)
```

(Reported by Eugene Kirpichov.)

Page 59, `select_2_5_ab_cd`: The first statement should be:

```
compare_strict_or_reflexive<(ia < ic), R> cmp;
```

(Reported by Hao Song.)

Page 74: The sentence “While we believe that there is no logarithmic time, constant-space algorithm for remainder on Archimedean monoids, an iterative constant-space algorithm exists when we can divide by 2.³” should be changed to “Floyd and Knuth [1990] give a constant-space algorithm for remainder on Archimedean monoids that performs about 31% more operations than `remainder_nonnegative`, but when we can divide by 2 an algorithm exists that does not increase the operation count.³” (Reported by Max Hailperin.)

Page 95: The definition of *limit* of a range: the brackets should be hollow:

An iterator `f + n` is the limit of a half-open weak range $\llbracket f, n \rrbracket$.

(Reported by Eugene Kirpichov.)

Page 135, in line 9: “`t = successor(f)`” should be “`f = successor(t)`”. (Reported by Max Hailperin.)

Page 221: “performs reallocation only when `size(a) ≤ capacity(a)`” should be “performs reallocation only when the size after the insertion is greater than the capacity before the insertion”. (Reported by Max Hailperin.)

Page 244, [Fiduccia 1985]: Change “*SIAM Journal of Computing*” to “*SIAM Journal on Computing*”.

Page 244: After [Fletcher and Silver 1966] insert “Floyd, Robert W. and Donald E. Knuth. 1990. Addition Machines. *SIAM Journal on Computing* 19(2): 329-340.”

The following index items should all refer to page 40 rather than page 41:

page 250, second column:	<code>binary_scale_down_nonnegative</code> and <code>binary_scale_up_nonnegative</code>
page 253, first column:	<code>even</code>
page 253, second column:	<code>half_nonnegative</code>
page 255, second column:	<code>negative</code> , <code>odd</code> , and <code>one</code>
page 256, second column:	<code>positive</code> and <code>predecessor</code> , of integer
page 260, second column:	<code>successor</code> , of integer
page 261, first column:	<code>twice</code>
page 262, second column:	<code>zero</code>

Also, on page 262, second column: the heading letter “X” should be “Z”.

Code on web site

`type_functions.h`: The incorrect line:

```
#define NeedsDestruction(T) typename needs_construction_type<T>::type
```

has been corrected to:

```
#define NeedsDestruction(T) typename needs_destruction_type<T>::type
```

(Reported by Steven Gratton.)