

Errata for *Elements of Programming*  
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[www.elementsofprogramming.com](http://www.elementsofprogramming.com)

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## Second printing, October 2009

### Chapter 1

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:

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

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

### Chapter 2

Page 25, *convergent\_point*: Add this precondition:

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

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.)

### Chapter 3

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.)

## Chapter 4

Page 49, the *Relation* concept should be:

$$\begin{aligned} \text{Relation}(\text{Op}) &\triangleq \\ &\quad \text{HomogeneousPredicate}(\text{Op}) \\ &\quad \wedge \text{Arity}(\text{Op}) = 2 \end{aligned}$$

(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.)

## Chapter 5

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.)

## Chapter 6

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

## Chapter 7

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.)

## Chapter 10

Page 178, change the sentence beginning “Since  $m$  is the smallest” to “Since  $m$  is the smallest positive number such that  $mk \bmod n = 0$ ,  $\text{lcm}(k, n) = mk$ , where  $\text{lcm}(a, b)$  is the *least common multiple* of  $a$  and  $b$ .”

## Appendix 2

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.)

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## First printing, June 2009

### Chapter 1

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

### Chapter 2

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

```
// Precondition:  $n \geq 0 \wedge (\forall i \in \mathbb{N}) 0 < i \leq n \Rightarrow f^i(x)$  is defined
```

(Reported by Alexei Nekrassov.)

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

### Chapter 4

Page 52, the `weak_ordering` property should be:

**property**( $R : Relation, E : Relation$ ) **requires**( $Domain(R) = Domain(E)$ )  
**weak\_ordering** :  $R$   
 $r \mapsto \text{transitive}(r) \wedge (\exists e \in E) \text{equivalence}(e) \wedge$   
 $(\forall a, b \in Domain(R))$  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.)

## Chapter 5

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.<sup>3</sup>” 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.<sup>3</sup>” (Reported by Max Hailperin.)

## Chapter 6

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.)

## Chapter 8

Page 135, in line 9, “ $t = \text{successor}(f)$ ” should be “ $f = \text{successor}(t)$ ”. (Reported by Max Hailperin.)

## Chapter 12

Page 221, “performs reallocation only when  $\text{size}(a) \leq \text{capacity}(a)$ ” should be “performs reallocation only when the size after the insertion is greater than the capacity before the insertion”. (Reported by Max Hailperin.)

## Bibliography

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): 329-0340.”

## Index

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

page 250, second column: binary\_scale\_down\_nonnegative and binary\_scale\_up\_nonnegative  
page 253, first column: even  
page 253, second column: half\_nonnegative  
page 255, second column: negative, odd, and one  
page 256, second column: positive and predecessor, of integer  
page 260, second column: successor, of integer  
page 261, first column: twice  
page 262, second column: zero

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.)