

Real World Algorithms: A Beginners Guide

Errata to First Printing

Last updated 25 July 2017

There are three different kinds of changes noted here. In all of them the date that they became known to the author is given at the first line of each item. The name of the person who suggested the change is also given at the end of each change.

► **Page 1** line 1 _____ 1 Jan 1

These are technical or typographical errors. The date shows when they became known.

Page 1 line 1 _____ 1 Jan 1

These are changes that improve the book, even if they do not correct an error. They include small rewordings, or material that became known to the author after the book was published.

Page 1 line 1 _____ 1 Jan 1

These are minor fixes that although they do not make a big difference they do pain the author's eye. Some of them might strain the reader's eye to see where the improvement is exactly.

- Page 10 line -14 _____ 01 Apr 2017
hear \leadsto year (P. Tsanakas)
- Page 11 line -2 _____ 01 Apr 2017
 $f(n) = e^x \leadsto f(n) = e^n$ (P. Tsanakas)
- Page 20 line -4 _____ 30 Mar 2017
line 3 \leadsto line 4
- Page 20 line -3 _____ 30 Mar 2017
line 11 \leadsto line 12
- Page 20 line -1 _____ 30 Mar 2017
line 6 \leadsto line 7
- Page 65 line 2 _____ 06 Mar 2017
011110 \leadsto 011011
- Page 71 algorithm 3.1, line 1 _____ 26 Mar 2017
Size \leadsto SizePQ
- Page 80, line -6 _____ 25 May 2017
Joyces's \leadsto Joyce's
- Page 80, line -5 _____ 29 Jun 2017
41% \leadsto 53%
- Page 95 figure 4.1, caption _____ 21 Apr 2017
encryption \leadsto decryption
- Page 140, line -2 to -1 _____ 17 Jul 2017
SHA-2 (Secure Hash Standard-2) \leadsto SHA-2 (Secure Hash Algorithm 2)
- Page 144, line 2 _____ 21 Apr 2017
command packet \leadsto *command packet*
- Page 145, line -14 _____ 01 Jun 2017
 $OR_3 \leadsto OR_2$
- Page 145, line -12 _____ 01 Jun 2017
Alice $\leadsto OR_1$.
- Page 147, line -13 _____ 17 Jul 2017
SHA-224. \leadsto SHA-224,

- **Page 157** figure 6.6, caption _____ 21 Mar 2017
weighed $\wedge \rightarrow$ weighted
- **Page 166** figure 6.13, second panel, label under t _____ 21 Apr 2017
 $13 \wedge \rightarrow 13 / -\infty$
- **Page 166** figure 6.13, fourth panel, label under t _____ 21 Apr 2017
 $13 \wedge \rightarrow 13 / -\infty$
- **Page 166** figure 6.13, fifth panel, label under t _____ 21 Apr 2017
 $-inf ty \wedge \rightarrow -\infty$
Page 178, algorithm 7.1, line 12 _____ 23 Apr 2017
 $\text{ExtractMinFromPQ}(pq) \wedge \rightarrow \text{ExtractMinFromPQ}(pq)$
- **Page 179**, lines 10, 12 _____ 24 Jul 2017
line 11 $\wedge \rightarrow$ line 14
- **Page 180**, line 13 _____ 26 Mar 2017
lines 1–7 $\wedge \rightarrow$ lines 1–10
Page 181, line –4 _____ 23 Jul 2017
re-weighting $\wedge \rightarrow$ reweighting
- **Page 182**, figure 7.11 _____ 22 Jul 2017
link $0 \xrightarrow{0} 2 \wedge \rightarrow 0 \xrightarrow{4} 2$ and link $0 \xrightarrow{8} 3 \wedge \rightarrow 0 \xrightarrow{7} 3$
Page 182, figure 7.11, caption _____ 23 Jul 2017
re-weighted $\wedge \rightarrow$ reweighted
Page 206, line 1 _____ 23 Apr 2017
Euros $\wedge \rightarrow$ euros
- **Page 214**, line 8 _____ 04 Apr 2017
 $P_{B_j} \wedge \rightarrow B_{P_j}$
- **Page 217**, line –3 _____ 04 Apr 2017
page 3 $\wedge \rightarrow$ page 6
- **Page 217**, line –2 _____ 04 Apr 2017
page 4 $\wedge \rightarrow$ page 5
Page 222, figure 9.6 _____ 28 Apr 2017
change line arrow to stealth shape

- Page 229, line -16 _____ 04 May 2017
support $\wedge \rightarrow$ supported
- Page 230, line -3 _____ 23 Apr 2017
If there are n voters, then candidate A gets $(60 \times 2)n = 120n$ points $\wedge \rightarrow$ If there are $100m$ voters, candidate A gets $(60 \times 2)m = 120m$ points
- Page 230, line -2 _____ 23 Apr 2017
 $(60 + 2 \times 40)n = 140n \wedge \rightarrow (60 + 2 \times 40)m = 140m$
- Page 230, line -2 _____ 23 Apr 2017
 $40n \wedge \rightarrow 40m$
- Page 231, heading 10.2 _____ 23 Apr 2017
Shulze $\wedge \rightarrow$ Schulze
- Page 233, algorithm 10.1, line 4 _____ 23 Apr 2017
 $P[i][j] \wedge \rightarrow P[i, j]$
- Page 234, line -8 _____ 04 May 2017
 $P[i, j] \wedge \rightarrow P[c_i, c_j]$
- Page 234, line -7 _____ 04 May 2017
 $P[j, i] \wedge \rightarrow P[c_j, c_i]$
- Page 234, line -6 _____ 04 May 2017
 $P[i, j] - P[j, i] \wedge \rightarrow P[c_i, c_j] - P[c_j, c_i]$
- Page 236, line -4 _____ 28 Apr 2017
 $(k + 1) \wedge \rightarrow k + 1$
- Page 238, algorithm 10.2, line 6 _____ 23 Apr 2017
 $S[i][j] \wedge \rightarrow S[i, j]$
- Page 238, algorithm 10.2, line 9 _____ 23 Apr 2017
 $S[i][j] \wedge \rightarrow S[i, j]$
- Page 241, algorithm 10.3, second line of output _____ 23 Apr 2017
 $s[i, j_k] > s[j_k, i] \wedge \rightarrow S[i, j_k] > S[j_k, i]$
- Page 244, algorithm 10.4 _____ 23 Apr 2017
all *pred* and *dist* $\wedge \rightarrow$ *pred* and *dist*

- **Page 249, algorithm 11.1** _____ 24 Apr 2017
a array of items \leadsto an array of items (S. Subramanya)
- **Page 249, algorithm 11.1** _____ 24 Apr 2017
a element we are searching for \leadsto an element we are searching for (S. Subramanya)
- Page 249, figure 11.1** _____ 28 Apr 2017
Change the array to [114 , 480 , 149 , 903 , 777 , 65 , 680 , 437 , 4 , 181 , 613 , 551 , 10 , 31 , 782 , 507]; we need not use sequential search in a sorted array.
- **Page 260, algorithm 11.2** _____ 24 Apr 2017
a element we are searching for \leadsto an element we are searching for (S. Subramanya)
- **Page 260, algorithm 11.2, line 10** _____ 24 Apr 2017
NULL; \leadsto NULL
Page 261, algorithm 11.3 _____ 24 Apr 2017
a list of items, \leadsto a list of items
- **Page 261, algorithm 11.3** _____ 24 Apr 2017
a element we are searching for \leadsto an element we are searching for (S. Subramanya)
- **Page 261, algorithm 11.3, line 12** _____ 25 Apr 2017
NULL; \leadsto NULL
- **Page 262, algorithm 11.4** _____ 24 Apr 2017
a array of items \leadsto an array of items (S. Subramanya)
- **Page 262, algorithm 11.4** _____ 24 Apr 2017
a element we are searching for \leadsto an element we are searching for (S. Subramanya)
- **Page 264, algorithm 11.5** _____ 25 Apr 2017
SecretarySearch(A, s) \leadsto SecretarySearch(A)
- **Page 264, algorithm 11.4** _____ 24 Apr 2017
a array of items \leadsto an array of items (S. Subramanya)
- **Page 264, algorithm 11.5, line 4** _____ 24 Apr 2017
Compare($A[i], A[b]$) \leadsto Compare($A[i], A[c]$) (S. Subramanya)

- Page 262, algorithm 11.6 _____ 24 Apr 2017
a element we are searching for $\wedge \rightarrow$ an element we are searching for (S. Subramanya)
- Page 264, algorithm 11.5, line 6 _____ 25 Apr 2017
 $i \leftarrow m + 1 \wedge \rightarrow i \leftarrow m$
- Page 267, line 18 _____ 6 May 2017
Unless you are not psychic $\wedge \rightarrow$ Unless you are psychic
- Page 270, figure 11.14b, last row _____ 31 May 2017

$$\begin{array}{cc} l = 7 & l = 8 \\ m = 7 & m = 8 \end{array} \wedge \rightarrow$$

(I. Kafetzaki)
- Page 276, line -2 _____ 02 May 2017
one's complement $\wedge \rightarrow$ ones' complement
- Page 278, algorithm 11.7 _____ 24 Apr 2017
a element we are searching for $\wedge \rightarrow$ an element we are searching for (S. Subramanya)
- Page 298, caption of figure 12.6b _____ 28 Apr 2017
 $1 \wedge \rightarrow$ one
- Page 310, figure 12.12, third panel _____ 08 May 2017
 $i \rightarrow 5 \wedge \rightarrow i \rightarrow 37$
 Page 333, line -11 _____ 09 May 2017
 minimal perfect mapping $\wedge \rightarrow$ *minimal perfect mapping*
 Page 340, line -3 _____ 09 May 2017
 456, 976 $\wedge \rightarrow$ 456, 976
 Page 343, figure 13.5 _____ 09 May 2017
 4, 847 $\wedge \rightarrow$ 4, 847
 Page 343, figure 13.5 _____ 09 May 2017
 126, 033 $\wedge \rightarrow$ 126, 033
 Page 343, figure 13.5 _____ 09 May 2017
 3, 276, 872 $\wedge \rightarrow$ 3, 276, 872
 Page 346, line 3 _____ 09 May 2017
 binary fractional number $\wedge \rightarrow$ *binary fractional number*
- Page 353, line -12 _____ 23 Jul 2017
An successful search $\wedge \rightarrow$ An unsuccessful search

- Page 359, line -9 _____ 13 May 2017
z-values $\wedge \rightarrow$ z-values
- Page 359, line -9 _____ 13 May 2017
z-axis $\wedge \rightarrow$ z-axis
- Page 361, line 7 _____ 31 May 2017
the number of frequency peaks in the song, and there is even a notation for it: $\wedge \rightarrow$ being the number of frequency peaks in the song, and there is even a notation for it:
- Page 361, line 16 _____ 31 May 2017
move “of” to the next line
- Page 362, line -1 _____ 31 May 2017
the data are not the $\wedge \rightarrow$ the data are not in the
- Page 367, line 7 _____ 13 May 2017
 $(1 - 1/m)^{m(\frac{k}{m})} \wedge \rightarrow (1 - 1/m)^{m(\frac{k}{m})}$
- Page 370, figure 13.20, third panel _____ 13 May 2017
The solid arrows should emanate from “this”.
- Page 383, table 14.1 _____ 14 May 2017
letter $\wedge \rightarrow$ letters
- Page 385, line 3 _____ 14 May 2017
Move J. to next line.
- Page 386, line 9, 12, 19 _____ 25 May 2017
Gibb’s $\wedge \rightarrow$ Gibbs’s
- Page 387, line 25 _____ 16 May 2017
“ineligible” $\wedge \rightarrow$ “ineligible.”
- Page 390, line 3 _____ 16 May 2017
six $\wedge \rightarrow$ five
- Page 396, figure 14.8, fourth panel _____ 17 May 2017
 $H = 0.40 \wedge \rightarrow H = 0.940$
- Page 397, line -9 _____ 16 May 2017
tox $\wedge \rightarrow$ to
- Page 400, figure 14.10 _____ 08 Jun 2017
{1, 2, ..., 14}: outlook $\wedge \rightarrow$ {1, 2, ..., 15}: outlook (V. Malandrakis)
- Page 417, line -3 _____ 26 Feb 2017
Witten, Frank, and Hall $\wedge \rightarrow$ Witten, Frank, Hall, and Pal

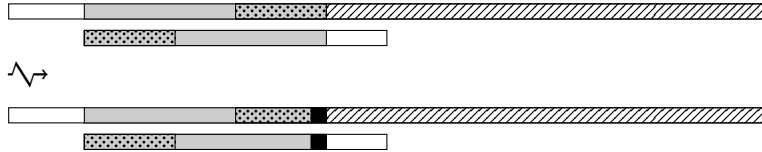
Page 430, line -17 _____ 23 May 2017

at the start of a string $\nwarrow \rightarrow$ at the start of the string

Page 430, line -16 _____ 23 May 2017

at the end of a string is its *suffix* $\nwarrow \rightarrow$ at the end of the string is a *suffix*

► Page 431, fourth graphic _____ 23 May 2017

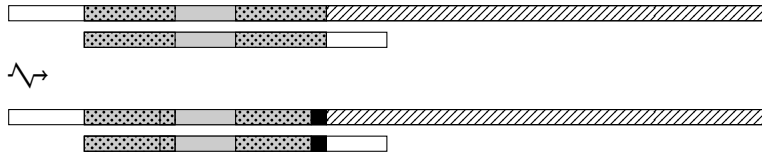


$\nwarrow \rightarrow$

► Page 431, line -10 _____ 23 May 2017

of the pattern $\nwarrow \rightarrow$ of the matched pattern

► Page 431, fifth graphic _____ 23 May 2017



$\nwarrow \rightarrow$

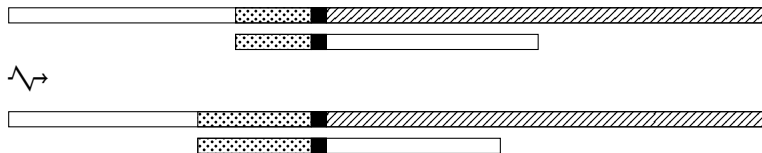
Page 431, line -1 _____ 24 May 2017

longer shifts $\nwarrow \rightarrow$ longer shifts

► Page 432, line -9 _____ 24 May 2017

So we get: $\nwarrow \rightarrow$ So we get, indicating the mismatched character:

► Page 432, second graphic _____ 23 May 2017



$\nwarrow \rightarrow$

► Page 432, line 7 _____ 24 May 2017

AABAABAA $\nwarrow \rightarrow$ AABAABAAAA

► Page 432, third graphic _____ 24 May 2017

A A B A A B A A A A B A A B A A A A
 A A B A A A $\nwarrow \rightarrow$ A A B A A A

► Page 432, line -4 _____ 24 May 2017

define its length to be zero $\nwarrow \rightarrow$ define its border length as zero

- **Page 433, line 13** _____ 25 May 2017
borders array \swarrow border array
- **Page 434, algorithm 15.2, line 9** _____ 02 Jun 2017
 $p[i] \swarrow p[j]$ (A. Tsalapatis)
- **Page 435, figure 15.5 caption** _____ 24 May 2017
Another trace the Knuth-Morris-Pratt algorithm; the borders array is at the bottom. \swarrow Another trace of the Knuth-Morris-Pratt algorithm; the border array is at the bottom.
- **Page 437, line 3** _____ 25 May 2017
borders array \swarrow border array
- **Page 440, line 12** _____ 30 May 2017
mattern \swarrow pattern
- **Page 441, figure 15.3b** _____ 30 May 2017
. S E P T E M B E R
E M B E R
 $r = 1$
 \swarrow
. S E P T E M B E R
E M B E R
 $r = 1$
- Page 449, line 16* _____ 23 May 2017
50-50 \swarrow 50-50
- **Page 462, line 10** _____ 20 May 2017
line 6 \swarrow line 7
- **Page 463, line 4** _____ 20 May 2017
change \swarrow maybe fix
- **Page 466, lines 18, 21, 23** _____ 20 May 2017
ECC \swarrow EEC
- **Page 467, lines 12, 19, 23** _____ 20 May 2017
ECC \swarrow EEC

- Page 467, paragraph –2 _____ 22 May 2017
 Rewrite the paragraph as follows:
 To tackle this kind of question, we must adopt a systematic approach.
 We have a set of voters, $V = \{v_1, v_2, \dots, v_n\}$, and a set of weights, $W = \{w_1, w_2, \dots, w_m\}$. A voter v_i has a weight w_j given by a mapping $f: V \rightarrow W$.
 For a decision to be taken, it needs to meet a *quota* Q . In the example of the EEC, we have $Q = 12$. The setup of V , W , f , and Q is called a *voting game*.
- Page 468, line 3 _____ 21 May 2017
 such as $\wedge \rightarrow$ such that
- Page 468, line 4 _____ 21 May 2017
 in obtaining losing coalition $\wedge \rightarrow$ in obtaining a losing coalition
- Page 468, line 14 _____ 21 May 2017
 ECC $\wedge \rightarrow$ EEC
- Page 468, line –7 _____ 21 May 2017
 then then $\wedge \rightarrow$ then the
- Page 468, lines –3 to –1 _____ 30 May 2017
 As an example, take four voters $V = \{A, B, C, D\}$ with corresponding weights $W = \{4, 2, 1, 3\}$ and quota $Q = 6$. The critical coalitions are (we underline the critical voters) $\{\underline{A}, \underline{B}\}$, $\{\underline{A}, \underline{D}\}$, $\{\underline{A}, \underline{B}, C\}$, $\{\underline{A}, B, D\}$, $\{\underline{A}, C, \underline{D}\}$, $\{\underline{B}, \underline{C}, \underline{D}\}$.
 $\wedge \rightarrow$
 As an example, let us take four voters A, B, C, D with corresponding weights equal to 4, 2, 1, 3, and quota $Q = 6$. The critical coalitions then are, underlining the critical voters: $\{\underline{A}, \underline{B}\}$, $\{\underline{A}, \underline{D}\}$, $\{\underline{A}, \underline{B}, C\}$, $\{\underline{A}, B, D\}$, $\{\underline{A}, C, \underline{D}\}$, and $\{\underline{B}, \underline{C}, \underline{D}\}$.
- Page 479, line –4 _____ 21 May 2017
 primes $\wedge \rightarrow$ composites
- Page 479, lines –4 to –3 _____ 21 May 2017
 $n(1/2 + 1/3 + 1/5 \dots + 1/k) \wedge \rightarrow n(1/2 + 1/3 + 1/5 + \dots + 1/k)$
- Page 479, line –3 _____ 21 May 2017
 $(1/2 + 1/3 + 1/5 \dots + 1/k) \wedge \rightarrow (1/2 + 1/3 + 1/5 + \dots + 1/k)$
- Page 485, output _____ 23 May 2017
Output: (r, q) , such that $n = 2^r q \wedge \rightarrow$ **Output:** (r, q) , such that $n = 2^r q$ with q odd

Page 498, reference 219 _____ 26 Mar 2017

Ian H. Witten, Eibe Frank, and Mark A. Hall. *Data Mining: Practical Machine Learning Tools and Techniques*. Morgan Kaufmann Publishers Inc., San Francisco, CA, 3rd edition, 2011.

$\wedge \rightarrow$

Ian H. Witten, Eibe Frank, Mark A. Hall, and Christopher J. Pal. *Data Mining: Practical Machine Learning Tools and Techniques*. Elsevier, Cambridge, MA, 4th edition, 2016.

► Page 503, second column _____ 20 May 2017

European Economic Community (ECC) $\wedge \rightarrow$ European Economic Community (EEC)

Page 504, first column, line −15 _____ 23 Jul 2017

re-weighting $\wedge \rightarrow$ reweighting