

**Errata:**  
**An Introduction to Optimization, Third Edition**  
by  
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June 16, 2010

**Typos and minor changes**

- p. 26, Theorem 3.2: Add “real” before “symmetric.”
- p. 63, line 10, displayed equation for  $D^2f$ : In the denominator of the  $(2, n)$  entry of the matrix, change  $x_1$  to  $x_2$ ; it should be  $\partial^2 f / \partial x_n \partial x_2$ .
- p. 63, Example 5.1: The function should be changed to

$$f(\mathbf{x}) = \begin{cases} x_1 x_2 (x_1^2 - x_2^2) / (x_1^2 + x_2^2) & \text{if } \mathbf{x} \neq \mathbf{0} \\ 0 & \text{if } \mathbf{x} = \mathbf{0} \end{cases}$$

and the Hessian should be evaluated at  $\mathbf{0} = [0, 0]^\top$ . The intermediate steps will also change accordingly, but the final Hessian matrix on p. 65 is the same as before.

- p. 73, 8 lines from bottom: Add “ $\|\mathbf{x} - \mathbf{x}_0\|$ ” to the end of the line (should be  $(\mathbf{x} - \mathbf{x}_0)^\top Df(\mathbf{z}(\alpha))^\top / \|\mathbf{x} - \mathbf{x}_0\|$ ).
- p. 74, line 2, displayed equation for  $D^2f$ : In the denominator of the  $(2, n)$  entry of the matrix, change  $x_1$  to  $x_2$ ; it should be  $\partial^2 f / \partial x_n \partial x_2$ .
- p. 86, first displayed equation: Exchange the numerator and denominator. The correct equation should read:

$$f(x) = \frac{1 + (2 - x)^2}{1 + x^2}.$$

- p. 86, second and third displayed equations: The correct equations should read:

$$\begin{aligned} f'(x) &= \frac{-2(2 - x)(1 + x^2) - 2x(1 + (2 - x)^2)}{(1 + x^2)^2} \\ &= \frac{4(x^2 - 2x - 1)}{(1 + x^2)^2}. \end{aligned}$$

- p. 94, exercises 6.11: Change the equation for  $f(\mathbf{x})$  to  $f(\mathbf{x}) = -3x_1$  (insert a negative sign). Also, change the equation for  $\Omega$  to  $\Omega = \{\mathbf{x} = [x_1, x_2]^\top : x_1 + x_2^2 \leq 2\}$  (reverse the inequality).
- p. 103, first line below Figure 7.3: Replace “function of  $\rho$ ” by “equation” (to read “the equation above”).
- p. 104, first line of Iteration 2: add “so” after “and” (to read “and so  $f$  need only be”).

- p. 162, 13 lines from bottom: Remove “the” before “Section 9.2”.
- p. 138, Example 8.3: The values of  $\gamma_{2k}$  and  $\gamma_{2k+1}$  should be interchanged:  $\gamma_{2k} = -1/2$  and  $\gamma_{2k+1} = 1/2$ .
- p. 207, Exercise 11.9: In the equation for  $\mathbf{v}_1^\top$ , change  $\mathbf{v}$  on the right-hand side to  $\mathbf{x}$ .
- p. 223: Add p. 223 to a new index entries for “Woodbury.”
- p. 224, Example 12.6, first three displayed equations: Add comma and spaces before  $\mathbf{b}^{(0)}$ ,  $\mathbf{b}^{(1)}$ , and  $\mathbf{b}^{(2)}$ .
- p. 251, first two displayed equations in the middle of the page: Change  $R(k)$  to  $R(k) + 1$ .
- pp. 262–263, Example 13.3: To be consistent with the notation in Section 13.2, we should use indices  $d, i$  with  $i = 1, 2, 3, 4$  (instead of  $0, 2, 3, 4$ ). So, on p. 262, the vectors in the displayed equation should start with  $\mathbf{x}_{d,1}$  (not  $\mathbf{x}_{d,0}$ ). Similarly, we should start with  $y_{d,1}$  (not  $y_{d,0}$ ). On p. 263, change  $(\mathbf{x}_{d,R(k)}, y_{d,R(k)})$  to  $(\mathbf{x}_{d,R(k)+1}, y_{d,R(k)+1})$ .
- p. 277, last line: Insert superscript “(0)” to  $\mathbf{g}$ ,  $\mathbf{x}_1$ , and  $\mathbf{x}_d$ . The last equation should read:  $\mathbf{g}^{(0)} = \arg \min_{\mathbf{x} \in \{\mathbf{x}_1^{(0)}, \dots, \mathbf{x}_d^{(0)}\}} f(\mathbf{x})$ .
- p. 278, first two displayed equations: Swap the order of these two equations and replace  $\mathbf{v}_i^{(k)}$  by  $\mathbf{v}_i^{(k+1)}$  in the (new) second equation. They should read:

$$\begin{aligned}\mathbf{v}_i^{(k+1)} &= \omega \mathbf{v}_i^{(k)} + c_1 \mathbf{r}_i^{(k)} \circ (\mathbf{p}_i^{(k)} - \mathbf{x}_i^{(k)}) + c_2 \mathbf{s}_i^{(k)} \circ (\mathbf{g}^{(k)} - \mathbf{x}_i^{(k)}), \\ \mathbf{x}_i^{(k+1)} &= \mathbf{x}_i^{(k)} + \mathbf{v}_i^{(k+1)}.\end{aligned}$$

- p. 401, 8 lines from bottom: Insert “=” between “ $\mathbf{e}$ ” and “ $[1, \dots, 1]^\top$ .”
- p. 512, line 8: Change “ $l(\mathbf{x}, \boldsymbol{\mu})$ ” to “ $l(\mathbf{x}, \boldsymbol{\mu}) = f(\mathbf{x}) + \boldsymbol{\mu}^\top \mathbf{g}(\mathbf{x})$ ”.
- p. 522, Lemma 22.2: Change  $\mathbf{f}^*$  to  $\mathbf{x}^*$ .
- p. 522, displayed equation in middle of page: Change the sign in front of  $D\mathbf{h}$  to “+” so that it reads

$$\mathbf{U}(\mathbf{w}) = \begin{bmatrix} \mathbf{x} - \alpha(\nabla f(\mathbf{x}) + D\mathbf{h}(\mathbf{x})^\top \boldsymbol{\lambda}) \\ \boldsymbol{\lambda} + \alpha \mathbf{h}(\mathbf{x}) \end{bmatrix}.$$

- p. 522, second to last displayed equation at bottom of page: Change the signs in front of  $D\mathbf{h}$  so that it reads

$$D\mathbf{U}(\mathbf{w}) = \mathbf{I} + \alpha \begin{bmatrix} -\mathbf{L}(\mathbf{x}, \boldsymbol{\lambda}) & -D\mathbf{h}(\mathbf{x})^\top \\ D\mathbf{h}(\mathbf{x}) & \mathbf{O} \end{bmatrix}.$$

- p. 523, third displayed equation: Change the signs in front of  $D\mathbf{h}$  so that it reads

$$\mathbf{M} = \begin{bmatrix} -\mathbf{L}(\mathbf{x}^*, \boldsymbol{\lambda}^*) & -D\mathbf{h}(\mathbf{x}^*)^\top \\ D\mathbf{h}(\mathbf{x}^*) & \mathbf{O} \end{bmatrix},$$

- p. 524, Lemma 22.3: Change  $\mathbf{f}^*$  to  $\mathbf{x}^*$ .

- p. 525, displayed equation in middle of page: Change the sign in front of  $D\mathbf{g}$  to “+” so that it reads

$$\mathbf{U}(\mathbf{w}) = \begin{bmatrix} \mathbf{x} - \alpha(\nabla f(\mathbf{x}) + D\mathbf{g}(\mathbf{x})^\top \boldsymbol{\mu}) \\ \boldsymbol{\mu} + \alpha\mathbf{g}(\mathbf{x}) \end{bmatrix}.$$

- p. 525, displayed equation at bottom of page: Change the signs in front of  $D\mathbf{g}$  so that it reads

$$D\mathbf{U}(\mathbf{w}) = \mathbf{I} + \alpha \begin{bmatrix} -\mathbf{L}(\mathbf{x}, \boldsymbol{\mu}) & -D\mathbf{g}(\mathbf{x})^\top \\ D\mathbf{g}(\mathbf{x}) & \mathbf{O} \end{bmatrix}.$$

- p. 526, displayed equations for  $\mathbf{U}_A$  and  $D\mathbf{U}_A$  at middle of page: Change the signs in front of  $D\mathbf{g}_A$  so that they read

$$\mathbf{U}_A(\mathbf{w}_A) = \begin{bmatrix} \mathbf{x} - \alpha(\nabla f(\mathbf{x}) + D\mathbf{g}_A(\mathbf{x})^\top \boldsymbol{\mu}_A) \\ \boldsymbol{\mu}_A + \alpha\mathbf{g}_A(\mathbf{x}) \end{bmatrix},$$

and

$$D\mathbf{U}_A(\mathbf{w}_A) = \mathbf{I} + \alpha \begin{bmatrix} -\mathbf{L}(\mathbf{x}, \boldsymbol{\mu}_A) & -D\mathbf{g}_A(\mathbf{x})^\top \\ D\mathbf{g}_A(\mathbf{x}) & \mathbf{O} \end{bmatrix}.$$

- pp. 575–576: Add p. 512 to the index entries for “Function, Lagrangian” and “Lagrangian function.”
- p. 584: Add p. 223 to a new index entry for “Woodbury.”