# Errata:
# An Introduction to Optimization, Fourth Edition
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## Typos and minor changes: Printings 1–3

- p. 12, second line from bottom: Remove one of the two repeated instances of "use."
- p. 15, line 5: Add to the end of the sentence: "Moreover, it follows from properties 1 and 2 that the determinant of a matrix with two identical columns, not necessarily next to each other, is always $0$." [Thanks to Zain Khandwala.]
- p. 52, four lines from bottom: Change "convex polytope" to "polyhedron". (Unfortunately, the definitions of *polytope* and *polyhedron* are not universal, so the original text is still consistent with some definitions in the literature.)
- p. 52, caption of Figure 4.10: Change to "Polyhedra."
- p. 52, three lines from bottom: Change "A nonempty bounded polytope is called a *polyhedron*" to "A nonempty bounded polyhedron is called a *polytope*". (Unfortunately, the definitions of *polytope* and *polyhedron* are not universal, so the original text is still consistent with some definitions in the literature.)
- p. 53, caption of Figure 4.11: Change "polyhedron" to "polytope".
- p. 94, Exercise 6.7: In the right-hand side of the equation, change $f(\boldsymbol{y})$ to $f(\boldsymbol{y}-\boldsymbol{x}_0)$. [Thanks to Brandon Van Over.]
- p. 98, Exercise 6.20: Add the following after the last sentence: "The position $x \in \mathbb{R}$ is unconstrained." [Thanks to Brandon Van Over.]
- p. 144, Example 8.3: In line 8, change "$\boldsymbol{x}^{(k)} \to 0$" to "$\boldsymbol{x}^{(k)} \to \boldsymbol{x}^*$". In the second displayed equation, change "$\frac{1}{2}$" at the right-hand side of the inequality to "0". In the last line, add the following in between "$k$." and "Hence": ", showing that the condition $\sum_{k=0}^{\infty} \gamma_k = \infty$ fails." [Thanks to Yuwei Jheng.]
- p. 148, line 15: Change "reflects that fact" to "reflects the fact". [Thanks to Nikica Hlupić.]
- p. 153, line 2, just after "... not an eigenvector of $\boldsymbol{Q}$": Insert ", which has distinct eigenvalues (because $\lambda_{\max}(\boldsymbol{Q}) > \lambda_{\min}(\boldsymbol{Q})$)."
- p. 153, line 3: Add negative sign in front of "$(\boldsymbol{x}^{(k+1)} - \boldsymbol{x}^{(k)})$"; the equation should read $\boldsymbol{g}^{(k)} = -(\boldsymbol{x}^{(k+1)} - \boldsymbol{x}^{(k)})/\alpha_k$. [Thanks to Yuwei Jheng.]
- p. 153, line 10, just after "... corresponding to $\lambda_{\max}(\boldsymbol{Q})$ and $\lambda_{\min}(\boldsymbol{Q})$": Insert ", assumed unequal."

- p. 162, line 4: Replace "objection function" by "objective function" [thanks to Ali Pezeshki].
- p. 171, Exercise 9.1 question: At the end of the question after "minimizing $f$" append "with iterates $x^{(0)}, x^{(1)}, x^{(2)}, \ldots$."
- p. 173, Exercise 9.4, part b: At the end of the question after "Newton's method" append "(with unit step size)."
- pp. 177–178, proof of Theorem 10.1: Change the symbol $\beta$ to some other symbol, like $\eta$, so that there won't be any confusion with the same symbol used in Section 10.3.
- p. 201, equation four lines from bottom: Add $\top$ next to the leftmost superscript $(k)$. The equation should be

  $$\Delta \boldsymbol{g}^{(k)\top}(\Delta \boldsymbol{x}^{(k)} - \boldsymbol{H}_k \Delta \boldsymbol{g}^{(k)})$$

  [Thanks to Vishal Shetty.]
- p. 202, part of Example 11.2: Replace the part of the example from the first displayed equation with the following:

  $$f(\boldsymbol{x}) = (x_2 - x_1)^4 + 12x_1x_2 - x_1 + x_2 - 3$$

  with an initial point

  $$\boldsymbol{x}^{(0)} = [-0.5262, 0.6014]^\top$$

  and initial matrix

  $$\boldsymbol{H}_0 = \begin{bmatrix} 0.1186 & -0.0376 \\ -0.0376 & 0.1191 \end{bmatrix}.$$

  Note that $\boldsymbol{H}_0 > 0$. We have

  $$\Delta \boldsymbol{g}^{(0)\top}(\Delta \boldsymbol{x}^{(0)} - \boldsymbol{H}_0 \Delta \boldsymbol{g}^{(0)}) = -0.00076948$$

  and

  $$\boldsymbol{H}_1 = \begin{bmatrix} 0.0331 & 0.0679 \\ 0.0679 & -0.0110 \end{bmatrix}.$$

  It is easy to check that $\boldsymbol{H}_1$ is not positive definite (it is indefinite, with eigenvalues $0.0824$ and $-0.0603$).

  [Thanks to Julio Gonzalez-Saenz for pointing out the need to change the numerical values in this example.]
- p. 281, second paragraph, line 2, change "step 5" to "step 3". [Thanks to Nikica Hlupić.]
- p. 284, line 8: Replace "$\boldsymbol{g}^{(k+1)} = \boldsymbol{x}_i^{(k+1)}$" by "$\boldsymbol{g}^{(k+1)} = \arg\min_{\boldsymbol{x} \in \{\boldsymbol{x}_1^{(k+1)}, \ldots, \boldsymbol{x}_d^{(k+1)}\}} f(\boldsymbol{x})$".
- p. 287, 8 lines from bottom: Change "left" to "right" (should be "... right of the crossing site").
- p. 290, last line: Change "8-bit" to "16-bit."
- p. 316, eight lines from bottom: Change "polytope" to "polyhedron" (two occurrences).

- p. 316, seven lines from bottom: Change "polyhedron" to "polytope". Same with occurrences of "polyhedron" six, four, three, and two lines from the bottom. (Unfortunately, the definitions of *polytope* and *polyhedron* are not universal, so the original text is still consistent with some definitions in the literature.)

- p. 317, Figure 15.4 caption and line two: Change "polyhedron" to "polytope". (Unfortunately, the definitions of *polytope* and *polyhedron* are not universal, so the original text is still consistent with some definitions in the literature.)

- p. 539, line 4: Change "`gep`" to "`gevp`" in the MATLAB command.

- p. 539, line 7: Change "$\boldsymbol{C}(\boldsymbol{x}) \leq \boldsymbol{D}(\boldsymbol{x})$, $\boldsymbol{C}(\boldsymbol{x}) \leq \boldsymbol{D}(\boldsymbol{x})$" to "$\boldsymbol{C}(\boldsymbol{x}) \leq \boldsymbol{D}(\boldsymbol{x})$, $0 \leq \boldsymbol{B}(\boldsymbol{x})$" (the second inequality should be $0 \leq \boldsymbol{B}(\boldsymbol{x})$).

- p. 550, line 19 (middle of page): Change "define $\boldsymbol{y} = \boldsymbol{\Pi}[\boldsymbol{x}] \in \mathbb{R}^n$" to "define "$\boldsymbol{y} = \boldsymbol{\Pi}[\boldsymbol{x}] \in \Omega$" (change $\mathbb{R}^n$ to $\Omega$; not strictly an error, but to improve the exposition). [Thanks to Nikica Hlupić.]

- p. 558, proof of Theorem 23.2, 8th line (just above first displayed equation): Change "$\mathbb{R}^{n\times m} \to \mathbb{R}^{n\times m}$" to "$\mathbb{R}^{n+m} \to \mathbb{R}^{n+m}$" ($\times$ should be $+$). [Thanks to Nikica Hlupić.]

- p. 565, 11 lines from bottom: Change $\|h(\boldsymbol{x})\|^2 \leq 0$ to $\|\boldsymbol{h}(\boldsymbol{x})\|^2 \leq 0$ (the $\boldsymbol{h}$ should be boldface). [Thanks to Nikica Hlupić.]

- p. 582, second bullet item (line 9): Insert "nor is dominated by" between "dominate" and "any" (should be "$\boldsymbol{x}^j$ does not dominate nor is dominated by any existing candidate solutions"). [Thanks to Nikica Hlupić.]

- p. 582, end of line 13 and beginning of line 14: Insert "nor is dominated by" between "dominate" and "any" (should be "$\boldsymbol{x}^j$ does not dominate nor is dominated by any existing candidate solutions"). [Thanks to Nikica Hlupić.]

- p. 583–584, Algorithm for Generating a Pareto Front: In step 2, line 2, change "candidate solutions" to "solutions to be generated".

  In step 4, change the displayed inequality to "$f_i(\boldsymbol{x}^j) \leq f_i(\boldsymbol{x}^{*r})$" (i.e., should be $\leq$, not $<$), and just after the inequality add "and $f_i(\boldsymbol{x}^j) < f_i(\boldsymbol{x}^{*r})$ for at least one $i$". [Thanks to Nikica Hlupić.]

  In step 4, delete "$\boldsymbol{f}^{*R} := \boldsymbol{f}(\boldsymbol{x}^j)$,".

  In step 5, just after the displayed inequality add "and $f_i(\boldsymbol{x}^j) > f_i(\boldsymbol{x}^{*r})$ for at least one $i$".

  In step 7, delete ", add $\boldsymbol{x}^j$ as a new candidate Pareto solution, and go to step 2".

- p. 611, index entry for "polyhedron" under "Convex set": Change 317 to 316.

- p. 611, index entry for "polytope" under "Convex set": Change 316 to 316, 317. (Unfortunately, the definitions of *polytope* and *polyhedron* are not universal, so the original text is still consistent with some definitions in the literature.)

- p. 609, Index: All page numbers above 348 are probably one to five pages lower than they should be. Some examples shown below:

– p. 610, index entry for “Bland’s rule”: Change 375 to 376.
– p. 612, index entry for “dual nonlinear program” under “Duality”: Change 543 to 546.
– p. 612, index entry for “duality theorem” under “Duality”: Change 543 to 547.
– p. 612, index entry for “weak duality lemma” under “Duality”: Change the page numbers to 387, 401, 547.
– p. 612, index entry for “dual quadratic program” under “Duality”: Change 399 to 401.
– p. 612, index entry for “primal quadratic program” under “Duality”: Change 399 to 401.
– p. 612, index entry for “quadratic programming” under “Duality”: Change 399 to 401.
– p. 612, index entry for “Duality theorem”: Change 543 to 547.
– p. 612, index entry for “Lagrangian” under “Function”: Change 543 to 547.
– p. 612, index entry for “utility” under “Function”: Change 542 to 546.
– p. 615, index entry for “Klee-Minty problem”: Change 401 to 403.
– p. 615, index entry for “Lagrangian function”: Change 543 to 547.
– p. 615, index entry for “Bland’s rule” under “Linear programming”: Change 375 to 376.
– p. 615, index entry for “Klee-Minty problem” under “Linear programming”: Change 401 to 403.
– p. 616, index entry for “Lyapunov inequality”: Change the page numbers to 531, 547.
– p. 616, index entry for “MATLAB”: Change 543 to 547.
– p. 617, index entry for “Minimax”: Change the page numbers to 581, 586, 590.
– p. 615, index entry for “Minty”: Change 401 to 403.
– p. 618, index entry for “Primal nonlinear program”: Change 542 to 546.
– p. 618, index entry for “Primal quadratic program”: Change 399 to 401.
– p. 619, index entry for “Proportional fairness”: Change the page number to 545.
– p. 619, index entry for “Quadratic programming”: Change the page numbers to 401, 476, 485, 504.
– p. 620, index entry for “Bland’s rule” under “Simplex method”: Change 375 to 376.
– p. 621, index entry for “Singular value decomposition”: Change the page number to 575.
– p. 621, index entry for “Subgradient”: Change the page numbers to 519, 541.
– p. 622, index entry for “Utility function”: Change 542 to 546.
– p. 622, index entry for “Weak duality lemma”: Change the page numbers to 387, 401, 547.