Corrections for the first printing[1] of INTRODUCTION TO NONLINEAR OPTIMIZATION: THEORY, ALGORITHMS, AND APPLICATIONS WITH MATLAB, SIAM, 2014, by Amir Beck[2]

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p. 5 First line of Section 1.4. Change "nonzero vector $\mathbf{v} \in \mathbb{R}^n$" to "nonzero vector $\mathbf{v} \in \mathbb{C}^n$"

p. 7 In Example 1.15, remove the line

$$\text{int}([\mathbf{x}, \mathbf{y}]) = (\mathbf{x}, \mathbf{y})$$

(it is incorrect when $n > 1$)

p. 7 One line after Definition 1.16, remove "open line segments".

p. 8 At the end of the page, the sentence starting from "For any $i = 1, 2, \ldots, n$, the directional derivative at..." until the end of the page should change to "For any $i = 1, 2, \ldots, n$, if the limit

$$\frac{\partial f}{\partial x_i}(\mathbf{x}) = \lim_{t \to 0} \frac{f(\mathbf{x} + t\mathbf{e}_i) - f(\mathbf{x})}{t}$$

exists, then it is called *the i-th partial derivative* of f at $\mathbf{x}$."

p.9. Line -9. Replace "$o(\cdot) : \mathbb{R}^n_+ \to \mathbb{R}$" with "$o(\cdot) : \mathbb{R}_+ \to \mathbb{R}$"

p.19 two lines before Theorem 2.17, replace "charachterization" with "characterization"

p. 21 Change

$$\mathbf{A}^{\frac{1}{2}}\mathbf{A}^{\frac{1}{2}} = \mathbf{U}\mathbf{E}\mathbf{U}^T\mathbf{U}\mathbf{E}\mathbf{U}^T = \mathbf{U}\mathbf{E}\mathbf{E}\mathbf{U}^T = \mathbf{U}\mathbf{D}\mathbf{U} = \mathbf{A}.$$

to

$$\mathbf{A}^{\frac{1}{2}}\mathbf{A}^{\frac{1}{2}} = \mathbf{U}\mathbf{E}\mathbf{U}^T\mathbf{U}\mathbf{E}\mathbf{U}^T = \mathbf{U}\mathbf{E}\mathbf{E}\mathbf{U}^T = \mathbf{U}\mathbf{D}\mathbf{U}^T = \mathbf{A}.$$

(add transpose to the last $\mathbf{U}$)

p. 37 Two lines before (3.1) – change "if $\mathbf{A}$ if not of full column" to "if $\mathbf{A}$ is not of full column"

p. 47 Line 4. Change "$(\hat{\mathbf{x}}, R)$" to "$(\hat{\mathbf{x}}, \hat{R})$"

p. 47 In Lemma 3.5, change $r = \sqrt{\|\hat{\mathbf{x}}\|^2 - y_{n+1}}$ to $\hat{r} = \sqrt{\|\hat{\mathbf{x}}\|^2 - y_{n+1}}$

[1] The corrections were incorporated in the second printing of the book

[2] I would like to thank Heinz Bauschke, David Cohen, Christian Kanzow, Luba Tetruashvili and Yakov Vaisbourd for their invaluable comments that helped to compile the list of corrections.

p. 58 At the end, replace "Therefore," with "It holds that"

p. 62 Last sentence before the MATLAB code. Change "20000" to "200000"

p. 68 Change "anchor point" to "anchor points"

p. 69 Two lines before (4.14), change "$\mathbf{x} \neq \mathbf{a}_1, \mathbf{a}_2, \ldots, \mathbf{a}_m$" to "$\mathbf{x}_0 \neq \mathbf{a}_1, \mathbf{a}_2, \ldots, \mathbf{a}_m$".

p. 72 Change "cannot be verified easily" to "cannot be easily guaranteed"

p. 72 The two occurrences of $\min\{f(\mathbf{x}_0), f(\mathbf{x}_1), \ldots, f(\mathbf{x}_p)\}$ should be replaced with $\min\{f(\mathbf{x}_0), f(\mathbf{x}_1), \ldots, f(\mathbf{x}_m)\}$

p. 73 Line 5 in Section 4.7.1. After "meaning that" add "there exists $L > 0$ for which"

p. 73 After "denote the class by $C^{1,1}$." add the following sentence: "For a given $D \subseteq \mathbb{R}^n$, the set of all continuously differentiable functions over D whose gradient satisfies the above Lipschitz condition for any $\mathbf{x}, \mathbf{y} \in D$ is denoted by $C_L^{1,1}(D)$."

p. 74 Lemma 4.22. The sentence "Let $f \in C_L^{1,1}(\mathbb{R}^n)$. Then for any $\mathbf{x}, \mathbf{y} \in \mathbb{R}^n$" should be replaced with "Let $D \subseteq \mathbb{R}^n$ and $f \in C_L^{1,1}(D)$ for some $L > 0$. Then for any $\mathbf{x}, \mathbf{y} \in D$ satisfying $[\mathbf{x}, \mathbf{y}] \subseteq D$ it holds that"

p. 85 Replace the sentence "Combining the latter equality with the fact that $\nabla^2 f(\mathbf{x}_k) \succeq m\mathbf{I}$ implies that $\|\nabla^2 f(\mathbf{x}_k)^{-1}\| \leq \frac{1}{m}$. Hence," to "Since $\nabla^2 f(\mathbf{x}_k) \succeq m\mathbf{I}$, it follows that $\|\nabla^2 f(\mathbf{x}_k)^{-1}\| \leq \frac{1}{m}$. Hence,"

p. 94 Two occurrences of "17 iterations" should be replaced with "18 iterations"

p. 105 Line 3. Change "The set C is clearly a convex cone" to "The set C is clearly a convex set"

p. 105 Example 6.17. Change "Lorenz" to "Lorentz"

p. 105 Last line. Change

$$K^2 = \{(x_1, x_2)^T : x_1 t + x_2 \geq 0\} = \{(x_1, x_2) : x_1 = 0, x_2 \geq 0\},$$

to

$$K^2 = \{(x_1, x_2)^T : x_1 t + x_2 \geq 0 \text{ for all } t \in \mathbb{R}\} = \{(x_1, x_2) : x_1 = 0, x_2 \geq 0\},$$

p. 106 Just before Theorem 6.23, change "recall that in Carathéodory $n + 1$ vectors" to "recall that in Carathéodory's theorem $n + 1$ vectors"

p. 107 2nd line. Change "convex hull" to "conic hull".

p. 111 In definition 6.33, change "Let $S \subseteq \mathbb{R}^n$" to "Let $S \subseteq \mathbb{R}^n$ be a convex set"

p. 118 Line 4. After "concave" add "over a convex set $C \subseteq \mathbb{R}^n$".

p. 120 Last line. Replace "the global minimizer" with "a global minimizer".

p. 123 Second line in the premise of Theorem 7.12. Add "over C" between "convex" and "if and only if"

p. 133 Change "Then by the Krein-Milman theorem (Theorem 6.35), for any" to "Then obviously, for any" (it is correct as it is, but there's no real need to use Krein-Milman)

p. 140 Second line of the proof of Lemma 7.46. It should be $\frac{y}{q}$ and not $\frac{y}{p}$

p. 147 Second line in Section 8.1 and one line after (8.1), change "closed and convex set" to "convex set"

p. 147 Change "level sets of convex sets" to "level sets of convex functions"

p. 147 Line -8. Delete the sentence starting with "The set C is closed" and ending with "see Theorem 7.36".

p. 149 Change "we assume that $\alpha_i \leq \beta_{i+1}$ for any $i = 1, 2, \ldots, n-1$" to "we assume that $\alpha_i \leq \beta_j$ for any $j > i$"

p. 150 Change "since the condition $\alpha_i \leq \beta_{i+1}$ will guarantee" to "since the feasibility condition will guarantee"

p. 157 Line -4. Should be "onto $\mathbb{R}^n_+$" instead of "onto $\mathbb{R}^n$"

p. 169 Line -3. Change "local optimum" to "local minimum".

p. 171 Line -3. Change "differetiable" to "differentiable"

p. 172 Just before (9.6), change "stationry" to "stationary"

p. 174 Theorem 9.8. Change "Then $\mathbf{z} = P_C(\mathbf{x})$ if and only if" to "Then $\mathbf{z} = P_C(\mathbf{x})$ if and only if $\mathbf{z} \in C$ and"

p. 177 In the premise of Lemma 9.12, change "Suppose that $L_1 \geq L_2$" to "Suppose that $L_1 \geq L_2 > 0$.

p. 182 Equation (9.29) should end with a period and not a comma

p. 190 Exercise 9.6. Change "dented" to "denoted"

p. 197 Change $\mathbf{x}$ to $\mathbf{x}^*$ in equations (10.8), (10.10), (10.11) and (10.12)

p. 207 In definition 11.1, change "continuously differentiable over the closed and convex set" to "continuously differentiable over the set".

p. 207 Lemma 11.2. Change the problem from

$$(\text{G}) \quad \begin{array}{ll} \min & h(\mathbf{x}) \\ \text{s.t.} & \mathbf{x} \in C, \end{array}$$

to

$$(\text{G}) \quad \begin{array}{ll} \min & f(\mathbf{x}) \\ \text{s.t.} & \mathbf{x} \in C, \end{array}$$

p. 212 In the last line, change the constraint "$x_1^2 + 2x_2^2 + 2x_3^3 = 2$" to "$x_1^2 + 2x_2^2 + 2x_3^2$"

p. 215 Change the first sentence of the proof of Theorem 11.13: "As in the proof of the necessity of the KKT conditions (Theorem 11.5)," to "By Theorem 11.4,"

p. 225 In the definition of $I(\mathbf{x}^*)$, change $f_i(\mathbf{x}^*) = 0$ to $g_i(\mathbf{x}^*) = 0$

p. 226 Change

$$\begin{pmatrix} 0 \\ d_2 \end{pmatrix} \nabla^2_{\mathbf{x}} L(x_1, x_2, \mu) \begin{pmatrix} 0 & d_2 \end{pmatrix} \geq 0$$

to

$$\begin{pmatrix} 0 & d_2 \end{pmatrix} \nabla^2_{\mathbf{x}} L(x_1, x_2, \mu) \begin{pmatrix} 0 \\ d_2 \end{pmatrix} \geq 0$$

p. 233 Line 4. Remove "f^*" from the chain of equalities/inequalities.

p. 238 Line -6. Change "$\lambda_1, \lambda_2, \lambda_m$ to "$\lambda_1, \lambda_2, \ldots, \lambda_m$"

p. 239 First line. Change "there are" to "there may be"

p. 239 In the premise of Theorem 12.2 change "being finite-valued functions" to "being functions"

p. 241 Just before Theorem 12.5, add the sentence "Although the theorem holds for any convex set C, we will state and prove it only for convex sets with a nonempty interior"

p. 241 Theorem 12.5. Replace "convex set and let" with "convex set with a nonempty interior and let" The beginning of the proof of Theorem 12.5 should be: "Although the theorem holds for any convex set C, we will prove it only for sets with a nonempty interior"

p. 242 In the statement of Theorem, 12.6, replace "two nonempty convex sets such that" with "two convex sets with nonempty interiors such that"

p. 242 First line of the proof of Theorem 12.6, after the parentheses write "with a nonempty interior"

p. 242 First line. Replace "Note that S, T are nonempty and convex and in addition" with "Note that S, T are convex with nonempty interiors and in addition"

p. 259 In the first displayed equation, change $L(\mathbf{x}, \boldsymbol{\lambda}_1, \boldsymbol{\lambda}_2, \ldots, \boldsymbol{\lambda}_m)$ to $L(\mathbf{x}, \mathbf{y}_1, \mathbf{y}_2, \ldots, \mathbf{y}_m, \boldsymbol{\lambda}_1, \boldsymbol{\lambda}_2, \ldots, \boldsymbol{\lambda}_m)$.

p. 265 5th line after (12.27). Remove "(see also part (i) of Exercise 1.13)"

p. 267 At the displayed equation at the beginning of Section 12.3.12 change the right-hand side of the inequality and equality constraints from 0 to 1.

p. 272 In question 12.12, change "Lat" to "Let"