

Corrections for the book **CONVEX ANALYSIS AND OPTIMIZATION**, Athena Scientific, 2003, by Dimitri P. Bertsekas

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- p. 3 (+22) Change “as the union of the closures of all line segments” to “as the closure of the union of all line segments”
- p. 37 (-2) Change “Every  $x$ ” to “Every  $x \neq 0$ ”
- p. 38 (+1) Change “Every  $x$  in” to “Every  $x \notin X$  that belongs to”
- p. 38 (+19) Change “i.e.,” to “with  $x_1, \dots, x_m \in \mathfrak{R}^n$  and  $m \geq 2$ , i.e.,”
- p. 51 (-10) Change “since  $x \in R_C$  and  $y \in R_C$ .” to “by our choice of  $x$  and  $y$ .”
- p. 63 (+4, +6, +7, +19) Change four times “ $c'\bar{y}$ ” to “ $a'\bar{y}$ ”
- p. 67 (+3) Change “ $y \in AC$ ” to “ $\bar{y} \in AC$ ”
- p. 70 (+9) Change “[BeN02]” to “[NeB02]”
- p. 80 (+7) Change “ $C \cap M$ ” to “ $\text{cl}(C) \cap M$ ”
- p. 84 (+10) Change “ $x \in X$ ” to “ $x \in X \cap \text{dom}(f)$ ”
- p. 84 (-6) Change “that the set of minima of  $f$  over  $X$ ” to “that for a feasible problem, the set of minima of  $f$  over  $X$ ”
- p. 85 (-14) Change “Prop. 1.2.2(b)” to “Prop. 1.2.2(ii)”
- p. 85 (-10) Change “Prop. 1.2.2(c)” to “Prop. 1.2.2(iii)”
- p. 86 (-13) Change “ $x^* \in X$ ” to “ $x^* \in X \cap \text{dom}(f)$ ”
- p. 93 (+14) Change “ $x \in R_{V_\gamma}$ ” to “ $x \in V_\gamma$ ”
- p. 93 (-15) Change “ $(0, y) \in R_{\text{epi}(f)}$ ” to “ $(y, 0) \in R_{\text{epi}(f)}$ ”
- p. 110 (+3 after the figure caption) Change “... does not belong to the interior of  $C$ ” to “... does not belong to the interior of  $C$  and hence does not belong to the interior of  $\text{cl}(C)$  [cf. Prop. 1.4.3(b)]”
- p. 116 (+16) Change “ $x = 0$ ” to “ $x - \bar{x} = 0$ ”
- p. 118 (+13) Change “proper” to “proper convex”
- p. 128 (+7) Change “Prop. 1.5.5” to “Prop. 1.5.4”
- p. 148 (-8) Change “ $\{x \mid r(x) \leq \gamma\}$ ” to “ $\{z \mid r(z) \leq \gamma\}$ ”
- p. 153 (-8) Part (a) Exercise 2.1 is trivial as stated and does not require the convexity assumption on  $f$ . Here is a corrected version and corresponding solution of part (a):

- (a) Consider a vector  $x^*$  such that  $f$  is convex over a sphere centered at  $x^*$ . Show that  $x^*$  is a local minimum of  $f$  if and only if it is a local minimum of  $f$  along every line passing through  $x^*$  [i.e., for all  $d \in \mathfrak{R}^n$ , the function  $g : \mathfrak{R} \mapsto \mathfrak{R}$ , defined by  $g(\alpha) = f(x^* + \alpha d)$ , has  $\alpha^* = 0$  as its local minimum].

**Solution:** (a) If  $x^*$  is a local minimum of  $f$ , evidently it is also a local minimum of  $f$  along any line passing through  $x^*$ .

Conversely, let  $x^*$  be a local minimum of  $f$  along any line passing through  $x^*$ . Assume, to arrive at a contradiction, that  $x^*$  is not a local minimum of  $f$  and that we have  $f(\bar{x}) < f(x^*)$  for some  $\bar{x}$  in the sphere centered at  $x^*$  within which  $f$  is assumed convex. Then, by convexity, for all  $\alpha \in (0, 1)$ ,

$$f(\alpha x^* + (1 - \alpha)\bar{x}) \leq \alpha f(x^*) + (1 - \alpha)f(\bar{x}) < f(x^*),$$

so  $f$  decreases monotonically along the line segment connecting  $x^*$  and  $\bar{x}$ . This contradicts the hypothesis that  $x^*$  is a local minimum of  $f$  along any line passing through  $x^*$ .

- p. 157 (-11 and -3)** Change “nondecreasing” to “nonincreasing”
- p. 213 (-6)** Change “remaining vectors  $v_j$ ,  $j \neq i$ .” to “vectors  $v_j$  with  $v_j \neq v_i$ .”
- p. 219 (+3)** Change “ $f_i : C \mapsto \mathfrak{R}$ ” to “ $f_i : \mathfrak{R}^n \mapsto \mathfrak{R}$ ”
- p. 262 (+5)** Change the equation to

$$g'(f(x); w) = \lim_{\alpha \downarrow 0, z \rightarrow w} \frac{g(f(x) + \alpha z) - g(f(x))}{\alpha}.$$

- p. 265 (+10)** Change “ $\bar{d}/\|\bar{d}\|$ ” to “ $-\bar{d}/\|\bar{d}\|$ ”
- p. 268 (-3)** Change “ $j \in A(x^*)$ ” to “ $j \notin A(x^*)$ ”
- p. 338 (+17)** Change “Section 5.2” to “Section 5.3”
- p. 382** In Sections 6.5.3 and 6.5.4, a distinction is made between the interior and the relative interior of  $\text{dom}(p)$ . However, this distinction is valid only for the primal function of a problem with equality and inequality constraints. For a problem with inequality constraints only, the interior and the relative interior of  $\text{dom}(p)$  coincide, since  $\text{dom}(p)$  contains the positive orthant.
- p. 384 (+6)** Change “convex, possibly nonsmooth functions” to “smooth functions, and convex (possibly nonsmooth) functions”
- p. 435 (-3)** Change “...  $f_1$  and  $-f_2$  are proper and convex, ...” to “...  $f_1$  and  $-f_2$  are proper and convex, and  $-f_2$  is also closed, ...”

- p. 446 (+6 and +8)** Interchange “... constrained problem (7.16)” and “... penalized problem (7.19)”
- p. 458 (+13)** Change “... as well real-valued” to “... as well as real-valued”
- p. 458 (-10)** Change “We will focus on this ... dual functions.” to “In this case, the dual problem can be solved using gradient-like algorithms for differentiable optimization (see e.g., Bertsekas [Ber99a]).”
- p. 466 (+6)** Change “ $y_i \subset \Re^m$ ” to “ $y_i \in \Re^m$ ”