

Applied Optimization  
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Errata to first printing  
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## Contents

<b>1</b>	<b>Errata to text</b>	<i>page</i> 1
<b>2</b>	<b>Errata to exercises</b>	9

# 1

## Errata to text

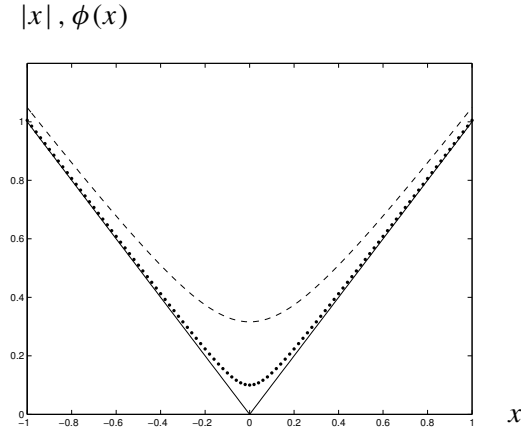
- Page 44** Section 2.3.3.3. Line 3. Change “constraint set” to “feasible set”
- Page 44** Section 2.3.3.3. Line 4. Change “constraint sets” to “feasible sets”
- Page 59** Third line from bottom. Add “The sets  $\mathbb{R}^n$ ,  $\mathbb{R}_+^n$ , and  $\mathbb{R}_{++}^n$  are all convex. (See Exercise 2.23.)”
- Page 74** Twelfth line from bottom. Change “Part (iii)” to “Part(ii)”
- Page 76** Section 2.6.3.5. Line 6. Change “second derivatives” to “second partial derivatives”
- Page 76** Section 2.6.3.5. Line 8. Change “**First derivative**” to “**First partial derivatives**”
- Page 76** Section 2.6.3.5. lines 8–9. Change “first derivative” to “first partial derivatives”
- Page 77** Sixth line from the bottom. Change “**Second derivative**” to “**Second partial derivatives**”
- Page 77** Fifth line from the bottom. Change “second derivatives” to “second partial derivatives”
- Page 89** Section 2.8. Line 2. Delete “solution of”
- Page 113** Third line from bottom. Change “local” to “local first derivative”
- Page 114** Line 4. Change:

$$\forall x \in \mathbb{R}^n, f_p(x) = \sum_{\ell=1}^r \max\{0, (h_\ell(x))^2\}.$$

to:

$$\forall x \in \mathbb{R}^n, f_p(x) = \sum_{\ell=1}^r (\max\{0, h_\ell(x)\})^2.$$

**Page 123** Fig. 3.14. In addition to the solid and dashed curve, there should be a dotted curve as shown in the following graph.



**Page 134** Theorem 3.10. Line 3. Change “assume” to “suppose”

**Page 137** Theorem 3.11. Line 3. Change “assume” to “suppose”

**Page 141** Third line after Theorem 3.13. Change “The bound” to “The lower bound”

**Page 142** Line 1. Change “ $\mathbb{E} = \emptyset$ ” to “ $\mathbb{E}_+ = \left\{ \begin{bmatrix} \lambda \\ \mu \end{bmatrix} \in \mathbb{E} \mid \mu \geq \mathbf{0} \right\} = \emptyset$ ”

**Page 142** Line 5. Change “ $\mathbb{E} = \emptyset$ ” to “ $\mathbb{E}_+ = \emptyset$ ”

**Page 143** Section 3.4.4, third line from bottom. Delete “value of the”

**Page 143** Section 3.4.4, last line. Add “There is no duality gap.”

**Page 170** Line after (4.8). Change “ $f(x^*)$ ” to “ $f^*(\bullet) = f(x^*(\bullet))$ ”

**Page 170** Third line after (4.8). Change “ $\frac{\partial[f(x^*)]}{\partial I_4}$ ” to “ $\frac{\partial f^*}{\partial I_4}$ ”

**Page 170** Fourth line after (4.8). Change “ $\frac{\partial[f(x^*)]}{\partial R_b}$ ” to “ $\frac{\partial f^*}{\partial R_b}$ ”

**Page 170** Fifth line after (4.8). Change “ $\frac{\partial[f(x^*)]}{\partial T}$ ” to “ $\frac{\partial f^*}{\partial T}$ ”

**Page 205** Line 2. Change “ $1 \leq j \leq n - 1$ ” to “ $2 \leq j \leq n$ ”

**Page 206** Lines 3–4. Change:

$$\begin{aligned} \frac{(n)^2 - n(n+1)/2}{(n)^2} &= \frac{(n)^2/2 - n/2}{(n)^2}, \\ &= \frac{n-1}{2n}, \end{aligned}$$

to:

$$\begin{aligned} \frac{(n-1)^2 - (n-1)n/2}{(n-1)^2} &= \frac{(n-1)^2/2 - (n-1)/2}{(n-1)^2}, \\ &= \frac{n-2}{2(n-1)}. \end{aligned}$$

- Page 207** Section 5.4.6 heading. Change “A” to “coefficient matrix”
- Page 207** Lemma 5.4, Proof. Line 3. Change “non-positive” to “not strictly positive”
- Page 215** Lemma 5.6. Line 1. Add “Suppose that  $A \in \mathbb{R}^{n \times n}$  is symmetric.”
- Page 215** Eighth and ninth line from the bottom. Change two occurrences of “A” to “ $A^{(j)}$ ”
- Page 216** Section 5.5.3.3. Line 4. Change “sometimes grows” to “elapsed computation time sometimes grows”
- Page 216** Section 5.5.3.3. Line 5. Change “See Exercise 5.26” to “See Exercises 5.23, 5.26, and 5.27.”
- Page 234** Section 5.7.3.2. Line 6. Change “Section 4.1.1” to “Section 4.1”
- Page 268** Section 6.2.2.1. Lines 7 and 9. Change two occurrences of “angle” to “angular”
- Page 269** Line 16. Change “phases” to “angles”
- Page 274** Last line. Change “the admittance” to “where  $R_{\ell k}$  is its resistance and  $X_{\ell k}$  is its inductive reactance, the admittance”
- Page 281** Section 6.2.4.4. Line 11. Change “admittance” to “admittance matrix”
- Page 281** Section 6.2.4.4. Line 12. Change “resistance” to “resistance  $R_{\ell k}$ ” and change “inductance” to “inductive reactance  $X_{\ell k}$ ”
- Page 281** Section 6.2.4.4. Lines 13–14. Change “inductance” to “inductive reactance”
- Page 288** Figure 7.1 Caption. Change “Taylor approximation” to “first-order Taylor approximation”
- Page 288** Line 4. Change “ $\begin{bmatrix} 1 \\ 3 \\ g_1 \begin{bmatrix} 1 \\ 3 \end{bmatrix} \end{bmatrix}$ ” to “ $\begin{bmatrix} 1 \\ 3 \\ g_1 \left( \begin{bmatrix} 1 \\ 3 \end{bmatrix} \right) \end{bmatrix}$ ”
- Page 296** Second line after (7.13). Change “The quasi-Newton method entirely avoids the need to calculate the Jacobian, since it uses the change in  $g$  to approximate  $J$ ” to “Quasi-Newton methods generalize the secant approximation to functions  $g : \mathbb{R}^n \rightarrow \mathbb{R}^n$  and entirely avoid the need to calculate the Jacobian, since the change in  $g$  is used to approximate  $J$ ”
- Page 320** Sixth line from bottom. Change “ $\|g(x^{(v)})\|$ ” to “ $\|g(x^{(v)})\|$ ”
- Page 321** Line before (7.30). Change “step length” to “step-size”

- Page 339** Section 8.1.7. Line 3. Change “ $g : \mathbb{R}^n \times \mathbb{R}^s \rightarrow \mathbb{R}^n$ ” to “ $g : \mathbb{R}^4 \times \mathbb{R}^s \rightarrow \mathbb{R}^4$ ”
- Page 366** Equation (9.3). Delete “ $+ \gamma$ ”
- Page 376** Section 9.2.2.3. Lines 3, 4, 7, and 8. Change four occurrences of “ $\mathbb{J}_\ell$ ” to “ $\mathbb{J}(\ell)$ ”
- Page 378** Second line from bottom. Change “estimate the voltage magnitudes and angles at the other buses” to “reliably estimate the voltage magnitudes and angles at the other buses, particularly in the presence of measurement failures.”
- Page 378** Last line. Delete “This is because the information from bus 1 does not uniquely identify the generation at bus 2 and the load at bus 3.”
- Page 379** Line 2. Change “do not have” to “have just”
- Page 379** Line 3. Add “however, we will see that if the voltage measurement at bus 1 fails then there is not enough information to determine the values of the entries in  $x$ ”
- Page 379** Line 4. Change “enough” to “redundancy of”
- Page 392** Line 13. Delete “at  $t \neq 0$ ”
- Page 395** Section 10.2.1.2. Third line from bottom. Change  $x^{(2)}$  to  $x^{(1)}$ .
- Page 396** Figure 10.8 caption. Line 1. Change “The steepest descent” to “Scaled versions of the steepest descent”
- Page 396** Section 10.2.1.4. Line 1. Change “the steepest descent” to “scaled versions of the steepest descent”
- Page 397** Sixth line from bottom. Change “ $f(x^{(v)} + \alpha \Delta x^{(v)})$ ” to “ $f(x^{(v)} + \alpha^{(v)} \Delta x^{(v)})$ ”
- Page 399** Figure 10.11 caption. Line 1. Change “The steepest descent” to “Scaled versions of the steepest descent”
- Page 399** Section 10.2.1.5. Line 5. Change “the steepest descent” to “scaled versions of the steepest descent”
- Page 400** Fourth line from bottom and bottom line. Change two instances “ $f(x^{(v)} + \alpha \Delta x^{(v)})$ ” to “ $f(x^{(v)} + \alpha^{(v)} \Delta x^{(v)})$ ”
- Page 402** Ninth line from bottom. Change “the Newton–Raphson” to “scaled versions of the Newton–Raphson”
- Page 403** Figure 10.14 caption. Line 1. Change “The Newton–Raphson” to “Scaled versions of the Newton–Raphson”
- Page 403** Fifth line from bottom. Change “ $f(x^{(v)} + \alpha \Delta x^{(v)})$ ” to “ $f(x^{(v)} + \alpha^{(v)} \Delta x^{(v)})$ ”
- Page 404** Line 1. Change “ $f(x^{(v)} + \alpha \Delta x^{(v)})$ ” to “ $f(x^{(v)} + \alpha^{(v)} \Delta x^{(v)})$ ”
- Page 407** Section 10.2.3.1. Line 6. Change “non-singular” to “positive definite”
- Page 409** Sixth–seventh line from bottom. Change “**Levenberg–Marquardt method**” to “**Levenberg–Marquardt method**”
- Page 413** Section 10.2.4.3. Fifth and sixth line from bottom. Change two occurrences of “ $\Delta x$ ” to “ $\Delta x^{(v)}$ ”

- Page 414** Line 5. Change “the minimizer” to “any minimizer”
- Page 415** Line 1. Change “optimizer” to “minimizer”
- Page 416** Section 10.3. Line 5. Change “solution” to “minimizer”
- Page 416** Section 10.3. Line 6. Change “base-case solution” to “minimizer and minimum”
- Page 416** Corollary 10.8. Line 1. Change “ $f : \mathbb{R}^n \times \mathbb{R}^s \rightarrow \mathbb{R}$ ” to “ $f : \mathbb{R}^n \times \mathbb{R}^s \rightarrow \mathbb{R}$ ”
- Page 416** Last line. Change “solution” to “minimizer”
- Page 418** Section 10.3.2. Line 6. Change “solution” to “minimizer”
- Page 428** (11.2) Add “ $\forall x \in \mathbb{R}^n$ ,”
- Page 428** (11.3) Add “ $\forall x \in \mathbb{R}^n$ ,”
- Page 438** Sixth and tenth line from bottom. Change two occurrences of “Levenberg–Marquandt” to “Levenberg–Marquardt”
- Page 439** Section 11.2.4.1. Line 1. Change “system” to “system or if there is a measurement failure”
- Page 439** Section 11.2.4.1. Line 9. Change “However, there is not enough” to “There is also just enough”
- Page 439** Section 11.2.4.1 Line 11. Change “In fact” to “However, suppose that there was a failure of the voltage measurement in the system in Figure 11.2. In this case”
- Page 439** Section 11.2.4.1 Line 14. Change “descent direction; however, because” to “descent direction if  $\nabla f(x^{(v)}) \neq \mathbf{0}$ ; however, if”
- Page 439** Seventh–eighth lines from bottom. Delete “Since our measurements do not determine the split of power flowing into buses 2 and 3, there will be many sets of voltages and angles  $\theta_2$ ,  $u_2$ ,  $\theta_3$ , and  $u_3$  that are consistent with maximizing the likelihood of the observed measurements.”
- Page 440** Section 11.2.4.2. Line 7. Add “Moreover, this will remain true even in the presence of a single failure of a voltage measurement.”
- Page 457** Section 12.1.4.3. Line 3. Change “ $x_k$ ” to “ $x_k \geq 0$ ”
- Page 458** Figures 12.5 and 12.6. Delete measurements  $\tilde{P}_{12}$ ,  $\tilde{Q}_{12}$ ,  $\tilde{P}_{13}$ , and  $\tilde{Q}_{13}$ .
- Page 458** Line 6. Change “seven measurements that are clustered around bus 1” to “three measurements”
- Page 458** Section 12.2.1.3. Lines 3 and 4. Change two occurrences of “nine” to “five”
- Page 458** Section 12.2.1.3. Lines 5–6. Delete “These measurements also provide redundancy.”
- Page 471** Lines 16–20. Change five occurrences of “ $n$ ” to “3”
- Page 477** Line 21. Delete “non-linear”
- Page 482** Corollary 13.4. Line 6. Change “a local” to “a strict local”
- Page 483** Section 13.2. Line 1. Change “constraint set” to “feasible set”

- Page 490** Section 13.2.2.3. Line 1. Change “separable” to “additively separable”
- Page 510** Line 6. Change “base-case solution” to “minimizer and minimum”
- Page 510** Corollary 13.10. Line 1. Change “ $f : \mathbb{R}^n \times \mathbb{R}^s \rightarrow \mathbb{R}^n$ ” to “ $f : \mathbb{R}^n \times \mathbb{R}^s \rightarrow \mathbb{R}$ ”
- Page 510** Corollary 13.10. Line 7. Change “solution” to “minimizer”
- Page 513** Line 5. Change “have continuous partial derivatives” to “have continuous partial derivatives in this neighborhood”
- Page 513** Proof of Corollary 13.11. Line 1. Delete “the proof of”
- Page 513** Line 6 and eleventh line from bottom. Change two occurrences of “ $\lambda^*$ ” to “ $[\lambda^*]^\dagger$ ”
- Page 533** Line 10. Change “Parts (ii) and (iv)” to “Part (iv)”
- Page 533** Line 12. Delete “significantly”
- Page 534** Third line from bottom. Change “ $x^* = \begin{bmatrix} 5 \\ -\sin(5) \end{bmatrix}$ ” to “ $x^* = \begin{bmatrix} 5 \\ \sin(5) \end{bmatrix}$ ”
- Page 535** Section 14.1.3.2. Line 6. Add “See Exercise 14.6.”
- Page 538** Section 14.2.1.3. Line 5. Change “of the constraints” to “of  $x^*$ ”
- Page 544** Section 14.3.2. Line 3. Change “argmin” to “inf”
- Page 546** Line 1. Change “ $J(x^*)$  and  $J(x^*; \mathbf{0})$ ” to “ $J(x^*; \mathbf{0})$  and  $J(x^*)$ ”
- Page 546** Eleventh line from bottom. Change “ $\lambda^*$ ” to “ $[\lambda^*]^\dagger$ ”
- Page 548** Section 14.5.2.1. Line 9. Change “Levenberg–Marquardt” to “Levenberg–Marquardt”
- Page 556** Figure 14.6. Delete measurements  $\tilde{P}_{12}$ ,  $\tilde{Q}_{12}$ ,  $\tilde{P}_{13}$ , and  $\tilde{Q}_{13}$ .
- Page 580** Section 15.4.2.5. Tenth line from the bottom. Change “point” to “pattern”
- Page 582** Section 15.4.4.3. Lines 1–2. Change “is infeasible” to “has a maximum that is zero or strictly negative” Add “Algorithms for solving this problem are sometimes called **support vector machines**.”
- Page 601** Line 4. Change “positive” to “non-negative”
- Page 615** Seventh line from the bottom. Change “objective” to “minimum”
- Page 622** Line 2. Change “step lengths” to “step-sizes”
- Page 622** Line 2. Change “step length” to “step-size”
- Page 622** Section 16.3.2.3. Lines 1–2. Change “ $\mathbf{1}^\dagger x = 10$ ” to “ $-\mathbf{1}^\dagger x = -10$ ”
- Page 624** Lines 7–8. Change “a minimum of the objective was reached” to “a sufficient decrease in the objective is achieved”
- Page 627** Section 16.3.5. Line 13 and (16.13). Change “ $w \in \mathbb{R}^n$ ” to “ $w \in \mathbb{R}^m$ ”
- Page 627** Fourth line from bottom. Change “a a” to “a”
- Page 630** Section 16.3.6.1. Last line. Change two occurrences of “Part” to “part”
- Page 631** Section 16.4.1. Lines 7 and 8. Change two occurrences of “constraint set” to “feasible set”

**Page 637** Section 16.4.2.6. Fourth–fifth line from the bottom. Change “Exercise 16.25 and Section 17.3.1.4” to “Section 16.4.6.4 and Exercise 16.25”

**Page 670** Theorem 17.1. Proof. Line 4. Change “where” to “where  $C_\ell$  is the  $\ell$ -th row of  $C$  and”

**Page 680** Section 17.2.2.1. Line 8. Change “ $\mathcal{D}$  is convex” to “ $\mathcal{D}$  is concave”

**Page 683** Line 1. Change “differentiable” to “differentiable with continuous partial derivatives”

**Page 684** Line 11. Change “Theorem 3.12” to “Theorems 3.12 and 17.4”

**Page 688** Line 2. Change “ $\left\{ \begin{bmatrix} \lambda \\ \mu \end{bmatrix} \in \mathbb{R}^{m+r} \mid \begin{bmatrix} A \\ C \end{bmatrix}^\dagger \begin{bmatrix} \lambda \\ \mu \end{bmatrix} = -c, \mu \geq \mathbf{0} \right\}$ ” to

$$\left\{ \begin{bmatrix} \lambda \\ \mu \end{bmatrix} \in \mathbb{R}^{m+r} \mid \begin{bmatrix} A \\ C \end{bmatrix}^\dagger \begin{bmatrix} \lambda \\ \mu \end{bmatrix} = -c, \mu \geq \mathbf{0} \right\}$$

**Page 695** Line 7. Change right-hand side of equation from “

$$\begin{bmatrix} -w^{(v)}\mu^{(v)} + t \\ -2(x_1^{(v)} - 1) - \lambda^{(v)} \\ -2(x_2^{(v)} - 3) + \lambda^{(v)} + \mu^{(v)} \\ -x_1^{(v)} \\ x_2^{(v)} \\ -3 + x_2^{(v)} - w^{(v)} \end{bmatrix},$$

$$\text{to “} \begin{bmatrix} -w^{(v)}\mu^{(v)} + t \\ -2(x_1^{(v)} - 1) - \lambda^{(v)} \\ -2(x_2^{(v)} - 3) + \lambda^{(v)} + \mu^{(v)} \\ -x_1^{(v)} + x_2^{(v)} \\ -3 + x_2^{(v)} - w^{(v)} \end{bmatrix} \text{”}$$

**Page 699** Line 6. Change “ $\lambda^*$  and  $\mu^*$ ” to “ $[\lambda^*]^\dagger$  and  $[\mu^*]^\dagger$ ”

**Page 714** Line 1. Change “maximum” to “strictly positive maximum”

**Page 714** Line 10. Change “feasible solution” to “feasible point”

**Page 714** Line 11. Change “ $\|\beta^*\|_2$ ” to “ $\max\{0.5, \|\beta^*\|_2\}$ ”

**Page 715** Line 15. Change “positive” to “strictly positive”

**Page 723** First–third lines from the bottom. Delete “and consideration of the **null space of the coefficient matrix** of the linearized constraints and the associated **tangent plane**”

**Page 724** Line 5. Change “conditions,” to “conditions, and”

**Page 724** Lines 6–7. Delete “use of a **merit function** in the trade-off between satisfaction of constraints and improvement of the objective, and”

**Page 724** Definition 19.1. Line 1. Change “ $h : \mathbb{R}^m \rightarrow \mathbb{R}^r$ ” to “ $h : \mathbb{R}^n \rightarrow \mathbb{R}^r$ ”

**Page 725** Line 1. Change “ $K$ ” to “ $K(x^*)$ ”

**Page 728** Line 15. Change “(or **FONC**)” to “(or **FONC**) or the **Karush–Kuhn–Tucker conditions** and a point satisfying the conditions is called a **KKT point**”

**Page 733** Seventh line from the bottom, change “ $\nabla f(x^*) + K(x^*)^\dagger \mu^* = \mathbf{1} + [-2 \ -2] \times [0.5]$ ” to “ $\nabla f(x^*) + K(x^*)^\dagger \mu^* = \mathbf{1} + [-2 \ -2]^\dagger \times [0.5]$ ”

**Page 734** Last line. Change “ $\mathcal{D}$  is convex” to “ $\mathcal{D}$  is concave”

**Page 765** Change “Levenberg–Marquandt” to “Levenberg–Marquardt”

**Page 743** Line 11. Change “ $\lambda^*$  and  $\mu^*$ ” to “ $[\lambda^*]^\dagger$  and  $[\mu^*]^\dagger$ ”

## 2

### Errata to exercises

- 2.4** Line 2. Change “where” to “where  $\mathbb{S} = \mathbb{R}$  and”
- 2.7(ii)** Line 1. Change “ $g : \mathbb{R} \rightarrow \mathbb{R}$ ” to “ $g : \mathbb{R}^2 \rightarrow \mathbb{R}$ ”
- 2.10** Line 1. Change “differentiable” to “partially differentiable”
- 2.12(ii)** Add “(assume that  $C\bar{\rho} < 1$ )”
- 2.12(iii)** Add “(assume that  $(C)^{1/(R-1)}\bar{\rho} < 1$ )”
- 2.14** Line 3. Change “Definition A.36” to “Definition A.36 in Section 4.3.1 of Appendix A”
- 2.14** Last line. Change “in Appendix” to “of Appendix”
- 2.32** Lines 1–2. Delete “with  $f$  continuous at  $x = 0$ ”
- 2.39** Lines 3–4. Change “one sentence” to “a few sentences”
- 2.49** Hint, line 3. Change “the MATLAB functions `sphere` and `mesh`” to “MATLAB functions such as `sphere`, `mesh`, and `cylinder`”
- 2.51(i)** Add “(Hint: Use Theorems 2.1 and 2.5 and Exercise 2.42.)”
- 2.51(ii)** Line 3. Delete “(Hint: Use Theorem 2.5 and Exercise 2.42.)”
- 2.54** First line on page 102. Change “ $h : \mathbb{R}^2 \times \mathbb{R} \rightarrow \mathbb{R}$ ” to “ $h : \mathbb{R}^2 \times \mathbb{R}^2 \rightarrow \mathbb{R}$ ”
- 3.13** Lines 1 and 2. Change two occurrences of “convex” to “concave.” Line 3. Change “ $\forall x \in \mathbb{R}^n, f(x) = \max_{\ell=1, \dots, r} f_\ell(x)$ ” to “ $\forall x \in \mathbb{R}^n, f(x) = \min_{\ell=1, \dots, r} f_\ell(x)$ .”
- 3.16** Line 7. Add “Assume that the optimization algorithm either finds the minimizer or identifies that the problem is unbounded.”
- 3.17(ii)** Lines 1–2. Delete “(Hint, use the definition of derivative and consider the limits from the left and from the right of  $x = 0$  in the definition.)”
- 3.26(ii)(a)** Line 1. Change “not convex” to “convex”
- 3.26(iii)** Lines 1–2. Change “Let  $\tilde{f} \in \mathbb{R}$  and consider the problem:

$$\max_{x \in \mathbb{R}^2} \{\varphi(x) | f(x) = \tilde{f}\}$$

to “Let  $\tilde{f} \in \mathbb{R}_{++}$  and consider the problem:

$$\min_{x \in \mathbb{R}^2} \{\varphi(x) | f(x) = \tilde{f}, x \geq \mathbf{0}\}$$

**3.26(iii)(c)** Line 1. Change “concave” to “convex”

**3.26(iv)** Lines 1–2. Change “Let  $\tilde{f} \in \mathbb{R}$  and consider the problem:

$$\max_{x \in \mathbb{R}^2} \{\phi(x) | f(x) = \tilde{f}\}$$

to “Let  $\tilde{f} \in \mathbb{R}_{++}$  and consider the problem:

$$\min_{x \in \mathbb{R}^2} \{\phi(x) | f(x) = \tilde{f}, x \geq \mathbf{0}\}$$

**3.26(iv)(b)** Line 1. Change “Show that the resulting transformed problem has a concave objective” to “Show that the resulting transformed problem has a convex objective”

**3.26(v)** Lines 1–2. Change “Let  $\tilde{\phi} \in \mathbb{R}$  and consider the problem:

$$\max_{x \in \mathbb{R}^2} \{\varphi(x) | \phi(x) = \tilde{\phi}\}$$

to “Let  $\tilde{\phi} \in \mathbb{R}_{++}$  and consider the problem:

$$\max_{x \in \mathbb{R}^2} \{\varphi(x) | \phi(x) = \tilde{\phi}, x \geq \mathbf{0}\}$$

**3.26(vi)** Lines 1–2. Change “Let  $\tilde{\phi} \in \mathbb{R}$  and consider the problem:

$$\max_{x \in \mathbb{R}^2} \{f(x) | \phi(x) = \tilde{\phi}\}$$

to “Let  $\tilde{\phi} \in \mathbb{R}_{++}$  and consider the problem:

$$\max_{x \in \mathbb{R}^2} \{f(x) | \phi(x) = \tilde{\phi}, x \geq \mathbf{0}\}$$

**3.38(iv)** Line 4. Change “solution” to “minimizer”

**3.41** Line 2. Change “ $\mathbb{R}^n \times \mathbb{R}^s$ ” to “ $\mathbb{R}^{n+s}$ ”

**4.6(ii)** Line 1. Change “for to the circuit” to “for the circuit”

**4.7** Line 1. Change “node circuit” to “node circuit that does not have any resistive branches joining a node to itself nor any branches in parallel”

**5.19(i)** Line 2. Change “ $A'$  from  $A$ ” to “ $A'$  obtained from  $A$ ”

**5.22(i)** Line 1. Change “factorization” to “factorization, if diagonal pivoting has been used at each previous stage then”

**5.22(ii)** Lines 1–2. Change “the largest element in the remaining matrix” to “if diagonal pivoting has been used at each previous stage then the element with the largest absolute value in the remaining sub-matrix”

**5.23(i)** Line 2. Change “non-zero” to “non-zero (a **density** of 0.1%)”

**5.23(i)** Lines 4, 8, and 10. Change three occurrences of “elapsed time” to “elapsed computation time”

**5.23(ii)** Line 7. Change “otherwise” to “since otherwise”

**5.23(iii)** Line 4. Change “elapsed time” to “elapsed computation time”

**5.24(i)** Line 3. Change “location[ $\ell$ ]” to “location( $\ell$ , :)”

**5.24(ii)** Line 4. Change “value[ $\ell$ ]” to “value( $\ell$ , :)”

**5.24(iii)** Lines 4 and 5. Change two occurrences of “[ $\ell$ ] [ $k$ ]” to “( $\ell$ ,  $k$ )”

**5.24(iv)** Lines 6 and 8. Change two occurrences of “[ $\ell$ ] [1]” to “( $\ell$ , 1)”

**5.24(v)** Line 12. Change “[ $\ell$ ] [ $K+1$ ]” to “( $\ell$ ,  $K+1$ )”

**5.24(vi)** Line 13. Change “[row] [4]” to “(row, 4)”

**5.24(vii)** Line 2. Change “ $Uy$ ” to “ $Ux$ ”

**5.26** Line 3. Change “Calculate” to “Estimate”

**5.28** Line 1. Change “Show” to “If the standard pivot is used at each stage, show”

**5.32(i)** Line 2. Change “ $A'$  from  $A$ ” to “ $A'$  obtained from  $A$ ”

**5.35** Line 3. Change “ $\|\Delta A\|_2 = \chi$ ” to “ $\|\Delta A\|_2 = |\chi|$ ”

**5.38(iii)** Line 1. Delete “and”

**5.38(iv)** Line 1. Add “and” at end of line

**5.40** Line 2. Change “ $\begin{bmatrix} 0.1 & 2 & 1 & 0 \\ 2 & 10 & 2 & 0 \\ 1 & 2 & 0.1 & 0 \\ 0 & 0 & 0 & 0.0001 \end{bmatrix}$ ” to “ $\begin{bmatrix} 0.1 & 2 & 0 & 0 \\ 2 & 10 & 2 & 0 \\ 0 & 2 & 0.1 & 0 \\ 0 & 0 & 0 & 0.0001 \end{bmatrix}$ ”

**5.49** Line 7. Change “inverse of  $A$ ” to “inverse of  $A^\parallel(\chi)$ ”

**6.2(i)** Line 8. Change “ $G$ ” to “ $G(x)$ ”

**6.4** Line 4. Change “net injection at” to “the net real power flow out of”

**6.4** Line 7. Change “ $G_{22} = G_{12} = B_{22} = 0$  and  $B_{12} = 1$ ” to “ $G_{22} = G_{12} = 0$  and  $B_{12} = 1$ ”

**6.5(ii)** Line 1. Change “ $\mathbb{S} = [-\frac{\pi}{4}, \frac{\pi}{4}]^n$ ” to “ $\mathbb{S} = \{\theta \in \mathbb{R}^n \mid |\theta_k| < \frac{\pi}{4}, k = 1, \dots, n\}$ ”

**7.2(ii)** Line 1. Delete “the update”

**7.2** Add new parts:

(v) Sketch  $g_1$ ,  $x^{(0)}$ ,  $x^{(1)}$ , and the first-order Taylor approximation to  $g_1$  about  $x^{(0)}$ .

(vi) Sketch  $g_1$ ,  $x^{(1)}$ ,  $x^{(2)}$ , and the first-order Taylor approximation to  $g_1$  about  $x^{(1)}$ .

(vii) Sketch, on a single graph, the points and functions in Parts (v) and (vi) versus  $x_1$  along the “slice” where  $x_1 = x_2$ . Discuss the progress of the iterates.

**7.6(ii)** Line 1. Change “symmetric rank two update” to “symmetric rank two update or a symmetric rank one update”

- 7.14(ii)** Line 2. Add “You should write a MATLAB M-file to evaluate both  $g$  and  $J$ .”
- 7.15(iii)** Line 3. Add “and the number of function evaluations”
- 7.15(vii)** Line 3. Add “and the number of function evaluations”
- 7.15(xi)** Line 3. Add “and the number of function evaluations”
- 8.10(ii)** Line 2. Change “rank 1” to “rank one”
- 8.13** Lines 1–2. Change “MATLAB function `lu`” to “MATLAB operator `\`”
- 8.13** Line 8. Change “Use the Armijo criterion with  $\delta = 0.1$ .” to “Use the Armijo step-size rule (7.29) with  $\delta = 0.1$  and find the largest value of  $\alpha^{(v)}$  of the form of (7.30) that satisfies (7.29).”
- 9.1** Line 2. Change “(9.1)” to “(9.3)”
- 10.8(i)** Line 7. Add “Report the number of iterations required.”
- 10.9** Line 1. Change “a function” to “two functions”
- 10.11(ii)** Line 2. Add “unless  $R = \mathbf{I}$ ”
- 10.19** Lines 7–8. Change “Further suppose that  $\frac{\partial^2 \mathcal{L}}{\partial x^2}(\hat{x}, \hat{\lambda}, \hat{\mu})$  is positive definite” to “Further suppose that  $\frac{\partial^2 \mathcal{L}}{\partial x^2}(x, \lambda, \mu)$  is positive definite for all  $x \in \mathbb{R}^n$  and for all  $\begin{bmatrix} \lambda \\ \mu \end{bmatrix}$  in a neighborhood of  $\begin{bmatrix} \hat{\lambda} \\ \hat{\mu} \end{bmatrix}$ ”
- 11.6** Lines 2–3. Change “for example:” to “for example,  $f : \mathbb{R}^n \rightarrow \mathbb{R}$  defined by:”
- 11.6** Lines 4–9. Add “ $\forall x \in \mathbb{R}^n$ ,” on each line
- 11.10** Add new part:
- (iv) “Suppose that the voltage measurement at bus 1 fails. Show that the system is unobservable.”
- 11.11(ii)** Delete part.
- 11.11(iv)** Line 5. Change “LevenbergMarquardt” to “Levenberg–Marquardt”
- 11.11(v)** Line 1. Change “Levenberg–Marquandt” to “Levenberg–Marquardt”
- 12.6(i)** Lines 1–2. Delete “(Hint: Consider Exercise 11.10.)”
- 13.2(i)** Line 3. Delete “and Exercise 2.27”
- 13.4(i)** Line 1. Change “one  $\lambda^*$  that satisfies (13.6) in Theorem 13.2” to “one value of  $\lambda^*$  that satisfies (13.6) in Theorem 13.2 corresponding to the local minimizer  $x^*$ ”
- 13.10(iii)** Line 2. Change “Hint: the” to “Hint: The”
- 13.15(ii)** Line 1. Change “ $\frac{1}{2}x^\dagger Qx + c^\dagger x + d$ ” to “ $\frac{1}{2}x^\dagger Qx + c^\dagger x$ ”
- 13.16** Line 8. Delete “Eliminate variables to”
- 13.23** Line 6. Change “the minimizer” to “each minimizer”
- 13.24** Line 8. Change “routine” to “algorithm”

- 13.25(i)** Line 4. Change “null space basis algorithm in Section” to “steepest descent null space basis algorithm described in Section”
- 13.25(i)** Line 5. Change “with the step-size” to “with  $\delta = 0.1$  and the step-size”
- 13.25(iii)** Line 2. Change “in Section” to “described in Section”
- 13.27** Line 3. Add “Suppose that  $A(\mathbf{0})$  has linearly independent rows.”
- 13.27(iii)** Line 1. Change “Suppose that  $A(\mathbf{0})$  has linearly independent rows and calculate” to “Calculate”
- 13.28** Line 1. Delete “the proof of”
- 13.31** Line 5. Add “For Part (i), use the MATLAB function `fminunc` with default parameters and initial guess given by the solution to Exercise 13.30. For Part (ii), use the MATLAB function `fsolve` with default parameters and initial guess given by the solution to Exercise 13.30.”
- 13.31** Line 5. Change “perform two inner iterations” to “perform two inner steepest descent iterations with step-size one”
- 13.31** Line 7. Add “Perform ten outer iterations.”
- 14.2(ii)** Lines 2 and 3. Change three occurrences of  $\chi$  to  $\chi'$ .
- 14.2(iii)** Lines 1 and 2. Change five occurrences of  $\chi$  to  $\chi'$ .
- 14.4** Lines 3–4. Change four occurrences of “ $x^*$ ” to “ $\hat{x}$ ”
- 14.4(i)** Line 1. Change “ $x^* = \begin{bmatrix} 5 \\ -\sin(5) \end{bmatrix}$ ” to “ $\hat{x} = \begin{bmatrix} 5 \\ \sin(5) \end{bmatrix}$ ”
- 14.4(ii)** Line 1. Change “ $x^*$ ” to “ $\hat{x}$ ”
- 14.5** Lines 3–4. Change four occurrences of “ $x^*$ ” to “ $\hat{x}$ ”
- 14.5(i)** Line 1. Change “ $x^* = \begin{bmatrix} 5 \\ -\sin(5) \end{bmatrix}$ ” to “ $\hat{x} = \begin{bmatrix} 5 \\ \sin(5) \end{bmatrix}$ ”
- 14.5(ii)** Line 1. Change “ $x^*$ ” to “ $\hat{x}$ ”
- 14.10** Add new part (vi). “Suppose we perturb the first entry of  $b$  to be  $\chi$  with  $\chi \neq 0$ . How does the solution change?”
- 14.12** Lines 4–5. Change “Assume that  $A$  has linearly independent rows. Show that Theorem 14.2 specializes to Corollary 13.4.” to “Use Corollary 13.4 to prove Theorem 14.2 in this special case.”
- 14.15** Line 4. Change “ $\|\Delta x\|_2 = 1$ ” to “ $\|\Delta x\|_2^2 = 1$ ”
- 14.15** Line 5. Change “Show that the solution is unique, that it satisfies” to “Show that only one of the solutions satisfies”
- 14.16** Line 6. Add “Use initial guess  $x^{(0)} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ .”
- 14.18** Line 4. Change “ $\forall x \in \mathbb{R}^2, g(x) = \frac{1}{4}(x_1)^2 + \frac{1}{4}(x_2)^2 - 1$ ” to “ $\forall x \in \mathbb{R}^2, g(x) = \frac{1}{4}(x_1)^2 + (x_2)^2 - 1$ ”
- 14.18** Line 6. Change “minimizer  $x^* \in \mathbb{R}$ ” to “base-case minimizer  $x^* \in \mathbb{R}^2$ ”
- 14.18** Line 9. Change “problem” to “problem between the base-case and change-case”

- 14.18(iii)** Line 2. Add “Use  $x^*$  as the initial guess.”
- 14.19(i)** Line 2. Change “problem” to “problem for a particular value of  $\chi \in \mathbb{R}$ ”
- 14.20** Figure 14.6. Delete measurements  $\tilde{P}_{12}$ ,  $\tilde{Q}_{12}$ ,  $\tilde{P}_{13}$ , and  $\tilde{Q}_{13}$ .
- 15.7(i)** Line 1. Change “MATLAB function `lsqlin`” to “MATLAB backslash operator”
- 15.11** Line 2. Change “is infeasible” to “has a maximum that is zero or strictly negative”
- 15.12(i)** Line 1. Change “solution” to “solution of Problem (15.19)”
- 15.14(i)** Line 2. Change “Consider an interconnect that consists of a single segment and take each constant in the Elmore delay function to be of value one.” to “Consider an interconnect that consists of two segments in series.”
- 15.15** Lines 2 and 3. Change two occurrences of “>” to “≥”
- 16.2** Last line. Change “ $\mu^*$ ” to “ $[\mu^*]^\dagger$ ”
- 16.7(iii)** Line 1. Add “where  $A = \begin{bmatrix} 1 & 1 \\ 0 & -1 \end{bmatrix}$ ,”
- 16.8(ii)** Line 2. Change “positive” to “non-negative”
- 16.16** Line 1. Add “Let  $A \in \mathbb{R}^{m \times n}$ ,  $b \in \mathbb{R}^m$ , and  $\forall v, x^{(v)} \in \mathbb{R}^n$ .”
- 16.21** Line 6. Change “and  $t^{(0)} = 1$ ” to “ $\mu^{(0)} = \begin{bmatrix} 0.2 \\ 0.2 \end{bmatrix}$ , and  $t^{(0)} = 1$ ”
- 17.2(i)** Line 5. Change “Show that there is at most one value of the vector of Lagrange multipliers” to “Show that there is at most one value of the pair of Lagrange multipliers  $\lambda^*$  and  $\mu^*$  satisfying (17.2) in Theorem 17.1 corresponding to the local minimizer  $x^*$ ”
- 17.9** Line 1. Change “positive definite” to “symmetric and positive definite”
- 17.14(i)** Line 4. Change “ $\lambda_1^{(0)} = 0, \lambda_2^{(0)} = 0$ ” to “ $\lambda^{(0)} = [0]$ ”
- 17.16** Line 17. Change “0.75” to “0.5”
- 17.16** Last four lines. Delete “Use as stopping criterion that all of the following are satisfied:
- $t_{\text{effective}} < 10^{-5}$ , and
  - the change in successive iterates is less than 0.0001 per unit.”
- 17.21** Line 5. Change “ $b = [-3]$ ” to “ $b = [0]$ ”
- 18.1(ii)** Line 5. Add “Perform ten iterations.”
- 18.2(ii)** Line 2. Add “Use as initial guess the minimizer of the base-case problem.”
- 18.2(iv)** Line 3. Add “Use as initial guess the minimizer of the base-case problem.”
- 18.3(i)** Line 3. Change “ $\lambda^{(0)} = [0]$ ” to “ $\lambda^{(0)} = \mathbf{0}$ ”
- 18.4(ii)** Line 2. Add “Use as initial guess the minimizer of the base-case problem.”
- 18.4(iv)** Line 2. Add “Use as initial guess the minimizer of the base-case problem.”
- 18.6(i)** Line 1. Change “`fmincon`” to “`linprog`”

**18.8** Line 4. Change “maximum” to “strictly positive maximum”

**18.8(ii)** Lines 1–2. Change “their maximizers specify the same hyperplane” to “every maximizer of one is a maximizer of the other”

**18.8** Line 8. Change “feasible solution  $\begin{bmatrix} z^{**} \\ x^{**} \end{bmatrix} = \begin{bmatrix} z^{**} \\ \beta^{**} \\ \gamma^{**} \end{bmatrix}$  of” to “feasible point

$$\begin{bmatrix} z^{**} \\ x^{**} \end{bmatrix} = \begin{bmatrix} z^{**} \\ \beta^{**} \\ \gamma^{**} \end{bmatrix} \text{ for”}$$

**18.8** Line 9. Change “feasible solution” to “feasible point”

**18.8** Line 10. Change “ $\|\beta^{**}\|_2$ ” to “ $\max\{0.5, \|\beta^{**}\|_2\}$ ”

**18.9(i)** Line 2. Change “is infeasible” to “has maximum equal to zero”

**19.2** Line 3. Change “g” to “h”

**19.3(v)** Lines 1–3. Change “Find another specification of the inequality constraint functions (possibly involving more than two inequality constraints) that specifies the same feasible set and such that  $x^*$  is a regular point of the constraints  $h(x) \leq \mathbf{0}$ ” to “Find a specification of an equality constraint function  $g : \mathbb{R}^n \rightarrow \mathbb{R}^m$  that specifies the same feasible set and such that  $x^*$  is a regular point of the constraints  $g(x) = \mathbf{0}$ ”

**20.5** Line 15. Change “0.75” to “0.5”