

# Errata

for

*Logic-Based Methods for Optimization: Combining Optimization and Constraint Satisfaction*

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*Page 17, paragraph 1 line 1.* Change ‘for deep analysis’ to ‘natural subject for deep analysis’.

*Page 18, paragraph 4 line 4.* Change ‘ $c_{y_1y_2}$ ’ to ‘ $c_{y_2y_3}$ ’.

*Page 22, first formula, line 3.* Change ‘all  $i$ ’ to ‘all  $j$ ’.

*Page 22, first formula, line 5.* Change ‘ $m_j$ ’ to ‘ $m_i$ ’.

*Page 23, first formula, line 3.* Change ‘all  $i$ ’ to ‘all  $j$ ’.

*Page 23, paragraph 2, line 2.* Change ‘known an’ to ‘known as an’.

*Page 23, end of (2.4).* Add ‘ $1 \leq x_j \leq 4$ , all  $j$ ’.

*Page 26, Fig. 2.1.* Change ‘ $y_{21}$ ’ to ‘ $y_{23}$ ’ on line to node 9, ‘ $y_{21}$ ’ to ‘ $y_{24}$ ’ on line to node 10, ‘ $y_{31}$ ’ to ‘ $y_{34}$ ’ on line to node 25.

*Page 27, line 1.* Change ‘node 15’ to ‘node 16’.

*Page 29, paragraph 4, line 4.* Change ‘fractional’ to ‘integral’.

*Page 30, Fig. 2.2, Node 3.* Change 
$$\begin{bmatrix} & 3 & 4 \\ & 2 & 3 & 4 \\ 1 & 2 & 3 & 4 \end{bmatrix}$$
 to 
$$\begin{bmatrix} & 3 & 4 \\ & 3 & 4 \\ 1 & 2 & & \end{bmatrix}.$$

*Page 30, Fig. 2.2, Node 4.* Change 
$$\begin{bmatrix} & 3 & 4 \\ & 2 & 3 \\ & 2 & 3 & 4 \end{bmatrix}$$
 to 
$$\begin{bmatrix} & & & 4 \\ & & 3 & \\ & 2 & & \end{bmatrix}.$$
  
infeasible  $\bar{x} = (4, 3, 2)$   
 $v = \infty$   $v = 52$

*Page 30, paragraph 2, line –2.* Change ‘node 6’ to ‘node 5’.

*Page 34, formula (2.7).* Change ‘minimize’ to ‘maximize’.

*Page 35, line 2.* Change ‘will be later’ to ‘will later’.

*Page 35, formula (2.9).* Change ‘minimize’ to ‘maximize’.

Page 36, paragraph 4, line 6. Change ‘ $\bar{y}_1$  to 0’ to ‘ $\bar{y}_1$  to  $1/2$ ’.

Page 38, constraint (d), line 2. Change ‘ $\geq$ ’ to ‘ $\leq$ ’.

Page 39, lines 8-9. Change ‘Integrality is enforced only for the  $\delta_{ijt}$  because it implies’ to ‘Integrality can be enforced only for the  $y_{it}$  because this implies’.

Page 39, constraints (f) and (g). Add ‘all  $i, t$ ’.

Page 44, paragraph 3, line 3. Change ‘em not’ to ‘not’.

Page 50, paragraph 1, line 1. Change ‘clearly’ to ‘clearly satisfies’.

Page 51, formula (3.7), line 2. Change ‘false’ to ‘true’.

Page 60, Fig. 3.6, line 2. Delete ‘ $\bar{D} = D$ ’.

Page 62, formula (4.1). Change ‘ $m$ ’ to ‘ $n$ ’.

Page 62, last formula. Change ‘ $\bigwedge_{i=1}^k \bigwedge_{j=1}^n$ ’ to ‘ $\bigwedge_{i=1}^k \bigvee_{j=1}^n$ ’.

Page 63, first formula. Same correction.

Page 64, paragraph 2, line 4. Change ‘no point is’ to ‘no point in’.

Page 65, line –5. Change ‘ $C_k$ ’ to ‘ $C_i$ ’.

Page 66, line –2. Change ‘sematic’ to ‘semantic’.

Page 68, line 6. Change ‘not part’ to ‘not be part’.

Page 71, formula following (5.4). Change ‘ $j \in J_1$ ’ on right-hand side of inequality to ‘ $j \in J_0$ ’.

Page 73, paragraph 3, last line. Change ‘ $\beta - \alpha$ ’ to ‘ $\alpha - \beta$ ’.

Page 74, paragraph 2, line 3. Change ‘ $i \in J$ ’ to ‘ $j \in J$ ’.

Page 76, line 1. Change ‘ $a_k$ ’ to ‘ $c_k$ ’.

Page 76, paragraph 4, line 2. Change ‘if degree  $\delta$ ’ to ‘of degree  $\delta$ ’.

Page 76, paragraph 4, line 4. Change ‘ $a_j \neq 0$ ’ to ‘ $c_j \neq 0$ ’.

Page 77, line –4. Change ‘all  $i \in J$ ’ to ‘all  $j \in J$ ’.

Page 82, part (a) of proof, line 1. Change ‘ $ax \geq \beta$ ’ to ‘ $ay \geq \beta$ ’. Same change in part (b) of proof.

Page 84, example, first formula, line 4. Change ‘ $-\frac{3}{2} \leq$ ’ to ‘ $-\frac{3}{2} \geq$ ’.

Page 84, example, second formula, lines 1-3. Change each ‘ $> \frac{3}{2}$ ’ to ‘ $< -\frac{3}{2}$ ’. Change ‘ $-\frac{3}{2}$ ’ in next line to ‘ $\frac{3}{2}$ ’.

Page 85, fourth formula, lines 1 and 4. Change each ‘ $>$ ’ to ‘ $<$ ’.

Page 86, second example, formula. Change ‘minimize’ to ‘maximize’.

Page 87, line 2. Change ‘ $v_3 < 0$ ’ to ‘ $v_3 > 0$ ’.

Page 87, formula (5.14), line 4. Change ' $< -\frac{3}{2}$ ' to ' $> -\frac{3}{2}$ '.

Page 87, formula (5.14), line 5. Change ' $> \frac{3}{2}$ ' to ' $< \frac{3}{2}$ '.

Page 92, paragraph 2, line 2. Change ' $\sum_{j \in b}$ ' to ' $\sum_{j \in B}$ '.

Page 92, lines -1, -2 and -4. Change 6 occurrences of ' $|B|$ ' to ' $|B_3|$ '.

Page 93, formula (6.17). Change 'if  $j = i$ ' to 'if  $j = i, j \in J$ '.

Page 93, Theorem 22. Change ' $ax \geq \beta + 1$ ' to ' $ax \geq \beta + 1 + n(a)$ '.

Page 94, line 5. Change ' $a^i \geq 2q\beta$ ' to ' $a^i x \geq \beta$ '.

Page 94, line 8. Change 'for  $j \in J$  and  $c_j \in \{1, -1, 0\}$  for  $j \in \bar{J}$ ' to 'for  $j \in J, c_j^i \in \{1, -1, 0\}$  for  $j \in \bar{J}$ , and  $b_j^i \in \{0, 1\}$ '.

Page 98, 2nd paragraph after Lemma 26, line 1. Change 'Lemma 26 implies' to 'Lemmas 25 and 26 imply'.

Page 98, line -4. Change 'Lemma 23' to 'Lemma 25'.

Page 99, Fig. 6.1. Add line from node 2 to node 13. Delete line from node 5 to node 13. Change right-hand side of first inequality at node 6 from 9 to 10.

Page 103, line 1. Change 'Lemma 31' to 'Lemma 30'.

Page 103, line 2. Change ' $\bar{x}_j + \dots$ ' to ' $\bar{x}_k + \dots$ '.

Page 123, last line. Change ' $+3y_4 + 2y_5$ ' to ' $+3y_5 + 2y_6$ '.

Page 128, paragraph 1, line 2. Change 'those structure' to 'those whose structure'.

Page 134, 2nd line after (d). Change 'lie between within' to 'lie within'.

Page 138, paragraph 2, line 6. Change 'traveling problem' to 'traveling salesman problem'.

Page 139, second formula, line 1. Change ' $5x_1$ ' to ' $5y_1$ '.

Page 139, third formula, line 2. Change ' $5x_1$ ' to ' $5y_1$ '.

Page 140, expression (a). Change 'minimize' to 'maximize'.

Page 141, line 2. Change 'minimize' to 'maximize'.

Page 142, paragraph 3, line -3. Change 'stage of the party' to 'one stage of the party'.

Page 143, lines 6 after formula. Change 'and (i)' to 'to (i)'.

Page 145, line 1 of formula. Change ' $u_j \geq t_j - S_j$ ' to ' $u_j \geq t_j + D_j - S_j$ '.

Page 147, Fig. 8.3(b). Change ' $t + \frac{b}{s}$ ' (axis label) to ' $u + \frac{b}{s}$ '.

Page 147, second formula. Change ' $\left(\frac{b_j}{r_j} - u_j\right)$ ' to ' $\left(t_j + \frac{b_j}{r_j} - u_j\right)$ '.

Page 147, third formula. Change ' $s_j u_j$ ' to ' $s_j(u_j - t_j)$ '.

Page 148, constraint (f). Change ' $s_i u_i$ ' to ' $s_i(u_i - t_i)$ '.

Page 150, bullet 4, line 3. Change 'constrains' to 'constraints'.

Page 150, bullet 5, line 2. Change 'of set' to 'a set'.

Page 152, line 14. Change 'if an only of' to 'if and only if'.

Page 155, point (d), line 1. Change 'also generated' to 'also be generated'.

Page 155, first line following point (d). Change 'used is precisely' to 'used in precisely'.

Page 156, line 4. Change 'my indicate' to 'may indicate'.

Page 159, section 9.2, line 2. Change 'triple' to 'quadruple'.

Page 159, section 9.2, paragraph 3, line 4. Change 'then then  $Q$ ' to 'then the node'.

Page 159, line -2. Change 'to than the value' to 'to the value'.

Page 160, line 1. Change ' $S = \{p_i(y)\}$ ' to ' $S = \{g_i(y)\}$ '.

Page 170, line 4. Change 'it convenient' to 'it is convenient'.

Page 170, paragraph 3, lines 5 and 7. Change ' $x_2$ ' to ' $x_3$ '.

Page 172, Fig. 10.3, lines 4 and 5. Change '(a),(b)' to '(a)'.

Page 172, Fig. 10.3, line 6. Change ' $(x_5, x_6) = (1, 0)$ ' to ' $(x_5, x_6) = (0, 1)$ '.

Page 173, Fig. 10.4, lower right. Change ' $(x_2, x_5, x_6) = (1, 0, 0)$ ' to ' $(x_2, x_5, x_6) = (1, 1, 0)$ '.

Page 173, Fig. 10.4, caption. Change 'graph is 4' to 'graph is 3'.

Page 175, Section 10.3, ine 2. Remove 'indexconsistency, adaptive'.

Page 178, proof of Lemma 38, line 5. Change ' $(k + 1, \dots, n)$ ' to ' $(w + 1, \dots, n)$ '.

Page 186, paragraph 2, line 2. Change 'who optimal value' to 'whose optimal value'.

Page 187, Section 11.1, paragraph 2, line 2. Change 'adaptive consistency' to 'adaptive consistency'.

Page 190, first formula. Change 'with  $a_j > 0$ ' to 'with  $a_j^i > 0$ '.

Page 190, formula (11.1). Change ' $\min D_k$ ' to ' $\min D_{x_k}$ '.

Page 191, fifth formula. Change ' $[\min_{j \in D_y} \{c_j\}, \min_{j \in D_y} \{c_j\}]$ ' to ' $[\min_{j \in D_y} \{c_j\}, \max_{j \in D_y} \{c_j\}]$ '.

Page 192, Example, line 2. Change 'element' to 'xelement'.

Page 193, last 2 formulas. Change ' $j \in F(i)$ ' to ' $j \in S_i$ '.

Page 194, part (a), line 4. Change ‘and no larger than’ to ‘and the largest element no larger than’.

Page 195, Example, line 2. Change ‘sum’ to ‘xsum’.

Page 195, line –7. Change ‘can be exactly equal to 50; however, a sum of 80 or 100’ to ‘can be exactly equal to 50 or 100; however, a sum of 80’.

Page 195, line –2. Change ‘ $\geq 60 - (40 + 30) = -10$ ’ to ‘ $\geq 50 - (40 + 30) = -20$ ’.

Page 199, Section 11.3.2, paragraph 3, line 5. Change ‘has running time is’ to ‘has running time’.

Page 200, Fig 11.4. Add an arc from  $y_5$  to 2.

Page 200, paragraph 2, line 3. Change ‘part of an alternating’ to ‘part of an even alternating’.

Page 201, Example, line 3. Change ‘ $(y_6, 4)$ ’ to ‘ $(y_5, 4)$ ’.

Page 208, Fig. 12.2, lower right. Change ‘parent(alice,debby)’ to ‘parent(charles,debby)’.

Page 226, paragraph 2, line 1. Change ‘takes of advantage’ to ‘takes advantage’.

Page 228, lines –12 and –14. Change ‘ $\sum_{j \in J} \lambda_j \leq 1$ ’ to ‘ $\sum_{j \in J} \lambda_j = 1$ ’.

Page 230, Fig. 13.1, line –2. Change ‘ $(x_1, \dots, x_m)$ ’ to ‘ $(y_1, \dots, y_m)$ ’ and change ‘ $(y_{j_1}, \dots, y_{j_{n-1}})$ ’ to ‘ $(z_{j_1}, \dots, z_{j_{n-1}})$ ’.

Page 230, Theorem 46, line 2. Change ‘(13.5)’ to ‘(13.4)’.

Page 231, formula (13.7), line 2. Change ‘–7’ to ‘–2’.

Page 232, formula (13.10). Change ‘ $J \in \{1, \dots, n\}$ ’ to ‘ $J \subset \{1, \dots, n\}$ ’.

Page 235, formula (13.15), line 4. Change ‘ $x_1, x_2 \leq M$ ’ to ‘ $0 \leq x_1, x_2 \leq M$ ’.

Page 235, next line. Change ‘could be scheduled’ to ‘could finish’.

Page 235, formula (13.16). Insert to inequalities after line 2: ‘ $x_1 - x_2 \geq -8$ ’ and ‘ $x_1 - x_2 \leq 8$ ’.

Page 236, Fig. 13.2. Add cuts for  $x_1 - x_2 \geq -8$  and  $x_1 - x_2 \leq 8$ .

Page 240, formula (13.24). Change all occurrences of ‘ $i$ ’ to ‘ $k$ ’ and both occurrences of ‘ $I$ ’ to ‘ $K$ ’.

Page 241, formula (13.25), line 3. Change ‘ $x_1 = x_2 = 0$ ’ to ‘ $x_1 = 0, x_2 \geq 0$ ’.

Page 241, paragraph 1, lines –1 and –2. Change ‘all directions between north and east (i.e., directions of the form  $(\alpha, \beta)$  for  $\alpha, \beta \geq 0$ )’ to ‘all directions of the form  $(\alpha, \beta)$  with  $\alpha \geq c, \beta \geq 0$ ’.

Page 243, paragraph 3, line 2. Change ' $P(\bar{y})$ ' to ' $P(\bar{y})$ '.

Page 244, formula (13.29), line 3. Change ' $y_k \in \{0, 1\}$ ' to ' $0 \leq y_k \leq 1$ '.

Page 244, line -8. Change ' $A_i^k \geq a_i^k$ ' to ' $A_i^k x \geq a_i^k$ '.

Page 246, Theorem 50, line 2. Change ' $0 \leq x \leq M_k$ ' to ' $0 \leq x \leq m$ '.

Page 246, Theorem 50, line 5. Change '(13.23)' to '(13.29)'.

Page 247, Proof of Claim, line 3. Change '(13.35)' to '(13.36)'.

Page 247, Proof of Claim, paragraph 2, line -1. Change ' $P_{\bar{x}}$ ' to ' $P(\bar{x})$ '.

Page 248, Section 13.3.3, paragraph 2, line 3. Change '(13.25)' to '(13.26)'.

Page 248, both formulas, line 2. Add ' $k \in K$ '.

Page 249, lines 2-3. Change 'satisfy the continuous relaxation (13.18)' to 'satisfy the above continuous relaxation'.

Page 249, first formula, line 2. Add ' $k \in K$ '.

Page 252, second formula. Change ' $u^k A \geq u^k a$ ' to ' $u^k Ax \geq u^k a$ '.

Page 252, line -5. Change '(13.16)' to '(13.47)'.

Page 253, line 5. Change '(13.16)' to '(13.47)'.

Page 253, formula (13.48a). Change ' $\alpha^i$ ' to ' $\alpha_i$ '.

Page 253, formula (13.48d). Change ' $y \geq 0$ ' to ' $0 \leq y \leq 1$ '.

Page 255, line 1. Change '(13.16)' to '(13.47)'.

Page 255, line -1. Change '(13.22) in' to 'at the end of'.

Page 257, formula (13.55). Change ' $\hat{b}x$ ' to ' $\hat{b}\hat{x}$ '.

Page 258, paragraph 3, line 4. Change '(surrogate)' to '(surrogate) of'.

Page 259, Example, line 7. Change ' $\bar{x} = (1, 1)$ ' to ' $\bar{x} = (3, 3)$ '.

Page 260, line -4. Change '(13.23)' to '(13.27)'.

Page 261, paragraph 2, line -1. Change 'Theorem 57' to 'Theorem 53'.

Page 261, line -2. Reverse signs of both terms of left-hand side of equation. Thus the equation becomes ' $-\sum_i x_{ij} + \sum_i x_{ji} = S_j$ '.

Page 262, line 3 of first and second formulas, line 4 of third formula. Reverse signs of both terms of left-hand side of these three equations.

Page 264, line -4. Change ' $1, \dots, k$ ' to ' $1, \dots, K$ '.

Page 265, Section 13.4.7, line 3. Delete 'EQ'.

Page 266, all three formulas. Change ' $x$ ' to ' $z$ '.

Page 270, line 6. Change '(13.68)' to '(13.70)'.

Page 270, second formula. Line 1 should be ' $\sum_{k \in D_y} x_k \leq Kz + (K - 1)m_0$ '.

Line 2 should be ' $\sum_{k \in D_y} x_k \geq Kz - (K - 1)m_0$ '.

Page 270, line -8. Change '(13.68)' to '(13.69)'.

Page 270, line -7. Change '(13.69)' to '(13.70)'.

Page 274, formula (14.3). Change ' $\neg g_i(y)$ ' to ' $\neg q_i(y)$ '.

Page 276, paragraph 2, line 2. Change 'Section refinferredual.lp' to 'Section 17.3'.

Page 277, line -5. Change ' $z(\bar{y}^p)$ ' to ' $z(\bar{y}^p) + f(\bar{y}^p)$ '.

Page 281, line -8. Change 'Langrage' to 'Lagrange'.

Page 281, last two formulas. Remove all four occurrences of ' $\nabla$ '.

Page 282, formula (14.22). Remove all three occurrences of ' $\nabla$ '.

Page 295, Table 15.3. Move 'short clauses' to third column.

Page 321, second formula. Change 'minimize  $\theta(\lambda)$ ' to 'maximize  $\theta(\lambda)$ '.

Page 333, formula (17.4). Change 'minimize' to 'maximize'.

Page 338, formula (17.8). Change 'minimize' to 'maximize'.

Page 375, line -7. Change 'partial resolution' to 'parallel resolution'.

Page 384, paragraph 1, line 2. Change 'partial resolution' to 'parallel resolution'.

Page 387, Table 18.5, line 3. Move ' $\neg x_2 \vee (\neg x_1)$ ' to column 3 of table.

Page 417, formula after (19.51). Add the constraint  $\sum_i x_{ij} \geq 1$ , all  $j$  immediately after constraint (c). Relabel constraints (d)-(f) to (e)-(g).

Page 416, line -12. Change 'Constraints (e)' to 'Constraints (f)'.

Page 419, third formula. Change ' $b - B^2\bar{y}^2$ ' to ' $a - B^2\bar{y}^2$ '.