

Errata for
Network Flows: Theory, Algorithms, and
Applications.¹

By

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Errors listed in **blue** were corrected in the 4th printing of the textbook.
Errors listed in **boldface black** still remain as errors.

I thank all of you who have sent me corrections over the years. If you find any errors that are not currently listed, please send them to [Jim Orlin \(jorlin@mit.edu\)](mailto:jorlin@mit.edu)

Chapter 1

page 2, line 3. **“in this book are” should be “in this book is”.**

page 15, line -8. *“ $r_{ij}x^2_{ij}$ ohms” should be “ $r_{ij}x^2_{ij}$ watts”.*

page 17, line -10. *“(b_i, b_j)” should be “(b_i, c_j)”.*

Chapter 2

page 27. **Figure 2.4a. The arc (2, 3) should be (3, 2) to be consistent with the description on page 26.**

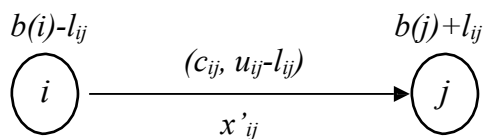
page 27, line 4. *“Acyclic Network” should be “Acyclic Graph”.*

page 29, line -6. **“two special type” should be “two special types”.**

page 29, line -4. *“Directed-out-Tree” should be “Directed-Out-Tree”.*

page 30, line 1. *“Directed-in-Tree” should be “Directed-In-Tree”.*

page 39, **Figure 2.19 the graph on the right should be:**



page 40, line 15. *“new mode” should be “new node”.*

page 41, Figure 2.22.(b) *“ b_i ” should be “ $b(i)$ ” and “ b_j ” should be “ $b(j)$ ”.*

Chapter 3

page 62, line -7. *“polynomial time algorithm” should be “polynomial-time algorithms”.*

page 64, line 18. *“empty state” should be “empty stack”.*

page 65, line 5. *“ $|\phi(k)|$ ” should be “ $\phi(k)$ ”.*

page 74, line 18. *“ $order(i)$ is the i th node” should be “ $order(i)$ is the order of node i ”.*

¹ Last update: January 20, 2014

page 74, Figure 3.4. line 7. “order(next) := s” should be “order(s) := next”.

page 74, Figure 3.4. line 7. “order(s) := s” should be “order(s) := next”.

page 74, Figure 3.4. line –6. “order(j) := next” should be “order(j) := next;”.

page 75. Figure 3.5b. order(4) = 4 and order(5) = 5.

page 77, line –10. “a network that possesses a topological order cannot contain a cycle” should be “we shall show next that a network that does not contain any negative cycle can be topologically ordered”.

page 80, line –15. “set of path and cycle flow” should be “set of path and cycle flows”.

page 80, line –15. “cycle fow” should be “set of path and cycle flows”.

page 80, line –7. “path and cycle flow” should be “a path and cycle flow”.

page 83, line 22. “ $cx = cx^0 + cx^1$ ” should be “ $x = x^0 + x^1$ ”.

page 85, line 1. “used” should be “use”.

page 85, line 13. “correspond” should be “corresponds”.

page 86, Exercise 3.9. line 4. “every pairs of elements” should be “every pair of elements”.

page 86, Exercise 3.9. line 5. “ $k = 1, \dots, n$ ” should be “ $k = 1, \dots, (n-1)$ ”.

page 86, Exercise 3.9. line 5. “ $k = 1, \dots, (n-1)$ ” should be “ $k = 1, \dots, (n-1)$ ”.

page 88, Exercise 3.19. Please ignore this exercise. It was intended to be an easy exercise in dynamic programming, but the proof was incorrect.

page 88, Exercise 3.20. This exercise is a follow-on to Exercise 3.19 and can also be ignored.

page 90, Exercise 3.34. “the longest path in any depth-first search tree, no matter which node is selected as the source node” should be “the longest path in some depth-first search tree”.

page 92, Figure 3.15. (b) Arrows should be added: $1 \rightarrow 4$, $2 \rightarrow 1$, $2 \rightarrow 3$, $3 \rightarrow 1$, $3 \rightarrow 4$, $4 \rightarrow 5$, $5 \rightarrow 1$, $5 \rightarrow 2$.

page 92, Exercise 3.51. line 1. “node $j (i \neq j)$ can be” should be “node $j (i \neq j)$ containing any arc at most once can be”.

Chapter 4

page 96, line 4. “analog mode” should be “analog model”.

page 98, Figure 4.1. line 2. “shortest problem” should be “shortest path problem”.

page 103, line –12. “ $n \times m$ constraint matrix” should be “ $m \times n$ constraint matrix”.

page 103, line –3. “this model in the telephone” should be “this model in telephone”.

page 105, line –14. “ $x(23) = y_0 + y_2 + \dots + y_{23} = p$ ” should be “ $x(23) = y_0 + y_1 + \dots + y_{23} = p$ ”.

page 107, line –12. “become” should be “because”.

page 109, line –2. “(e) illustrate the operations for these iterations” should be “(c) illustrate the operations for some of these iterations”.

page 109, line –1. “Figure 4.7(f) shows the shortest path tree for this example” should be deleted.

page 110, line 4. “hypothesis” should be “hypotheses”.

page 110, line 5. “each node in S is the shortest path length” should be “each node in \bar{S} is the shortest path length”. This was correctly printed in the first printings of the book, but incorrect in subsequent printings.

page 115, Figure 4.10, line -4. “*decrease-key*(value, i , H)” should be “*decrease-key*(value, j , H)”.

page 119, Figure 4.12. *content*(7) should be “ \emptyset ”.

page 121, line 12. “algorithm” should be “algorithms”.

page 122, line 3. “before 1984” should be “before 1980”.

page 123, line 1. [1997a] should be [1997].

page 125, Exercise 4.3. line -5. “the shelf per unit length” should be “the shelf per unit length $C_1 \leq C_2 \leq \dots \leq C_h$ ”.

page 125, Exercise 4.4. “ E_i ” should be “ F_i ”.

page 130, Exercise 4.41. line 5. “capacity in the cut” should be “capacity among forward arcs in the cut”.

page 131, Exercise 4.44. (b) “ $\beta_{ij} = +\infty$ and” should be deleted.

Chapter 5

page 138. Figure 5.2f. Arc (3,5) should be shaded rather than (4,5).

page 138. Figure 5.2. The cost of arc (4,5) should be 3 in all figures. In Figure 5.2f, arc (3,5) should be shaded rather than (4,5).

page 139, line 7. “Property 5.1” should be “Property 5.2”

page 140, line 3. “each $d(j)$ ” should be “each finite $d(j)$ ”.

page 143, line 7. “solving the shortest path” should be “solving shortest path”.

page 144, line 3. “marked” should be “labeled” and “unmarked” should be “unlabeled”.

page 144, line 4. “marked” should be “labeled”.

page 144, line 4. “We mark node k , trace the predecessor indices starting at node k , and mark all the nodes encountered until we reach the first already marked node, say node l . If $k = l$, the predecessor graph contains a cycle, which must be a negative cycle (why?)” should be replaced by “We assign a label k to node k , trace the predecessor indices starting at node k , and assign the label k to all the nodes encountered until we reach the first already labeled node, say node l . If nodes k and l have the same labels, then the predecessor graph contains a cycle, which must be a negative cycle (why?)”.

page 144, line 16. “from node 1 to node j ” should be “from node s to node j ”.

page 144, line 16. “ $d(k) \geq d(l) + c_{kl}$ ” should be “ $d(l) \geq d(k) + c_{kl}$ ”.

page 144, line 18. “connected to node 1” should be “connected to node s ”.

page 144, line -14. “with nonnegative arc” should be “with arbitrary arc”.

page 146, line 4. “label represents” should be “label, if finite, represents”.

page 146, Theorem 5.5. line 3. “node i to node j ” should be “node i to node j satisfying $d[i,i] = 0$ for all $i \in N$, and $d[i,j] \leq c_{ij}$ for all $(i,j) \in A$ ”.

page 146, Theorem 5.5. line 3. “satisfying $d[i,j] = 0$ ” should be “satisfying $d[i,i] = 0$ ”.

page 146, line –4. “Label Correcting Algorithm” should be “Label-Correcting Algorithm”.

page 148, Prop 5.6. “ $d^k[i,k] + d^k[k,i]$ ” should be “ $d^k[i,k] + d^k[k,j]$ ”.

page 149, line 17. “length – nC ” should be “length less than – nC ”.

page 159, Exercise 5.8. line 3, “and the network contains no negative cycles.” should be added.

page 159, Exercise 5.8, parts b and c. “ $O(2^n)$ ” should be “ $O(n 2^n)$ ”

page 159, Exercise 5.8. (c) “label correcting algorithm” should be “label-correcting algorithm”.

page 160, Exercise 5.19. Add the assumption that there are no negative length cycles in G.

page 162, Exercise 5.38. “Let $d^{n+1}(i,j)$ denote the node pair distances at the end of the Floyd-Warshall algorithm” should be replaced by “Let $d^{n+1}(i,j)$ denote the node pair distances at the end of the Floyd-Warshall algorithm, when the network is initialized with $d[i,i] = \infty$ instead of $d[i,i] = 0$ for all i ”.

page 164, Exercise 5.47, lines 7 and 8. “defines a set of one or more directed cycles with the same ratio” should be “defines a set of one or more directed cycles. If there is one directed cycle, it has the same ratio. If there is more than one directed cycle, then one of the cycles C has a ratio that is at most the value of the optimum solution.”

page 165, Exercise 5.55. line 1. “at most k ” should be “exactly k ”.

Chapter 6

page 168, line 3. “ $\max \{u_{ij} : (i, j) \in A\}$ ” should be “ $\max \{u_{ij} : u_{ij} < \infty \text{ and } (i, j) \in A\}$ ”.

page 168, line 3. “ $\max \{u_{ij} : U_{ij} < \infty \text{ and } (i, j) \in A\}$ ” should be “ $\max \{u_{ij} : u_{ij} < \infty \text{ and } (i, j) \in A\}$ ”.

page 171, line –7. “scheme, if it exists, by” should be “scheme by”.

page 171, line –5. “solving two maximum flow problems” should be “solving a maximum flow problem”.

page 177, line 11. “We use these properties” should be “We will later use these properties”.

page 179, line –8. “in the next section” should be “in section 6.5”.

page 179, line –8. “in section 6–5” should be “in section 6.5”.

page 185, Figure 6.17. line 9. “**while** LIST $\neq \emptyset$ or t is unlabeled **do**” should be “**while** LIST $\neq \emptyset$ and t is unlabeled **do**”.

page 185, Figure 6.17. line 11. “if $r_{ij} > 0$ and node j is unlabeled” should be “if node j is unlabeled”.

page 189, Theorem 6.8, line 2. Add “not including s and t ” after “nodes”

page 189, Theorem 6.8. line 3. “nodes s to node t ” should be “node s to node t ”.

page 190, line –12. “out Q consists solely of artificial arcs” should be “forward arcs in the cut Q must be artificial arcs”.

page 190, line –11. “if $(s, i) \in Q$ and $(i, t) \in Q$ ” should be “if $(s, i) \in Q$ or $(i, t) \in Q$ ”.

page 193, line 1. “ r'_{ij} ” should be “ r'_{ji} ”.

page 194, line 1. “equals its flow” should be “equals its inflow”.

page 196, line 16. “related of each other” should be “related to each other”.

page 196, line 21. “establish” should be “established”.

page 199, Exercise 6.3. line 1. “node p in a communication network G ” should be “node p in an undirected communication network G ”.

page 202, Exercise 6.18 (b) line 3. “value of all the flows” should be “value of all feasible flows”.

page 206, Figure 6.26. line 1. “the fall graph” should be “the full graph”.

page 206, Figure 6.26. line 2. “capacity are connecting” should be “capacity arc connecting”.

Chapter 7

page 211, line 24. “within $O(m \log U)$ ” should be “within $O(m \log U)$ iterations”.

page 211, line –20. “capacity because” should be “capacity, because”.

page 216, line 10. “new distance labels” should be “new distance label”.

page 217, Figure 7.7. r_{12} should be 2 and $d(2)$ should be 3.

page 217, line –10. “which is same” should be “which is the same”.

page 222, line 19. “when as” should be “when, as”.

page 228, line 9. “so a directed” should be “so there is a directed”.

page 228, lines -17 and -16. “7.12” should be “7.13”
 “Lemma 7.7” should be “Property 7.7”

page 236, line –4. “A *phase* consists of the sequence of pushes between two consecutive relabel operations” should be replaced by “Let $d_{\max} = \max\{d(i) : i \text{ is an active node}\}$. A phase consists of the sequence of pushes during which there are no relabels”.

page 236, line –4. “an active nvd1” should be “an active node”.

page 246, Exercise 7.19. line 2. “the maximum flow problem works” should be “the maximum flow problem”.

page 248, Exercise 7.31. After line 3, add “Assume that $0 \leq \alpha_i, \beta_i \leq p$ for each i .”
 Replace part (a) with the following. Let “ $\alpha_j^* = |\{i : \alpha_i \geq j\}|$, the number of rows whose sum is at least j . Show that the vectors α and β must satisfy the following conditions, (1) $\sum_{i=1}^p \alpha_i = \sum_{i=1}^p \beta_i$ and $\sum_{i=1}^j \alpha_i \geq \sum_{i=1}^j \beta_i$ for each $j = 1$ to p .”

Chapter 8

page 253, line 10. “a node in the k th layer” should be “a node in the $(k+1)$ th layer”.

page 253, line 11. “ $(k+1)$ th layer for some k ” should be “ k th layer for some k ”.

page 253, line –19. “in $G(x)$ ” should be “in $G(x)$ ”.

page 254, line 14. “of labeling algorithm” should be “of the labeling algorithm”.

page 257. The algorithm assumes that all flow is sent from s along single arcs, and then all flow is returned along paths of length 2. This would not work because no flow would ever return to s . The algorithm can be patched by permitting flows in admissible arcs (i, s) . We should also permit flows in admissible arcs (i, t) so that we do not need to assume which part t belongs to.

page 261. line -5. “ $n \geq m/3$ ” should be “ $n \geq m/3$ ”

page 273, Prop. 8.11.(b) “ $\alpha(G) \leq \lfloor m/n \rfloor$ ” should be “ $\alpha(G) \leq \lfloor 2m/n \rfloor$ ”.

page 287, line 9. “ $\notin (\min\{n^{3/2}m, m^{3/2}\})$ ” should be “ $\notin (\min\{n^{2/3}m, m^{3/2}\})$ ”.

page 289. Exercise 8.6. line 1. “for bipartite networks” should be “for unit capacity”

simple bipartite networks”.

page 289, Exercise 8.10. (b) “the nodes have a total excess of at most $n^{1/2}$ ” should be “the maximum additional flow that can reach the sink is at most $n^{1/2}$ ”.

page 289, Exercise 8.11. (Rephrasing) Let x be a flow in a directed network. Assume that x is not a maximum flow. Let P and P' denote two successive shortest paths (i.e, P' is the shortest path after augmentation on path) and suppose that P' contains at least one arc whose reversal lies in P . Show that $|P'| \geq |P| + 1$.

page 289, Exercise 8.11. line 4. “ $|P'| \geq |P| + 2$ ” should be “ $|P'| \geq |P| + 1$ ”.

page 289, Exercise 8.12. “ $w_{\max} < \frac{\sum_{i \in S} w_i + \sum_{1 \leq i < j \leq n} g_{ij}}{|S|}$ ” should be

$$\text{“} w_{\max} < \frac{\sum_{i \in S} w_i + \sum_{1 \leq i < j \leq n} g_{ij} - \sum_{i \in S \text{ and } j \in S} g_{ij}}{|S|}\text{”}$$

page 291, Exercise 8.25. line 4. “value of 4” should be “value of 3”.

page 293, Exercise 8.35. (d) line 3. “(of minimum degree)” should be deleted.

Chapter 9

page 307, line 15. “label correcting algorithm” should be “label-correcting algorithm”.

page 307, line –11. “is a direct consequence” should be “are a direct consequence”.

page 309, line 20. “ $c^{\pi}_{ij} \geq$ ” should be “ $c^{\pi}_{ij} \geq 0$ ”.

page 313, line –13. “the second last inequality” should be “the second last equality”.

page 314, line 13. (b) “otherwise, the right hand side of (9.19) is negative” should be “otherwise, we get contradictions”.

page 321, line 9. Figure 9.9. “from node s to all” should be “from node k to all”.

page 322, Figure 9.10 (d) and (e) c^{π}_{31} should be 1.

page 325, Figure 9.12 (c) $\pi(4)$ should be -1 . $\pi(t)$ should be -1 . $\pi(5)$ should be -2 .

page 325, Figure 9.12 (d) r_{14} and r_{24} should be 1.

page 327, line 9. “To describe the out-of-kilter algorithm, we refer to the complementary slackness optimality conditions stated in Theorem 9.4. For case of reference, let us restate these conditions” should be replaced by “To describe the out-of-kilter algorithm, we use the following optimality conditions, which can be easily derived from the reduced cost optimality conditions(9.7)”.

page 344, Exercise 9.1. line 5. “the entrepreneur cannot sell the commodity in the same period in which he buys it” should be deleted.

page 345, Exercise 9.6. line 2. “(homogeneous) general” should be “(homogeneous) s general”.

page 346, Exercise 9.9. “Minimize $\sum_{i=0}^{23} y_i$ ” should be “Minimize $\sum_{i=0}^{23} c_i y_i$ ”.

page 349, Exercise 9.17. (b) “ $\pi = (0, -6, -9, -12, -5, -8, -15)$ ” should be “ $\pi = (0, -3, -6, -1, -6, -2, -9)$ ”

page 350, Exercise 9.20. on arc $3 \rightarrow 7$, $(2, \infty)$ should be $(3, \infty)$. page

351, Exercise 9.29. hint should be deleted.

page 353, Exercise 9.43. line 3. “zero residual capacity” should be “zero residual cost”.

page 354, Exercise 9.52. “the minimum cost flow problem with surplus” should be “the minimum cost flow problem with nonnegative costs and with surplus”.

page 354, Exercise 9.54. line 5. “spanning tree” should be “spanning tree (not necessarily a spanning tree)”.

Chapter 10

page 361, line 2. “ $S(\Delta) = \{i : e(i) \geq \Delta\}$ ” should be “ $S(\Delta) = \{i \in N : e(i) \geq \Delta\}$ ”.

page 361, line 3. “ $T(\Delta) = \{i : e(i) \leq -\Delta\}$ ” should be “ $T(\Delta) = \{i \in N : e(i) \leq -\Delta\}$ ”.

page 361, Figure 10.1. line 5. “**while** $\Delta \geq 1$ ” should be “**while** $\Delta \geq 1$ **do**”.

page 364. Line 3 of Figure 10.4. “ $(i, j) \in A$ ” should be “ $(i, j) \in G(x)$ ”

page 376, line -4. “residential network” should be “residual network”.

page 379, Lemma 10.15. line 2. “deceases” should be “decreases”.

page 397. An important reference was omitted. The preflow push algorithm is a scaling variant of the algorithm by Bertsekas [1986].

D. Bertsekas, 1986. “Distributed asynchronous relaxation methods for linear network flow problems, in Proc. 25th IEEE Conference on Decision and Control, Athens, Greece.

page 398, Exercise 10.4. “ $\epsilon = 0$ ” should be “ $\epsilon = 10^{-6}$ ”.

page 399, Exercise 10.11. line 3. “ $\Delta = k^{\lfloor \log_k C \rfloor}$ ” should be “ $\Delta = k^{\lfloor \log_k C \rfloor}$ ”.

page 399, Exercise 10.12. line 9. “set of potential” should be “set of potentials”.

page 399, Exercise 10.15. line 2. “Will the algorithms” should be “Will the weakly polynomial-time algorithms”.

page 400, Exercise 10.25.(a) line 5. “Assume that $c_{ij} \geq 0$ for each arc $(i, j) \in A$ ” should be “Assume that $c_{ij} \geq 0$ for each arc $(i, j) \in A$ and the cost of each directed path from node s to node t is strictly positive”.

Chapter 11

page 414, Figure 11.7. line 11. “**else** $x_{ji} := b'(j)$,” should be “**else** $x_{ji} := b'(j)$,”. page

415, line -6. “arc $(1, j)$ in T ” should be “arc $(j, 1)$ in T ”.

page 415, line -5. “arc $(j, 1)$ in T ” should be “arc $(1, j)$ in T ”.

page 454, Exercise 11.3. line 11. “Formulate this problem as a minimum cost flow problem” should be “Show how this problem can be solved using network flow techniques”.

page 455, Exercise 11.13. "Are these solutions feasible?" should be added at the end of the problem.

page 459, Exercise 11.47.(a) line 3. "the average depth" should be "the average depth plus one".

Chapter 12

page 475. Lines 1 and 2. "Sue prefers Steve to Dave" should be "Joan prefers Steve to Dave"

page 484, Prop 12.9. (a) "A stem spans $2l$ nodes" should be "A stem spans $2l+1$ nodes".

page 487. line 5 of "examine-odd" "unmatched and unlabeled" should be "matched and unlabeled"

page 495, Figure 12.21. (a) c_{53} should be 6.

page 495, Figure 12.21. (b) c_{53} should be 6.

page 495, Figure 12.21. line 3, "from node 1 to node 6" should be "from node 1 to node 5".

page 501, Exercise 12.2. line 5. "total difference" should be "total absolute difference".

page 502, Exercise 12.5. (a) "the youngest item" should be "the oldest item".

page 502, Exercise 12.5. (b) "the oldest item" should be "the youngest item".

page 505, Exercise 12.22. (a) line 4. "given the node numbers" should be "given nonnegative node numbers".

page 507, Figure 12.24. (a) edge (11, 9) should not be bold faced, edge (9,10) and edge (11,12) should be bold faced.

page 508, Exercise 12.42. (b) line 2. " $O(m)$ " should be " $O(n^2)$ ".

Chapter 13

page 517, Figure 13.3. (c) edge (1,4) should be added. "(b) two spanning trees; (c) nonspanning tree (disconnected graph);" should be "(b) and (c) two spanning trees;".

page 517, Figure 13.5. line 3. " $[S, S]$ " should be " $[S, \bar{S}]$ ".

page 518. lines 9 to 13 of the second paragraph of the proof. It should be "Now if we introduce arc (i, j) in the tree T° in place of the arc (k, ℓ) , we produce another minimum spanning tree, and it has one more arc in common with T^* . Repeating this argument several times, we can transform T° into the tree T^* satisfying the cut optimality conditions."

page 535, line 22. The correct definition of β is as follows:

$$\beta(m, n) = \min\{i : \log^{(i)} n < m/n\}.$$

page 541, Exercise 13.36. (d) line 3. " $j = q$ " should be " $j = p$ ".

page 541, Exercise 13.40. line 2. " k arcs" should be " k or fewer arcs".

page 541, Exercise 13.43. (a) (13.3b) " $S \subseteq \varphi$ " should be " $S \subseteq E$ ".

Chapter 14

page 563, Exercise 14.6. line 5. " $|\alpha_j| y$ " should be " $\alpha_j |y|$ ".

Chapter 15

page 569, line –4. “network has p product nodes, 1, 2, ..., p and r machine nodes, $\bar{1}, \bar{2}, \dots, \bar{r}$ ” should be “network has r product nodes, 1, 2, ..., r and p machine nodes, $\bar{1}, \bar{2}, \dots, \bar{p}$ ”

page 570, line 20. “valuable bounding” should be “variable bounding”.

page 579, line –5. “ $e(i) - e(j)/\mu_{ij}$ ” should be “ $e(i) + e(j)/\mu_{ij}$ ”.

page 580, Figure 15.8. (a) “ $e(i) + e(j)\mu_{ij}$ ” should be “ $e(i) + e(j)/\mu_{ji}$ ”.

page 580, Figure 15.8. (b) “ $e(i) - e(j)/\mu_{ij}$ ” should be “ $e(i) + e(j)/\mu_{ij}$ ”.

page 580, Figure 15.9. line 9. “add $-e(j)\mu_{ji}$ to $e(i)$ ” should be “add $e(j)\mu_{ji}$ to $e(i)$ ”.

page 587, Figure 15.12. (c) “ -2θ ” on arc (1,3) should be “ $-0.5 - 1.5\theta$ ”.

page 591, line –2. “Dantzig [1962]” should be “Dantzig [1963]”.

page 595, Exercise 15.16. line 3. “ $y_{ij} = \alpha(i) x_{ij}$ ” should be “ $y_{ij} = x_{ij} / \alpha(i)$ ”.

page 595, Exercise 15.16. line 4. “ $x_{ij} = y_{ij} / \alpha(i)$ ” should be “ $x_{ij} = y_{ij} \alpha(i)$ ”.

page 597, Exercise 15.27. “Hint: Generalize the method we described I the proof of Theorem 3.5 for identifying a breakeven cycle or a bicycle” should be “Hint: Use the generalized simplex method to find a breakeven cycle or a bicycle”.

page 597, Exercise 15.29. line 1. “Show that by adding a loop with a multiplied of $\frac{1}{2}$ to every node of a network,” should be replaced by “Show that by adding a loop arc (i,i) of zero cost with a multiplier of $\frac{1}{2}$ to every node with $\leq b(i)$ constraint and a loop arc (j,j) of zero cost with a multiplier of 2 to every node j with $\geq b(j)$ constraint.”.

Chapter 16

page 612, line –7. “ $18 - 4 = 4$ ” should be “ $18 - 14 = 4$ ”.

page 614, line 14. “path 1-2-3-6” should be “path 1-2-4-6”.

page 625. Application 6.3 The following set of constraints are missing:

$$\sum_j x_{ij}^k - \sum_j x_{ji}^k = 0 \quad \text{for all } i \text{ and } k.$$

page 640, Exercise 16.8. (a) “the constraint (16.9b)” should be “the constraint (16.10b)”.

page 641, Exercise 16.11. (a) “ x_{ij} ” $\min \{y_j, K_j\}$ ” should be “ x_{ij} ” $\min \{y_j, K_j / d_i\}$ ”.

page 641, Exercise 16.11. (b) “ x_{ij} ” $\min \{y_j, K_j\}$ ” should be “ x_{ij} ” $\min \{y_j, K_j / d_i\}$ ”.

page 641, Exercise 16.13. (a) “ $x_{ik} \geq x_{ij}$ ” should be “ $x_{kj} \geq x_{ij}$ ”.

page 643, Exercise 16.21. (a) line 6. “in Exercise 16.21.” should be “in Exercise

16.20.”
 page 643, Exercise 16.21. (b) line 4. “see Exercise 13.37.” should be “see Exercise 13.38.”
 page 643, Exercise 16.21. (b) line 5. “a circulation problem” should be “a matching problem”.

page 646, Exercise 16.28. line 1. “ $\sum_{(i,j) \in A} y_{ij} = n + K$ ” should be

$$\text{“} \sum_{(i,j) \in A} y_{ij} = n + K - 1 \text{”}$$

page 646, Exercise 16.30. line 7. “theorem 16.10” should be “theorem 16.8”.

page 647, Exercise 16.31. (a) line 2. “ $\sum_{j \neq 1} x_{ij} = k$ ” should be “ $\sum_{j \neq 1} x_{1j} = k$ ”.

page 648, Exercise 16.37. line -3. “(1) $4x_1 + 9x_2$ ”36” should be “ $9x_1 + 10x_2$ ”63”.

Chapter 17

page 665, line -1. “ $f(P) = x_{ij}^k \sum_{P \in P^k} \delta_{ij}(P) f(P)$ ” should be “ $x_{ij}^k = \sum_{P \in P^k} \delta_{ij}(P) f(P)$ ”.

page 673, line -19. "Theorem 16.7" should be "Theorem 16.6"

page 675, (17.9a) “ $z^k(r^k) = \min \sum_{1 \leq k \leq K} c^k x^k$ ” should be “ $z^k(r^k) = \min c^k x^k$ ”.

page 688, Exercise 17.14. line 7. “ $x^k = \sum_{1 \leq k \leq K} \lambda^{k,q} x^{k,q}$ ” should be

$$\text{“} x^k = \sum_{1 \leq q \leq Q_k} \lambda^{k,q} x^{k,q} \text{”}.$$

page 691, Exercise 17.27. line 4. “lie in S ” should be “lie in S and destination nodes lie in N ”.

page 691, Exercise 17.27. line 5. “destination nodes lie in $N - S$ ” should be “destination nodes lie in N ”.

page 694, Exercise 17.38. line -6. “ $x \in H(x)$ ” should be “ $x \in H(X)$ ”.

page 694, Exercise 17.38. line -5. “ $x \in H(x)$ ” should be “ $x \in H(X)$ ”.

Chapter 18

page 710, line 6. “nondecreasing functions” should be “nonincreasing function”.

page 711. Figure 18.7 "Occurance" should be "Occurrence".

Chapter 19

page 721, line 8. “the total weight of all nodes” should be “the total weight of all positive weight nodes”.

page 728, (19.9a), “Minimize” should be “Maximize”. page

728, line 3 "u/2" should be "u'/2".

page 729, (19.10a) “ $f(i, 0) = \beta_i$ ” should be “ $f(i, 0) = \beta_i$ ”.

page 729, (19.10b) “ $f(0, j) = \alpha_j$ ” should be “ $f(0, j) = \alpha_j$ ”.

page 736, line 14. “We assuxe” should be “We assume”
page 762, Exercise 19.11. line 4. “ s^p ” should be “ s^r ” and “ t^p ” should be “ t^r ”.
page 762, Exercise 19.15. line 1. “with arc costs c_{ij} ” should be “with nonnegative arc costs c_{ij} ”.
page 762, Exercise 19.15. line 3. “to the nodes in S ” should be “to each node in S ”.
page 762, Exercise 19.15. line 4. “to the nodes in $N - S$ ” should be “to each node in $N - S$ ”.

References

page 823, line –1. “*Management Science* 21. 1-38” should be “*Management Science* 24. 1-34”.
page 825, line 27. “DANTZIG, G.B. 1962” should be “DANTZIG, G.B. 1963”.
page 832, “Johnson, D.B. 1977. Efficient shortest path algorithms. *J. ACM.* 24, 1-13.” should be added.

The following reference should have been included:

D. Bertsekas, 1986. “Distributed asynchronous relaxation methods for linear network flow problems, in Proc. 25th IEEE Conference on Decision and Control, Athens, Greece.

Back Cover

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