<p align="center">Errata</p>

<p align="center">for</p>

Discrete Structures, Logic, and Computability, Second Edition

This is the errata of *Discrete Structures, Logic, and Computability*, Second Edition. The errata corrects typos, errors, and clarifies some of the exposition.

Note: The brackets that precede each item indicate the printings in which the errata occur.

Preface

[1] Page v line 13. Move the question "Can the problem be solved by a computer program?" onto a line by itself like the other four questions.

[1] Page v lines 18 to 22. The left margin of this paragraph should line up with the text above it. Also, don't indent the first line.

Contents

[1] Page x line –3. Delete "an" from "Recalling an English Grammar".

[1] Page xiii line 1. Insert "(UI)" after "Universal Instantiation".

Chapter 1

[1] Page 7 line 8. Replace 25 by 27, so the list looks like "6, 11, 18, 27, 38, 51.".

[1, 2] Page 8 line –10. The italic "*contrapositve*" is misspelled and should be

"*contrapositive*".

[1, 2] Page 14, lines 10 to 12. Delete this paragraph of two sentences, "An important characteristic…occurrences of the letter L."

[1, 2] Page 14, lines −3 to −6. Replace these four lines with the following text:

"It follows from the definition of equality that there is no particular order or arrangement of the elements in a set. For example, since {u, g, h} and {h, u, g} have the same elements, we have

$$\{u, g, h\} = \{h, u, g\}.$$

It also follows that there are no repeated occurrences of elements in a set. For example, since {h, u, g, h} and {h, u, g} have the same elements, we have

$$\{h, u, g, h\} = \{h, u, g\}.$$

So {h, u, g, h}, {u, g, h}, and {h, u, g} are different representations of the same set."

[1, 2] Page 22 line 12. In Example 1.14 replace "$x \in \mathrm{N}$" with "$x \in \mathrm{Z}$".

[1] Page 31 line −15. Exercise 2c should have 9 included in the set, so it looks like "{1, 4, 9, 16, 25, 36, 49, 64}".

[1] Page 31 line −5. Exercise 6e should be blue color.

[1] Page 44 line −5. Insert space between uppercase lambda and "or". In other words, replace "Λor" with "Λ or".

[1] Page 45 line 7. Delete space between $\varnothing$ and *. i.e., replace "$\varnothing$ *" with "$\varnothing$*".

[1, 2] Page 46 line −4. Change "ternary operation on" to "ternary relation on".

[1, 2] Page 50 line −8. The third line of the displayed equations is missing an absolute value brace "|" at the right end. In other words, replace "| {a, c, d}^{5}" with "| {a, c, d}^{5} |".

[1] Page 53 line 15. Change Exercise 11c from "{a, b, c}* − {a, b}*"
to "{a, b, c}* − {a}*".

Chapter 2

[1, 2] Page 80 line 4. Change "divisiors" to "divisors".

[1, 2] Page 87 line 13 (5 lines below the box). Replace the two sentences,

 "At this point we're stuck for an exact answer. But we can make an estimate."

with the single sentence,

"Now we can easily estimate the value of the expresson."

[1] Page 88 line –12. Change Exercise 6c
from "15 mod (–12)" to "–12 mod 15".

[1] Page 88 line –12. Change Exercise 6d
from "–15 mod (–12)" to "–21 mod 15",

[1, 2] Page 90 line –9. In exercise 20c change "$1 = ab \bmod n$" to
 "$1 \bmod n = ab \bmod n$".

[1, 2] Page 96 line –12. Change a comma to a decimal point. Change
"map(floor, $\langle$–1, 5, " to "map(floor, $\langle$–1.5, ".

[1, 2] Page 97 line –16 (3rd line above "end example"). There is a missing
left parenthesis. Change "= map($*$,$\langle$(0, 0), (1, 1), 2, 2),..." to
"= map($*$,$\langle$(0, 0), (1, 1), (2, 2),..."

[1, 2] Page 99 line –16 (last line of exercise 6). Replace "five binary" with
"four binary".

[1] Page 100 line 11. Change "Proofs" to boldface with no color.

[1, 2] Page 101 line –10. Change "$f(3.5) = f(3)$" to "$f(3.5) = f(3.6)$".

[1, 2] Page 104 line 16. In the equation change "$n(q_1 - nq_2)$" to "$n(q_1 - q_2)$".

[1, 2] Page 106 line –4. Replace "how wrap" with "how to wrap".

[1, 2] Page 107 line 3. Replace the sentences, "Is f a bijection? Yes, because f
has type $\mathbf{N}_{26} \rightarrow \mathbf{N}_{26}$." with the following sentence.

"It follows from (2.6) that f is a bijection of type $\mathbf{N}_{26} \to \mathbf{N}_{26}$."

[1, 2] Page 107 line –16. Replace "abut" with "about".

[1, 2] Page 107 line –4. Change "(M, A)" to "(A, M)".

[1, 2] Page 107 line –1. Change "$(3x+ 5)$ mod 26" to "$(3x + 15)$ mod 26".

[1, 2] Page 108 line 3. Change "$(9x + 7)$ mod 26" to "$(9x + 21)$ mod 26".

[1, 2] Page 111 line –16. Change "$(g, n) = 1$" to "$\gcd(g, n) = 1$".

[1] Page 113 line –2. In Exercise 10 change "0 to 26" to "0 to 25".

[1, 2] Page 114 line 17. In Exercise 13 change "$\mathbf{N}_7$" to "$\mathbf{N}_8$".

[1] Page 115 line 3. In Exercise 20 change "16 to prove" to "19 to prove".

[1] Page 117 line –10. Replace "Therefore $f(s)$ is" with "Therefore $f(S)$ is".

[1, 2] Page 124 line 8. In Exercise 1a, replace "≤ 100" by "≤ 98".

[1] Page 124 line –1. Delete the period to the right of the first right brace.

Chapter 3

[1, 2] Page 131 line –3 (from bottom of example). There is a missing equals sign. The line should look like the following:

$$\text{"}1 = 0 \cup \{0\} = \varnothing \cup \{0\} = \{0\}\text{,"}$$

[1, 2] Page 136 line 8. Replace "of this" with "of these".

[1, 2] Page 141 line 12. Change the sentence by adding a phrase at the end so the sentence reads as follows:

"So the area A can be described as the following set of points, where $a, b \in \mathbf{N}$ and $f : \mathbf{N} \to \mathbf{N}$."

[1] Page 143 line 5. In Exercise 6e, replace "$n \in \mathrm{N}$" with "$m, n \in \mathrm{N}$".

[1, 2] Page 150 line −10. Replace "popular" with "the popular".

[1, 2] Page 155 line −13. Replace "difinition" with "definition".

[1, 2] Page 156 line 5. In the right side of the equation replace "⟨1⟩" with "⟨2⟩".

[1, 2] Page 166 line 9. Replace "is is" with "it is".

[1] Page 168 line −4. In Exercise 4c, replace the line with the following line:

"c. $f(k, n) = \gcd(1, n) + \gcd(2, n) + ... + \gcd(k, n)$ for $k > 0$."

[1] Page 180 line 15. The letter M should be italic.

[1] Page 180 lines −11, −13, and −14. These lines contain the symbols "$\Rightarrow$ $^+$" or "$\Rightarrow$ *". Remove the space in each occurrence to obtain "$\Rightarrow^+$" or "$\Rightarrow^*$" and insert a space to the right of each "$+$" or "$*$". For example, replace "$\Rightarrow$ ^+w" with "$\Rightarrow^+ w$".

[1] Page 181 line 7. Replace "$\Rightarrow$ ^+ay" with "$\Rightarrow^+ ay$".

[1] Page 181 line 9. Replace "$\Rightarrow$ ^+aby" with "$\Rightarrow^+ ayy$".

[1, 2] Page 189 line 13. In Exercise 4b, replace "$n \in N$" with "$m, n \in N$".

[1, 2] Page 191 line 8. In Exercise 15b, change "$b \rightarrow b \mid bB$." to "$B \rightarrow b \mid bB$."

Chapter 4

[1, 2] Page 197 line 1. In the title of box (4.1) replace the word "Relation" with its plural "Relations".

[1, 2] Page 219 line 5. Replace "proptery" with "property".

[1, 2] Page 226 line −16. Replace "might a set" with "might be a set"

[1] Page 228 line −3, −4, and −15. Decrease the space to the right of the union symbol. i.e., center the union symbol between its two arguments.

[1, 2] Page 229 line −7. In last line of example, replace "treee" with "tree".

[1, 2] Page 238 several lines. The symbol Q (in five places on this page) for rational numbers is the wrong font. It should be the same font as introduced on page 15. The same problem occurs on page 569.

[1, 2] Page 243 line 19. Remove the period at the end of the quoted question.

[1, 2] Page 247 line −9. Insert the phrase "if no two elements are defined in terms of each other." at the end the first sentence. So the new first sentence should read, "It's easy to make an inductively defined set into a well-founded set if no two elements are defined in terms of each other."

[1, 2] Page 255 line −10. Replace "natural numbers n:" with "natural numbers $n \geq 1$:".

[1] Page 268 line 16. Exercise 10a should be blue color.

[1, 2] Page 269 line 9. Replace "(2.2b)" with "(2.2a and 2.2b)".

[1, 2] Page 269 line −10. Replace "$l = \langle \; \rangle$"with "$L = \langle \; \rangle$".

Chapter 5

[1] Page 282 line 8. Change "Summation Fact" to "Summation Facts".

[1] Page 282 line −4. In (5.2a) Change "$\sum_{i=1}^{n} \; =$" to "$\sum_{i=1}^{n} i \; =$".

[1] Page 282 line −2. In (5.2c) change the lower limit of the summation from "$i = 1$" to "$i = 0$".

[1] Page 286 lines 7 and 8. Replace sentence and phrase

"There are no operations for $n = 0$. If $n > 0$, then there are $n − 1$ addition operations and"

with the following phrase:

"There are n addition operations and"

[1] Page 286 line 9. Replace "operations for $n > 0$ is given by" with "operations is given by".

[1] Page 286 lines 11, 12, and 13. Replace these three displayed lines with the following three lines:

$$n + (0 + 1 + 2 + \ldots + n) = n + \sum_{i=0}^{n} i$$
$$= n + \frac{n(n+1)}{2}$$
$$= \frac{n^2 + 3n}{2}.$$

[1] Page 286 line 15. Replace 494 with 495.

[1] Page 294 line 13. In box (5.8), the term at the right end of the equation contains the term $(n - r!)$ in the denominator. It should be $(n - r)!$. Here is the proper equation with the correct term on the right:

$$C(n, r) = \frac{P(n, r)}{r!} = \frac{n!}{r!(n - r)!}.$$

[1] Page 298 line –9. Replace "be bit tricky" with "be a bit tricky".

[1, 2] Page 308 line 10. Replace "Frst" with "First".

[1] Page 311 line 7. In exercise 15, replace "home after 6 p.m." with "home by 6 p.m.".

[1] Page 311 line –10. In exercise 18c, change "with four of" to "with four or five of".

[1, 2] Page 319 line 6. Replace "closed from" with "closed form".

[1, 2] Page 322 line 2. In the first summation, change "$a_{n+1}x^n$" to "$a_{n-1}x^n$".

[1, 2] Page 322 line -3. Change the lower limit in the first summation from "$n = 0$" to "$n = 2$" so the line looks like the following:

$$= x + 5 \sum_{n=2}^{\infty} a_{n-1}x^n - 6 \sum_{n=2}^{\infty} a_{n-2}x^n$$

[1, 2] Page 323 line 11. Change the minus between the two expressions to a plus, so that the line looks like the following:

$$= -\frac{1}{1-2x} + \frac{1}{1-3x} \quad \text{(put into form } \tfrac{1}{1-t}\text{)}$$

Chapter 6

[1, 2] Page 350, line 14. On the line "Punctuation symbols:" eliminate the period and eliminate the space before the comma.

[1, 2] Page 353, line –3 (start counting above the figure). Change spelling of "contraditions" as "contradictions".

[1, 2] Page 355, line 8. Replace "to old" with "to the old".

[1] Page 354 below "Figure 6.5...". In "*Basic Equivalences* (6.1)" move (6.1) to the right margin.

[1] Page 368 line 14. In Exercise 10c replace "$\neg B$ " with "B ", so the formula becomes "$(A \vee B) \wedge \neg A \to B$."

[1, 2] Page 370, line 2. Replace "required, and we'll discuss them next." with "required: inference rules and axioms. We'll discuss them next.".

[1, 2] Page 372 line 3. Replace "the way we reason informally." with "the natural way that we reason.".

[1] Page 372 line –1. Replace "allows us prove" with "allows us to prove".

[1] Page 386 lines 8 to 13 (the six line proof). Delete the 4th line of the proof and replace the last two lines as follows:

4. $(A \to B_i) \to (A \to B_k)$ 2, 3, MP
5. $A \to B_k$ 1, 4, MP.

So the result should be the following five line proof:

1. Proof of $A \to B_i$ Induction

2. Proof of $A \to (B_i \to B_k)$ Induction
3. $(A \to (B_i \to B_k)) \to ((A \to B_i) \to (A \to B_k))$ Axiom 2
4. $(A \to B_i) \to (A \to B_k)$ 2, 3, MP
5. $A \to B_k$ 1, 4, MP.

[1, 2] Page 388, line –10, in Example 6.18. Replace "QED 1, 3, CP." With "QED.". In other words, delete "1, 3, CP.".

[1, 2] Page 390, line –1. Replace "$(A \to B) = W$." with "$\neg (A \to B) = \neg W$.".

Chapter 7

[1, 2] Page 402, line 11. On the line "Punctuation symbols:" eliminate the space before the comma and add a comma followed by a quoted comma at the end of the line. i.e., change "(,)" to "(,), ","".

[1, 2] Page 405, line 6. After the sentence, "The expression x/t is called a *substitution*." insert the following new sentences:

"We should note that in Chapter 9 we'll say that x/t is a binding and a set of bindings with certain properties is a substitution. But for now it's convenient to just call x/t a substitution."

[1, 2] Page 405, line –10. Change "$W(x, y)$" to "$W(x/y)$".

[1] Page 410 lines 14 to 18 (the paragraph beginning with "Indirect approach:"). Add some white space after the end of this paragraph in the same way that there is white space above and below the "Direct approach:" paragraph.

[1] Page 410 line –1. Add the following sentence to the end of the paragraph:

     "The proofs of (7.2a–7.2d) are left as exercises."

[1] Page 412 line 13 (second line of proof). Replace "variable of W" with "variable in a wff W".

[1, 2] Page 413, lines 1 to 4. Replace these four lines with the following sentence.

"The proof of part (2) is similar to that of part (1) and we'll leave it as an exercise. QED."

[1] Page 416 line –11. Do not indent the beginning paragraph of Section 7.2.

[1] Page 417 line –14. Replace "$pq(a) = q(b) = $ false." with the following:

"$p(a) = p(b) = $ true and $q(a) = q(b) = $ false."

[1] Page 418 line –12. Replace "$\neg p(0) \wedge \neg p(1)$" with "$\neg p(0) \vee \neg p(1)$" so that the line looks like the following:

"$\equiv \neg p(0) \vee \neg p(1) \vee \neg p(2) \vee \neg p(3)$".

[1] Page 420 line –3. Replace the phrase,

"the following equivalence to distribute an existential quantifer over disjunction."

with the phrase,

"the following equivalences."

[1] Page 420 lines –1 and –2. Replace the two-line box with the following three-line box:

Distributing the Quantifiers (7.7)

a. $\exists x \, (p(x) \vee q(x)) \equiv \exists x \, p(x) \vee \exists x \, q(x)$.

b. $\forall x \, (p(x) \wedge q(x)) \equiv \forall x \, p(x) \wedge \forall x \, q(x)$.

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[1] Page 421 line 1. Replace "Proof:" with "Proof of (7.7a):".

[1] Page 421 line 4. Insert the following sentence after line 4.

Proof of (7.7b): Use the fact that $\forall x \, (p(x) \wedge q(x)) \equiv \neg \, \exists x \, (\neg \, p(x) \vee \neg \, q(x))$ and then apply (7.7a). QED.

[1] Page 423 line –1. Delete the "$\neg$" from this formula. So the line should be as follows:

$\equiv C \wedge \exists x \, A(x)$.

[1, 2] Page 424, lines –12 to –15. Replace the text

"A wff W is in *prenex normal form* if all its quantifiers are on the left of the expression. In other words, a prenex normal form looks like the following:

$$Q_1x_1 \ldots Q_nx_n\ M,"$$

WITH

"A wff W is in *prenex normal form* if it has the following form:

$$W = Q_1x_1 \ldots Q_nx_n\ M,"$$

[1] Page 425 line –5. Replace "$C(z, y) \to \forall w \neg A(w)$" with "$C(z, y) \lor \forall w \neg A(w)$" so that the line looks like the following:

"$\equiv\ \forall z\, \exists y\, (A(x) \land (B(z) \to C(z, y) \lor \forall w \neg A(w)))$ (7.4)"

[1, 2] Page 427 line 8. There are two occurrences of ""$\exists y$ " on this line. Delete the rightmost one. i.e., replace "$\exists y\, C(z, y)$" with "$\exists y\, C(z, y)$".

[1] Page 429 line 14 (fomula 7 in the box of equivalences). Add "(7.7)" at the right margin of this line . In other words, the last line in the box should be as follows:

7. $\forall x\, (A(x) \land B(x)) \equiv \forall x\, A(x) \land \forall x\, B(x).$ (7.7)

[1] Page 430 Exercise 3. Make replacements in each of the four parts as follows:

In 3a replace "(use 7.7a)" with "(use 7.10a)".
In 3b replace "(use 7.7b)" with "(use 7.10b)".
In 3c replace "(use 7.7b)" with "(use 7.10b)".
In 3d replace "(use 7.7b)" with "(use 7.10b)".

[1, 2] Page 433, lines –5 to –7. Replace the sentence "We say that the term t *is free to replace x* in $W(x)$ if either no variable of t occurs bound to a quantifier in $W(x)$ or x does not occur free within the scope of a quantifier in $W(x)$."
WITH
"We say that a term t *is free to replace x* in $W(x)$ if for each variable of t that occurs bound to a quantifier in $W(x)$, x does not occur free within the scope of the quantifier."

[1, 2] Page 436, line 3. Replace "use same wff" with "use the wff".

[1, 2] Page 437, line –11. The title of the box needs "(EG)" so that the line becomes "Existential Generalization Rule (EG)   (7.16)".

[1, 2] Page 437, lines –2 to –4. Delete the phrase,

"This means, as always, that we must be able to write the wff in the form $W(x)$ for some variable x"

and attach the rest of the phrase to the end of the preceding sentence.

Then add the following new sentence:

"In other words, we must have $W(t) = W(x)(x/t)$."

With these changes the Usage Note at the bottom of page 437 should look like the following:

"There is a kind of forward-backward reasoning to keep in mind when using the EG rule. If we want to apply EG to a wff, then we must be able to write the wff in the form $W(t)$ for some term t such that $W(t)$ is obtained from $W(x)$ by replacing all free occurrences of x by t. In other words, we must have $W(t) = W(x)(x/t)$. Once this is done, we check to see whether t is free to replace x in $W(x)$."

[1, 2] Page 439 line 13. Replace "2, Proposed EI rule" with "1, Proposed EI rule".

[1, 2] Page 439 line 14. Replace "3, Proposed EI rule" with "2, Proposed EI rule".

[1, 2] Page 439 line 15. Replace "4, 5, Conj." with "3, 4, Conj.".

[1, 2] Page 439, line –8. The title of the box needs "(EI)" so that the line becomes "Existential Instantiation Rule (EI)   (7.17)".

[1] Page 440 line 6. Replace "Since y does not occur in A," with "Since y does not occur in $P \land \exists x\ W(x)$ or A,".

[1, 2] Page 441, line 16. On line 5 of the proof, replace "3, EG" with "4, EG".

[1] Page 442 lines 19 and 20. Replace the sentence in box (7.19) with the following sentence.

Conditional Proof Rule (CP) (7.19)

If A is a premise in a proof of B, then there is a proof of $A \rightarrow B$ that does not use A as a premise.

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[1] Page 442 line –18 to page 443 line 14. Replace the entire proof with the following proof:

Proof: Let W_1, ..., $W_n = B$ be a proof of B that contains A as a premise. We'll show by induction that for each k in the interval $1 \leq k \leq n$, there is a proof of $A \rightarrow W_k$ that does not use A as a premise. Since $B = W_n$, the result will be proved. For the case $k = 1$, the argument is the same as that given in the proof of the CP rule for propositional calculus. Let $k > 1$ and assume that for each $i < k$ there is a proof of $A \rightarrow W_i$ that does not use A as a premise. If W_k is not inferred by a quantifier rule, then the argument in the proof of the CP rule for propositional calculus constructs a proof of $A \rightarrow W_k$ that does not use A as a premise. The construction also guarantees that the premises needed in the proof of $A \rightarrow W_k$ are the premises other than A that are needed in the original proof of W_k.

Suppose that W_k is inferred by a quantifier rule from W_i, where $i < k$. First, notice that if A is not needed to prove W_i, then A is not needed to prove W_k. So we can remove A from the given proof of W_k. Now add the valid wff $W_k \rightarrow (A \rightarrow W_k)$ to the proof and then use MP to infer $A \rightarrow W_k$. This gives us a proof of $A \rightarrow W_k$ that does not use A as a premise. Second, notice from the proof of the EI rule (7.17) that for any proof that uses EI, there is an alternative proof that does not use EI. So we can assume that A is needed in the proof of W_i and EI is not used in the given proof.

If W_i infers W_k by UG, then $W_k = \forall x \, W_i$, where x is not free in any premise needed to prove W_i. So x is not free in A. Induction gives a proof of $A \rightarrow W_i$ that does not use A as a premise and x is not free in any premise needed to prove $A \rightarrow W_i$. So we can use UG to infer $\forall x \, (A \rightarrow W_i)$. Since x is not free in A, it follows from (7.12a) that $\forall x \, (A \rightarrow W_i) \rightarrow (A \rightarrow \forall x \, W_i)$ is valid. Now use MP to infer $A \rightarrow \forall x \, W_i$. So we have a proof of $A \rightarrow W_k$ that does not use A as premise.

If W_i infers W_k by UI, then there is a wff $C(x)$ such that $W_i = \forall x \, C(x)$ and $W_k = C(t)$, where t is free to replace x in $C(x)$. The proof of the UI rule tells us that $\forall x \, C(x) \rightarrow C(t)$ is valid. Induction gives a proof of $A \rightarrow \forall x \, C(x)$ that does not use A as a premise. Now use HS to infer $A \rightarrow C(t)$. So we have a proof of $A \rightarrow W_k$ that does not use A as premise.

If W_i infers W_k by EG, then there is a wff $C(x)$ such that $W_i = C(t)$ and $W_k = \exists x \, C(x)$, where t is free to replace x in $C(x)$. The proof of the EG rule tells us that $C(t) \rightarrow \exists x \, C(x)$ is valid. By induction there is a proof of $A \rightarrow C(t)$ that does not use A as a premise. Now use HS to infer $A \rightarrow \exists x \, C(x)$. So we have a proof of $A \rightarrow W_k$ that does not use A as premise. QED.

[1] Page 448 Example 7.29. Replace the entire content of this example with the following lines:

We'll give a proof of the validity of the following wff:

$$\forall x\, A(x) \lor \forall x\, B(x) \to \forall x\, (A(x) \lor B(x)).$$

Proof: 1. $\forall x\, A(x) \lor \forall x\, B(x)$ *P*
     2. $\forall x\, A(x)$ *P*
     3. $A(x)$ 2, UI
     4. $A(x) \lor B(x)$ 3, Add
     5. $\forall x\, (A(x) \lor B(x))$ 4, UG
     6. $\forall x\, A(x) \to \forall x\, (A(x) \lor B(x))$ 2, 5, CP
     7. $\forall x\, B(x)$ *P*
     8. $B(x)$ 7, UI
     9. $A(x) \lor B(x)$ 8, Add
     10. $\forall x\, (A(x) \lor B(x))$ 9, UG
     11. $\forall x\, B(x) \to \forall x\, (A(x) \lor B(x))$ 7, 10, CP
     12. $\forall x\, (A(x) \lor B(x))$ 1, 6, 11, CD
         QED 1, 12, CP.

[1] Page 449 line −14. In Example 7.31, replace the sentence

"The converse of the wff in Example 7.29 is the following wff."

 with

"Suppose we're given the following wff."

[1] Page 451 line 6. Add "(EG)" after "Existential Generalization Rule".

[1] Page 454 line 14 (Exercise 9). Insert the boldface subtitle **Equivalences** before Exercise 9.

[1] Page 454 line −11. In exercise 11 put a comma at end of the line that contains the formula "$A = ...$".

Chapter 8

[1, 2] Page 461, line –6. Change "letters t, u, and v denote" to "letters t and u denote".

[1, 2] Page 461, line –3. Change the rightmost "=" to "→" so that the right portion of the line looks like:

"$p(t_1, \ldots, t_k) \rightarrow p(u_1, \ldots, u_k)$".

[1] Page 462 (lines –1 to –5) and page 463 (lines 1 to 4). In **Example 8.3**, the lines of the proof numbered 1 through 9 should have the formulas indented. So the proof should look like the following.

Proof:
1. $x + x = x$ P
2. $-x = -x$ EA
3. $(x + x) + -x = x + -x$ 1, 2, EE
4. $x + (x + -x) = (x + x) + -x$ Associativity
5. $x + (x + -x) = x + -x$ 3, 4, Transitivity
6. $x + -x = 0$ Property of –
7. $x + 0 = 0$ 5, 6, EE
8. $x = x + 0$ Property of 0
9. $x = 0$ 7, 8, Transitivity
10. $(x + x = x) \rightarrow (x = 0)$ 1, 9, CP
11. $\forall x\, ((x + x = x) \rightarrow (x = 0))$ 10, UG.
    QED

[1] Page 462 lines –1 to –4. On each of these lines, remove the space between the negative sign and x. In other words, replace "– x" with "$-x$".

[1, 2] Page 464 lines 5 and 6. Replace the two lines
"4. $(x < y) \rightarrow (x \leq y)$ 1, 3, CP.
   QED"
with the single line
"QED   1, 3, CP."

[1, 2] Page 464 lines 10 and 11. Replace the two lines
"4. $(x < y) \rightarrow (x \leq y)$ 1, 3, CP.
   QED"
with the single line
"QED   1, 3, CP."

[1, 2] Page 466 line 13 (Exercise 8b). Replace "that that" with "that".

[1, 2] Page 469 line –1. In the display for (8.11), remove the comma at the end of the "numerator" in the rightmost expression.

[1] Page 472 lines –5 and –2. On each of these lines, remove the space between the negative sign and x. In other words, replace "– x" with "–x".

[1] Page 473 line 2. Remove the space between the negative sign and x. In other words, replace "– x" with "–x".

[1, 2] Page 476 lines 10 and 11. Replace "$(a \geq 0) \wedge (b > 0)$" with "$(a > 0) \wedge (b \geq 0)$".

[1] Page 477 line –8. Replace "11, 14, IP" with "12, 14, IP" .

[1] Page 477 line –3. Replace "Conseq, Comp" with "Comp, Conseq".

[1] Page 477 lines –1 to –18. It looks as though the lines numbered 7 to 21 should be moved left a bit so that the line numbers align with the line numbers numbered 1 to 6.

[1] Page 490 lines –9 to –12. In exercise 19, the left ends of the four displayed lines should be aligned.

[1] Page 495 line 13. Remove the space between S and comma. i.e., replace "S ," with "S,".

[1, 2] Page 500, line 3. Change "indivdual" to"individual".

Chapter 9

[1] Page 509 line –12. Remove space between "C" and "$(x_1, ..., x_k, y)$."

[1] Page 509 line –8. Replace "$A(d_1, ..., d_k, e)$" with "$C(d_1, ..., d_k, e)$".

[1] Page 509 line –6. Replace "$A(d_1, ..., d_k, e)$" with "$C(d_1, ..., d_k, e)$".

[1, 2] Page 511, line 4. Change "$(\neg p(a)vq)$" to "$(\neg p(a) \vee q)$".

[1] Page 516 lines 21 and 22. On the last two lines of Example 9.6 remove the space between $f(y)$ and comma, and between $f(b)$ and comma.

[1, 2] Page 516, line 21. Remove redundant parentheses. Change

"$((p\ (x, y, z)\ \theta)\ \sigma) = ...$"

to

"$(p\ (x, y, z)\ \theta)\ \sigma = ...$"

[1, 2] Page 517, line 11. Change "unifer" to "unifier".

[1, 2] Page 518, line –2. Change "in the numerator" to "in any numerator".

[1] Page 520 line 5. Replace the sentence,

"Either a most general unifier or a statement that the pair is not unifiable."

with

"Either a most general unifier of A and B or a statement that they are not unifiable."

[1, 2] Page 522, line 10. Replace the first word of the second sentence, "Let", with "Since there could be additional occurrences of N in $C\theta$, we'll let".

[1] Page 527 line 13. On line 2 of the proof, replace "$p(v, w)$" with "$\neg\, p(v, w)$". In other words, the line should look like

"2. $\neg\, p(u, v) \lor \neg\, p(v, w) \lor p(u, w)$ P".

[1] Page 527 line 16. On line 5 of the proof, replace "$p(v, x)$" with "$\neg\, p(v, x)$". In other words, the line should look like

"5. $\neg\, p(x, v) \lor \neg\, p(v, x)$ $1, 2, R, \{u/x, w/x\}$".

[1] Page 527 line 18. On line 7 of the proof, replace "$4, 7, R, \{\}$."
with "$4, 6, R, \{\}$.".

[1] Page 531 line 7. Remove the space between θ and σ. In other words, replace "$\theta\ \sigma$" with "$\theta\sigma$".

[1] Page 536 lines 1, 7, and 10. On each of these three lines there is a double word. Replace "unifier unifier" with "unifier".

[1, 2] Page 538 line 1. Replace "there a proof" with "there is a proof".

[1] Page 543 line –7. Replace "grandparent of a." with "grandparent of c.".

[1] Page 549 line –8. Change the title of Example 9.23 from "Transitive Closure" to "Acyclic Transitive Closure".

[1] Page 549 lines – 7 to –5. Delete the sentence "So we'll discuss...of a binary relation."

[1] Page 549 line –5. Replace the phrase,

"binary relation r and"

 with the phrase,

"binary relation r whose graph is acyclic (i.e., there are no cycles) and".

Chapter 10

[1] Page 560 line 10. Change "Recall that" with "Note that".

[1, 2] Page 569 several lines. The symbol Q (in three places on this page) for rational numbers is the wrong font. It should be the same font as introduced on page 15. The same problem occurs on page 238.

[1, 2] Page 571 lines 20 to 24. In each of the parts (a), (b), (c), and (d) remove the phrase, "for ∘,".

[1] Page 572 line –2. Reduce the length of the overbar "‾‾" to about "‾".

[1] Page 573 line –13 . Replace the missing right parenthesis. In other words, replace "(do it last." with "(do it last).".

[1, 2] Page 581 line –10 . Replace $\overline{xyz}$ with $x\overline{y}z$.

[1, 2] Page 581 line –10 . Replace $x\overline{yz}$ with $x\overline{y}\overline{z}$.

[1, 2] Page 584 line 12 (Exercise 5f). Replace this exercise with the following:

$$\text{``f. } x(y+z)(\bar{x}+y)(\bar{y}+x+z).\text{''}$$

[1, 2] Page 584 line – 8 (Exercise 9). Replace "$\overline{a+b}$ =" with "$\overline{ab}$ = ".

[1] Page 586 line –1 . Remove space between $s(x)$ and comma.

[1] Page 587 line 3. Remove space between $s(s(0))$ and comma.

[1] Page 587 line 4. Remove space between $s(0)$ and comma.

[1] Page 587 line 10. Remove space between $s(x)$ and comma.

[1] Page 587 line 16. Remove space between $s(x)$ and comma.

[1] Page 587 line 16. Remove space between mult(0, 4) and comma.

[1] Page 587 lines 19 to 23. On each of these lines there is a comma with too much preceding space. Remove it.

[1] Page 587 line –3. Remove space between $p(x)$ and comma.

[1] Page 587 line –1. Remove space between $p(x)$ and comma.

[1] Page 589 line 10. Remove space between succ(x) and comma.

[1] Page 589 line 12. Remove space between succ(x) and comma.

[1] Page 589 line 16. Remove space between pred(x) and comma.

[1, 2] Page 593 line –15. Replace "Then b and c are" with "Then c and b are".

[1, 2] Page 593 line –14. Replace "Finally, a and $b+c$ are" with "Finally $b+c$ and a are".

[1, 2] Page 593 line –1. Replace the arguments "a" and "b" with "z" and "y" so that the equation becomes the following:

$$\text{``eval(op, push}(z, \text{push}(y, \text{stk}))) = \text{push(val}(y, \text{op}, z), \text{stk}).\text{''}$$

[1] Page 601 lines 4 and 5. On each of these lines, remove space between $p(x)$

and comma.

[1, 2] Page 602 Figure 10.11. Change "Classooms" to "Classrooms".

[1, 2] Page 604 Figure 10.12. In the left figure the word "Satelllite" should be spelled "Satellite".

[1, 2] Page 605 line 13. Replace
"project(join(Rooms, Schedule), {Dept, Course, Section})"
with
"project(select(join(Rooms, Schedule), Computer, Yes), {Dept, Course, Section})"

[1] Page 608 line 18. Replace the missing right parenthesis. In other words, replace "(e.g., $[f, g, h]$," with" with "(e.g., $[f, g, h]$),".

[1] Page 608 line –13. Add the statement "(e.g., $2 : \langle a, b, c \rangle = b$)" to the end of this line so that the line becomes the following:

"1, 2, ...   selectors (e.g., $2 : \langle a, b, c \rangle = b$),"

[1] Page 611 lines –5 and –6. In Exercises 1d and 1e, change "projects" to "project".

[1] Page 614 line –13. Replace "kl" with "kln". In other words, this line should look like the following:

"$ac = bd + (bl + kd + kln)n$,"

[1, 2] Page 619 line 4. Replace "choose $d = 19$" with "choose $d = 23$".

[1, 2] Page 619 lines 6 and 7. Replace

"which becomes $19e \bmod 221 = 1$. Since $\gcd(19, 221) = 1$,"

    with

"which becomes $23e \bmod 192 = 1$. Since $\gcd(23, 192) = 1$,"

[1, 2] Page 619 line 8. Replace "$1 = 19e + 221s$." with "$1 = 23e + 192s$."

[1, 2] Page 619 line 9. Replace "$\gcd(19, 221)$." with "$\gcd(23, 192)$."

[1, 2] Page 619 lines 11 to 15. Replace these five lines with the following three lines:

$$192 = 23 \cdot 8 + 8$$
$$23 = 8 \cdot 2 + 7$$
$$8 = 7 \cdot 1 + 1.$$

[1, 2] Page 619 line 17. Replace "the fifth equation" with "the third equation".

[1, 2] Page 619 line 18. Replace "2, 5, 7, and 12" with "7 and 8".

[1, 2] Page 619 lines 19 to 27. Replace these nine lines with the following five lines:

$$
\begin{aligned}
1 &= 8 - 7 \cdot 1 \\
&= 8 - (23 - 8 \cdot 2) \cdot 1 \\
&= 8 \cdot 3 - 23 \cdot 1 \\
&= (192 - 23 \cdot 8) \cdot 3 - 23 \cdot 1 \\
&= 23 \cdot (-25) + 192 \cdot 3.
\end{aligned}
$$

[1, 2] Page 619 lines 28 to 37 (i.e., lines –10 to –1). Replace these last ten lines of the example with the following lines:

Therefore, $1 = 23 \cdot (-25)$ mod 192. But we can't choose e to be -25 because e must be positive. This is no problem because we can add any multiple of 192 to -25. For example, let $e = 192 + (-25) = 167$. We'll verify that this value of e works.

$$
\begin{aligned}
de \bmod 192 &= 23 \cdot 167 \bmod 192 \\
&= 23 \cdot (192 - 25) \bmod 192 \\
&= ((23 \cdot 192 \bmod 192) + (23 \cdot (-25) \bmod 192) \bmod 192 \\
&= (0 + 1) \bmod 192 \\
&= 1.
\end{aligned}
$$

Therefore, the public key is $(e, n) = (167, 192)$ and the private key d is 23.

Chapter 11

[1, 2] Page 649 line 1. Delete the phrase "into a DFA or an NFA" from the sentence.

[1, 2] Page 659 line 5. Replace, "useful represent" with "useful to represent".

[1] Page 661 line 17. Put space around "::" so the "Head::Tail" is changed to "Head :: Tail".

[1] Page 661 line 20. Remove space between "⟨" and "a" so the line looks like "← accept(⟨a, a, a, b⟩)."

[1] Page 663 line –2. Put space around "::" so the "Head::Tail" is changed to "Head :: Tail".

[1] Page 664 line 3. Remove space between "⟨" and "a" and remove space between "⟩" and ")" so the line looks like "← accept(⟨a, b, a, a⟩)."

[1] Page 678 line –13. Reduce space between "E_i" and "}".

[1] Page 689 line –9. Replace "to the final state" with "to a final state".

[1] Page 690 line 5. The letter "z" should be italic "z".

[1, 2] Page 690 line (pumping lemma box). Delete the phrase, "over the alphabet A." from the first sentence.

[1, 2] Page 690 line (pumping lemma box). In the second sentence, replace the phrase

"such that for any string $s \in L$ where $|s| \geq m$ there exist strings $x, y, z \in A^*$, where $y \neq \Lambda$, such that $s = xyz$, $|xy| \leq m$ and $xy^k z \in L$ for all $k \geq 0$."

with the phrase

"such that for any string $s \in L$ with $|s| \geq m$, there exist strings x, y, and z such that $s = xyz$, $y \neq \Lambda$, $|xy| \leq m$, and $xy^k z \in L$ for all $k \geq 0$."

[1] Page 693 line 14 (Exercise 1h). Remove the space between ")" and "(".

[1] Page 693 line –6 (Exercise 3b). Replace "of" with "that is".

Chapter 12

[1] Page 698 line 9. There is a missing Λ in "$S \rightarrow | \ aSb$". The expression should look like "$S \rightarrow \Lambda \ | \ aSb$".

[1] Page 699 line –8. Change "with the production" to "with the two productions".

[1] Page 707 line 8. Remove extra space in "$\{\Lambda \ \}$" to obtain "$\{\Lambda\}$".

[1] Page 713 line –13. Replace ":" by "," in "path($k : a \ t, X :: Y$)" to obtain "path($k, a \ t, X :: Y$)".

[1] Page 715 line –12. Change the misspelled subtitle "Pushdowm Automata" to "Pushdown Automata".

[1] Page 719 line 16. Replace "$\Rightarrow aAb$" with "$\Rightarrow aAB$".

[1] Page 729 line 6. Remove space between "w" and ":".

[1] Page 732 line –2. Remove space between "b" and ",".

[1] Page 738 (in Figure 12.2) The rows labeled 3 and 9 have larger height than the others. All rows of the table should be the same height.

[1] Page 743 line 9. Replace "push state j" with "push a and state j".

[1] Page 745 line –11. In exercise 6b insert space between "aSB" and "|".

[1] Page 746 line 1. Center the union symbol "$\cup$" between the two sets.

[1] Page 746 line 7. Replace "ab." with "abb." so that the line looks like the following:

$$"B \rightarrow aBbb \ | \ abb."$$

[1] Page 749 line 10. Remove the period after "ATA".

Chapter 13

[1] Page 772 lines 8, 16, 19, 20, 22, and 23. On these lines, put a space on either side of each occurrence of "::". For example, change "Head::Tail" to

"Head :: Tail".

[1, 2] Page 778 line –6. Replace "the the" with "the".

[1, 2] Page 779 (line 5 of box in Figure 13.3). Delete the comma at the end of "add$(x, 0) = x$".

[1, 2] Page 780 line 5 (of Example 13.12). Replace "notEq$(x + y, 1) = 0$" with "notEq$(x, y + 1) = 0$".

[1] Page 780 line –12. In part 3 of Example 13.12, replace "$f(x, y) = \min(y,$" with "$f(x, y) = \min(z,$".

[1, 2] Page 782 line –10. Replace "number in" with "number is in".

[1,2] Page 784 lines 4 and 5. Delete the sentence, "So a Post algorithm computes a function from A^* to A^*.".

[1,2] Page 784 lines 7. Replace the sentence, "A variable X occurs in s if and only if X occurs in t." with the sentence, "If a variable X occurs in t, then X must also occur in s.".

[1,2] Page 784 lines –16 and –17. Delete the two sentences on these two lines, "Any nondeterministic Post algorithm can be rewritten as a deterministic Post algorithm. So no additional power is obtained by nondeterminism."

[1] Page 788 line 12. In Exercise 3c, replace "$f(x, y) = \min(y,$" with "$f(x, y) = \min(z,$".

[1] Page 788 line 12. In Exercise 3d, replace "$f(x, y) = \min(y,$" with "$f(x, y) = \min(z,$".

Chapter 14

[1, 2] Page 797 line –18. Replace "that when, given n,produces" with "that, when given n,produces",

[1, 2] Page 799 line –12 (Sentence preceding the box (14.8)). Replace "Here's 10th problem" with "Here's the 10th problem".

[1, 2] Page 800 line 10. Replace "f" with the function symbol "f",

[1] Page 801 lines 7 to 10. Replace the sentences and phrase,

"For any given n, we can modify T as follows: Replace the Halt state by a state that looks to the right for an empty cell and when it is found, it writes a 1. Then it uses $n - 1$ more states to write $n - 1$ more 1's and then halts. The modified machine"

with the following sentences and phrase:

"For any given n, construct a new machine that starts with an empty tape and uses n states to write n 1's onto the tape. Then it transfers to the start state of T. The new machine"

[1] Page 803 line –13. In exercise 6, replace "state where no" with "state that no".

[1] Page 812 line –10. Replace "$\forall x\, \exists y\, \neg\, x \lor y$" with "$\forall x\, \exists y\, (\neg\, x \lor y)$".

[1] Page 812 line –4. Replace "$\forall x\, \exists y\, \neg\, x \lor y$" with "$\forall x\, \exists y\, (\neg\, x \lor y)$".

[1] Page 812 line –3. Replace "$\exists z$" with "$\forall z$".

[1] Page 825 line 7. Replace the phrase,

"theorem that states $\text{NSPACE}(n^i) \subset \text{DSPACE}(n^{2i})$."

with

"theorem stating that $\text{NSPACE}(n^i) \subset \text{DSPACE}(n^{2i})$ for $i \geq 1$.".

Answers to Selected Exercises

[1] Page 827 line 8. In answer 3c, replace

"9 is odd but not prime. Therefore the statement is false" with

"The statement is true".

[1] Page 828 line 10. In answer 1e, replace

"{California, Nevada, Idaho, Washington}" with "{M, I, S, P, R, V, E}".

[1] Page 830 line 4. In answer 5a, insert 3 between the 2 and 4 so that the answer looks like "$\langle 24, 60, \langle 2, 3, 4, 6, 12 \rangle \rangle$".

[1, 2] Page 830 lines 12 and 13. Change answer 10e to:
"$x = \Lambda$ or $s_1 \ldots s_n$ or $u_1 \ldots u_m$ or $(s_1 \ldots s_n)(u_1 \ldots u_m)$, where $s_k \in L$ and $u_k \in M$."

[1, 2] Page 830 line 21. In answer 13c, replace the answer
"$\{x \mid (x, \text{None}, \text{None}) \in \text{Borders for some } x\}$." with

"$\{x \mid (x, y, \text{None}) \in \text{Borders for some } y\}$.".

[1] Page 834 line –1. In answer 9e, italicize the n in $f(n)$.

[1] Page 839 line 9. In answer 2e, replace $(x + 1)^2$ with $\left(\sqrt{x} + 1\right)^2$.

[1] Page 839 line 15. In answer 6a, replace "$axb \in S$" with "$axc \in S$".

[1] Page 840 lines 20 to 23 (answer 3). Delete this entire answer and replace it with the following answer:

3. For (3.9): makeTree($\langle\ \rangle$, $\langle 3, 2, 4 \rangle$) = makeTree(insert(3, $\langle\ \rangle$), $\langle 2, 4 \rangle$)
$$= \text{makeTree(insert}(2, \text{insert}(3, \langle\ \rangle)), \langle 4 \rangle)$$
$$= \text{makeTree(insert}(4, \text{insert}(2, \text{insert}(3, \langle\ \rangle))), \langle\ \rangle)$$
$$= \text{insert}(4, \text{insert}(2, \text{insert}(3, \langle\ \rangle))).$$

For (3.10): makeTree($\langle\ \rangle$, $\langle 3, 2, 4 \rangle$ = insert(3, makeTree($\langle\ \rangle$, $\langle 2, 4 \rangle$))
$$= \text{insert}(3, \text{insert}(2, \text{makeTree}(\langle\ \rangle, \langle 4 \rangle)))$$
$$= \text{insert}(3, \text{insert}(2, \text{insert}(4, \text{makeTree}(\langle\ \rangle, \langle\ \rangle))))$$
$$= \text{insert}(3, \text{insert}(2, \text{insert}(4, \langle\ \rangle))).$$

[1] Page 840 line –15. In answer 4c, replace the entire line with the following answer:

$$f(1, n) = \gcd(1, n) \text{ and } f(k, n) = f(k - 1, n) + \gcd(k, n).$$

[1] Page 841 line 3. Replace answer 7e with the following answer:

$$f(0, k) = \langle 0 \rangle \text{ and } f(n, k) = \text{cat}(f(n - 1, k), \langle nk \rangle).$$

[1] Page 843 line 16.

In answer 1a, replace "All" with "Reflexive, symmetric, transitive".
In answer 1c, replace "All" with "Reflexive, symmetric, transitive".
In answer 1e, replace "All" with "Reflexive, symmetric, transitive".
In answer 1g, replace "Transitive" with "Irreflexive, transitive".

[1] Page 845 line –4. In answer 5a, replace "$\{5k + n \mid k \in \mathbb{N}\}$" with "$\{6k + n \mid k \in \mathbb{N}\}$".

[1] Page 846 line –13. In the graph for answer 3b, delete the vertical line between $\{a, c\}$ and $\{b\}$.

[1] Page 848 line 7. In answer 2i, replace "for $n = 1$." with "for $n = 2$."

[1, 2] Page 848 line –10. In answer 3a, replace "$n = 1$" with "$n = 0$".

[1, 2] Page 848 line –7. In answer 3a, add "$= F_{(n+1)+2} - 1$." to the end of the line so the line looks like "$= F_{n+2} - 1 + F_{n+1} = F_{n+3} - 1 = F_{(n+1)+2} - 1$."

[1, 2] Page 848 line –6. In answer 3c, replace
"For $(m, n) = (0, 0)$ the equation becomes $0 = 0 + 0$. Assume"
with
"Since the equation contains the term F_{m-1}, we must have $m \geq 1$. For $n = 0$ or $n = 1$ the equation holds for any $m \geq 1$. Let $n \geq 2$ and assume

[1, 2] Page 848 lines –1, –2, and –3. In answer 3c, replace the four occurrences of "F_{m+1}" on these three lines with "F_{m-1}".

[1, 2] Page 850 line 21. In answer 13, replace, "Since $\gcd(x, y) = \gcd(x, y - x)$ (by 2.1b)" with "Since $\gcd(x, y) = \gcd(y, x) = \gcd(x, y - x)$ (by 2.1a and 2.1b))".

[1, 2] Page 851 line 21. In answer 20, remove a closing parens. In other words, replace "$= \text{cat}(a :: \text{cat}(x, y)), z)$" with "$= \text{cat}(a :: \text{cat}(x, y), z)$".

[1, 2] Page 851 line 22. Misspelling: Change "(defintion)" to "(definition)".

[1] Page 853 line 1. In answer 1c, replace the term $3(3^3)$ with $3(3^2)$.

[1, 2] Page 853 line 4. In answer 2e, replace "x^{1+4}" with "x^{i+4}".

[1] Page 853 lines 14 and 15. Replace answer 8a with the following:

$3 + 5 + \dots + (2k + 3)$, where $k = \text{ceiling}(n/2) - 1$. This sum has the value

$(k + 1)(k + 3) = (k + 2)^2 - 1 = (\text{ceiling}(n/2) + 1)^2 - 1.$

[1] Page 854 line 11. Change answer 13a from "0.52" to "0.21".

[1] Page 854 line 15. Change answer 18a from "$C(49, 6)$" to "$1/C(49, 6)$".

[1] Page 854 lines 16 to 24. Replace answer 18c with the following answer:

c. $[C(6, 5)C(43, 1) + C(6, 4)C(43, 2)]/C(49, 6)$. To obtain the answer, notice that there are $C(49, 6)$ 6-element subsets of a 49-element set. Now suppose that $\{a, b, c, d, e, f\}$ is the winning set of numbers. First, we'll count all the 6-element sets that contain exactly five winners. To do this, notice that there are $C(6, 5)$ 5-element subsets of $\{a, b, c, d, e, f\}$. To each of these 5-element subsets we add a non-winner from the set $\{1, ..., 49\} - \{a, b, c, d, e, f\}$. Since there are 43 (= $C(43,1)$) non-winners, it follows that there are $C(6, 5)C(43, 1)$ sets of 6 numbers that contain exactly five winners. Next, we'll count the 6-element sets that contain exactly four winners. To do this, notice that there are $C(6, 4)$ 4-element subsets of $\{a, b, c, d, e, f\}$. To each of these 4-element subsets we add two non-winners from the set $\{1, ..., 49\} - \{a, b, c, d, e, f\}$. Since there are $C(43, 2)$ possible pairs of non-winners, it follows that there are $C(6, 4)C(43, 2)$ sets of six numbers that contain exactly four winners. So the probability of choosing either four or five of the six winning numbers is given by $[C(6, 5)C(43, 1) + C(6, 4)C(43, 2)]/C(49, 6)$.

[1] Page 857 lines –1 to –3. Replace answer 10c with the following:

c. $(A \lor B) \land \neg A \to B \equiv \neg ((A \lor B) \land \neg A) \lor B \equiv \neg (A \lor B) \lor A \lor B$
$\equiv (\neg A \land \neg B) \lor (A \lor B) \equiv (\neg A \lor A \lor B) \land (\neg B \lor A \lor B)$
$\equiv (\text{true} \lor \neg B) \land (\text{true} \lor A) \equiv \text{true} \land \text{true} \equiv \text{true}.$

[2] Page 857 line –2. In answer 10c, replace "(true $\lor \neg B$)" with "(true $\lor B$)".

[1, 2] Page 860 line 7. In answer to exercise 6a, insert the new line
"7.   false   6, T"
and replace "QED   1, 2, 6, IP." with
"QED   1, 2, 7, IP."

[1, 2] Page 860 line 14. In answer to exercise 6c, insert the new line
"7.   false   6, T"
and replace "QED   1, 2, 6, IP." with
"QED   1, 2, 7, IP."

[1, 2] Page 860 line –11. In answer to exercise 6e, insert the new line
"9.   false   8, T"
and replace "QED   1, 2, 8, IP." with
"QED   1, 2, 9, IP."

[1, 2] Page 860 line –1. In answer to exercise 6g, insert the new line
"10.   false   9, T"
and replace "QED   1, 2, 3, 9, IP." with
"QED   1, 2, 3, 10, IP."

[1, 2] Page 861 line –11. In answer to exercise 7c, insert the new line
"8.   false   7, T"
and replace "QED   1, 2, 3, 7, IP." with
"QED   1, 2, 3, 8, IP."

[1, 2] Page 861 line –1. In answer to exercise 7e, insert the new line
"10.   false   9, T"
and replace "QED   1, 2, 9, IP." with
"QED   1, 2, 10, IP."

[1, 2] Page 862 line 13. In answer to exercise 7g, insert the new line
"13.   false   12, T"
and replace "QED   1, 2, 3, 4, 12, IP." with
"QED   1, 2, 3, 4, 13, IP."

[1, 2] Page 862 lines –10, –11, and –12. In answer to exercise 7i, replace the
the three lines
"8. $A \to C$ 3, 4, 7, IP
 9. $B \to (A \to C)$ 2, 8, CP
        QED   1, 9, CP.
with the following four lines:
"8.   false   7, T
 9. $A \to C$ 3, 4, 8, IP
10. $B \to (A \to C)$ 2, 9, CP
        QED   1, 10, CP."

[1] Page 862 line –2. In answer to exercise 7k on line #8, replace
"$A \land B \to C$" with "$A \to B \lor C$".

[1, 2] Page 862 lines –1 and –2. In answer to exercise 7k, replace the two
lines
"8. $A \to (B \lor C)$ 2, 3, 7, IP
        QED   1, 8, CP.

with the following three lines:
"8.   false   7, T
 9. $A \rightarrow (B \vee C)$ 2, 3, 8, IP
         QED   1, 9, CP."

[1, 2] Page 863 line –14. In answer to exercise 9a, insert the new line
"12.   false   11, T"
and replace "QED   1, 2, 3, 4, 11, IP." with
"QED   1, 2, 3, 4,12, IP."

[1, 2] Page 863 line –3. In answer to exercise 10a on line #11, replace
"$A \wedge \neg A$" with "$A \vee \neg A$"

[1] Page 865 line 5. In answer 2c replace "$x \in \{0, 1\}$" with "$y \in \{0, 1\}$".

[1] Page 865 line –9. In answer 12g replace "consequent is true." with "consequent is false.".

[1, 2] Page 866, line –6. Insert the following sentence at the beginning of the answer for to Exercise 1 Section 7.2 (between "**1.**" and "**a.**"):

"For each part we'll assume that I is an interpretation with domain D."

[1, 2] Page 866, lines –6 and –4. On each of these two lines, replace "true for domain D" with "true for I".

[1, 2] Page 866 line –5 to page 867 line 6. On these lines, replace all occurrences (there are eight of them) of "true for D" with "true for I."

[1] Page 868 line 2. In the answer to exercise 8e, replace " $\forall x$" with "$\forall x \, \forall y$", so the line looks like the following:

"**e.** $\forall x \, \forall y \, (B(x) \wedge E(x, y) \rightarrow W(y))$."

[1, 2] Page 869 line –1. In answer to exercise 7c, insert the new line
"9.   false   8, T"
and replace "QED   1, 2, 8, IP." with
"QED   1, 2, 9, IP."

[1, 2] Page 872 line 11. In the first part of answer 9c, insert the new line
"11.   false   10, T"
and replace "QED   1, 2, 10, IP." with
"QED   1, 2, 11, IP."

[1, 2] Page 872 line –15. In the second part of answer 9c, insert the new line
"11.   false   10, T"
and replace "QED   1, 2, 10, IP." with
"QED   1, 2, 11, IP."

[1, 2] Page 876 line –15 (in answer to 9). Replace "5, EG" with "4, EG".

[1, 2] Page 879 line 6 (in answer to 9). Replace "is equivalent to" with "is implied by".

[1, 2] Page 880 line 18 (in answer to 14c). Replace "2, Simp" with "5, Simp".

[1, 2] Page 880 line 24 (in answer to 14c). Replace "2, 4" with "2, 4, 8".

[1, 2] Page 881 line 15 (in answer to 16c). Replace, "so we have $f(s)$, fx is nonzero" with "so we have $f(s)$, $f(t) \in$ N. Since x is nonzero".

[1, 2] Page 881 line 21 (in answer to 17a). Replace "$f(t) = x$" with "$f(t) = y$".

[1, 2] Page 881 line 22 (in answer to 17a). Replace "$f(t) = y$" with "$f(t) = x$".

[1] Page 883 line 12. In answer to exercise 5, replace "¬ $R(y, $ z$)$" with
"¬ $R(y, x)$".

[1] Page 883 line –11. Change"T" to italic.

[1, 2] Page 884 line 4. In answer to 10a, replace "Axiom 3" with "Axiom 4".

[1, 2] Page 894 line –8. In answer 8a replace "$g(g(g(x)))$" with "$f(f(f(x)))$"

[1, 2] Page 897 lines 14 to 19. Align so that there is equal space on either side of the equal symbol "=".

[1] Page 907 line –13. In answer to 9, replace "$B \rightarrow ab$" with "$B \rightarrow abb$".

[1] Page 907 line –11. In answer to 9, replace "need three" with "need two".

[1, 2] Page 912 line 9. In answer to 2a, replace "monus(1, less(x, y))" with "monus(1, greater(x, y))"

Bibliography

(No Errata)

Greek Alphabet

(No Errata)

Symbol Glossary

[1] Page 927 line 6. Change "578" to "758" so that the line looks like,

"(i, a, b, L, j) Turing machine instruction   758".

Then move the line down the page so that it becomes line −4. i.e., so that it sits between the line that contains 739 and the line that contains 781.

Index

[1, 2] Page 939 second column line 9. Add page 151 to the entry, so it should be "Prefix of a string, 151, 245".

[1] Page 943 second column lines −1 and −2. Delete these last two entries, "pushdown automaton, 701" and Turing machine, 758, 766".

Other Fit and Finish Notes

[1] Pages 640 to 642 Exercises. In several exercises the letters of the parts are not aligned on the period. For example, in Exercise 2 on page 640, notice the jagged alignment of the letters "a." to "f.". This is also the case in Exercises 1, 2, 4, 5, 6, 8, 9, and 10. See also **page 465 Exercise 4.**

[1] Page 648 Figure 11.4. Some arrows have minor overlaps or gaps with circles. This is also the case for the arrow in the diagram at the bottom of

page **648** (the arrow overlaps one circle and doesn't touch the other circle.).
This is also the case with some other graphs. e.g., pages **643, 649, 650, 653,
654, 656, 657, 658, 659, 664, 665, 666, 674, 676, 681, 687, 702, 703, 705, 707,
731, 760, 902.**