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F O R   E N G I N E E R S   A N D   S C I E N T I S T S   U S I N G   M A T L A B

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K E N N E T H   H A R D Y                      I S B N   0-13-906728-0

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**ERRATA for FIRST EDITION (First Printing)**

Please send any errata to: [khardy@connect.carleton.ca](mailto:khardy@connect.carleton.ca)  
so that corrections can be made in subsequent printings.

Page 14. Line 2. Change  $\mathbf{r}_2$  to  $\mathbf{r}_1$  in second ERO so that  $\mathbf{r}_3 - 5\mathbf{r}_2 \rightarrow \mathbf{r}_3$  reads  $\mathbf{r}_3 - 5\mathbf{r}_1 \rightarrow \mathbf{r}_3$ .

Page 19 Exercise 49. Add sentence, "... (b)  $y = 0$ . Find coordinates of points  $A, B, C, D$ ."

Page 35 Exercises 43, 44. Insert " $\mathbf{A} =$ " before each matrix.

Page 48 Exercise 10. Delete "(a)" and "(b)" from the problem.

Exercise 14. In the figure, change output at  $B$  from 200 to 500 in order to balance input and output.

Page 49. Exercise 15. Insert two words, "and solve the resulting ..."

Exercise 16. In the last line, change  $AE$  to  $AB$  and  $BD$  to  $BC$ .

Page 51. Chapter Review [5]. Change "reduction" to "elimination." Reduction refers to matrices.

Page 53. Edit line 4. Reverse order of words: "... how matrices (plural for matrix) were used ..."

Page 71. Exercise 18. Correct three entries in last matrix: 
$$\begin{bmatrix} -2.7 & * & -18.8 \\ * & * & * \\ 27.0 & 31.0 & * \end{bmatrix} = \mathbf{C}$$

Page 73. Exercise 46. Insert the word "main" before diagonal in two places.

Page 74. Exercise 76. Edit: Move " $(\mathbf{A}^2 = \mathbf{A})$ " just after the word "matrix"

Page 91. Exercise 23. Replace  $\mathbf{Y} = \mathbf{P}\mathbf{X}\mathbf{Q}^{-1}$  by  $\mathbf{Y} = \mathbf{P}^{-1}\mathbf{X}\mathbf{Q}$ .

Page 93. Exercise 83. Spelling: "Hilbert" on line 4.

Page 104. Delete the edge between nodes 2 and 5 in graph  $G_4$ .

Page 109. Delete labels on edges:  $e_1, e_2, \dots, e_6$

Page 118. After (2.73), replace "price vector" with "production vector."

Page 122. Change em dash to minus sign and write  $\mathbf{I}_2 - \mathbf{C}$ .

Page 124. Example 7. Edit: "Refer to Figure 2.7." and correct numerical data:

$$\mathbf{A} = \begin{bmatrix} -0.8660 & -0.9397 & -0.7660 \\ -0.5000 & -0.3420 & 0.6428 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 110.9923 & 13.1001 \\ 13.1001 & 39.0077 \end{bmatrix}, \quad \det(\mathbf{B}) = 4157.9,$$
$$\mathbf{B}^{-1} = \begin{bmatrix} 0.0094 & -0.0032 \\ -0.0032 & 0.0267 \end{bmatrix}, \quad \mathbf{d} = \begin{bmatrix} 0.0308 \\ 0.5024 \end{bmatrix}$$

Exercise 11. Replace "paths" with 'walks.'

Exercise 12. Replace "circuit" with "cycle."

Page 125. Exercise 13. Replace "walk" with "path" in two places.

Exercise 19. Delete *square*.

- Page 127. Delete words “the” and “are” and read: “. . . fraction of birds . . . , killed by hunters.”
- Page 133. In Figure 3.2, read  $x, y$  as vectors  $\mathbf{x}, \mathbf{y}$  (bold faced).
- Page 149. Exercise 18. Change second  $u_2$  to  $u_3$  and read “ $(u_1, u_2, u_3)$ ” .
- Page 151. Exercise 70. Change “ $\mathbf{v}_1-$ ” to “ $\mathbf{v}_1 =$ ” and the same for  $\mathbf{v}_2, \mathbf{v}_3$ . Insert “and  $\mathbf{0}$ ” reading: “. . . components in  $\mathbf{v}_1$  and  $\mathbf{0}$  and . . .” . Change  $\mathbf{x}_2 = [0, -3]$  to  $\mathbf{y}_1 = [0, -3]$ ,  $\mathbf{x}_1$  to  $\mathbf{x}_1$ ,  $\mathbf{y}_1$  to  $\mathbf{y}_1$ .
- Page 155. Theorem 3.5. Proof. Delete transpose operator and read: “. . . in Section 2.2,  $\mathbf{A}$  is invertible . . .” .
- Page 175. Exercise 17. Insert “that” to read “condition that will imply” .  
 Exercise 20. Delete “largest possible” .  
 Exercises 23–24. Add “s” to read “. . . basis vectors . . .” .
- Page 176. Exercise 25. Write “ $\mathbf{A} =$ ” before the matrix.  
 Exercise 35. Insert the word “reduced” to read “reduced echelon” .  
 Exercises 53–56. Delete the word “binary” .
- Page 188. Edit line 5 from foot of page: “Observe that  $\text{ran } T (= \text{col } \mathbf{A})$  is . . .” .
- Page 190. Exercise 24. Replace “defined” by “represented” .  
 Exercises 43–44. Replace sentence “Express . . .  $\mathbf{B}$ .” with “Use block form to compute  $\mathbf{B}$ .”
- Page 191. Exercise 17. Delete “s” in “rows” .  
 Exercise 18. Replace “independent” by “dependent” in two places.
- Page 218. Exercise 33. Replace “defines” by “represents” in two places.  
 Exercise 34. Replace “defined” by “represented” .
- Page 219. Exercise 37. Insert “from” after  $\mathbb{R}^n$  on the last line.
- Page 231. Exercise 15. Change 1 into 2 to read  $\mathbf{u}_2 = [3 \ -1 \ 0]^\top$ .
- Page 234. Theorem 4.16 (a). Delete “classifying solutions” .
- Page 238. Middle of page: Read “. . . satisfies  $-1 \leq r \leq 1$  and . . .” .
- Page 240. Example 5. Notation: Replace  $\sim$  with  $\simeq$  (approximately) in three places.  
 Exercises 5–6. Read “Figure 4.15,” .
- Page 241. Exercise 14. In the numerator of quotient, read  $\overline{\mathbf{v}}\overline{\mathbf{v}}$  (insert small space).  
 Exercise 16. Read “. . . the vectors  $\mathbf{s}$  and  $\mathbf{b}$ ?”
- Page 257. Exercise 46. The reference (5.15) is not required.
- Page 263. Definition 5.3. Delete hyphen from “cross-product.”
- Page 267. Line 2. Replace “We have” with “Viewing  $\mathbf{u}, \mathbf{v}, \mathbf{w}$  as column vectors, we have” .  
 Exercise 5. Insert word, “. . . be square matrices . . .” .
- Page 268. Exercise 18. Edit the *Hint* to read: “Consider  $\mathbf{V}^\top$ , take  $x_1$  times row 2 from row 1,  $x_1$  times row 3 from row 2 and so on.”
- Page 269. Exercise 37. To keep terminology uniform, change “noninvertible” to “singular” in the *Hint*.
- Page 270. Exercises 69–71. Delete “n” in “Shown” and correct font to read  $P_3$ .  
 Exercise 72. Change the word “hard” to “hand.”
- Page 271. Exercise 19. Add comma: “unimodular, then.”
- Page 277. Last line before EXAMPLE 1. Add word “the” to read “. . . on the main diagonal . . .” .
- Page 283. Exercise 3. Change (2, 1)-entry in matrix from 3 to 0.
- Page 284. Exercise 28. Change last equation to read “ $\det(\lambda \mathbf{I}_n - \mathbf{A}) = 0$ .”
- Page 292. Exercises 21–24. Spelling: “the given power.”
- Page 300. Edit entries in matrix:  $\mathbf{D}(1, 1) = 0.86$ ,  $\mathbf{D}(2, 2) = -0.04 + 0.70i$ ,  $\mathbf{D}(3, 3) = -0.04 - 0.70i$ . Then  $\lambda_1 = 0.86$ ,  $\lambda_2 = -0.04 + 0.70i$ ,  $\lambda_3 = -0.04 - 0.70i$  and  $\mathbf{x}_k = (0.86)^k \dots$

- Page 303. In Figure 6.4 at node  $C$  change 0.86 to 0.80.
- Page 313. Exercise 3. In line 2, read “The state diagram shown gives . . . .”
- Page 315. Exercise 17. Better notation: Change  $\mathbf{P}$  to  $\mathbf{T}$  in four places and edit to read: “. . . distribution state vector and the . . .” .
- Page 321. Line 3: Change “chain” to “product” .
- Page 322. Exercise 10. Correct entries in the equation in the *Hint* and include  $\gamma$  as follows,  
 “. . . +  $\beta \left\{ \begin{bmatrix} 9 \\ 3 \\ 1 \end{bmatrix} t + \begin{bmatrix} 6 \\ 1 \\ 0 \end{bmatrix} \right\} + \dots$ , where  $\alpha, \beta, \gamma$  are scalars.”
- Page 323. Exercise 12. Change reference (6.1) to (6.34).
- Page 334. Exercise 2. Change italic  $u, v$  to bold face  $\mathbf{u}, \mathbf{v}$  in two places.
- Page 335. Exercise 36. Use the definition  $s(x, y) = \left(\frac{x}{s}, \frac{y}{s}\right)$ , when  $s \neq 0$ , and  $0(x, y) = (0, 0)$ .  
 Exercise 45. Delete word “are” .
- Page 346. Exercise 6. Change polynomial to  $\mathbf{p} = 4t + t^2$ .
- Page 347. Exercises 13–14. Change  $p(x)$  to  $p(t)$ .  
 Exercise 28. Edit:  $\mathbf{p}_1 = 1$ ,
- Page 348. Exercise 41. Edit: Consider the vector space  $\mathbf{F}(-\infty, \infty)$  and let . . . .  
 Exercise 44. Replace “vectors” by “objects” .
- Page 361. Exercise 27. Capital: “Show . . .” .  
 Exercise 32. Edit “ $T(\mathbf{p}) = (1 + t)\mathbf{p}' - 3\mathbf{p}$ , where . . .” .
- Page 362. Exercise 35. Change  $\mathbb{R}^n$  to  $\mathbb{R}^{n \times n}$ .  
 Exercise 39. Change (2, 2)-entry in  $\begin{bmatrix} 0 & 0 \\ 1 & 1 \end{bmatrix}$  to read  $\begin{bmatrix} 0 & 0 \\ 1 & 2 \end{bmatrix}$ .
- Page 374. Exercise 28. Change problem to  $\frac{-5i}{4 + 3i}$ .
- Page 375. Exercise 73. Delete first instance of word “nonzero” .
- Page 382. First circle in Figure 8.7. Replace 1 by  $i$  on imaginary axis.
- Page 383. First line, read: “. . . , and using (8.30), we . . .” .
- Page 386. After (8.37) read “where  $e \simeq 2.7183$  is . . .”.
- Page 387. Exercise 12. Edit to read  $(\sqrt{3} - i)^{382}$ .
- Page 402. Exercises 35–40. Replace “corresponding to” with “associated with” .  
 Exercise 40. Replace entry 3 with  $-3$ .  
 In MATLAB preamble, replace italic  $u$  with bold  $\mathbf{u}$ .
- Page 414. Exercise 1. Change inequality in (b) to read  $4x_1 + 6x_2 \leq 12$  .  
 Exercise 7. Read:  $\pi : -x_1 + 2x_2 + x_3 = 8$ .
- Page 415. To clarify, add brackets: Exercise 8 has two inequalities, Exercise 9 has three inequalities, Exercise 10 has two inequalities, Exercise 11 has three inequalities.
- Page 423. Initial Tableau, row 1, read  $2 \div 2 = 1^*$  and  $4 \div 1 = 4$ . Second Tableau, row 3,  $9 \div \frac{1}{2} = 18^*$ .
- Page 429. Initial Tableau, row 1, replace  $1^*$  with  $\textcircled{1}$  and, in row 5, add star  $10^*$ .
- Page 434. Figure 9.11. Delete shading and  $S$  in Dual problem. Feasible set is indicated by small triangle in upper right corner: Shade this and label  $S$ .
- Page 435. Change + to - in second equation to read  $y_1 - y_2 - u_2 + a_2 = 3$ .
- Page 437. Edit second sentence in **Step 2**: “In column  $\mathbf{b}$ , let  $k$  ( $1 \leq k \leq m$ ) be the largest integer with  $b_k < 0$ .”
- Page 439. Exercise 4. First constraint:  $x_1 + x_2 + x_3 \leq 1$ .  
 Exercise 6. Change “or” to “for” .

Exercises 1.2 [7]. First row in  $\mathbf{A}^*$  reads 1 1 1 0.

Exercises 1.3 [19]. Edit “ $\dots = \frac{1}{13}(16, 10, 6, 4, 2, 6)$ .”

Exercises 2.3 [9]. Edit: “ $\dots$  and so, by Theorem 2.9, we  $\dots$ ” .

Exercises 2.4 [33]. Better notation: Replace  $\mathbf{A}\mathbf{x} = \mathbf{x}$  with  $\mathbf{P}\mathbf{u} = \mathbf{u}$  and change  $\mathbf{A}^{110}\mathbf{u}$  to  $\mathbf{P}^{110}\mathbf{u}_0$ .

Exercises 3.3 [39]. Change F to T.

Exercises 3.3 [43]. Change (1, 3)-entry to  $-1$ .

Exercises 3.3 [45]. Delete letter “T”.

Exercises 3.4 [1]. Edit: “(b)  $\ker T = \{\mathbf{0}\}$ ,  $\text{ran } T = \mathbb{R}^2$ ,” .

Exercises 3.4 [19]. Change (2, 1)-entry to  $-1$ .

Exercises 3.4 [21]. Replace matrix with  $\begin{bmatrix} -1 & 0 \\ 0 & 0 \end{bmatrix}$ .

Exercises 3.4 [37]. Edit: “ These are represented by matrices  $\mathbf{A}$  with  $\mathbf{A}^2 = \mathbf{I}$ .” .

Exercises 4.1 [41]. Replace first instance of  $\text{comp}_{\mathbf{v}}\mathbf{u}$  by  $\text{comp}_{\mathbf{u}}\mathbf{v}$  and change entry in  $\text{comp}_{\mathbf{v}}\mathbf{u}$  from  $-1$  by 1.

Exercises 4.3 [15]. Replace  $-\frac{5}{6}$  by  $-\frac{3}{2}$  and replace  $\frac{9}{210}$  by  $\frac{3}{70}$ .

Exercises 4.3 [23]. Replace “The” by “An” .

Exercises 4.4 [7]. Edit: “ $\mathbf{r}(\mathbf{x}_0) = [2, -5, 1]^T$ ,” and add at end “ $\mathbf{r}(\bar{\mathbf{x}}) = [\frac{3}{2}, 0, \frac{3}{2}]^T$ .”

Exercises 5.2 [9]. Edit:  $\begin{bmatrix} 4 & -2 \\ -3 & 1 \end{bmatrix}$ .

Exercises 5.2 [11]. Edit:  $\begin{bmatrix} 1 & -1 & 0 \\ 0 & 1 & -1 \\ 0 & 0 & 1 \end{bmatrix}$ .

Exercises 6.1 [37]. Delete “s” in “polynomials.”

Exercises 6.4 [7]. Change fourth component in  $\mathbf{u}_3$  from 0.625 to 0.125.

Exercises 8.1 [53]. Change answer to  $\pm(1 + i\sqrt{3})$ .

Exercises 8.1 [67]. Change answer to 5/4.

Exercises 8.3 [11]. In polar form, the answer is  $\frac{2^9}{3^4} \cos \frac{4\pi}{3} \text{cis } 0$ .

Exercises 8.4 [5]. Change  $\text{cis}(-\frac{\pi}{8})$  to  $\text{cis}(-\frac{\pi}{8})$ .

Exercises 8.4 [9]. Change  $\pm\sqrt{3} - i$  to  $\pm\sqrt{3} + i$

Exercises 8.4 [11]. Answer is  $\sqrt[6]{2} \text{cis}(\frac{\pi}{12} + \frac{2k\pi}{3})$ ,  $k = 0, 1, 2$ .

Exercises 8.5 [15]. Read  $\mathbf{A}^{-1} = \begin{bmatrix} i & 1-i \\ 1+i & -i \end{bmatrix}, \dots$

Exercises 8.5 [29]. Transpose first matrix.

Exercises 8.5 [31]. Transpose first matrix.

Exercises 8.5 [33]. Transpose first matrix and insert fraction: “ $\mathbf{A}^{-1} = \frac{1}{20} \dots$ ” .

Exercises 9.1 [11]. Change (0, 0) to (1, 0) and, in the figure, change color of triangle with nodes (0, 0), (1, 0), (0, 1) to white.

Exercises 9.2 [9]. Edit: “ $f = 4$ .” .

Exercises 9.4 [3]. Edit: “ $f \simeq 9.9231$ .” .