Errata for Second Printing of Numerical Methods with MATLAB: Implementations and Applications

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This document lists only the technical errors in the mathematics or in the prose. Typographical errors in spelling and punctuation are not included. Some changes to the prose to clarify a technical concept are noted. The errors noted here occurred in the *second printing*.

Chapter 2: Interactive Computing in MATLAB

page 36

At about the middle of the page the expression `>> x = (end-3,end) = [\,]` should be

```
x(end-3,end) = []
```

page 81, Exercise 28

The tabulated data for viscosity of water are inconsistent with the contents of `H2Ovisc.dat`. The data in `H2Ovisc.dat` are correct. The table should read

T °C	μ_{air} kg/(m·s)	T °C	μ_{H_2O} kg/(m·s)
0	1.720×10^{-5}	0	1.787×10^{-3}
20	1.817×10^{-5}	5	1.519×10^{-4}
40	1.911×10^{-5}	10	1.307×10^{-4}
60	2.002×10^{-5}	20	1.002×10^{-4}
80	2.091×10^{-5}	30	7.975×10^{-4}
100	2.177×10^{-5}	40	6.529×10^{-4}
127	2.294×10^{-5}	50	5.468×10^{-4}
177	2.493×10^{-5}	60	4.665×10^{-4}
227	2.701×10^{-5}	70	4.042×10^{-4}
		80	3.547×10^{-4}
		90	3.147×10^{-4}
		100	2.818×10^{-4}

Chapter 3: MATLAB Programming

page 145, Exercise 24

On the third line of page 145, the formula for $x_{\max}$ should be $x_{\max} = L - \sqrt{b(b+2a)/3}$. The closing parenthesis should immediately follow a, not 3.

page 145, Exercise 27

Replace "`xy4.dat`" with "`xy5.dat`". The `xy4.dat` file is not in the NMM Toolbox.

page 148, Exercise 44

The first `end` statement is on line 30, not line 33.

pages 149–150, Exercise 47

This Exercise contains four errors:

1. In the third line, "pressure" is misspelled: replace "pressuce" with "pressure".
2. The upper limit for the sums should be $n + 1$, not n.
3. the lower limit of the sum for μ should be $i = 1$, not $i - 1$.
4. In the table on page 150, the coefficient $c_{\mu,4}$ has an extraneous letter "e" in the mantissa.

A complete and corrected version of Exercise 3-47 is given on the following page.

Corrected Version of Exercise 3-47:

47. (3) Using the `H2Odensity` function in Listing 3.12 as a guide, construct an `airProps` function that returns values for the density (ρ), viscosity (μ), specific heat at constant pressure (c_p), and thermal conductivity (k), of air as a function of temperature and pressure. The function definition statement should be

```
function [rho,cp,mu,k] = airProps(T,p,units)
```

Where `T` is the temperature, `p` is the pressure, and `units` is a string indicating the system of units. Values for `T`, `p`, and `units` should be optional. Your function should be callable in the following ways:

```
[rho,cp,mu,k] = airProps
[rho,cp,mu,k] = airProps(T)
[rho,cp,mu,k] = airProps(T,p)
[rho,cp,mu,k] = airProps(T,p,units)
```

with reasonable default values for `T`, `p`, and `units` provided. Use the following equations to compute the density and the thermophysical properties:

$$\rho = \frac{p}{RT} \qquad c_p = \sum_{i=1}^{n+1} c_{cp,i} T^{n-i+1}$$

$$\mu = \sum_{i=1}^{n+1} c_{\mu,i} T^{n-i+1} \qquad k = \sum_{i=1}^{n+1} c_{k,i} T^{n-i+1}$$

where p is the absolute pressure of the air, $R = 287.0$ J/kg/K is the ideal gas constant for air, T is the *absolute* temperature in kelvins ($T(K) = 273.15 + T(^\circ\text{C})$), and $c_{cp,i}$, $c_{\mu,i}$, and $c_{k,i}$ are constants in the following table

i	$c_{cp,i}$	$c_{\mu,i}$	$c_{k,i}$
1	$-2.455322455 \times 10^{-7}$	$2.156954157 \times 10^{-14}$	$-2.486402486 \times 10^{-12}$
2	$6.701631702 \times 10^{-4}$	$-5.332634033 \times 10^{-11}$	$-2.871794872 \times 10^{-8}$
3	$-2.992579643 \times 10^{-1}$	$7.477905983 \times 10^{-8}$	$9.629059829 \times 10^{-5}$
4	$1.042503030 \times 10^{3}$	$2.527878788 \times 10^{-7}$	$2.060606061 \times 10^{-5}$

These polynomial curve fit coefficients were obtained from data in the range $100 \le T \le 600K$. Make sure you check that the input value of T lies in this range. Note that n is the degree of the polynomial, and that there are $n + 1$ coefficients for each property in the preceding table.

Chapter 5: Unavoidable Errors in Computing

page 197

In the last line of the page, change $\sum_{j=1}^{k} b_k 2^{-k}$ to $\sum_{j=1}^{k} b_j 2^{-j}$, i.e., replace k inside the sum with j.

page 198

In the displayed equation at the top of the page, change $\sum_{j=1}^{k} b_k 2^{-k}$ to $\sum_{j=1}^{k} b_j 2^{-j}$, i.e., replace k inside the sum with j.

page 198, Algorithm 5.1

Inside the `else` block, the line $r_k = r_{k-1}$ is missing. The correct version of the algorithm is

Algorithm 5.1 Conversion from Floating-Point to Binary

$r_0 = \mathrm{x}$
for $k = 1, 2, \ldots, m$
  if $r_{k-1} \geq 2^{-k}$
    $b_k = 1$
    $r_k = r_{k-1} - 2^{-k}$
  else
    $b_k = 0$
    $r_k = r_{k-1}$
  end if
end for

page 204

In the displayed equation at the bottom of the page, the value of x_1 has an extra "2" as the fourth digit. The correct value of x_1 (to eleven digits) is

$$x_1 = 54.318158995$$

page 205–206, Equations (5.5), (5.6) and below

In the denominators of last terms in both Equation (5.5) and Equation (5.6), the discriminant should be $b^2 - 4ac$, not $b^2 + 4ac$. Equations (5.5) and (5.6) should look like

$$x_1 = \ldots = \frac{2c}{-b - \sqrt{b^2 - 4ac}}, \tag{5.5}$$

$$x_2 = \ldots = \frac{2c}{-b + \sqrt{b^2 - 4ac}} \tag{5.6}$$

This typographical error is also present in the expression for $x_{2,4}$ at the bottom of page 205, and the expression for $x_{1,4}$ at the top of page 206. The corrected formulas for $x_{2,4}$ and $x_{1,4}$ should look like

$$x_{2,4} = \frac{2c}{-b + \sqrt{b^2 - 4ac}} \cdots$$

$$x_{1,4} = \frac{2c}{-b - \sqrt{b^2 - 4ac}} \cdots$$

In all, the plus sign should be changed to a minus sign in four places, once in each equation.

page 218

The displayed equation for T_k is missing a minus sign on the right hand side. The correct equation is

$$T_k = -\frac{x^2}{k(k-1)} T_{k-2}.$$

The code in `sinser` is correct.

page 226

In Equation (5.24) and in the last sentence of the paragraph preceding Equation (5.24), change $E(h, x)$ to $E(x, h)$.

page 235, Exercise 15

At the end of the first line, change $x =$ `logspace`$(-12, 12, 100)$ to $x =$ `logspace`$(-12, 2, 100)$. In other words, the second argument to `logspace` becomes 2 instead of 12.

page 238, Exercise 26

The formula for γ_n is missing $1/3$ as the third term in the series. The correct formula for γ_n is

$$\gamma_n = \left[1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \cdots + \frac{1}{n} - \ln n\right].$$

Chapter 6: Finding the Roots of $f(x) = 0$

page 253

In the displayed equation in §6.2.1, the convergence criteria for fixed point iteration should read

$$\left|g'(x)\right| < 1, \quad \text{and} \quad a \le g(x) \le b, \quad \text{for all } x : a \le x \le b.$$

page 254, Algorithm 6.3

In the fourth line of the algorithm, the test should be

$$\text{if sign}\,(f(x_m)) = \text{sign}\,(f(a))$$

i.e., replace $f(x_a)$ with $f(a)$.

page 257

There is a minus sign missing from the right hand side of equation immediately under Table 6.1. The equation should read

$$n = -\log_2\left(\frac{\delta_n}{\delta_0}\right)$$

page 272

The displayed equation for Δx near the middle of the page is missing a minus sign on the right hand side. The correct equation is

$$\Delta x = -f(x_k)\frac{x_k - x_{k-1}}{f(x_k) - f(x_{k-1})}.$$

page 281

The order of the c_i in Equation (6.15) are reversed. The correct form of the equation is

$$c_1\lambda^4 + c_2\lambda^3 + c_3\lambda^2 + c_4\lambda + c_5 = 0. \tag{6.15}$$

page 285, Exercise 7

$|g'(x) < 1|$ should be $|g'(x)| < 1$.

page 286, Exercise 14

In the third line, the stopping criterion should be $|f(x)| < 5 \times 10^{-10}$, not $f(x) < 5 \times 10^{-10}$.

page 290, Exercise 32

The generally accepted criteria for the transition from laminar to turbulent flow is Re = 2000. The f formula for laminar flow applies to Re $\leq$ 2000. Also change the values of Re in part (c) and part (d) to 2001 (instead of 3001).

Chapter 7: A Review of Linear Algebra

page 315, Algorithm 7.1
The statement "initialize $b = \texttt{zeros}(n, 1)$" should be "initialize $b = \texttt{zeros}(m, 1)$"

page 318, Algorithm 7.2
The statement "initialize $b = \texttt{zeros}(n, 1)$" should be "initialize $b = \texttt{zeros}(m, 1)$"

page 358, Exercise 7
Part (b) (only) should read

> Column scaling: $B = AD$, ...

page 359, Exercise 16, two errors
On the first line, the recommended name of the m-file function should be `vecMatRow` not `vecMatCol`.

On the third line, "Algorithm 7.2" should be "Algorithm 7.3" so that the second sentence reads

> ...replacing the inner loop of Algorithm 7.3...

page 360, Exercise 19
At the end of the last sentence, replace γ with ζ.

page 361, Exercise 29
c should also be a column vector, i.e, add a transpose operator so that text in the first lines reads:

> ...where $a = (1, 0, 0)^T$, $b = (0, 1, 0)^T$, $c = (0, 0, 1)^T$, and $d = 2a + b$,
> ...

page 362, Exercise 39, part (b)
The u vectors should all be column vectors. There is a transpose missing from each of the u vectors. The first line of part (b) should begin:

> for $\theta = \pi/4$ and $u = [1, 0]^T$, $u = [1, 1]^T$, and $u = [0, 1]^T$, compute
> ...

Chapter 8: Solving Systems of Equations

page 394, Algorithm 8.5
Replace the fourth line of the algorithm with

> find i_p such that $|\tilde{a}_{i_p,i}| = \max(|\tilde{a}_{ki}|)$ for $k = i \ldots n$

page 405

The value of δ specified in the second line of text is inconsistent with the value of the first element of `bp` in the MATLAB example. Change $\delta = 0.01$ to $\delta = 0.001$. In other words, the second equation on the page should read

> Consider $b' = [1 + \delta,\ 2]^T$ where $\delta = 0.001$.

page 407

Insert "with pivoting" after "elimination" in the second rule of thumb at the bottom of the page (inside the box). The second rule of thumb should read

> ... the numerical solution to $Ax = b$ by any variant of Gaussian elimination with pivoting is correct to d digits, ...

page 411

The displayed equation in the middle of the page should read

$$Ux = y$$

i.e., replace b with y.

page 412

In the last two displayed equations on the page, change $j = 1, \ldots, n$ to $k = i + 1, \ldots, n; j = i, \ldots, n$. In Equation (8.41), change m_{ki} to m_{kj}.

Chapter 9: Least Squares Fitting of a Curve to Data

page 465

At the end of the first line of text below Equation (9.16), the $\|r\|_2$ term should be squared. The second in-line equation should be

$$\|r\|_2^2 = \sum_{i=1}^{m} (y_i - \hat{y}_i)^2$$

page 479

In the middle of the page, the demonstration of `fitnorm` is potentially misleading. The second return argument is `r`, which is used for the residual in the preceding paragraphs. If the user wishes to have `fitnorm` return the residual vector the call to `fitnorm` should be:

```
>> [c,R2,r] = fitnorm(x,y,'xinvpxBasis');
```

or, if the value of `R2` is not needed,

```
>> c = fitnorm(x,y,Afun);
```

page 479

Near the bottom of the page, the demonstration of `fitnorm` with an in-line function object is potentially misleading. The second return argument is `r`, which is used for the residual in the preceding paragraphs. If the user wishes to have `fitnorm` return the residual vector the call to `fitnorm` should be:

```
>> [c,R2,r] = fitnorm(x,y,Afun);
```

or, if the value of `R2` is not needed,

```
>> c = fitnorm(x,y,Afun);
```

page 496

Midway down the page, two ways of calling the `polyval` function are demonstrated. The second line calls `polyfit` instead of `polyval`. The second line should be:

```
[yf,dy] = polyval(p,xf,S)
```

page 497

In the displayed equation one third down the page, the order of terms on the right hand side are reversed. This equation should be:

$$r_i = T_i - T_{\text{fit},i}$$

page 497

The equation at the right end of the second-to-last line on the page should be $r_i = T_i - T_{\text{fit},i}$

page 513, Exercise 11
The correct form of the transformed linear relationship is $z = c_1 + c_2 w$.

Chapter 10: Interpolation

page 523, Example 10.1
In the seventh line of text from the top of the page, change 3:54 to 2:54.

page 528, Equation (10.4)
The exponent of the second term on the right hand side should be $n-2$, not $n-1$.

page 529, Example 10.4
The price for 1986 should be 133.5, not 113.5.

page 530
In third line of the paragraph preceding Equation (10.8) is a reference to Equation (8.38). Equation (8.38) is on page 407, not page 363.

page 538
In the equation for $P_n(x)$, the last term contains an extraneous factor of $(x - x_{n+1})$. The correct definition of $P_n(x)$ is

$$P_n(x) = c_1 + c_2(x - x_1) + c_3(x - x_1)(x - x_2) + \cdots + c_{n+1}(x - x_1)(x - x_2)\cdots(x - x_n),$$

page 540
Replace the fourth equation from the bottom of the page, and the text preceding it and following it with

where, after some algebra we get

$$\frac{f[x_1, x_3] - f[x_1, x_2]}{x_3 - x_2} = \frac{f[x_2, x_3] - f[x_1, x_2]}{x_3 - x_1} \equiv f[x_1, x_2, x_3]$$

and $f[x_1, x_2, x_3]$ is the second-order divided difference...

page 545, Example 10.8
Two thirds down the page, after "The fourth and fifth columns are filled in with", the displayed equations for the third order and fourth order divided differences contain errors. The denominators of both terms are reversed (the have the wrong sign), and the arguments of the divided differences in the numerator are in the wrong order. The correct versions of these equations are

$$f[V_{i-2}, V_{i-1}, V_i] = \frac{f[V_{i-1}, V_i] - f[V_{i-2}, V_{i-1}]}{V_i - V_{i-2}}$$

and

$$f[V_{i-3}, V_{i-2}, V_{i-1}, V_i] = \frac{f[V_{i-2}, V_{i-1}, V_i] - f[V_{i-3}, V_{i-2}, V_{i-1}]}{V_i - V_{i-3}},$$

page 562

In Equation 10.35, the x on the left hand side should be $\hat{x}$. In other words the left hand side of the equation is $P_i(\hat{x}) =$.

page 563

In Equation 10.36, the x on the left hand side should be $\hat{x}$. In other words the left hand side of the equation is $P_i(\hat{x}) =$.

page 583, Figure 10.19

The legend in each of the subplots is incorrect. The solid line is $x\exp(-x)$ and the dashed line is the spline plot. The correct plot is created with the `compSplinePlot` function in version 1.04 of the NMM toolbox.

Chapter 11: Numerical Integration

page 599, Example 11.1

The the upper limit of the integral is $\pi/2$ (not 2π), the width of the sheet is $L = 2aE$ (not $4aE$), and the parameter of the elliptic integral is $k^2 = 1 - b^2/a^2$ (not $k = 1 - b^2/a^2$).

page 603

In the middle of the page, the integrand should be $x^3 - c$, not $x^3 - 1$.

page 613, Equation (11.9)

The three coefficients involving h^2 should be $1/(2h^2)$, $-1/h^2$, and $1/(2h^2)$, respectively. The correct form of Equation (11.9) is

$$P_2(x) = \frac{1}{2h^2}(x - x_2)(x - x_3)f_1 - \frac{1}{h^2}(x - x_1)(x - x_3)f_2 + \frac{1}{2h^2}(x - x_1)(x - x_2)f_3 \tag{11.9}$$

page 613, Figure 11.9

On the right half of the figure, the point labelled (x_{n-3}, f_{n-3}) should be (x_{n-4}, f_{n-4}).

page 617

In the first line of the expression for $\int_a^b P_n(x)\,dx$, the second term has subscripts of 1 instead of 2. The correct expression is

$$\int_a^b P_n(x)\,dx = \int_a^b \left[L_1(x)f_1 + L_2(x)f_2 + \cdots + L_n(x)f_n\right]\,dx$$

page 621

In the last sentence on the page, change "which is a factor of 100 smaller than the error produced by Simpson's rule" to "much smaller than the error produced by the Trapezoid rule"

page 636, Figure 11.13

In the right half of the diagram, the two intervals are incorrectly labelled as having a size of 1/2 in the transformed coordinate z. The correct interval width is one, which is consistent with the magnitudes on the z axis.

page 649

In the second displayed equation from the top of the page, in Equation (11.41), and in Equation (11.42), replace $S_1 - S_2$ with $S_2 - S_1$. (In other words, make the change in three places.)

page 669, Exercise 7

The variable `y` does not appear in the `trapezoid` function. Change all occurrences of `y` to `f`. The displayed line of code should read

```
I = h * (0.5*f(1) + sum(f(2:n)) + 0.5*f(n));
```

On the first line of page 670, change `y(2:n-1)` to `f(2:n-1)`, and change `y(2:n)` to `f(2:n)`.

Chapter 12: Numerical Integration of ODEs

page 688, Equation (12.14)

Change $f(t, y)$ to $f(t, z_j)$.

page 717

In the eighth line from the bottom of the page, change α_1 to α_2. The sentence in the middle of the line should begin

> The α_2 coefficient describes both ...

page 728, Exercise 8

The initial condition is $y = 1$, not $y = 1.x$.

page 729, Exercise 12.b

Change $\dfrac{1}{x+\alpha}$ to $\dfrac{1}{t+\alpha}$.

page 729, Exercise 12.e

Change the "b" to "β" in the denominator of the expression for $y(t)$. The correct expression for $y(t)$ is

$$y(t) = \frac{\alpha y_0}{\beta y_0 + (\alpha - \beta y_0)\exp(-\alpha t)}$$

Appendix A: Eigenvalues and Eigensystems

page 756

In the third line from the top of the page, insert "square roots of" before "eigenvalues". The corrected text should read

> the singular values of A are the square roots of the eigenvalues of $A^T A$ if $m \geq n$...

Appendix B: Sparse Matrices

page 764

In the MATLAB code in the bottom right corner of the page, change `a = 1:5;` to `a = (1:5)';` (note the transpose operator between the ")" and the ";". This change is only necessary for the right hand code section.