GENG-8030 Computational Methods and Modeling for Engineering Applications

Summer 2023

Tutorial 1 - B

All questions were taken from the course textbook:

Title	MATLAB for engineering applications
Author	William J. Palm
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Chapter 1: An Overview of MATLAB

3. Suppose that $x = 5$ and $y = 2$. Use MATLAB to compute the following, and check the results with a calculator.

a. $\left(1 - \frac{1}{x^5}\right)^{-1}$

b. $3\pi x^2$

c. $\frac{3y}{4x - 8}$

d. $\frac{4(y - 5)}{3x - 6}$

5. Assuming that the variables a, b, c, d, and f are scalars, write MATLAB statements to compute and display the following expressions. Test your statements for the values $a = 1.12, b = 2.34, c = 0.72, d = 0.81$, and $f = 19.83$.

$$x = 1 + \frac{a}{b} + \frac{c}{f^2} \qquad s = \frac{b - a}{d - c}$$

$$r = \frac{1}{\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \frac{1}{d}} \qquad y = ab\frac{1}{c}\frac{f^2}{2}$$

9. The functions `realmax` and `realmin` give the largest and smallest possible numbers that can be handled by MATLAB. Calculations generating numbers that are too large or too small result in *overflow* and *underflow*. Usually this does not present a problem if you arrange the calculation sequence properly. Type `realmax` and `realmin` in MATLAB to determine the upper and lower limits for your system. For example, suppose you have the variables $a = 3 \times 10^{150}, b = 5 \times 10^{200}$.

a. Use MATLAB to calculate $c = ab$.

b. Suppose $d = 5 \times 10^{-200}$, use MATLAB to calculate $f = d/a$.

c. Use MATLAB to calculate the product $x = abd$ two ways, i) by calculating the product directly as `x = a*b*d` and then ii) by splitting up the calculation as `y = b*d` and then `x = a*y`. Compare the results.

22. Use MATLAB to calculate

a. $e^{(-2.1)^3} + 3.47 \log(14) + \sqrt[4]{287}$

b. $(3.4)^7 \log(14) + \sqrt[4]{287}$

c. $\cos^2\left(\frac{4.12\pi}{6}\right)$

d. $\cos\left(\frac{4.12\pi}{6}\right)^2$

Check your answers with a calculator.

34. The four-sided figure shown in **Figure P34** consists of two triangles having a common side a. The law of cosines for the top triangle states that

$$a^2 = b_1^2 + c_1^2 - 2b_1c_1 \cos A_1$$

and a similar equation can be written for the bottom triangle. Develop a procedure for computing the length of side c_2 if you are given the lengths of sides b_1, b_2, and c_1 and the angles A_1 and A_2 in degrees. Write a script file to implement this procedure. Test your script, using the following values: $b_1 = 200$ m, $b_2 = 180$ m, $c_1 = 120$ m, $A_1 = 120°$, and $A_2 = 100°$.

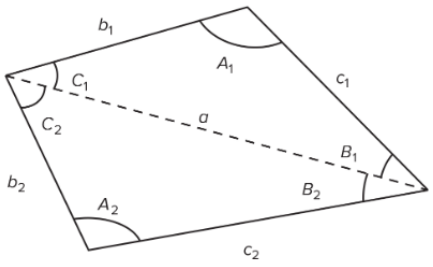

Figure P34

15.* Given the matrices

$$\mathbf{A} = \begin{bmatrix} -7 & 11 \\ 4 & 9 \end{bmatrix} \qquad \mathbf{B} = \begin{bmatrix} 4 & -5 \\ 12 & -2 \end{bmatrix} \qquad \mathbf{C} = \begin{bmatrix} -3 & -9 \\ 7 & 8 \end{bmatrix}$$

Use MATLAB to

a. Find **A** + **B** + **C**.

b. Find **A** − **B** + **C**.

c. Verify the associative law

$$(\mathbf{A} + \mathbf{B}) + \mathbf{C} = \mathbf{A} + (\mathbf{B} + \mathbf{C})$$

d. Verify the commutative law

$$\mathbf{A} + \mathbf{B} + \mathbf{C} = \mathbf{B} + \mathbf{C} + \mathbf{A} = \mathbf{A} + \mathbf{C} + \mathbf{B}$$

19. Plot the following function for x over the interval $-2 \leq x \leq 16$

$$f(x) = \frac{4 \cos x}{x + e^{-0.75x}}$$

Use enough points to get a smooth curve.

22. A ship travels on a straight line course described by $y = (200 - 5x)/6$, where distances are measured in kilometers. The ship starts when $x = -20$ and ends when $x = 40$. Calculate the distance at closest approach to a lighthouse located at the coordinate origin $(0, 0)$. Do not solve this using a plot.

41. Solve the following problem using the left-division method.

$$\begin{aligned} 6x - 3y + 4z &= 41 \\ 12x + 5y - 7z &= -26 \\ -5x + 2y - 6z &= 16 \end{aligned}$$