

Matlab Sheet 4**Conditional Statements and Loops**

1. It is desired to compute the sum of the first 10 terms of the series

$$14k^3 - 20k^2 + 5k. \quad k = 1, 2, 3, \dots$$

Write and run the program to calculate the sum.

2. Create Find the results of the following operations by hand and use MATLAB to check your results.

a. $z = 6 > 3 + 8$

b. $z = 6 + 3 > 8$

c. $z = 4 > (2 + 9)$

d. $z = (4 < 7) + 3$

e. $z = 4 < 7 + 3$

f. $z = (4 < 7) - 5$

g. $z = 4 < (7 * 5)$

h. $z = 2/5 >= 5$

3. Given: $a = -2, b = 3, c = 5$. Evaluate the following expressions without using MATLAB. Check the answers with MATLAB.

(a) $y = a - b > a - c < b$

(b) $y = -4 < a < 0$

(c) $y = a - c <= b > a + c$

4. For the arrays x and y given below, use MATLAB to find all the elements in x that are greater than the corresponding elements in y .

$$x = [-3 \ 0 \ 0 \ 2 \ 6 \ 8] \quad y = [-5 \ -2 \ 0 \ 3 \ 4 \ 10]$$

5. The arrays $price_A$ and $price_B$ given below contain the price in dollars of two stocks over 10 days. Use MATLAB to determine how many days the price of stock A was above the price of stock B.

$$price_A = [19 \ 18 \ 22 \ 21 \ 25 \ 19 \ 17 \ 21 \ 27 \ 29]$$

$$price_B = [22 \ 17 \ 20 \ 19 \ 24 \ 18 \ 16 \ 25 \ 28 \ 27]$$

6. Suppose that $x = [-3, 0, 0, 2, 5, 8]$ and $y = [-5, -2, 0, 3, 4, 10]$. Find the results of the following operations by hand and use MATLAB to check your results.
- $z = y < \sim x$
 - $z = x \& y$
 - $z = x | y$

7. Evaluate the following expressions without using MATLAB. Check the answers with MATLAB
- $-3 \& 3$
 - $\sim 5 < 4 \& \sim 0 > -3$
 - $-2 \& 2 > 3 | 8 / 3$

8. Create The height and speed of a projectile (such as a thrown ball) launched with a speed of at an angle A to the horizontal are given by

$$h(t) = v_0 t \sin A - 0.5gt^2$$

$$v(t) = \sqrt{v_0^2 - 2v_0gt \sin A + g^2t^2}$$

where g is the acceleration due to gravity. The projectile will strike the ground when $h(t) = 0$, which gives the time to hit $t_{hit} = 2(v_0/g) \sin A$. Suppose that $A = 30^\circ$, $v_0 = 40$ m/s, and $g = 9.8$ m/s². Use the MATLAB relational and logical operators to find the times when

- The height is no less than 15 m.
 - The height is no less than 15 m and the speed is simultaneously no greater than 36 m/s.
 - The height is less than 5 m or the speed is greater than 35 m/s.
9. Write a program in a script file that finds the smallest even integer that is divisible by 13 and by 16 whose square root is greater than 120. Use a loop in the program. The loop should start from 1 and stop when the number is found. The program prints the message "The required number is:" and then prints the number.

10. Write a program in a script file that determines the real roots of a quadratic equation. Name the file "quadroots". When the file runs, it asks the user to enter the values of the constants a, b, and c. To calculate the roots of the equation the program calculates the discriminant D, given by:

$$D = b^2 - 4ac$$

If $D > 0$, the program displays message "The equation has two roots," and the roots are displayed in the next line.

If $D = 0$, the program displays message "The equation has one root," and the root is displayed in the next line.

If $D < 0$, the program displays message "The equation has no real roots."

Run the script file in the Command Window three times to obtain solutions to the following three equations:

a. $3x^2 + 6x + 3 = 0$

b. $-3x^2 + 4x - 6 = 0$

c. $-3x^2 + 7x + 5 = 0$

11. The Pythagorean theorem states that $a^2 + b^2 = c^2$. Write a MATLAB program in a script file that finds all the combinations of triples a, b, and c that are positive integers all smaller or equal to 50 that satisfy the Pythagorean theorem. Display the results in a three-column table in which every row corresponds to one triple. The first three rows of the table are:

3 4 5

5 12 13

6 8 10

12. Rewrite the following statements to use only one if statement.

if $x < y$

if $z < 10$

$w = x * y * z$

end

end

13. Figure 1 shows a mass-spring model of the type used to design packaging systems and vehicle suspensions, for example. The springs exert a force that is proportional to their compression, and the proportionality constant is the spring constant k . The two side springs provide additional resistance if the weight W is too heavy for the center spring. When the weight W is gently placed, it moves through a distance x before coming to rest. From statics, the weight force must balance the spring forces at this new position. Thus

$$W = k_1 x \quad \text{if } x < d$$

$$W = k_1 x + 2k_2(x - d) \quad \text{if } x \geq d$$

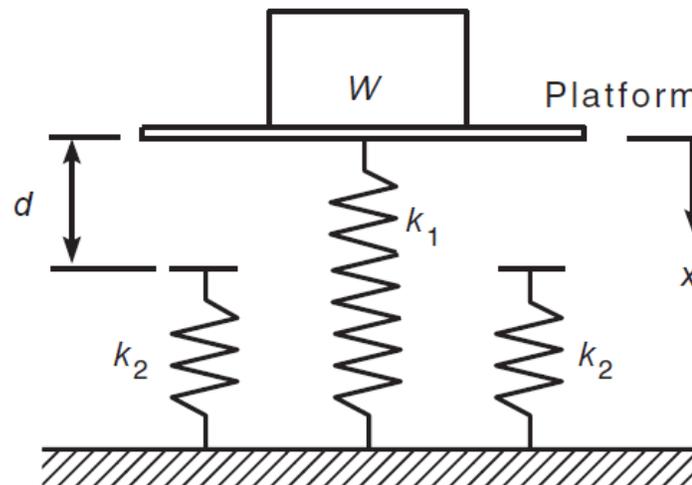


Figure 1.

These relations can be used to generate the plot of x versus W .

- Create a function `le` that computes the distance x , using the input parameters W , k_1 , k_2 , and d . Test your function for the following two cases, using the values $k_1 = 10^4$ N/m; $k_2 = 1.5 \times 10^4$ N/m; $d = 0.1$ m.

$$W = 500 \text{ N}$$

$$W = 2000 \text{ N}$$

- Use your program to plot x versus W for $0 \leq W \leq 3000$ N for the values of k_1 , k_2 and d given in part a.

14. Consider the array **A**.

$$\mathbf{A} = \begin{bmatrix} 3 & 5 & -4 \\ -8 & -1 & 33 \\ -17 & 6 & -9 \end{bmatrix}$$

Write a program that computes the array **B** by computing the natural logarithm of all the elements of **A** whose value is no less than 1, and adding 20 to each element that is equal to or greater than 1. Do this in two ways:

- By using a for loop with conditional statements.
- By using a logical array as a mask.

15. A company has the choice of producing up to four different products with its machinery, which consists of lathes, grinders, and milling machines. The number of hours on each machine required to produce a product is given in the following table, along with the number of hours available per week on each type of machine. Assume that the company can sell everything it produces. The profit per item for each product appears in the last line of the table.

	Product				Hours available
	1	2	3	4	
Hours required					
Lathe	1	2	0.5	3	40
Grinder	0	2	4	1	30
Milling	3	1	5	2	45
Unit profit (\$)	100	150	90	120	

16. Create Use a while loop to determine how many terms in the series 2^k , $k = 1, 2, 3, \dots$, are required for the sum of the terms to exceed 2000. What is the sum for this number of terms?

17. Compute Use a loop in MATLAB to determine how long it will take to accumulate \$1,000,000 in a bank account if you deposit \$10,000 initially and \$10,000 at the end of each year; the account pays 6 percent annual interest.

18. One numerical method for calculating the cubic root of a number $\sqrt[3]{P}$, is in iterations. The process starts by choosing a value x_1 as a first estimate of the solution. Using this value, a second, more accurate value x_2 can be calculated with $x_2 = (P/x_1^2 + 2x_1)/3$, which is then used for calculating a third, still more accurate value x_3 , and so on. The general equation for calculating the value of from the value of x_i is $x_{i+1} = (P/x_i^2 + 2x_i)/3$. Write a MATLAB program that calculates the cubic root of a number. In the program use $x_1 = P$ for the first estimate of the solution. Then, by using the general equation in a loop, calculate new, more accurate values. Stop the looping when the estimated relative error E defined by $E = \left| \frac{x_{i+1} - x_i}{x_i} \right|$ is smaller than 0.00001. Use the program to calculate:

a. $\sqrt[3]{100}$

b. $\sqrt[3]{53701}$

c. $\sqrt[3]{19.35}$

19. The overall grade in a course is determined from the grades of 6 quizzes, 3 midterms, and a final exam, using the following scheme: Quizzes: Quizzes are graded on a scale from 0 to 10. The grade of the lowest quiz is dropped and the average of the 5 quizzes with the higher grades constitutes 30% of the course grade. Midterms and final exam: Midterms and final exams are graded on a scale from 0 to 100. If the average of the midterm scores is higher than the score on the final exam, the average of the midterms constitutes 50% of the course grade and the grade of the final exam constitutes 20% of the course grade. If the final grade is higher than the average of the midterms, the average of the midterms constitutes 20% of the course grade and the grade of the final exam constitutes 50% of the course grade.

Write a computer program in a script file that determines the course grade for a student. The program first asks the user to enter the six quiz grades (in a vector), the three midterm grades (in a vector), and the grade of the final. Then the program calculates a numerical course grade (a number between 0 and 100). Finally, the program assigns a letter grade according to the following key: A for $Grade \geq 90$, B for $80 \leq Grade < 90$, C for $70 \leq Grade < 80$, D for $60 \leq Grade < 70$, and E for a grade lower than 60. Execute the program for the following cases:

(a) Quiz grades: 6, 10, 6, 8, 7, 8. Midterm grades: 82, 95, 89. Final exam: 81.

(b) Quiz grades: 9, 5, 8, 8, 7, 6. Midterm grades: 78, 82, 75. Final exam: 81.

20. Given Cam is a mechanical device that transforms rotary motion into linear motion. The shape of the disc is designed to produce a specified displacement profile. A displacement profile is a plot of the displacement of the follower as a function of the angle of rotation of the cam. The motion of a certain cam is given by the following equations:

$$y = 6[2\theta - 0.5 \sin\theta] / \pi \quad \text{for } 0 \leq \theta \leq \pi/2$$

$$y = 6 \quad \text{for } \pi/2 \leq \theta \leq 2\pi/3$$

$$y = 6 - 3 \left[1 - 0.5 \cos \left(3 \left(\theta - 2\frac{\pi}{3} \right) \right) \right] \quad \text{for } 2\pi/3 \leq \theta \leq 4\pi/3$$

$$y = 3 \quad \text{for } 4\pi/3 \leq \theta \leq 3\pi/2$$

$$y = 3 - 1.5 \left(\frac{\theta - 3(\pi/2)}{\pi/4} \right)^2 \quad \text{for } 3\pi/2 \leq \theta \leq 7\pi/4$$

$$y = 0.75 - 0.75 \left(1 - \frac{t - 7(\pi/4)}{\pi/4} \right)^2 \quad \text{for } 7\pi/4 \leq \theta \leq 2\pi$$

