

Exercises for MATLAB Course

1. Run the MATLAB code:

```
a = 1:5;
d = a + i * a;
e = d'
f = d.'
```

2. Given $A = \begin{bmatrix} 1 & 2 & 4 \\ 1 & 1 & 1 \\ 2 & 3 & 1 \end{bmatrix}$, and $B = \begin{bmatrix} 2 & 2 & 2 \\ 2 & 2 & 2 \\ 2 & 2 & 2 \end{bmatrix}$.

Run the MATLAB code:

```
Greater = A > B
```

```
GreaterThanOrOne = A >= 1
```

3. Given $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{bmatrix}$, $x = [-5 \ -10 \ -15]$.

Run the MATLAB code:

```
DiagElement = diag(A)
DiagMatrix = diag(diag(A))
Dmatrixx = diag(x)
SuperDiagElement = diag(A,2)
NewMatrix = diag(diag(A,2))
SuperDiagonalMatrix = diag(diag(A,2),2)
```

4. Find a way to delete zeros from the vector x.

5. Run the MATLAB code:

```
x = [1/4 1 sqrt(2) .3];
y = sin(x);
plot(y)
```

6. Run the MATLAB code:

```
name = upper('matlab')
fun = strrep('hahaha','a','i')
greet = 'Welcome';
where = 'to Joan''s';
party = 'birthday party';
final = str2mat(greet, where, party)
text = 'Monday,Tuesday,Wednesday,Thursday,Friday,Saturday,Sunday';
[day,rest] = strtok(text,',')
[day2,rest] = strtok(rest,',')
```

7. The MATLAB code

```
text(x,y,'\alpha')
```

places the letter α at position (x, y) . Write the text “Graph of $e^{-x} \sin \varphi$ ” at $(.5, .2)$.

8. Given $A = \begin{bmatrix} 1 & 1 \\ 2 & 2 \\ 3 & 3 \\ 4 & 100 \end{bmatrix}$

Run the MATLAB code:

```
average = mean(A)
med = median(A)
dev = std(A)
```

9. Given $A = \begin{bmatrix} 0 & 4 & 4 \\ 2 & 0 & 2 \\ 4 & 2 & 0 \end{bmatrix}$

Run the MATLAB code:

```
[Ascend,Ind] = sort(A)
Descend = flipud(sort(A))
```

10. Find the solution of the equation $\sin x = 2x - 2$. We define the function `sinm(x)` and store it in the M-file `sinm.m`:

```
function s = sinm(x)
s = sin(x) - 2.*x + 2;
```

Plot the curve to find a starting value:

```
fplot('sinm', [-10 10])
grid on
title('The function sin(x) - 2.*x + 2')
```

We see that 2 is an acceptable first guess and type

```
xzero = fzero('sinm',2)
```

which gives the solution to the equation $\sin x = 2x - 2$.

11. The following MATLAB code plots polynomials of third, fourth, and fifth degree approximating data given by the vectors \mathbf{x} and \mathbf{y} :

```

x = [-3 -1 0 2 5.5 7];
y = [ 3.3 4.5 2 1.5 2.5 -1.2];
p3 = polyfit(x,y,3);
p4 = polyfit(x,y,4);
p5 = polyfit(x,y,5);
xcurve = -3.5:.1:7.2;
p3curve = polyval(p3,xcurve);
p4curve = polyval(p4,xcurve);
p5curve = polyval(p5,xcurve);
plot(xcurve,p3curve,'--',xcurve,p4curve,'-.', ...
     xcurve,p5curve,'-',x,y,'*')
lx = [-1 1.5];
ly = [0 0];
hold on
plot(lx,ly,'--',lx,ly-1.3,'-.',lx,ly-2.6,'-')
text(2, 0,'degree 3')
text(2,-1.3,'degree 4')
text(2,-2.6,'degree 5')
hold off

```

12. Run and study the M-file ex10.m
13. Run and study the M-file ex11.m. Input values like 40 and 40 or, if you have a quick machine and want a nice output, 200 and 200
14. Given the date, write a function that computes the day number in a year
15. Write a function that prints out the binary equivalent of a number
16. How long does it take to count from 1 to 100 000?
17. Print a table that converts °C (from 0° to 100° with intervals of 20) to °F. Hint: $c = 5 * (f - 32) / 9$;
18. In Europe daylight time starts on the last Sunday of March and ends on the last Sunday of October. Write a function that determines whether a given daynumber is in the summertime period or in the wintertime period of the Daylight Saving Time
19. Given two data matrices

$$\text{dataA} = \begin{bmatrix} 1 & 120 \\ 1 & 130 \\ 2 & 140 \\ 3 & 180 \\ 3 & 160 \end{bmatrix},$$

and

$$\text{dataB} = \begin{bmatrix} 1 & 91 \\ 2 & 92 \\ 3 & 93 \end{bmatrix}.$$

The first column in `dataA` and `dataB` describe a key for the data. Now we want to “merge” the two data sets so that the result looks like

$$\text{targetdata} = \begin{bmatrix} 1 & 120 & 91 \\ 1 & 130 & 91 \\ 2 & 140 & 92 \\ 3 & 180 & 92 \\ 3 & 160 & 93 \end{bmatrix}$$

20. Let be given three points A, B, and C in the Euclidean plane. Determine a fourth point D on the line BC so that AD is orthogonal to BC
21. Let be given the string ‘Need-to-split-this-string’. We want to break it into the five strings ‘Need’, ‘to’, ‘split’, ‘this’, and ‘string’.
Solutions may be based on `strtok` and the much faster `strread`
22. We have a string that looks like ‘18°C’. How to keep only the number 18?
23. We want to save a vector `v=[1 2 3 4]`; into a text file. How to that? [Hint use `save`]
24. Write a code that removes all 2’s in a matrix A
25. How can I comment several lines at once in stead of typing the symbol % at the beginning of each line?
26. How can I find where the matrix A changes sign?
27. I want to place a dot, raised half the height of the letter x, between m and n in a label. How do I do this?
28. Given an array like `[2,8,3,30,4,50,100,200,4,80,500]`. I want to split it into three arrays with different ranges: `[0–10)`, `[10–100)`, and `[100–1000)`. The above array should become

2, 8, 3, 4, 4
30, 50, 80
100, 200, 500

How to do this?

29. For writing formatted ascii output you often write like
`fprintf(fid,'%5.3f %5.3f %5.3f %5.3f %5.3f .. ',A)`
Describe a code that avoids repeating the format description, say, 5 times.
30. Is there a convenient way of listing the names of all *.m functions that are called by a given *.m function?
31. How can one set the background of a figure view as white?
32. How can one simulate a curve shaped like a heart by a spline function?

33. We create a vector

$$z = \text{ones}(1,10);$$

and define some intervals of z to be zero. The intervals are stored in vectors a and b where a contains the start indices and b the end indices of the intervals. With $a = [3 \ 8]$ and $b = [5 \ 9]$ the desired result should be $r = [1 \ 1 \ 0 \ 0 \ 0 \ 1 \ 1 \ 0 \ 0 \ 1]$.

How do we make this?

34. Write a code that adds new information to an already opened plot. This is typically necessary to illustrate the output of a filter. [Hint use the command `drawnow`].
35. Try to make a string including the carriage return character.
36. How can I determine if a (nested) structured element $a.b.c = 5$ exists?
37. I want to index the entries in a matrix by using vectors with row and column indices. How to do that?
38. I want to display variable values inside a `disp` command: "This is number: k ". How to do that?
39. How do I make Matlab draw lines between points $(1,1)$ and $(2,0)$; $(3,1)$ and $(2,4)$; and $(2,2)$ and $(3,4)$?
40. How do I plot on top of an image?
41. How to plot the surface $f = (x_1 - 3)^2 + (x_2 - 3)^2$ and add the boundary surface $g = 10(x_1 + x_2 \geq 4)$?
42. How do I create a maximized figure window?
43. I have to plot a variable number of data sets on the same graph with different symbols. How can I specify the symbols I want to use? How can I specify the order and color of the symbols to be used?
44. Given a vector p with integer elements, I want to create a vector q of length $\text{sum}(p)$ such that the first $p(1)$ elements are 1, the next $p(2)$ elements are 2 and so on. Is there a neat vectorized way to do this?
45. I want to visualize a surface given with basic line, i.e. $y(x) = (16 - x^2)^{1/2}$
46. I have a char array '000101'. Is there any way to split this into six separate elements: '0' '0' '0' '1' '0' '1'?
47. How can I store strings of variable length? [Hint use cell arrays]
48. How can I read a file of unknown length with five parameters on each line like
`Time = 0.5... | ypp = 0.1... | yp = 0.9... | y = 0.2... | ext = 4.0...`
49. How can I read a file consisting of an unknown number of lines and a variable number of data on each line. Each line starts with an identifier like A3. The identifier always is composed of one letter and one integer.

50. We seek the indices of matching entries of two vectors x and y . The vectors are not necessarily of the same length.
51. Given a vector x with positive, negative, or null entries. Replace all negative entries with zero.
52. Given a matrix A . Make a new matrix B from the 1st, 5th, 10th, 15th, ... row of A .
53. We want to import all formatted ascii files with extension txt into the workspace.
54. Let A be a 2 by 5 matrix. Reshape A to consist of one row from which we select the first eight entries.
55. Given a 3 by 3 matrix F and a 3-dimensional vector a which holds the entries for a 3 by 3 matrix $A = [0 \ -a(3) \ a(2); \ a(3) \ 0 \ a(1); \ -a(2) \ a(1) \ 0]$; Compute the cross product of A and F .
56. Given two vectors $a = [1 \ 2 \ 3]'$; and $b = [2 \ 4 \ 7]'$. Perform an elementwise division of the two vectors a and b .
Why does $[1 \ 2 \ 3]/[2 \ 4 \ 7]$ yield 0.4493?
57. Given a matrix A . We want a print where each entry is framed with vertical and horizontal lines.
58. A filled contour plot has by default black contours. How to make these edges the same color as the contour they encompass?
59. How to generate a binary matrix B including all binary code words from 0 to N :

$$B = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \\ \vdots & & \end{bmatrix} ?$$

60. The new L^AT_EX interpreter produces pretty legend, xlabel, ylabel, title, etc. The default interpreter is the more limited T_EX interpreter.
How to make the L^AT_EX interpreter the default interpreter?
61. How to change the text color in legend boxes?
62. How to set the background of a plot to transparent?
63. I would like to plot a set of data where each point corresponds to an L^AT_EX
↑
64. A matrix consists of row-vectors of different length:

$$v(1) = [1 \ 0]; \ v(2) = [1 \ 2 \ 3]; \ v(3) = [3 \ 2 \ 1 \ 4];$$

I want to collect all vectors in a matrix such that the vectors flush left and the remaining entries are filled in with zeros.

65. We create a name list of 'Bob', 'Mary', 'Fred', and 'Ken' as a cell. How can I print out the first and third name?

66. I have got a C++ dll whose functions I would like to access from inside Matlab. Is there a way to do this?

67. Solve the equation

$$ax^2 + bx + c = 0$$

symbolically for x, and next for b.

68. Solve the equation

$$\cos(2x) + \sin(x) - 1 = 0$$

symbolically. Next use ezplot to verify the result.

69. Solve the equation

$$\tan(x) + \sin(x) - 2 = 0$$

symbolically. Next, determine the numerical values of the roots.

70. Use ezplot to graph

$$\tan(x) - \sin(x) - 2$$

and next add

hold on

w = -2*pi:pi/2:2*pi;

plot(w,0*w,'r-.')

71. Solve the two equations

$$x^2y^2 = 0$$

$$x - y/2 - \alpha = 0.$$

72. Solve the differential equation

$$\frac{dy}{dx} + 4y = e^{-t}$$

$$y(0) = 1.$$

73. Find the Laplace transform for $u = 1 + t$.

74. Find the Laplace transform for $u = t \cos(\omega t)$.

75. Find the Laplace transform for $u = \cos(\omega t - \theta)$.

76. Find the Laplace transform for $u = \cos^2(t)$.

77. Find the Laplace transform for $u = 1 - e^{-t}$.

78. Find the Laplace transform for $u = te^{-t} \sin(\omega t)$.

79. Find the Laplace transform for $u = 1$ for $t \leq 1$, $u = 0$ elsewhere.

80. Find the Laplace transform for $u = 2$ for $1 \leq t \leq 2$, $u = 0$ elsewhere.
81. Find the Laplace transform for $u = \text{next integer above } t$.
82. Find the Laplace transform for $u = t\delta(t)$.
83. Solve the initial-value problem by Laplace transform $u' + u = e^{i\omega t}$, $u_0 = 8$.
84. Solve the initial-value problem by Laplace transform $u' - i\omega u = \delta(t)$, $u_0 = 0$.
85. Solve the initial-value problem by Laplace transform $u' + u = e^t$, $u_0 = 2$.
86. Solve the initial-value problem by Laplace transform $u'' + u = 6t$, $u_0 = u'_0 = 0$.
87. Solve the initial-value problem by Laplace transform $u'' - u = e^t$, $u_0 = u'_0 = 0$.
88. Solve the initial-value problem by Laplace transform $mu'' + cu' + ku = 0$, $u_0 = 1$, $u'_0 = 0$.
89. Solve the difference equation by the z-transform $u_{n+1} - 2u_n = 0$, $u_0 = 5$.
90. Solve the difference equation by the z-transform $u_{n+1} - u_n = 2^n$, $u_0 = 0$.
91. Solve the difference equation by the z-transform $u_{n+2} - 3u_{n+1} + 2u_n = 0$, $u_0 = 1$, $u_1 = 0$.
92. Solve the difference equation by the z-transform $u_{n+1} - nu_n - u_n = 0$, $u_0 = 1$.
93. Which number does the touchtone file dial?
94. Click the mouse in the upper left corner of the upper left plot in fftgui. You are taking the fft of the zeroth unit vector. Explain the result.
95. Click the mouse in the upper left corner of the the upper left plot in fftgui and move the mouse vertically.
96. Click the mouse in the upper left corner of the the upper left plot in fftgui to set $y_0 = 0$ and $y_1 = 1$.
97. Click the mouse in the upper left corner of the the upper left plot in fftgui to set $y_2 = 1$ and vary y_4 with the mouse.

Some of the exercises are based on examples in

- Pärt-Enander, Eva and Sjöberg, Anders (1999): *The Matlab 5 Handbook*. Addison-Wesley
- Kernighan, Brian W. and Ritchie, Dennis M. (1988) *The C Programming Language*, Second Edition. Prentice Hall Software Series
- Sedgewick, Robert (1992) *Algorithms in C++*. Addison-Wesley Publishing Company

or stolen from the news-group

comp.soft-sys.matlab