

Assignment MATLAB, 1MA465 Multivariable calculus and vector calculus,
2021

Please provide your solutions and answers as m-files with comments and move them into a folder. The name of the folder must be the same as your name. Then upload a zipped version of it on MyMoodle. Please submit your folder in MyMoodle no later than **19 October**. Good luck!

1. Plot the curve represented by

$$\begin{cases} x = 2 + t \\ y = 1 + 2t^2 \end{cases}$$

for $0 \leq t \leq 5$. Hint: Open the matlab editor by writing `edit` in the command window. Give the solution in this text file, i.e. give the code that you shall submit:

```
% Task1
clear
t = 0 : 0.01 : 5;
x = 2 + t;
y = 1 + 2 * t.^2;
plot(x, y)
```

Save the file as `Task1.m` and press F5 to run the commands, or type “Task1” in the command window followed by enter.

2. Plot a circle of radius 4.
3. A curve in three dimensions is plotted with the command `plot3`. Create a helix given by:

$$\begin{cases} x = \cos t \\ y = \sin t \\ z = t^2 \end{cases}$$

4. Create a helix with radius 2, which makes one revolution in the xy-plane and moves one unit in z-direction in the same time.
5. Define the following matrices and vectors:

$$A = \begin{pmatrix} 2 & 3 & 3 \\ 9 & 6 & 2 \\ 1 & 1 & 8 \end{pmatrix}, \quad B = \begin{pmatrix} 1 & 1 & 1 \\ 2 & 2 & 2 \\ 3 & 3 & 3 \end{pmatrix}, \quad a = \begin{pmatrix} 2 \\ 2 \\ 8 \end{pmatrix}, \quad b = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}.$$

Do the following calculations:

$A * B$, $A * a$, $B * b^T$, $a * A$, $b^T * B$, $a^T * b$, $a * b^T$, $a .* b$, $A .* B$

Some of them do not work: which, why? Which of them define a scalar product, matrix multiplication, element-by-element operation?

6. There are two commands for plotting surfaces in three dimensions, **surf** which gives a color surface and **mesh** which gives a color mesh. Below is an example for the plane $x + y + z = 0$. Comments in the code are written after a % sign.

```
figure(1)           % create or activate a figure with number 1
clf                 % clear the figure
hold on             % the following plots will be superposed in the same figure
grid on             % visible grid lines
x = -2 : 0.1 : 2;    % plotting intervall in x-direction
y = -2 : 0.1 : 2;    % plotting intervall in y-direction
[X,Y] = meshgrid(x,y); % create a mesh of (x,y)-coordinate points in the xy-plane
Z = -X - Y;          % define a z-value for each (x,y)-coordinate
surf(X,Y,Z)          % plots a surface
view(35, 35)         % choose the viewing angle
                    % can be changed with the rotation arrow in the figure

hold off            % inactivate the figure
```

Plot two planes that are parallel in the same figure.

7. Matlab has a command **sphere** to create the coordinates of a sphere. Use this command to create a unit sphere, enlarge its radius to 6 and move its centre to $(-1, 1, 0)$. Find the parametric representation of the surface of a unit sphere, with the variables θ and ϕ (longitude and colatitude). Plot a sphere without using the command **sphere**.
8. Show surfaces and level curves of
- (1) $z = x^2 + y^2$
 - (2) $z = x^2 - y^2$
 - (3) $z = \frac{1}{x^2 + y^2}$
 - (4) $z = \sqrt{4 - x^2 - y^2}$
- Choose a suitable domain. Hint: Use the commands **surf** and **contour**. Choose your own function $z = f(x, y)$ to plot.

9. Solve the system of equations $Ax = b$. Choose your own matrix A and vector b .

10. Calculate the integral

$$\int_0^8 e^{x^2} dx.$$

11. Choose some problem that you have solved in the exercises of the course and use Matlab to solve it, or create a problem that you want to solve and try to solve it with Matlab.