

# Introduction to MATLAB

## Plotting 2-d graphs

In the following example, we are plotting the graph of the function

$$f(x) = 5x^2 + 10x + 2$$

using the interval  $[-10, 10]$  as domain of definition. You can use the following commands:

```
>> x = linspace(-10,10);  
>> y = 5*x.^2 + 10*x + 2;  
>> plot(x,y)
```

What is the range of the  $f$ ? **Answer:**

Choose now three other functions and domains of that you want to plot. Which functions and domains did you choose? **Answer:**

Describe in a few sentences how using MATLAB is different from using a calculator. **Answer:**

Name.....

## Creating 3d graphs using MATLAB

We want to visualize the function

$$f(x, y) = \exp(-x^2 - y^2)$$

Use the following commands to create a three-dimensional graph:

```
>> [x,y] = meshgrid(-2:.1:2, -2:.1:2);  
>> z = x .* exp(-x.^2 - y.^2);  
>> mesh(z)
```

Use the mouse to rotate the picture. What happens? What can you see?

**Answer:**

Now try a different example:

```
>> g = 0:0.2:10;  
>> [x,y] = meshgrid(g);  
>> z = 2*sin(sqrt(x.^2 + y.^2));  
>> mesh(z);
```

What is different if you compare this graph to the previous function?

**Answer:**

Name.....

## Symmetry and transformations

Graph the following functions using MATLAB and decide whether they have a symmetry.

$$f(x) = x^4 - 2x^2, \quad g(x) = x^3 - 4x + 2, \quad h(x) = \frac{\sin(x)}{x^2 + 1}$$

**Answer:**

Now choose a function by yourself and check whether it has symmetries. Which function did you choose, does it possess any symmetries? **Answer:**

Take the basic graph  $f(x) = x^2$  and perform choose three elementary transformations as discussed in class and create the corresponding graphs using MATLAB. Which transformation did you choose? What are the corresponding equations? **Answer:**

Name.....

## Fractals

Generating fractals with MATLAB is easy! In case you want to make changes, or corrections, use an M-file: Go to the File menu and click on New and choose then M-file. Insert the commands below:

```
col=20;
m=400;
cx=-.6;
cy=0;
l=1.5;
x=linspace(cx-1,cx+1,m);
y=linspace(cy-1,cy+1,m);
[X,Y]=meshgrid(x,y);
Z=zeros(m);
C=X+i*Y;
for k=1:col;
Z=Z.^2+C;
W=exp(-abs(Z));
end
colormap copper(256);
pcolor(W);
shading flat;
axis('square','equal','off');
```

Save your M-File as “mandel.m”. You can access this function by typing “mandel”. What do you see? **Answer:**

Try to modify the M-File to view other intervals on the complex plane. Try the values in the following table. To modify the colormap, you might use “jet”, “hot”, “cool”, “winter”. You can also increase and decrease the value of the “col”-variable.

$$\begin{array}{lll} cx = -0.81 & cy = -0.1795 & l = 0.1 \\ cx = 0.273 & cy = 0.595 & l = 0.1 \end{array}$$

Which parameters did you try out? What are the parameters of your favorite figure? **Answer:**

Name.....

## More fractals

First we want to understand the above program that produces fractal sets better. The most important sequence of the program is the “for” loop. Try out how the “for” works by putting the following sequence into the command window:

```
>> for k=1:100;  
k  
end;
```

Now write a MATLAB program that will give you all squares from 1 to 30. Which commands did you use? **Answer:**

Now we turn to the fractals again. Instead of retyping it, download it from the link provided at the course website

<http://www.math.csi.cuny.edu/~tobias/mth130.html>

after finding the way to the file on the website (look for “Mandelbrot sets with MATLAB”). Copy the program to the “work” directory and run it to make sure that it works. Now download the julia set program on the website in MATLAB and run it. Now modify the  $c$  value. What do you find? **Answer:**

Name.....

## Finding zeros using MATLAB

Try now to create a graph of the function

$$f(x) = 3x^3 + 10x^2 + 6x + 1$$

Trick: don't forget the "dots" in the MATLAB commands! Choose different domains and try to find an approximation of all zeros of the function. Which commands did you use to graph the function? **Answer:**

Which are the zeros? **Answer:**

Choose now a function by yourself and find its zeros. Which function did you choose? What are the zeros? **Answer:**

Name.....

## Finding roots of polynomials

In MATLAB you have the possibility to compute roots of polynomials directly. For instance, the polynomial

$$p(x) = 2x^3 + 6x^2 - 4x - 5$$

is presented as

$$p = [2 \ 6 \ -4 \ -5]$$

Now try the matlab command `roots(p)`. What answer do you get?

**Answer:**

MATLAB can also perform polynomial division. Try out the following commands

```
>> p=[1 4 1 -6]
>> q=[1 -1]
>> [firstpart,remainder]=deconv(p,q)
```

What do you think happened? **Answer:**

Pick a polynomial and find its zeros with any method you prefer. Which polynomial did you pick? What are the zeros? **Answer:**

Name.....