
MATH 353: Engineering Mathematics III – Section 012

Spring 2013 (F.–J. Sayas)

Lab # 1

February 8

What you should have learned today

- To open Matlab, and to change the location of where you are so that you go to a recently created folder. To use `diary` to record your working session.
- Create a list of equispaced numbers, as in,...

```
1:0.1:2      [1 2 3 4 5]      -1:-2:-10
```

- Manipulate arrays (row vectors actually), with the symbols

```
+      -      .*      ./      .^
```

These symbols define *element-by-element* operations. Element-by-element product, division, etc are called *vectorized*. One of the elements can be a *scalar* (that is, a number). In that case, you compute the operation of all elements of the list/array to that scalar.

- Get to know the usual mathematical functions

```
sin      cos      exp      log      abs      sqrt      ....
```

These functions are vectorized by default.

- Define anonymous functions of a single variable. Here's an example of the function

$$f(x) = \sqrt{\frac{x+1}{x^2+2}} + \cos(3x(2+x))$$

programmed as follows

```
>> f = @(x) sqrt((x+1)./(x.^2+2)) + cos(3.*x.*(2+x));
```

Note the use of the vectorized for of division, multiplication and exponentiation. The goal is to be able to evaluate it at many points at the same time

```
>> f(0:0.1:1)
```

```
ans =
```

```
1.7071    1.5478    1.0151    0.3099   -0.1609   ...   -0.0946
           % only beginning and end are shown
```

- Understand loss of precision due to cancelations. Here's a good example:

$$\sqrt{x+3} - \sqrt{x} = \frac{3}{\sqrt{x+3} + \sqrt{x}}.$$

For large x , the expression on the right is more precise than the one on the left. You should know why.

- Understand ways of avoiding numerical overflow and underflow.
- **Free advice, maybe good after all.** Matlab has been used by hundreds of thousands of individuals for quite some time. Google can find the answer to questions like: how do I define a base 10 logarithm in Matlab? how do I plot a function of one variable in Matlab? You'll probably be redirected to the online help of Matlab, which contains useful examples.

Exercises

1. Use a single instruction to generate the list of numbers

-4 -4.5 -5 -5.5 ... -10

2. Define the function

$$h(x) = \frac{x^2 + 2x - 4}{x^4 + 1} \cos(x)$$

and plot it in $(-2, 2)$ using `plot` and one hundred points at least.

3. Compare the values obtained by evaluation of the two mathematically identical functions

$$f(x) = (x + 1)^2 - x^2 \quad g(x) = 2x + 1$$

for $x = 10^{10}$.

4. Compare the values given (if at all) by evaluation of the mathematically identical functions

$$f(x) = \frac{x^{1000}}{x^{1000} + 1} \quad g(x) = \frac{1}{1 + x^{-1000}}$$

when $x = 10$.

5. Figure out how to use `fplot` to plot functions without evaluating them yourself and use it to get a plot of

$$\frac{1}{1 + x^2}$$

in the interval $(-3, 3)$.

6. Guess work. Here's a function:

```
f = @(x) (x.^2+1).*(x>=1);
```

Can you write it in mathematical terms?