MATLAB, Lab 8 – Group work

Numerical error is inevitable in all sorts of numerical methods and one has to be aware of its size in order to know the reliability of the result. Let us consider the following examples:

```
>> x=linspace(0,5,10);
>> y=x.^2;
>> Integral=sum(diff(x).*y(1:9))
Integral =
   34.9794
```

```
>> x=linspace(0,5,100);
>> y=x.^2;
>> Integral=sum(diff(x).*y(1:99))
Integral =
   41.0375
```

One can see that number of samples (step size) influenced results of integration to a very high extent. This factor has critical influence on numerical error and the main aim of this homework is to analyze how the numerical error can be estimated.

Task

Choose set of three test functions: one trigonometric function, one higher order polynomial and third function of your choice. Fill the table below with your choices:

Function1:	
y=2cosx+1	
Function2:	
$y=5x^5-x$	
Function3:	
y=3x	
Lower limit of integration:	Upper limit of integration:
a=0	b=π

Repeat integration of each function with at least 10 different numbers of samples. Plot the results of integration `I` versus number of samples `n`. For each plot add closest exponential curve of the form

$$|y(x) - I_{final}| = ae^{bn}$$

Where I_{final} is the most accurate value of the integral that is available for you. It could be either a result of analytical integration (if known) or the result obtained for the highest tested number of samples `n`.

Coefficients a and b could be obtained with function `fit(I,n,'exp1')`.

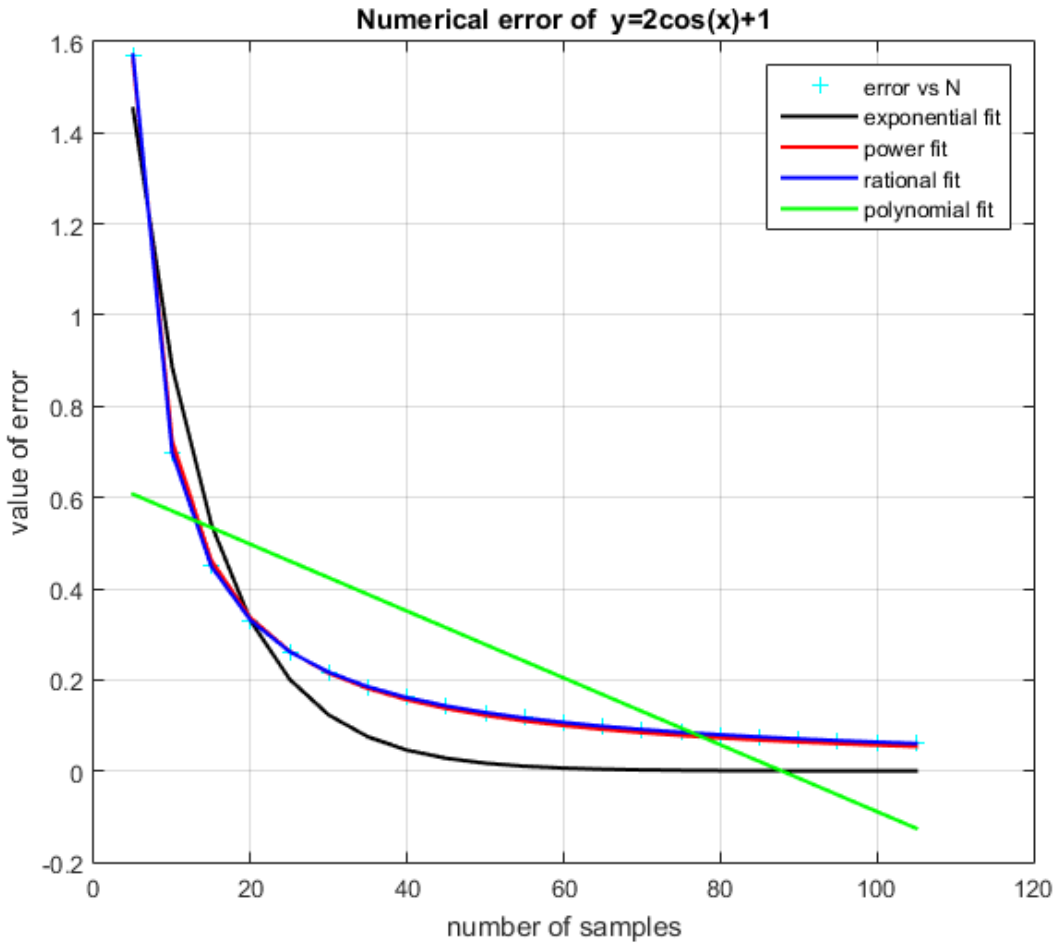
1. Fill the table below with results of curve fitting

	a	b	Confidence level
Function 1	2.382	-0.09888	0.95

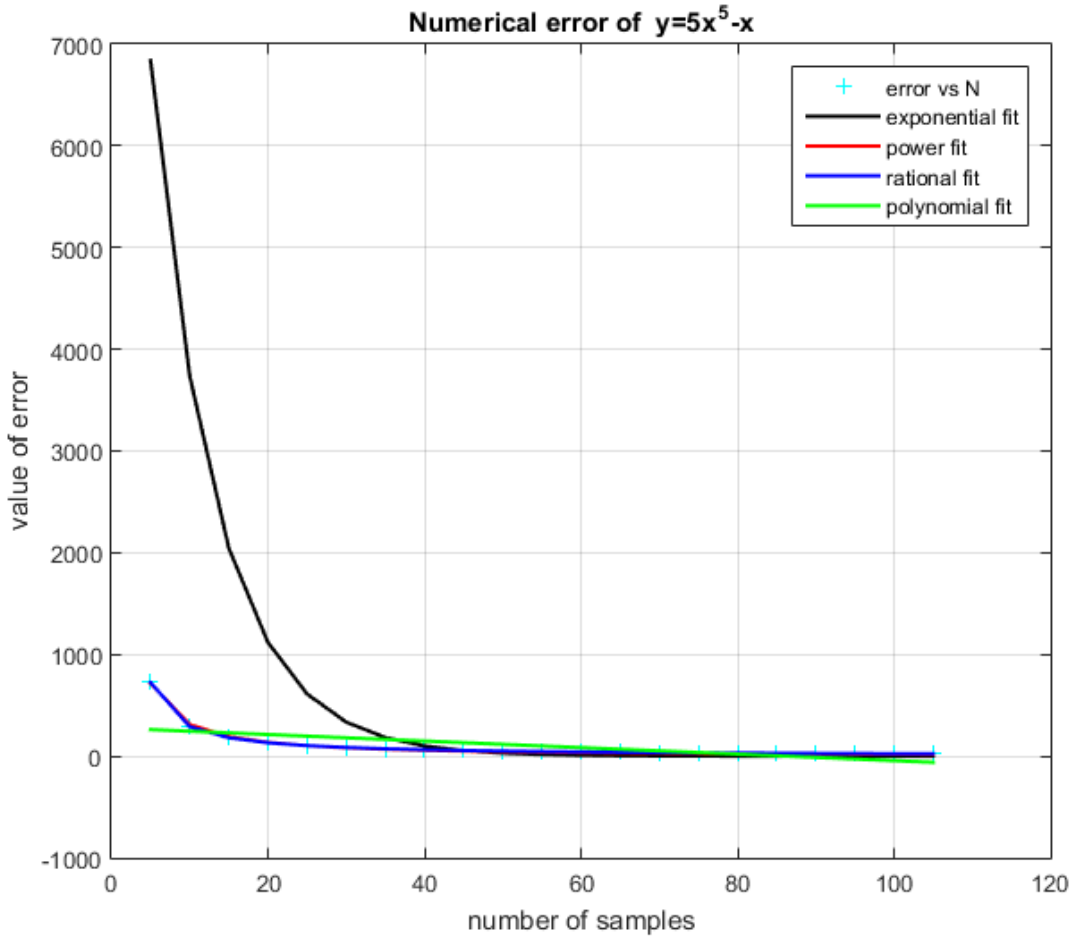
Function 2	1250	-0.1207	0.95
Function 3	5.615	-0.09892	0.95

2. Plot your points together with four fit curves. Each plot should have proper labeling, title and legend:

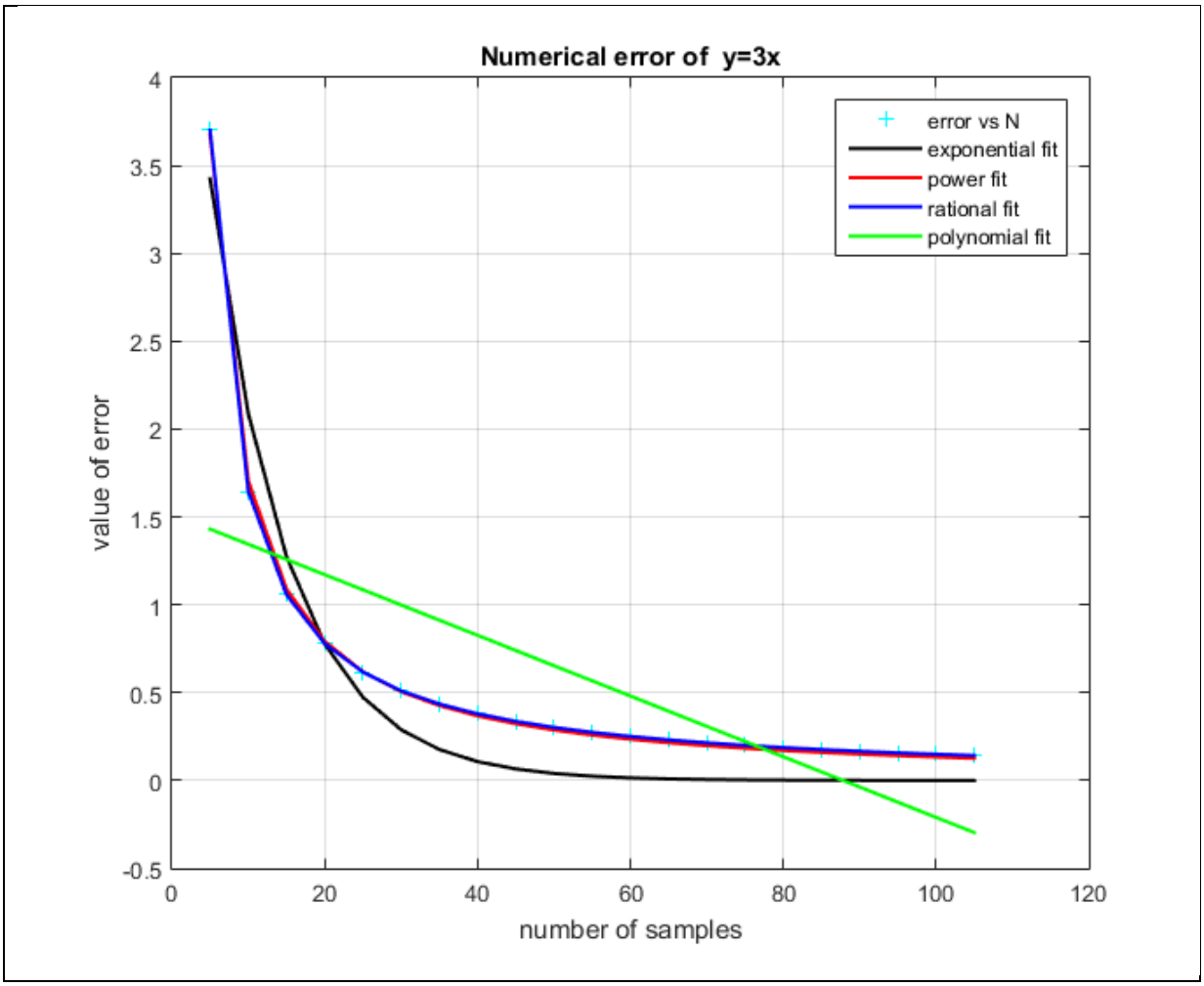
Screenshot (function 1):



Screenshot (function 2):



Screenshot (function 3):



3. Give some comments on how to choose a proper step size and how the error of numerical integration could be estimated

Comments:
Taking into consideration above analyses we conclude that the more samples N are taken the more accurate result we obtain. This rule perfectly fits to every case we have chosen. Therefore, every type of function can be calculated with higher accuracy examining more samples. Step size should be choose in such a way that x is divided into small distances across the given range and number of samples is distributed along a range with large number of divisions. For instance we have chosen x=linspace(a,b,100000) and N=5:5:105.