MATH 353: Engineering Mathematics III – Section 012

Spring 2014 (F.–J. Sayas) Homework #4 Due March 15

From this homework assignment on, the axes in every graph you produce have to be labeled and the graph should have a title and, if needed, a legend.

1. (Computer – 3 points) Define a function

$$f(x) = x \sin\left(\frac{1}{x}\right)$$

and evaluate it *simultaneously* at the points $0.01, 0.02, 0.03, \ldots, 0.5$.

2. (Computer + explanation – 3 points) Explain what the following commands do:

```
>> m1=linspace(0,2,10);
>> m2=linspace(0,2,11);
```

In addition to running the lines, explain how many elements you get and what these elements are.

3. (Computer + explanation – 4 points) Explain what the following lines do:

```
>> A=[1 2 3 4;5 6 7 8;-1 -2 -3 -4];
>> A(:,2)+A(:,3)
>> A(3, end:-1:1)
>> size(A)
```

Once again, run the lines and explain what happens.

4. (Computer – 5 points) Using `fplot`, show the graphs of

$$\sin x, \qquad \sin(2x) \qquad \sin(4x)$$

in the interval $[-2\pi, 2\pi]$. All of them should appear together in the same graph, with different colors or line styles. A legend should say which is which.

5. (Computer – 10 points) Consider the following interpolation points

$$(0,-1), \quad (1,2), \quad (\tfrac{3}{2},-1), \quad (2,2), \quad (\tfrac{1}{2},-1), \quad (3,2).$$

   (a) Using the function `evaluatelagrange` and a collection of points in the interval $[0,3]$, make a plot of the interpolation polynomial in these points. On top of the graph, plot the interpolation points. (Recall that we can put a circular marker on points by doing `plot(x,y,'o')`.

(b) Repeat the exercise using now the divided difference function `divideddiff` and the nested evaluation of polynomials `nested`.

6. (Computer – 5 points) We are given four points

$$x_1 = 1.5, \qquad x_2 = 2, \qquad x_3 = 3.5, \qquad x_4 = 4.$$

Plot the four Lagrange polynomials associated to these points in the same graph. To plot L_j ($j = 1, 2, 3, 4$) you can use `evaluatelagrange` in a collection of points in $[1.5, 4]$ with properly chosen values of the y_j coordinates.

7. (By hand – 10 points) We are given five points, in this particular order:

$$(1, -1), \qquad (2, 0), \qquad (3, 3), \qquad (4, 8), \qquad (0, 0).$$

(a) Compute the divided differences corresponding to these points. Once you are done, compare with what you get using `divideddiff`.

(b) Write the quartic interpolation polynomial at these points. What is the effective degree of this polynomial? Can you say anything about where these five points are placed?