Lab 4 for Math 398 Section 952: Caculus and Differential Equations

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This document constitutes your fourth lab assignment, which will be largely worked in the lab session. It will draw on material from Lecture 5, so it would be a good idea to go to my Home Page (http://www.math.unl.edu/~tshores/) and thence to my Teaching Page, thence to the Math398 Section 952 Home Page. Really, it would be a good idea to bookmark the class home page.

Reminder: Here is how to do these lab assignments. You will need to open a Matlab session and have this pdf file open for reading as well. To keep a recording of your work, you issue the following command to Matlab

```
> diary 'myfile'
```

Matlab will then send a copy of all your typed input and the output to a file called 'myfile.' For clarity, use descriptive names for your files, such as 'jsmithasgn1' so that when I save the files that you will email me, I can tell what it's about by the title. If at any point you want to stop the diary feature, issue the command

```
> diary off
```

To resume the diary feature, simply type

```
> diary on
```

This will cause input to be appended to myfile. You can make comments in your homework file by typing % at the command line and this too will be recorded. For example

```
> % This is a comment.
```

Be sure to start your file with the comments

```
> % Name:  yourname
> % Email:  your email addresss
```

When you end your session, the file will be closed and you can view it and even edit it with a text editor. As a matter of fact, you can even edit and view it with the Matlab Editor. Just type

```
> edit myfile
```

For problems where you are asked to write a small script or function file, you should use the Matlab editor to do so, and once you are satisfied that it works correctly, save this copy for emailing to me as another attachment. Be sure to put your name in the script or function file by way of a comment line:

```
> % programmer:  J. Smith, for exercise x of assignment xx.
```

When you have finished the assignment, email the files to me as attachments. My email address is `tshores@math.unl.edu`. Here is the assignment. As usual, turn the diary command on to record your session. Unless otherwise indicated, it is not necessary to save the graphics you create

for the assignment. Here is the assignment.

Problems

1. Use the methods of Lecture 5 to find a polynomial p of degree at most 5 that minimizes the pointwise error in approximating the function $f(x) = \sin(8x)$, $0 \leq x \leq 1$, and also find a polynomial q of degree at most 4 that best approximates the function $g(x) = e^x$. Don't spend too much time here; your approximations don't have to be perfect.

2. Calculate the infinity norm of the difference between the functions and their polynomial approximants.

3. Multiply the polynomials of 1 together to obtain an approximation to $h(x) = f(x)g(x)$. Find the infinity norm of the difference between the functions and this approximant.

4. Edit the file fcn.m to make it output $h(x)$. Now use quad to calculate the area of the integral $\int_0^1 h(x)dx$. Also find the minimum and maximum of the function on the interval $[0, 1]$. Do the same for the polynomial approximant to $h(x)$. (You may need to use a global variable in fcn.m, namely the vector that defines the product.)

5. Finish carrying out the commands in Matlab Lecture 5 from the Differential Equations section. Start at the beginning even though we already finished some of it in lecture.

6. Rewrite the second order van der Pol equation $y'' - \mu(1 - y^2)y' + y = 0$ as a first order system of two equations and edit the file fcn.m to be the right hand side function for an ode solver. However, define fcn to have *three* arguments, t,x, and mu. Then invoke ode45 with two extra arguments "[]" and "mu", where mu = 1. Find a solution for time t= 0 to $t = 20$ and do a time series plot of y and y' on the same graph.

7. Finish carrying out the commands in Matlab Lecture 5 from the Symbolic Math and Matlab section.