

Aero 320: Numerical Methods

Homework 1

Please submit your code (.cpp and .m files), figure (.pdf file) and write up (for part (b) and (c))

Due: September 11, 2013

Problem 1

Truncation and round-off error: derivative approximation revisited

Consider the function $f(x) = \exp(100x)$ as in Lab Assignment 2.

(a) Write a program to compute the *approximate* value of $f'(x)$ evaluated at $x = 0$ using the following approximation of the derivative

$$f'(x) \approx \lim_{h \rightarrow 0} \frac{f(x+h) - f(x-h)}{2h}$$

for different choices of $h = 2^{-k/4}$, where k varies from 20 to 200. Your code should output h and relative error as two columns in a file.

(b) Load your data file in MATLAB and plot the relative error (in the vertical axis) versus h (in horizontal axis) in log-log scale. Do this plot for both single precision and double precision arithmetic, on the same MATLAB figure. What are your conclusions from this plot?

(c) On the same figure generated in part (b), plot the results of Lab 2. Label your plots so that you know which curve is what. Looking at all the 4 plots on the same figure, explain the difference in results in part (b) and Lab 2.

(d) Run the following commands from MATLAB command line, to save your MATLAB figure as a high quality .pdf file. Before running these commands, please make sure to keep the figure window open, and you may resize the window manually to adjust the plot area in the .pdf file.

```
>> set(gcf, 'PaperPositionMode', 'auto')
```

```
>> print -dpdf 'YourFilename.pdf'
```