ECS230 Applied Numerical Linear Algebra 2015-04-15

Homework1 due Tue 2015-04-23 at 23:55

(Create a pdf file containing your work and upload it to Smartsite)

1) Error analysis

Consider the problem of solving $Ax = b$ for the unknown $x \in \mathbb{R}^2$ with

$$A = \begin{pmatrix} a & (a-1) \\ (a-1) & (a-2) \end{pmatrix} \tag{1}$$

where $a \in \mathbb{R}$ and $a > 2$. Assuming that the relative error in b is bounded by

$$\frac{||\delta b||_\infty}{||b||_\infty} < \epsilon \tag{2}$$

compute a bound for the relative error

$$\frac{||\delta x||_\infty}{||x||_\infty} \tag{3}$$

2) Using timing functions

a) Copy the file `timing1.c` from the course web site using (on stampede)

```
$ wget web.cs.ucdavis.edu/~fgygi/ecs230/homework/hw1/timing1.c
```

Study and understand the program. Compile the program using `gcc -o timing1 -lm timing1.c`. Create a job script (by modifying the example test2.job) to run the program 10 times with a command line argument of 5000000. Submit the job and report the timings observed in the output file. Repeat the process with arguments 10000000 and 20000000. Discuss the results observed, in particular regarding the resolution of the timing procedure used and the reproducibility of the results between runs. From the observed results, estimate the time needed to compute a square root.

b) Copy the file `timing2.c` from the course web site using (on stampede)

```
$ wget web.cs.ucdavis.edu/~fgygi/ecs230/homework/hw1/timing2.c
```

Study and understand the program. Create a job script that runs the program 10 times with the same arguments as in case a). Discuss the results obtained. The Intel Xeon E5-2680 used on the compute nodes of stampede runs at a clock rate of 2.7 GHz. Using your timing information, compute the number of clock cycles needed to compute a square root and the corresponding time. Compare with the results obtained in a).

c) Compile `timing2.c` using the `-O3` optimization option and run the same tests again. Discuss the differences observed.