AMSC/CMSC 662 Homework 6 , Fall 2013
Due: 9:30am Tuesday, November 26.

1. (10) Pick your favorite computer and run `cache.c` to determine for that computer some of the hardware parameters that influence program design.

Note: This program takes a long time to run, and it sends some of its output to `cache.m`, a MATLAB program that you should run.

- Add documentation to `cache.c` to explain clearly what it does.
- Use the Matlab output `cache.m` to make a plot, and also make a "memory mountain" plot using `mesh`. (You may use 0 for nonexistent values.)
- Determine the number of levels of cache memory.
- For each cache, determine the cache size, the block size, and the cache miss penalty.
- Determine from the results other parameters related to the main memory and disk, if possible.
- Identify what kind of computer you are running. Then find the manufacturer's claims for at least some of these parameters (the Linux commands `cat /proc/cpuinfo` and `cat /proc/meminfo` and `getconf -a | grep -i cache` might be helpful) and determine whether your estimates agree or disagree, and why.

2. (10) Write a C function that multiplies two $n \times n$ lower triangular matrices using blocks of size $b \times b$ ($1 \leq b \leq n$, and b a power of 2). (Make sure to include a clean-up loop. See specification of calling sequence on next page.) Also write a ijk function for performing the multiplication. Run your programs, and make a graph similar to Figure 3 in the Web Aside cited below, but just for ijk and the blocked version with blocksizes $2, 4, 8, 16, 32$, and 64. (Your vertical axis can be time rather than cycles, if you prefer.) Discuss your results, in particular, what the best blocksize is for your particular computer and how the times compare.

Note: A lower triangular matrix $\boldsymbol{A}$ is one for which $a_{ij} = 0$ when $i < j$. Take advantage of the fact that you know that almost half the elements of $\boldsymbol{A}$ are zero.

Hint: Use the slides in
`http://www.cs.umd.edu/~oleary/c662/material/10-cache-memories.pdf` pp. 39-46,
and the B& H "Web Aside" at
`http://csapp.cs.cmu.edu/public/waside.html`, Chapter 6,
to make this problem easier.

Note: Submissions between 9:31am on Nov 26 and 9:30am on Nov 30 will have a 15% late penalty. Submissions between 9:31am on Nov 30 and 9:30am on Dec 3 will have a 30% late penalty. After that, penalties increase (as usual) by 15% every 48 hours.

Submit: Please send 2 emails.

The first, with subject "Hmwk 6 Prob 1" should have these 4 attachments:

- Documented cache.c.
- PDF file containing the plot from `cache.m`.
- PDF file containing the well-labeled `mesh` plot.
- List of experimentally determined parameters and true values and discussion of how you determined the parameters and how well they compare with the "truth" (plain text file or PDF, not docx, etc.).

If it is easier to combine the last three into a single PDF file, that is fine.

The second, with subject "Hmwk 6 Prob 2" should have these 4 attachments:

- Listing of `multijk.c`. Parameter list: `multijk(n, A[], B[], C[])` to form $C = A * B$.
- Listing of `multblock.c`. Parameter list: `multblock(n, b, A[], B[], C[])`.
- PDF file containing the well-labeled plot.
- Discussion (plain text file or PDF).

If it is easier to combine the last two into a single PDF file, that is fine.