CS 378: PfC-HP
University of Texas at Austin — Project #2
Dr. Devangi Parikh — April 23-May 14, 2020

Project #2

You will do this project in groups of two or three. If you have trouble finding a project partner, we can help you find someone to work with.

For this project, you will implement an optimized double precision matrix multiplication kernel (DGEMM) that will run on a single thread. Your grade will be determined based on how well your performance compares to the reference kernel.

Files to look at:

- `driver.c` - Driver to run and record the experiment. You do not need to change this file.
- `gemm_<num>.c` - Skeleton in which you will implement the microkernel and pack routines. You must change `<num>` to match your two-digit group number. For example, if your group number was 0, then the file should be `gemm_00.c`. If you do not follow this formatting, your project will not be graded. You can find your project number on the Groups tab under People on Canvas.
  This is the **only** file you will **edit, and submit**.

How to run the test:

- run `make` within the directory.
- run `driver.x`.

Suggestions for optimization:

- Find optimal cache block and microkernel sizes [6].
- Use inline assembly. [1] is a good starting point. Documentation for x86 assembly can be found at [2]. A reference guide for x86 is available at [5].
- Unroll the inner loops and/or the packing routines.
- Vectorize the packing routine.
- Reduce function/loop overhead.
- Use static inline functions [4].
- Use the restrict keyword [3].

References

[1] How to use inline assembly language in c code. `https://gcc.gnu.org/onlinedocs/gcc/Using-Assembly-Language-with-C.html#Using-Assembly-Language-with-C`. Accessed: 2019-11-10.

[2] Intel 64 and ia-32 architectures software developer's manual. `https://software.intel.com/sites/default/files/managed/39/c5/325462-sdm-vol-1-2abcd-3abcd.pdf`. Accessed: 2019-11-10.

[3] Restrict keyword. `https://en.wikipedia.org/wiki/Restrict`. Accessed: 2019-11-10.

[4] Static inline functions. `https://stackoverflow.com/questions/7762731/whats-the-difference-between-static-and-static-inline-function`. Accessed: 2019-11-10.

[5] x86 and amd64 instruction reference. `https://www.felixcloutier.com/x86/`. Accessed: 2019-11-10.

[6] LOW, T. M., IGUAL, F. D., SMITH, T. M., AND QUINTANA-ORTI, E. S. Analytical modeling is enough for high-performance blis. *ACM Trans. Math. Softw. 43*, 2 (August 2016), 12:1–12:18.