Davood Mohajerani

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I am an HPC software developer/researcher experienced in the design, implementation, and optimization of parallel algorithms on CPUs (Cilk/OpenMP) and GPUs (CUDA). I am interested in performance portability, optimizing compilers, parallel algorithms, and computational number theory. As a team member, I focus on iterative development, effective (written and verbal) presentation of ideas, simplifying the workflow, and maximizing the outcome within the constraints.

Open Source Portfolio (2015-Present)

- **Lead developer of KLARAPTOR (Kernel Launch Rational Program Estimator)**
  A tool for improving running time of CUDA kernels by estimating block dimensions built on top of CUPTI and LLVM.
- **A CUDA library for parallel arbitrary-precision integer arithmetic on GPUs (in progress)**
  Supporting addition, subtraction, multiplication, and FFT for vectors of arbitrary-length large integers.
- **A new parallel algorithm for arbitrary-precision integer multiplication on GPUs (in progress)**
  - A new algorithm based on quadratic plain multiplication with a low span and a high degree of parallelism.
  - The fine-tuned implementation (via specialized arithmetic and PTX) in CUDA will be released soon.
- **Parallel FFT over big prime fields (for integer coefficients fitting on multiple 64-bit machine-words)**
  - Developed and optimized parallel implementations of six-step FFT over big prime fields.
  - The cache-friendly Cilk implementation aimed at multi-core CPUs (with near linear speedup) is integrated in BPAS.
  - The GPU (CUDA) implementation is fine-tuned for high ILP, high occupancy, and fully-coalesced accesses.
- **Parallel FFT over small prime fields (for integer coefficients that fit on a 64-bit machine-word)**
  - The cache-friendly Cilk implementation aimed at multi-core CPUs (with near linear speedup) is integrated in BPAS.
  - A vectorized reimplementation using AVX2 has speedup of 1.1x to 1.3x on an Intel i7-7700 (4.2 GHz).
- **Developed and optimized a new parallel algorithm for univariate polynomial division on GPUs (CUDA).**

Education

2017-2021 **Ph.D. candidate in Computer Science**, University of Western Ontario, Canada
Thesis: Parallel arbitrary-precision integer arithmetic on GPUs and multi-core CPUs

2015-2016 **M.Sc. in Computer Science**, University of Western Ontario, Canada
Thesis: "FFT over Prime Fields of Large Characteristic and Their Implementation on GPUs"

2010-2015 **B.Sc. in Computer (Software) Engineering**, Isfahan University of Technology, Iran

Skills

Programming	C, C++, CUDA, PTX, Cilk, OpenMP, x86 Assembly, AVX/AVX2, Python, bash, Make
Libraries/API	LLVM (Pass Framework), NVIDIA CUPTI, GNU GMP, POSIX, NTL
Tools/DBMS	LaTeX, GDB, valgrind, perf, nvprof, SQL (MySQL/SQL Server)
Familiar with	MPI, OpenCL, NumPy/SymPy, Verilog, MATLAB, Maple, OpenGL, Web development

Awards

- "Distinguished Software Demonstration Award" for presenting CUMODP library in ACM ISSAC 2017 conference.
- University of Western Ontario Graduate Research Scholarship (WGRS) for Ph.D. and M.Sc. in Computer Science.
- Ranked among the top 1% in the Iranian university entrance exam in 2010 ($\sim$ 320,000 participants).

Publications

[1] S. Covanov, Davood Mohajerani, M. M. Maza, and L. Wang, "**Big Prime Field FFT on Multi-core Processors**," in *ISSAC 2019*.

[2] A. Brandt, Davood Mohajerani, M. M. Maza, J. Paudel, and L. Wang, "**KLARAPTOR: A Tool for Dynamically Finding Optimal Kernel Launch Parameters Targeting CUDA Programs**," *CoRR*, vol. abs/1911.02373, 2019.

[3] S. A. Haque, X. Li, F. Mansouri, M. M. Maza, Davood Mohajerani, and W. Pan, "**CUMODP: a CUDA library for modular polynomial computation**," *ACM Commun. Comput. Algebra*, vol. 51, no. 3, pp. 89–91, 2017.

[4] S. A. Haque, A. Hashemi, Davood Mohajerani, and M. M. Maza, "**Plain, and Somehow Sparse, Univariate Polynomial Division on Graphics Processing Units**," in *PASCO@ISSAC 2017*, ACM, 2017.

[5] L. Chen, S. Covanov, Davood Mohajerani, and M. M. Maza, "**Big Prime Field FFT on the GPU**," in *ISSAC 2017*, ACM, 2017. DOI: 10.1145/3087604.3087657.