Harry Hughes

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Skills

- High Performance Computing
  - I can design complex software that utilizes the maximum potential of all available computing resources. This involves designing or redesigning complex algorithms as separable components that can be parallelized. I can also accelerate existing software. This involves identifying problem areas with empirical testing, and then modifying source code while meticulously ensuring that correctness is maintained. The final solution will perform consistently and predictably, every time.
- Modern C++
  - Using modern language features and robust design heuristics, I can design or restructure software to be developer-friendly. This includes applying principles to reduce bugs and making the software as straightforward as possible so future developers can seamlessly integrate into the project and make changes without breaking it. The single biggest obstacle to sustainable progress with software is the accumulated development burden of poor software design.
- C
  - If C++ is not available, I am fully capable of developing in C.
- CUDA
  - If NVIDIA GPUs are available and viable computing resources, I can design/adapt algorithms to conform to the CUDA architecture, write them in CUDA, and offload them to the GPU for massive parallelism. Using NVIDIA tools to extract empirical runtime data, I can guide development to a solution that maximally utilizes the GPU's resources.
- Embedded systems
  - When available computing resources are limited, I can design software that maximally utilizes them to accomplish more with less.
- CPU parallelism
  - If multicore CPUs are an available computing resource, I can use OpenMP and threading to parallelize operations.
- MPI,
  - If multiple separate computers are available, I can use MPI to coordinate parallelism beyond a single node.
- Linux
  - I am comfortable and experienced in developing in a Linux environment.
- Python

Experience

ORNL / HPC Computer Engineer
July 2018 - July 2020, Oak Ridge, TN

- Contributed to multi-node, multi-gpu, multi-core high performance scalable finite-element method scientific code for plasma physics research: https://github.com/project-asgard/asgard
    - Development involved implementing prototype numerical linear algebra Matlab routines developed by mathematicians and physicists in high performance C++. This required rigorous testing to make sure the prototype and the production software matched across a wide range of input parameters.
- Sole developer of a nonlinear optimization solver used to impose self-consistency on sets of images needed for 3d reconstruction and image registration for computer vision
    - This is called the "bundle adjustment" problem: https://en.wikipedia.org/wiki/Bundle_adjustment
    - I designed an API to allow users to easily specify all input parameters. My software inferred necessary parameter relationships by constructing a graph. I used the toolkit made available in the Ceres Solver project to define optimization cost functions and carry out the numerical math needed to produce a final answer.
    - Reliably testing an optimizer solver is non-trivial, since the optimality of a result is subjective depending on the cost function used and solver hyperparameters. I wrote a testing solution that generated a unique, zero-error scenario according to specified parameters, and then perturbed the parameters. This solution allowed me to test the optimizer on an extremely wide range of problems and define the limits of the solver on pathologically bad problem configurations.

- Custom-written GPU software acceleration for image registration computer vision applications
    - Involved applying error correction functions to distorted images. This was inherently a highly parallelizable task. I used NVIDIA profilers to guild iterative development of a CUDA routine that achieved maximum hardware resource utilization for the particular problem.

Innovative Computing Lab / Graduate Research Assistant
August 2016 - May 2018, Knoxville, TN

- As a graduate student in Dr. Jack Dongarra's research group, I developed an experimental system to automatically tune hyperparameters for a high performance math library.
    - Detailed runtime execution data was needed to guide parameter optimization, so writing a program tracer was the first step.
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Manufacturing Demonstration Facility / ORNL Intern
May 2017 - August 2017, Knoxville, TN

- Developed software for processing 3D point meshes in a large scale 3D printer.
- QT Codebase

Garmin

May 2016 - August 2016, Kansas City, KS

- Embedded development on marine transceivers
    - Parsed and interpreted raw incoming radio messages
- Embedded development on boat GPS systems
    - Transported relevant data from aforementioned messages through abstraction layers up to user display

Garmin

May 2015 - August 2015, Kansas City, KS

- Data Analytics
    - Created a tool to automatically detect and flag catastrophic errors in computer-generated Garmin map files.
    - Fully integrated database support allowed smart tracking of map files across releases.
    - UI designed for ease of use and optimal data presentation.

L-3 Technologies

May 2014 - August 2014, Greenville, TX

- Internal signal intelligence R&D project
    - Signal processing C codebase
- Obtained an interim Security Clearance

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Education

University of Tennessee, Knoxville / MS Computer Engineering

August 2016 - May 2018, Knoxville, TN

Advisor: Dr. Jack Dongarra

Final GPA: 3.88

University of Tennessee, Knoxville / BS Computer Engineering

August 2012 - May 2016, Knoxville, TN

Final GPA: 3.92

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Professional Bio

My work style makes me particularly well suited to working on difficult problems that present significant algorithmic or mathematical complexity and require clever implementation to achieve maximum performance. Many such problems require extensive testing and have open ended solutions that may be non-trivial to verify as correct or optimal. These types of problems are often central to the core functionality of a project.

I am meticulous and approach any solution as a solution that could probably be improved or made more efficient in some way. In addition to more accurate and faster results, this includes improvements that fall under the realm of software engineering and robust, scalable software design.

I am social, respectful and amicable but also very competitive and high energy. I am easy to work with and have a positive influence on both morale and focus of any group I am a part of.