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Experience Summary

Developed high performance programs on a wide variety of serial and parallel architectures. Extensive experience with C++ and numerical methods. Moderate experience with parsers, multithreaded programming, Python, Docker, high performance web services, SQL, databases, and Google Cloud. Lead a technical team to enable public international access to multi-petabyte astronomical databases, updated daily. Publications in C++ programming, astronomy, geology, and physics.

Selected Public Projects

SDPB A highly parallel, arbitrary precision semidefinite solver in C++ designed for problems in Quantum Field Theory. <https://github.com/davidsd/sdpb>

Gamra A highly parallel, finite difference, adaptive mesh refinement C++ code for modeling deformation during an earthquake. <https://www.wlandry.net/Projects/Gamra>

Gale A parallel, finite element C++ code for modeling mountain building, rifting, and subduction. <https://geodynamics.org/cig/software/gale>

blocks_3d A heavily optimized, multithreaded C++ code to generate conformal blocks for SDPB. https://gitlab.com/bootstrapcollaboration/blocks_3d

libADQL A C++ library to parse ADQL (Astronomical Data Query Language), a variant of SQL 92 with extensions for geometric queries on the sky. <https://github.com/Caltech-IPAC/libadql>

SuGrSonic A highly optimized C++ library that uses Intel intrinsics (SSE2, SSE3, SSSE3) to model sound on a grid, requiring only 5 cycles per grid point per iteration. <https://gitlab.com/wlandry/sugrsonic>

libhires A C++ image processing library for converting observations from the Planck spacecraft into high resolution astronomical images. Libhires leverages mlpack and a variety of statistical methods (simple binning, Elastic Net, Maximum Correlation Method) to reconstruct images with resolution better than the underlying instruments. <https://github.com/Caltech-IPAC/libhires>

libtinyhtm A library for efficient storage and lookup of datasets with billions of stars. <https://github.com/Caltech-IPAC/libtinyhtm>

Education

Ph.D. in Astronomy, Cornell University, Ithaca, NY
B.S. in Astronomy, California Institute of Technology, Pasadena, CA

Select Work Experience

2018-Date: Research Software Engineer, Theoretical Physics, Caltech

- Improved the scaling and performance of SDPB, a semidefinite solver for Quantum Field Theory, scaling it to hundreds of cores and enabling new classes of problems to be solved. This also involved modifying Elemental, a massively parallel linear algebra library, to fix bugs and use faster arbitrary precision arithmetic libraries.
- Ported SDPB to Google Cloud.
<https://cloud.google.com/blog/topics/hpc/introducing-hpc-vm-images>
- Converted Mathematica codes `scalar_blocks` and `blocks_3d` to highly multithreaded C++, reducing runtime from a year to days.
- Installed and maintained SDPB on more than a dozen HPC systems throughout the world.
- Updated Python scripts for new versions of SDPB and Python.
- Provided support to scientists across the world, including providing personal assistance, creating Docker images, and giving presentations on progress and new features at conferences.

2012-2018: Lead Software Engineer, NASA/IPAC Infrared Science Archive, Caltech

- Managed a team of back end software engineers for IRSA, the NASA funded organization tasked with archiving and publishing NASA data in the infrared. This included:
 - Ingesting multi-petabyte data from multiple sources, with daily updates.
 - Maintaining, updating, and modernizing the publicly visible REST back end service (up to a million hits per day) that also powers the web front end.
 - Interfacing with staff astronomers, front end managers, and telescope operators to define formats and transfer mechanisms.
 - Triaging bug reports and assigning priorities.
 - Creating a unified coding standard.
- Implemented a TAP (Table Access Protocol) service to enable more of a direct database access to large astronomy databases. This included translating the queries from ADQL to the Postgres, Oracle, Informix and SQLite backends and implementing a queue system based on Slurm.
https://irsa.ipac.caltech.edu/docs/program_interface/TAP.html
- Created a web backend to query a specialized multi-terabyte data store containing all of the processed data from the Planck satellite. This included a tool to dynamically generate images from single pixel observations using various statistical algorithms.
<https://irsa.ipac.caltech.edu/applications/planck/>

2005-2012: Lead Software Engineer, Computational Infrastructure for Geodynamics, Caltech

- Created Gamra, a parallel, finite difference, adaptive mesh refinement C++ code for modeling deformation during an earthquake.
- In collaboration with a group in Melbourne, Australia, enhanced the numerical techniques and physics implemented in Gale, a parallel finite element and particle-in-cell code that models mountain building, rifting, and subduction in the Earth's crust.