

# Vishal Pramod Kasliwal

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## Summary

*Former astrophysicist with a passion and insatiable appetite for building highly scalable AI-systems.*

Two AI hardware startups (Luminous Computing & Wave Computing) and an AI chip behemoth (Intel Corp.) have taught me that AI systems are incredibly hard to design & build correctly. Having left my roots in Astrophysics & High Performance Computing in 2017, I've learned my way around the process of designing chips and systems to accelerate AI for both

training as well as inference. My experiences at chip startups and large established corporations have left me with a healthy respect for teamwork. My latest role at Luminous Computing is focused on technical product definition & performance architecture. It has given me the chance to interact not only with potential customers to better understand their needs & requirements, but also with the rank & file of the engineering team to create a truly performant AI system for powering the future.

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## Experience - Industry

### Luminous Computing - Office of the CTO

SANTA CLARA, CA

#### Technical Product Definition & Performance Architecture

April '22 – present

I work in the Office of the CTO at Luminous Computing. My role lies at the intersection of technical product definition, performance architecture & hardware/software co-development. In the Office of the CTO, I'm tasked with determining & defining what Luminous will build. My responsibilities include

- engaging with external customers to understand the evolving needs of the marketplace, expectations of system & software behavior
- identifying & collating key AI workloads of interest
- analyzing workloads with the goal of understanding workload characteristics
- mapping the workload into Luminous Computing's software & hardware
- building analytical performance models to determine expected system performance, discover system- and component-level bottlenecks, & problems
- advising & co-architecting hardware & software features to improve workload performance
- working with the engineering team to productize recommended architectural improvements
- assuring that what the engineers are building - cutting across the software stack, the digital architecture, the compiler, and the hardware - is consistent with the intended goals of the product requirements and product value proposition
- identifying key system figures-of-merit (FOM) & bottlenecks and utilizing this knowledge to help the CTO define a forward technology road-map for future products that address these bottlenecks

I interact and advise the engineering team on the architecture as it develops. I also work on future iterations of Luminous' product and help the CTO define the forward road-map.

### Intel Corporation - Senior GPU Software Architect

SANTA CLARA, CA

I worked in the Software Architecture group within AXG. My role focused on architecting Intel's Level Zero GPU driver.

#### Level Zero Architecture

August '21 – April '22

My responsibilities included

- defining the software architecture of the Level Zero GPU driver.
- defining new architectural features for enhancing Intel's GPU architecture for HPC & Deep Learning workloads.
- driving adoption of best practices, i.e. architecture-specific know-how, in software products.

### Intel Corporation - Senior Deep Learning Software Engineer

SANTA CLARA, CA

I worked in the Machine Learning Performance (MLP) organization in the Machine Learning Distributed Compute (MLDC) group on accelerating Deep Learning workloads on Intel's Xe-HPC discrete accelerator cards for Deep Learning & High-Performance Computing. My role focused on pre-Si performance optimization via hardware-software co-design. I developed & tested computation- & communication-kernels using hardware simulators.

## Hardware-Software Co-Design

April '19 – August '21

My responsibilities included

- evaluating & projecting pre-Si Deep Learning workload performance.
- creating the overall strategy for distributing Deep Learning workloads across multiple-cards & -nodes i.e. scale-up/scale-out strategy.
- defining architectural features for enhancing the architecture for Deep Learning workloads.
- driving adoption of best practices, i.e. architecture-specific know-how, in software products.

## oneCCL Development

October '20 – August '21

I was responsible for

- researching & implementing superior algorithms for hierarchical & non-hierarchical collective communication kernels.
- developing collective communication kernels for low-precision data-types (bfloat16, fp16, etc...).

## Wave Computing - Senior Staff Research & Development Software Engineer

CAMPBELL, CA

Wave Computing was developing the next-generation of solutions for speeding up Deep Learning applications using Dataflow Processing Units (DPUs), which contain thousands of interconnected dataflow Processing Elements (PEs). DPUs were meant to power Wave Computing's custom appliance for developing, testing, and deploying Deep Learning models. I developed the compute- and data movement- software kernels which were meant to be executed by Wave Computing's Dataflow Processing Units (DPUs) for Deep Learning acceleration.

### Deep Learning Kernel- & Library-Development

Dec '17 – April '19

I have worked extensively on compute- & communicate-kernels, tools, and the supporting library for enabling Deep Learning workloads on Wave's DPUs.

- Developed compute kernels for various Deep Learning layers such as Average Pooling, Convolutions, Feed-Forward, Activations, Concatenation & fork, etc...
- Developed a tool for visualizing the place & route performed by JitPR.
- Owner of the library of routines for performing IEEE 754 rounding.
- Owner of the library of routines for changing precision.
- Authored various block Matrix Multiplication operations.
- Authored various multi-byte addition operations.
- Authored various multi-byte shift operations.

### Tools Development

Nov '18 – Apr '19

I developed tools for

- Simulating (functional & performance) Deep Learning kernels.
- Visualizing the placement & routing performed by JitPR.

### Management Role

March '18 – April '19

I assisted my superior with the management of the kernel team consisting of seven engineers. My duties included

- maintaining the schedule of work being done by the members of the team.
- assisting in the planning of new work items.
- identifying & interviewing new compute-kernel team candidates.
- report on the progress of the compute-kernel team to the VP of product engineering.

Major accomplishments include

- I developed a workflow for creating new compute-kernels.
- I integrated the schedule of work into a JIRA managed project.

The outcome of my efforts is better project management leading to a significant reduction in the time taken to develop new compute-kernels.

## Colfax International - High Performance Computing (HPC) Research Engineer

SUNNYVALE, CA

### HPC Computational Fluid Dynamics (CFD) Application Development

Mar '17 – Dec '17

HPC consulting project. I parallelized a CFD simulation code written in C for a client in the oil & gas sector resulting in a ~10X speedup. I have also refactored the client's codebase to enable independent time-evolution in different regions of the simulation via domain-decomposition methods.

### C/C++ Compiler Analysis

Nov '17

HPC research project. I investigated suitability of C++ compilers for HPC applications. I developed optimized scientific computational kernels and investigated the performance obtained by each compiler from each kernel. I analyzed compiled binary code to determine reason for differences in performance. A technical report of my findings can be obtained at [Colfax Research](#).

## Research Experience in Academia (prior to March, 2017)

Large Synoptic Survey Telescope (LSST) Data Management (Princeton University) PRINCETON, NJ

### Postdoctoral Research Associate

Sept '15 – Feb '17

LSST Data Management is building a C++ & Python software stack to analyze raw imaging data from LSST. I worked on the software stack to add functionality, documentation, & tests. I developed & implemented algorithm to propagate covariance when stacking images and worked on techniques for optimal image stacking & differential chromatic refraction. I worked on a machine-learning based star-galaxy classifier and on converting the LSST stack to use py.test.

Department of Physics & Astronomy (University of Pennsylvania)

PHILADELPHIA, PA

### Postdoctoral Researcher

Sep '15 – Feb '17

I developed and implemented a parallelized Bayesian algorithm to estimate orbital parameters from stochastic light curves of binary supermassive black holes. I also developed and implemented Python framework to automatically wrangle astronomical time-series data from a variety of sources including web-servers, SQL servers, data servers and local data files.

### Principle Developer

Sept '15 – Feb '17

I architected and implemented `kālī`, an open-source high performance library to model stochastic time-series data in a Bayesian framework. `kālī` is capable of modeling time-series data as variants of C-ARMA processes (a type of Gaussian random process). Written primarily in C++ and exposed to Python using Cython, `kālī` uses scikit-learn for machine learning, Intel MKL for fast linear algebra, Intel Bull Mountain technology for hardware random number generation, & OpenMP 4.0 for vectorization & parallelization. `kālī` is being used to study astronomical time-series data by multiple research groups at Caltech, UPenn, & Drexel.

Department of Physics (Drexel University)

PHILADELPHIA, PA

### AGN Variability Analysis

June '09 – Aug '15

I developed C++ software for Intel Xeon Phi accelerator cards to model AGN variability. I developed vectorized & parallelized the C++ pipeline to forward-model and fit data to model using MLE of 2<sup>nd</sup>-order statistics.

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## Education

Drexel University

PHILADELPHIA, PA

### PhD. in Physics

2008 – 2015

Probing AGN Accretion Physics through AGN Variability: Insights from *Kepler*

Virginia Commonwealth University

RICHMOND, VA

### M.S in Physics & Applied Physics

2005 – 2007

CAFM Studies of Epitaxial Lateral Overgrowth GaN Films

University of Richmond

RICHMOND, VA

### B.S. in Mathematics & Physics

2001 – 2005

The Bispectrum as a Quantifier of non-Gaussianity in the Cosmic Microwave Background

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## Publications, Grants, & Service

A Performance-Based Comparison of C/C++ Compilers Colfax Research, 2017

Science-driven Optimization of the LSST Observing Strategy arXiv, 2017

Large Synoptic Survey Telescope Galaxies Science Roadmap arXiv, 2017

Extracting Information from AGN Variability MNRAS, 470, 3, 3027-3048, 2017

The LSST Data Management System Proceedings of ADASS XXV, 2015

Do the Kepler AGN light curves need reprocessing? MNRAS, 453, 2075, 2015

Are the variability properties of the Kepler AGN light curves consistent with a damped random walk?

MNRAS, 451, 4328, 2015

Thirty Meter Telescope Detailed Science Case: 2015 <http://arxiv.org/abs/1505.01195>, 2015

AFM and CAFM studies of ELO GaN films Proc. SPIE 6473, 647308, 2007

Local electronic and optical behaviors of a-plane GaN grown via epitaxial lateral overgrowth Appl.

Phys. Lett., 90, 011913, 2007

Kepler Guest Observer Program Co-Investigator on Kepler Guest Observer Program accepted proposals K2

GO16088, K2 GO14088, K2 GO12013, K2 GO8052, & K2 GO10052

NASA Grant NNX14AL56G Helped write proposal for awarded NASA Grant NNX14AL56G. Grant was used to fund my Ph.D. research.

The National Science Foundation Served on a grant review panel for the Division of Astronomical Sciences.

The Astrophysical Journal Peer reviewed publications.

The Astronomical Journal Peer reviewed publications.

Monthly Notices of the Royal Astronomical Society Peer reviewed publications.