HYOGI SIM

Oak Ridge National Laboratory, Virginia Tech

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CURRENT POSITION

HPC Systems Engineer: National Center for Computational Sciences, Oak Ridge National Laboratory

EDUCATION

Ph.D. in Computer Science, Virginia Tech, VA — *expected in 2018*

- Advisor: Dr. Ali R. Butt
- Thesis: Exploiting Storage-Side Computing Power for Fast and Efficient Scientific Data Discovery *(working title)*

M.S. in Computer Science, Virginia Tech, VA — *Dec. 2014*

- Advisor: Dr. Ali R. Butt
- Thesis: AnalyzeThis: An Analysis Workflow-Aware Storage System

M.S. in Electronics and Computer Engineering, Hanyang University, S. Korea — *Feb. 2008*

- Advisor: Dr. Jaehyuk Cha and Dr. Sooyong Kang
- Thesis: A Study of Performance Impact of Merging Storage Layers on Flash-Based DBMS

B.S. in Urban Planning, Hanyang University, S. Korea — *Feb. 2005*

SKILLS & EXPERTISE

Skillful in Linux application/system/kernel programming, parallel/distributed file systems, database systems.

- **Programming Languages**: C, C++, Python, JAVA, PHP, C#, BASH
- **File & Storage**: FUSE, Linux VFS, Device Mapper, SCSI OSD-2, Linux TGT, blktrace, exofs, ext3
- **Parallel & Distributed File Systems**: GlusterFS, Lustre, Ceph, NFS, HDFS
- **Non-Volatile Memory & SSD**: Linux MTD, Flash Translation Layer
- **Databases**: MySQL, PostgreSQL, SQLite, MS SQLServer, IBM DB2, WiSS, HyperDex
- **Parallel Programming**: MPI, Pthread, OpenMP, Spark
- **Parallel I/O Library**: netCDF, HDF5, SCR
- **I/O Benchmarks**: fio, mdtest, IOR, TPC-C, TPC-H
- **Tools**: gcc, gdb, cscope, ctags, autotools, git, svn, eclipse, glade, visual studio, latex, gnuplot
- **Web Development**: HTML, CSS, PHP, Javascript, JQuery, ASP.NET
- **Package Management**: RPM, Portage (Gentoo Linux), Pkgsrc (NetBSD)

CURRENT PROJECTS

Workflow-Aware Multi-Tiered Storage System in High Performance Computing — *2016-present, Oak Ridge National Lab.*

- Designing and developing a NoSQL store-based global metadata manager that provides a unified namespace abstraction atop heterogeneous storage tiers.
- Developing a client-side shared library that allows applications to interact with the metadata manager.
  (FUSE, Lustre, Ceph, MySQL, HyperDex)

Development of a Checkpoint File System for HPC Burst Buffers — *2017-present, Oak Ridge National Lab.*

- Designing and developing a ephemeral checkpoint file system for HPC burst buffers.
- Developing an efficient file system metadata management mechanism using a NoSQL database for supporting shared checkpoint files.
  (FUSE, MPI, MDHIM, LevelDB)

Development of a Fast Temporary Storage for Data-Intensive Applications using NVMe SSDs — *2016-present, Oak Ridge National Lab., Virginia Tech*

- Designing a zero-copy, out-of-core framework to temporally persist application objects in volatile memory.
- Implementing a userspace layer that directly manages NVMe devices to bypass the kernel page cache and file system.
- Identifying a potential extension of the NVMe protocol for offloading physical space management to the device and providing an object-based interface to applications.
  (Linux, NVMe, NVMeDirect)

PROJECT EXPERIENCES ON FILE & STORAGE SYSTEMS

Scientific User Behavior Analysis from the HPC File System Snapshot — *2016-2017, Oak Ridge National Lab.*

- Building an analysis framework using big data tools to analyze Spider II (Lustre PFS) daily snapshot data.
- Analyzing user behaviors and interactions through the observed file system activities.

(Spark, SparkSQL, Parquet, Python, Lustre)

File System-Integrated Search and Discovery Services for High Performance Computing — *2015-2016, Oak Ridge National Lab. and Virginia Tech*

- Designed and developed a file system-integrated metadata indexing framework that supports the user-defined tagging in GlusterFS.
- Developed a command-line utility using the GlusterFS API to allow interactive, tagging-based file search queries in SQL syntax.
- Developed a computation offloading framework via the tagging-based file search, similar to '`find -exec`'.
- Developed an automatic metadata extraction framework based on the tagging-based file search.

(GlusterFS, SQLite, Linux)

Analysis-Aware Storage System for High Performance Computing — *2013-2015, Oak Ridge National Lab. and Virginia Tech*

- Designed an active execution framework based on SCSI T10 OSD-2 specification and implemented the extended OSD-2 protocol on the Linux TGT.
- Extended the host-side OSD initiator driver and exofs in Linux Kernel to support the active execution framework.
- Designed and developed a FUSE file system that manages the array of active OSD devices.
- Integrated a workflow manager within the file system to support scientific workflow processing across the array of active OSD devices.
- Developed a provenance management framework based on the OSD-2 object abstraction using a light-weight database within the FUSE file system

(Linux Kernel, SCSI T10 OSD-2 Protocol, Linux TGT, FUSE, SQLite)

Hierarchical Data Management in Media Servers with Hybrid Storage Architecture — *2007-2009, Database Lab., Hanyang University*

- Developed a content popularity analyzer that periodically analyzes request log files and ranks frequently requested contents in a commercial media server running Windows Media Server.
- Developed a light-weight file system based on ext2 for the caching servers equipped with storage class memory devices, e.g., PRAM.

(Linux Kernel, Windows Media Server)

Development of a NAND Flash Memory-Based File System Supporting Transaction and Record Structure — *2006-2008, Database Lab., Hanyang University*

- Developed a DBMS that integrates FTL and directly manages a raw NAND flash memory chip via Linux MTD layer for managing EPG (Electronic Program Guide) data in a set top box.
- Developed a flash-aware buffer management policy in PostgreSQL to generates a flash-friendly LBA sequence for NAND flash memory.
- Developed a framework that generates a set of pre-defined I/O requests, measures latency, and identifies a FTL mapping algorithm of a NAND flash memory-based storage device.

(Linux Kernel, Linux MTD, Wisconsin Storage System, PostgreSQL, ARM-based embedded board)

OTHER PROJECT EXPERIENCES

A Programming Framework for Processing-In-Memory Architecture — *2015-2016, Oak Ridge National Lab.*

- Developed a high-level programming interface (C/C++) and a runtime environment that facilitates data analysis tasks with an array of PIM devices.
- Developed a kernel device driver that emulates PIM devices in a NUMA architecture.

(NUMA, Pthread, Intel TBB, Linux Kernel)

Development of a Web-Based Social Marketing Game — *Jan-June 2011, Pitapat Mobile, S. Korea*

- Developed a social quiz/marketing web application using the Microsoft ASP.NET.
- Integrated the web application to the Facebook app platform using the Facebook API.

(C#, Javascript, JQuery, HTML, PHP, SQL Server, MySQL, Amazon EC2)

Development of an Image Transfer Library for a Self-Driving Vehicle — *Dec 2008, Metabuild co., S. Korea*

- Developed a userspace library that transfers requested pixel data from the CMOS camera to a lane-recognition module in a self-driving vehicle.

(Linux, C, ARM-based embedded board)

Development of an Online Survey Website — *Feb 2010, Aug 2009, Dept. of English Education, Hanyang University*
- Developed an online-survey web application including administrative tools.
- Developed a web application that visualizes interactions among educators.
  (Linux, PHP, HTML, Javascript, MySQL, GD, Apache, Microsoft Excel)

Construction of a Protein Function Database — *2006-2008, Database Lab., Hanyang University*
- Developed a GUI environment that allows medical researchers to verify protein interaction graphs that are automatically extracted from academic articles.
  (Windows, SQLServer, Delphi)

Development of an Online Lesson Website — *2002-2003, Golfschool co., S. Korea*
- Developed and maintained a commercial company website that serves online golf lessons and an online shopping mall of sporting goods.
  (Linux, Apache, PHP, MySQL, HTML, Javascript)

WORK HISTORY

Oak Ridge National Laboratory: *HPC Systems Engineer — Feb 2015-present*
Oak Ridge National Laboratory: *Postmasters Research Assistant — Mar 2015-Jan 2017*
Oak Ridge National Laboratory: *Summer Intern — Jan-Aug 2013*
Virginia Tech: *Research and Teaching Assistant — Aug 2011-Dec 2013, Step 2013-Feb 2015*
Pitapat Mobile, S. Korea: *Senior Developer, Startup Member — Jan-June 2011*
Dept. of English Education, Hanyang University, S. Korea: *Part-Time Programmer — Feb 2010, Aug 2009*
Metabuild co., S. Korea: *Part-Time Programmer — Dec 2008*
Golfschool co., S. Korea: *Programmer, Startup Member — 2002-2003*
Military Conscription in a Combat Police Force, S. Korea — *May 1999 - July 2001*

RESEARCH PUBLICATIONS

- **Hyogi Sim**, Youngjae Kim, Sudharshan S. Vazhkudai, Geoffroy R. Vallée, Seung-Hwan Lim, Ali R. Butt, *Beagle: A Fast and Efficient Scientific Data Discovery Service*, Proceedings of the 2017 ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis (SC '17), Denver, CO — *to appear*
- **Hyogi Sim**, Seung-Hwan Lim, Raghul Gunasekaran, Sudharshan S. Vazhkudai, *Scientific User Behavior and Data-Sharing Trends in a Petascale File System*, Proceedings of the 2017 ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis (SC '17), Denver, CO — *to appear*
- Sangkuen Lee, **Hyogi Sim**, Youngjae Kim, Sudharshan S. Vazhkudai, *AnalyzeThat: A Programmable Shared-Memory System for an Array of Processing-In-Memory Devices*, IEEE/ACM International Symposium on Cluster, Cloud and Grid Computing (CCGRID '17), Madrid, Spain, May 2017
- **Hyogi Sim**, Youngjae Kim, Sudharshan S. Vazhkudai, Geoffroy R. Vallée, Seung-Hwan Lim, Ali R. Butt, *TagIt: An Integrated Search and Discovery Service for Extreme-Scale File Systems*, Poster in the 2016 USENIX Annual Technical Conference (ATC '16), Denver, CO, June 2016
- **Hyogi Sim**, Youngjae Kim, Sudharshan S. Vazhkudai, Devesh Tiwari, Ali Anwar, Ali R. Butt, Lavanya Ramakrishnan, *AnalyzeThis: An Analysis Workflow-Aware Storage System*, Proceedings of the 2015 ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis (SC '15), Austin, TX
- **Hyogi Sim**, Youngjae Kim, Sudharshan S. Vazhkudai, Devesh Tiwari, Ali Anwar, Ali R. Butt, Lavanya Ramakrishnan, *AnalyzeThis: An Analysis Workflow-Aware Storage System*, Poster in the 2015 USENIX Annual Technical Conference (ATC '15), Santa Clara, CA, July 2015
- **Hyogi Sim**, Hoyoung Jung, Sungmin Park, Sooyong Kang, Jaehyuk Cha, *Identifying the FTL Mapping Scheme for USB Flash Devices*, The 4th International Conference on Convergence Technology and Information Convergence, CTIC 2009, Oct. 12
- Sooyong Kang, Sungmin Park, Hoyoung Jung, **Hyogi Sim**, Jaehyuk Cha, *Performance Tradeoffs in Using NVRAM Write Buffer for Flash Memory-based Storage Devices*, IEEE Transactions on Computers, Vol. 58, Issue 6 (Jun. 2009) Pages 744-758
- Hoyoung Jung, **Hyogi Sim**, Sungmin Park, Sooyong Kang, Jaehyuk Cha, *LRU-WSR: Integration of LRU and Writes Sequence Reordering for Flash Memory*, IEEE Transactions on Consumer Electronics, Volume 54, Issue 3 (Aug. 2008)
- Sungmin Park, Hoyoung Jung, **Hyogi Sim**, Sooyong Kang, Jaehyuk Cha, *Using Non-Volatile RAM as a Write Buffer for NAND Flash Memory-based Storage Devices*, 2008 IEEE International Symposium on

Modeling, Analysis & Simulation of Computer & Telecommunication Systems, MASCOTS 2008, Sept 8-10, Baltimore, MD

- Sungmin Park, Hoyoung Jung, **Hyogi Sim**, Sooyong Kang, Jaehyuk Cha, *Write Buffer-aware Address Mapping for NAND Flash Memory Devices*, 2008 IEEE International Symposium on Modeling, Analysis & Simulation of Computer & Telecommunication Systems, MASCOTS 2008, Sept 8-10, Baltimore, MD
- Hoyoung Jung, Kyunghoon Yoon, **Hyogi Sim**, Sungmin Park, Sooyong Kang, Jaehyuk Cha, *LIRS-WSR: Integration of LIRS and Write Sequence Reordering for Flash Memory*, The 2007 International Conference on Computational Science and Its Applications, ICCSA LNCS 2007, Aug. 29

RECOGNITIONS

Analysis Restaurant: In November 2015, *DEIXIS online magazine* featured AnalyzeThis storage system as a monthly highlight, based on the SC '15 paper (*https://deixismagazine.org/2015/11/analysis-restaurant/*).

GRADUATE-LEVEL COURSES

Virginia Tech: Statistics in Research, Multiprocessor Programming, Research Method in Computer Science, Advanced Parallel Computation, Advanced Topics in System and Network Security, Operating Systems, Software Refactoring

Hanyang University: Advanced Operating System, Computer Algorithms, Database System Implementation, Real-Time Systems, Cryptography, Database Tuning

TEACHING EXPERIENCE

Computer Organization II — *Spring 2012, Fall 2011 (Teaching assistant)*

- Graduate Teaching Assistant, Dept. of Computer Science, Virginia Tech

File Structure — *Spring 2009, Fall 2007 (Leading lab sessions)*

- Graduate Teaching Assistant, Division of Computer Science and Engineering, Hanyang University

Data Structures — *Spring 2007 (Leading lab sessions)*

- Graduate Teaching Assistant, Division of Computer Science and Engineering, Hanyang University

Object Oriented Programming — *Spring 2005 (Leading lab sessions)*

- Graduate Teaching Assistant, Dept. of Computer Science Education, Hanyang University

AWARDS & SCHOLARSHIPS

Virginia Tech: Graduate Research Assistantship — *Fall 2011, 2012, 2013, Spring 2012, 2014*
Hanyang University: BK21 Scholarship — *2009*, Academic Record Scholarship — *2005*