

Hyogi Sim

HPC Systems Engineer (*R&D Associate*), Technology Integration Group
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Work Experience

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

Education

Ph.D. in Computer Science, Virginia Tech, VA	— expected in 2022
◦ Advisor: Dr. Ali R. Butt	
◦ Thesis: Storage System Support for Data-Intensive Computing in Large-Scale HPC Systems (<i>working title</i>)	
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
◦ 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, exofs, ext3
- Parallel & Distributed File Systems: GlusterFS, Lustre, CephFS, GPFS, NFS, HDFS, HPSS
- Non-Volatile Memory & SSD: Linux MTD, Flash Translation Layer, NVMe
- Databases: MySQL, PostgreSQL, SQLite, MS SQLServer, IBM DB2, WiSS, HyperDex, Elasticsearch
- Parallel Programming: MPI, Pthread, OpenMP, Spark
- Parallel I/O Library: netCDF, HDF5, SCR
- I/O Benchmarks/Profiling: fio, mdtest, IOR, TPC-C, TPC-H, blktrace, Darshan
- Tools: gcc, gdb, cscope, ctags, autotools, git, svn, eclipse, glade, visual studio, latex, gnuplot
- Web Development: HTML, CSS, Django, Jekyll, PHP, Javascript, JQuery, ASP.NET
- Container: Docker, OpenShift
- Package Management: RPM, Portage (Gentoo Linux), Pkgsrc (NetBSD), Ports (FreeBSD)

Project Experience in File and Storage Systems

Scalable data infrastructure for science	2019 – present, Oak Ridge National Lab.
◦ Developing a scientific data repository that allows data sharing among scientists.	
◦ Developing a web portal that interacts with the backend storage.	
◦ Deploying the services with containers on the OpenShift cluster.	
◦ (<i>Python, Django, PostgreSQL, OpenShift, Docker, Globus, DOI</i>)	
Metadata indexing framework for HPC archival storage systems	2018 – present, Oak Ridge National Lab.
◦ Developing a software framework that periodically collects metadata from HPSS and builds data catalog.	
◦ Developing a framework that extracts metadata from well-known document files without user intervention.	
◦ Developing command-line utilities for system administrators and users.	
◦ (<i>HPSS, IBM DB2, PostgreSQL, Apache Tika, XDR, cURL, Elasticsearch, Kafka</i>)	

- UnifyFS: A userspace checkpoint file system for HPC burst buffers** 2017 – present, Oak Ridge National Lab.
- Exascale Computing Project (ECP): Software technologies/Data and Visualization/ExaIO
 - Developing an ephemeral, distributed file system for node-local burst buffers to facilitate checkpointing of HPC applications.
 - (*FUSE, MPI, PMIx, MDHIM, LevelDB, Mercury, Margo, Argobots, Slurm, LSF*)

- Large-scale file system snapshot and workload analysis** 2016 – 2019, Oak Ridge National Lab.
- Analyzing the snapshot data of Spider II (32 PB Lustre) file system.
 - Analyzing the eight year worth workloads of 80 PB HPSS archival storage system.
 - (*Lustre, HPSS, Spark, SparSQL, Parquet, Python, MySQL, SQLite*)

- File system-integrated search and discovery services for HPC** 2015 – 2017, Oak Ridge National Lab.
- Developing a file system-integrated metadata indexing framework that supports taggings in GlusterFS and CephFS.
 - (*GlusterFS, CephFS, Linux, SQLite*)

- Programming framework for processing-in-memory architecture** 2015 – 2016, Oak Ridge National Lab.
- Developing a programming library (C/C++) and runtime environment for facilitating data analysis tasks with PIM devices.
 - Developing a kernel device driver that emulates PIM devices in a NUMA architecture.
 - (*NUMA, Pthread, Intel TBB, Linux Kernel*)

- Analysis-aware storage system for high performance computing** 2013 – 2015, Oak Ridge National Lab./Virginia Tech
- Developing an active execution framework by extending the SCSI T10 OSD-2 specification.
 - Extending the Linux exofs file system to support the extended OSD protocol.
 - Developing a FUSE file system that manages the array of active OSD devices.
 - (*Linux Kernel, SCSI T10 OSD-2 Protocol, Linux TGT, FUSE, SQLite*)

- Hierarchical data management in media servers with hybrid storage architecture** 2007 – 2009, Hanyang University
- Developing a content popularity analyzer that identifies popular media contents in a commercial media server.
 - Developing a light-weight file system for storage class memory devices (PRAM) in media cache servers.
 - (*Linux Kernel, Windows Media Server*)

- Development of a transactional record storage for NAND flash memory** 2006 – 2008, Hanyang University
- Developing a DBMS that directly manages a NAND flash memory via Linux MTD to manage EPG data in a set-top box.
 - Developing a new PostgreSQL buffer manager that generates an optimized LBA sequence for NAND flash memory.
 - Developing an interactive framework that identifies a FTL mapping schema for NAND flash memory.
 - (*Linux Kernel, Linux MTD, Wisconsin Storage System, PostgreSQL, ARM-based embedded board*)

Other Project Experience

- Development of a web-based social marketing game** 2011, Pitapat Mobile, S. Korea
- Developing a web application that features social quiz games and integrating it to the Facebook via Facebook API.
 - (*C#, Javascript, JQuery, HTML, REST, ASP.NET, SQL Server, Amazon EC2*)

- Development of an image transfer library for a self-driving vehicle** 2008, Metabuild co., S. Korea
- Developing a system library that transfers requested pixel data from the CMOS camera to a lane-recognition module.
 - (*Linux, C, ARM-based embedded board*)

- Development of an online survey website** Feb 2010, Aug 2009, Dept. of English Education, Hanyang University, S. Korea
- Developing a web application that dynamically visualizes online survey results with graphs.
 - (*Linux, PHP, HTML, Javascript, MySQL, GD, Apache, Microsoft Excel*)

- Construction of a protein function database** 2006 – 2008, Hanyang University
- Developing a GUI environment for verifying protein interaction graphs that are extracted automatically from academic papers.
 - (*Windows, SQLServer, Delphi*)

- Development of an online lesson website** 2002 – 2003, Golfschool co., S. Korea
- Developing and maintaining a commercial company website with online sports lessons and an integrated shopping mall.
 - (*Linux, Apache, PHP, MySQL, HTML, Javascript*)

Publications

- Awais Khan, Hyogi Sim, Sudharshan S. Vazhkudai, Ali R. Butt, Youngjae Kim, *An Analysis of System Balance and Architectural Trends Based on Top500 Supercomputers*, In Proceedings of the International Conference on High Performance Computing in Asia-Pacific Region (HPC Asia '21), January 2021
- Awais Khan, Hyogi Sim, Sudharshan S. Vazhkudai, Jinsuk Ma, Myeong-Hoon Oh, Youngjae Kim, *Persistent Memory Object Storage and Indexing for Scientific Computing*, In Proceedings of the IEEE/ACM Workshop on Memory Centric High Performance Computing (MCHPC '20) in conjunction with SC, GA, November 2020

- Hyogi Sim, Awais Khan, Sudharshan S. Vazhkudai, *An Analysis of System Balance and Architectural Trends Based on Top500 Supercomputers*, Oak Ridge National Laboratory, ORNL/TM-2020/1561, Aug. 2020
- Hyogi Sim, Awais Khan, S Vazhkudai, S Lim, Ali R. Butt, Youngjae Kim, *An Integrated Indexing and Search Service for Distributed File Systems*, IEEE Transactions on Parallel and Distributed Systems (TPDS), vol. 31, no. 10, pp. 23752391, 2020.
- Ali Anwar, Yue Cheng, Hai Huang, Jingoo Han, Hyogi Sim, Dongyoon Lee, Fred Douglass, Ali R. Butt, *Customizable Scale-Out Key-Value Stores*, IEEE Transactions on Parallel and Distributed Systems (TPDS), vol. 31, no. 9, pp. 20812096, 2020.
- Hyogi Sim, Sudharshan S. Vazhkudai, *Profiling the Usage of an Extreme-Scale Archival Storage System*, Proceedings of the 27th IEEE International Symposium on Modeling, Analysis and Simulation of Computer and Telecommunication Systems (MASCOTS '19), Rennes, France, October 2019
- Hyogi Sim, Geoffroy R. Vallée, Youngjae Kim, Sudharshan S. Vazhkudai, Devesh Tiwari, Ali R. Butt, *An Analysis Workflow-Aware Storage System for Multi-Core Active Flash Arrays*, IEEE Transactions on Parallel and Distributed Systems (TPDS), vol. 30, no. 2, pp. 271285, 2019.
- Hyogi Sim, Arnab K. Paul, Eli Tilevich, Ali R. Butt, *CSLIM: Automated Extraction of IoT Functionalities from Legacy C Codebases*, Proceedings of the 8th International Workshop on Computing and Networking for IoT and Beyond (ComNet-IoT 19) in conjunction with ICDCN '19, Bangalore, India, pages 6, January 2019
- Ali Anwar, Yue Cheng, Hai Huang, Dongyoon Lee, Jingoo Han, Hyogi Sim, Fred Douglass, and Ali R. Butt, *BESPOKV: Application Tailored Scale-Out Key-Value Stores*, Proceedings of the 2018 ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis (SC '18), Dallas, TX
- Sangkuen Lee, Hyogi Sim, Sudharshan S. Vazhkudai, *A Programmable Shared-Memory System for an Array of Processing-In-Memory Devices*, Cluster Computing: The Journal of Networks, Software Tools and Applications, 2018
- Feiyi Wang, Hyogi Sim, Cameron Harr, Sarp Oral, *Diving into Petascale Production File Systems through Large Scale Profiling and Analysis*, In Proceedings of the 2nd Joint International Workshop on Parallel Data Storage & Data Intensive Scalable Computing Systems (PDSW-DISC '17) in conjunction with SC, Denver, CO
- Hyogi Sim, Youngjae Kim, Sudharshan S. Vazhkudai, Geoffroy R. Vallée, Seung-Hwan Lim, Ali R. Butt, *TagIt: An Integrated Indexing and Search Service for File Systems*, Proceedings of the 2017 ACM/IEEE International Conference for High Performance Computing, Networking, Storage and Analysis (SC '17), Denver, CO
- Seung-Hwan Lim, Hyogi Sim, 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
- 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), Oct. 2009
- 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, iss. 6 (Jun. 2009), pp. 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, vol. 54, iss. 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*

Presentations

- Hyogi Sim, *Extracting Metadata from the ORNL HPSS Archive to Improve its Usability*, “Knowledge Is Power: Unleashing the Potential of Your Archives through Metadata” BoF in ACM/IEEE International Conference for High Performance Computing, Networking, Storage, and Analysis (SC), Denver, CO, November 2019
- Hyogi Sim, *Making a Peta-Scale Archival Storage System Searchable*, High Performance Storage Systems User Forum 2019 (HUF 2019), Indiana University, Bloomington, IN, October 2019
- Hyogi Sim, *Profiling the Usage of an Extreme-Scale Archival Storage System*, High Performance Storage Systems User Forum 2019 (HUF 2019), Indiana University, Bloomington, IN, October 2019
- Hyogi Sim, *TagIt: An Integrated Indexing and Search Service for File Systems*, ACM/IEEE International Conference for High Performance Computing, Networking, Storage, and Analysis (SC), Denver, CO, November 2017
- Hyogi Sim, *AnalyzeThis: An Analysis Workflow-Aware Storage System*, ACM/IEEE International Conference for High Performance Computing, Networking, Storage, and Analysis (SC), Austin, TX, November 2015

Professional Services

Program Committee Member:

- BenchCouncil International Symposium on Benchmarking, Measuring and Optimizing (Bench): 2018, 2019, 2020

Journal Reviewer:

- IEEE Transactions on Storage (TOS)
- IEEE Transactions on Parallel and Distributed Systems (TPDS)
- Journal of Parallel and Distributed Computing (JPDC)

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/>).

Teaching Experience

Computer Organization II, Virginia Tech, VA	— Spring 2012, Fall 2011 (Teaching assistant)
File Structure, Hanyang University, S. Korea	— Spring 2009, Fall 2007 (Leading lab sessions)
Data Structures, Hanyang University, S. Korea	— Spring 2007 (Leading lab sessions)
Object Oriented Programming, Hanyang University, S. Korea	— Spring 2005 (Leading lab sessions)

Awards & Scholarships

Graduate Research Assistantship, Virginia Tech, VA	— Fall 2011, 2012, 2013, Spring 2012, 2014
BK21 Scholarship, Hanyang Univeristy, S. Korea	— 2009
Academic Record Scholarship, Hanyang Univeristy, S. Korea	— 2005