Jongyul Kim

Postdoctoral Research Associate
Siebel School of Computing and Data Science, University of Illinois Urbana-Champaign

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RESEARCH INTERESTS

My research aims to design system software that fully utilizes emerging hardware technologies. Areas of focus include file systems, memory systems, disaggregated and distributed architectures, smart devices, and Compute Express Link (CXL).

EDUCATION

Korea Advanced Institute of Science and Technology (KAIST) Daejeon, South Korea
Ph.D. *Integrated master's/doctoral program in School of Computing* Feb. 2022
Thesis: "Distributed Persistent Memory File System for Programmable NIC"
Advisors: Seungryoul Maeng and Youngjin Kwon

Korea Advanced Institute of Science and Technology (KAIST) Daejeon, South Korea
B.S. *Double-majored in Computer Science and Management Science* Feb. 2012

WORK EXPERIENCE

Postdoctoral research associate, University of Illinois Urbana-Champaign Urbana, IL, USA
Siebel School of Computing and Data Science, Hosted by Prof. Tianyin Xu. Sep. 2023 – present

Postdoctoral researcher, KAIST Daejeon, South Korea
School of Computing, Hosted by Prof. Youngjin Kwon. Mar. 2022 – Sep. 2023

Software developer/Startup co-founder, Durooh, Inc. Seoul, South Korea
Developed a front-end Android application. Jun. 2011 – Feb. 2013

Undergraduate intern, TestMidas Co., Ltd. Daejeon, South Korea
Analyzed *Wine* source code to port Windows system calls to Linux. Jun. 2009 – Aug. 2009

RESEARCH EXPERIENCE

University of Illinois Urbana-Champaign (UIUC) Urbana, IL, USA

- **Postdoctoral Research Associate** Sep. 2023 - present

  An extensible abstraction layer for composing modular tiered file systems [3] (Oct. 2023 – present)
  - Designing an architecture that unifies device-optimized file systems into a single, coherent file system view.
  - Developing an efficient metadata management scheme for composite file systems.

  An OS framework for developing new memory translation architectures [1] (Oct. 2023 – June 2025)
  - Introduced a new abstraction layer to Linux that supports diverse memory translation architectures.
  - Developed toolchains to design and evaluate OS memory management for emerging memory translation hardware.

  Tiered memory management with access tracking offload to CXL device [2] (Oct. 2023 – Mar. 2025)
  - Developed a framework for page migration schemes with hotness tracking offloaded to CXL memory devices.

  Direct memory translation mechanism [4] (Oct. 2023 – Apr. 2024)
  - Designed a fast memory translation mechanism for native and virtualization environments that reduces the number of memory accesses by mapping the last-level page table entry directly.

Korea Advanced Institute of Science and Technology (KAIST) Daejeon, South Korea

- **Postdoctoral Researcher** Mar. 2022 - Sep. 2023

  Enhancing user-level file system architecture (Oct. 2022 – present)
  - Designing a file system that leverages computational storage to improve performance and reduce CPU usage.
  - Developing a kernel-interoperable framework for user-level file systems.
  - Designing an architecture that reduces development cost through kernel-device decoupling.

  In-SmartNIC metadata cache for Lustre client (May 2022 – Dec. 2022)
  - Analyzed the latency of metadata requests by a Lustre client.

– Developed Metadata Cache that operates on client-side SmartNIC to reduce the metadata lookup latency.

Operating system design for memory disaggregation (Dec. 2021 – May. 2022)
– Discovered the major cause of a bottleneck in a Linux-based operating system for memory disaggregation.

- **Research Assistant** Mar. 2013 - Feb. 2022

SmartNIC offload of distributed persistent memory file system [8, 6] (Jun. 2019 – Jan. 2022)
– Identified an interference problem in the client-local persistent memory distributed file system.
– Developed a rack-scale distributed file system that utilizes hardware features including persistent memory, RDMA, computing and memory resources of SmartNIC, and a memory copy DMA engine of Intel CPU.

Distributed file system with persistent memory [9, 7] (Oct. 2018 – Oct. 2020)
– Participated in developing a rack-scale distributed file system that utilizes persistent memory and RDMA.
– Analyzed the performance of the persistent-memory-based distributed file system, NFS, and Ceph file system.

On-demand virtualization for bare-metal cloud [10, 5] (Jul. 2015 – Sep. 2018)
– Devised an On-demand Virtualization technique that transforms a bare-metal machine into a virtual machine or vice versa at run-time.
– Demonstrated a live migration and checkpointing of a bare-metal instance.

Memory-centric architecture with processing-in-memory (Mar. 2016 – Oct. 2018)
– Research on a memory-centric architecture that utilizes the processing power of Hybrid Memory Cube (HMC).
– Implemented multi-HMC architecture and a memory management logic with Gem5 and McSimA+ simulators.

TEACHING EXPERIENCE

Teaching at UIUC

- Operating System Design (CS423, Honorary Instructor) Fall 2024
- UIUC Systems Research Seminar (CS591, Co-host) Spring 2024, Fall 2024, Spring 2025

Teaching Assistant at KAIST

- Digital System and Lab (CS211) Spring 2014 (Head), Spring 2015 (Head)
  Lab sessions: VHDL (Hardware description language) programming.
- Embedded Computer Systems (CS310) Fall 2013 (Head), Fall 2014, Fall 2015
  Lab sessions: FPGA and Arduino micro controller programming.
- Embedded Computing (SEP561) Spring 2014 (Head), Spring 2015, Spring 2019
  Lab sessions: FPGA and Arduino micro controller programming.

Mentoring at KAIST

- Jaehwan Lee Aug. 2021 – Dec. 2021
  Multi-thread support in the persistent-memory-based file system.
- Guseul Heo Aug. 2021 – Dec. 2021
  Replacing the extent tree with hash-based file mapping in the persistent-memory-based file system.
- Donggeun Kim Jan. 2022 – Aug. 2022
  Replacing the extent tree with hash-based file mapping in the persistent-memory-based file system (continued).

AWARDS

- 2022 Spring KAIST Breakthroughs (Biannual Engineering Research Webzine), 2022.
- Best Dissertation Award, School of Computing, KAIST, 2022.
- SOSP 2021 Best Paper Awards, ACM SIGOPS 28th Symposium on Operating Systems Principles, 2021.
- 2014 Fall Best Teaching Assistant Awards, School of Computing, KAIST, 2015.
- 2013 Fall Best Teaching Assistant Awards, School of Computing, KAIST, 2014.

PUBLICATIONS

[1] Siyuan Chai, Jiyuan Zhang, **Jongyul Kim**, Alan Wang, Fan Chung, Jovan Stojkovic, Weiwei Jia, Dimitrios Skarlatos, Josep Torrellas, and Tianyin Xu. "EMT: An OS Framework for New Memory Translation Architectures". *Proceedings of the 19th USENIX Symposium on Operating Systems Design and Implementation.* (OSDI 2025).

[2] Yan Sun, **Jongyul Kim**, Douglas Yu, Jiyuan Zhang, Siyuan Chai, Jaemin M. Kim, Hwayong Nam, Jaehyun Park, Eojin Na, Yifan Yuan, Ren Wang, Jung Ho Ahn, Tianyin Xu, and Nam Sung Kim. "M5: Mastering Page Migration and Memory Management for CXL-based Tiered Memory Systems". *Proceedings of the*

30th ACM International Conference on Architectural Support for Programming Languages and Operating Systems. (ASPLOS 2025).

[3] Jiyuan Zhang, **Jongyul Kim**, Chloe Alverti, Peizhe Liu, Weiwei Jia, and Tianyin Xu. "Rethinking Tiered Storage: Talk to File Systems, Not Device Drivers". *Proceedings of the 20th Workshop on Hot Topics in Operating Systems*. (HotOS 2025).

[4] Jiyuan Zhang, Weiwei Jia, Siyuan Chai, Peizhe Liu, **Jongyul Kim**, and Tianyin Xu. "Direct Memory Translation for Virtualized Clouds". *Proceedings of the 29th ACM International Conference on Architectural Support for Programming Languages and Operating Systems*. (ASPLOS 2024).

[5] Jaeseong Im, **Jongyul Kim**, Youngjin Kwon, and Seungryoul Maeng. "On-demand Virtualization for Post-copy OS Migration in Bare-metal Cloud". *IEEE Transactions on Cloud Computing*. 2022. **Impact factor: 5.938** by WOS.

[6] **Jongyul Kim**, Insu Jang, Waleed Reda, Jaeseong Im, Marco Canini, Dejan Kostić, Youngjin Kwon, Simon Peter, and Emmett Witchel. "LineFS: Efficient SmartNIC Offload of a Distributed File System with Pipeline Parallelism". *13th Annual Non-Volatile Memories Workshop 2022*. (NVMW 2022).

[7] Thomas E. Anderson, Marco Canini, **Jongyul Kim**, Dejan Kostić, Youngjin Kwon, Simon Peter, Waleed Reda, Henry N. Schuh, and Emmett Witchel. "Assise: Performance and Availability via Client-local NVM in a Distributed File System". *12th Annual Non-Volatile Memories Workshop 2021*. **Co-student author, Memorable Paper Award Finalists**. (NVMW 2021).

[8] **Jongyul Kim**, Insu Jang, Waleed Reda, Jaeseong Im, Marco Canini, Dejan Kostić, Youngjin Kwon, Simon Peter, and Emmett Witchel. "LineFS: Efficient SmartNIC Offload of a Distributed File System with Pipeline Parallelism". *Proceedings of the ACM SIGOPS 28th Symposium on Operating Systems Principles*. **Best paper awards.** (SOSP 2021).

[9] Thomas E. Anderson, Marco Canini, **Jongyul Kim**, Dejan Kostić, Youngjin Kwon, Simon Peter, Waleed Reda, Henry N. Schuh, and Emmett Witchel. "Assise: Performance and Availability via Client-local NVM in a Distributed File System". *Proceedings of the 14th USENIX Symposium on Operating Systems Design and Implementation*. **Co-student author**. (OSDI 2020).

[10] Jaeseong Im, **Jongyul Kim**, Jonguk Kim, Seongwook Jin, and Seungryoul Maeng. "On-demand virtualization for live migration in bare metal cloud". *Proceedings of the 2017 Symposium on Cloud Computing*. (SoCC 2017).

[11] Jaeseong Im, **Jongyul Kim**, and Seungryoul Maeng. "Whole System Checkpoint-recovery Mechanism in Bare-metal In-memory System". *Korea Computer Congress 2017*. (KCC 2017).

PATENTS & APPLICATIONS

All patent applications are in processing, except when mentioned otherwise.

1. KO/US/CN/EP, 10-2022-0173904, "COMPUTABLE NETWORK INTERFACE CARD AND ELECTRONIC APPARATUS INCLUDING THE SAME", Dec 2022.
2. KO, 10-2022-0165086, "METHOD FOR MANAGING MEMORY AND COMPUTER DEVICE FOR THE SAME", Nov 2022.

TALKS

CONFERENCE TALKS

1. "LineFS: Efficient SmartNIC Offload of a Distributed File System with Pipeline Parallelism", *The 28th ACM Symposium on Operating Systems Principles (SOSP 2021)*, Virtual, October 2021.

INVITED TALKS

2. "LineFS: Efficient SmartNIC Offload of a Distributed File System with Pipeline Parallelism", UIUC Systems Research Seminar, Urbana, IL, US, January 2024.
3. "Persistent-memory-based Distributed File System and SmartNIC Offloading", *Electronics and Telecommunications Research Institute (ETRI)* Seminar, Daejeon, South Korea, Mar 2023.
4. "Persistent-memory-based Distributed File System and SmartNIC Offloading", *Electronic & Information Research Information Center (EIRIC)* Seminar, Virtual, June 2022.
5. "LineFS: Efficient SmartNIC Offload of a Distributed File System with Pipeline Parallelism", Top conference session in *Korea Software Congress 2021 (KSC 2021)*, Pyeongchang, Gangwon, South Korea, December 2021.

SERVICE

Program Committee Member

- Usenix ATC: 2025.

External Program Committee

- Usenix ATC: 2024.

Shadow PC

- EuroSys: 2023.

Journal Reviewer

- ACM Transactions on Storage: 2022.

SKILLS

PROGRAMMING

- C, C++, Java, Python, Shell
- File system, RDMA, Persistent memory, Virtualization, SoC-based smart devices (NIC & SSD), Distributed file system, Android, Gem5 simulator

LANGUAGES

English, Korean (Korean citizen)