

# SUNHO LEE

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## RESEARCH INTERESTS

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**I am interested in the architecture of accelerators dedicated to machine learning.**

Since machine learning requires fast and secure processing, my research objective is to design high-performance accelerators with security guarantees. To achieve this goal, my recent studies proposed architectures to support efficient hardware-based protection for accelerators. In these works, I focus on security solutions that leverage characteristics of machine learning.

## EDUCATION

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| <b>KAIST</b> , Daejeon, Republic of Korea<br>Doctor of Philosophy, School of Computing<br>Advisor: Jaehyuk Huh   | <i>Mar 2021 -</i>          |
| <b>KAIST</b> , Daejeon, Republic of Korea<br>Master of Science, School of Computing<br>Advisor: Jaehyuk Huh<br>Thesis: <i>Hardware Security Techniques for Trusted Machine Learning Accelerators</i> | <i>Mar 2019 - Feb 2021</i> |
| <b>Yonsei University</b> , Seoul, Republic of Korea<br>Bachelor of Science, Computer Science   | <i>Mar 2015 - Feb 2019</i> |

## PUBLICATIONS

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- **Sunho Lee**, Seonjin Na, Jungwoo Kim, Jongse Park, and Jaehyuk Huh, “Tunable Memory Protection for Secure Neural Processing Units”, *the 40th IEEE International Conference on Computer Design (ICCD)*, October 2022
- Seungbeom Choi, **Sunho Lee**, Yeonjae Kim, Jongse Park, Youngjin Kwon, and Jaehyuk Huh, “Serving Heterogeneous Machine Learning Models on Multi-GPU Servers with Spatio-Temporal Sharing”, *the 2022 USENIX Annual Technical Conference (USENIX ATC)*, July 2022
- **Sunho Lee**, Jungwoo Kim, Seonjin Na, Jongse Park, and Jaehyuk Huh, “TNPU: Supporting Trusted Execution with Tree-less Integrity Protection for Neural Processing Unit”, *the 28th IEEE International Symposium on High-Performance Computer Architecture (HPCA)*, February 2022
- Seonjin Na, **Sunho Lee**, Yeonjae Kim, Jongse Park, and Jaehyuk Huh, “Common Counters: Compressed Encryption Counters for Secure GPU Memory”, *the 27th IEEE International Symposium on High-Performance Computer Architecture (HPCA)*, February 2021

## PATENTS

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- **[Pending]** Jaehyuk Huh, **Sunho Lee**, and Seonjin Na, “Apparatus and Method for Providing Secure Execution Environment for NPU”, *US Patent* (with Samsung Electronics)
- **[Pending]** Jaehyuk Huh, Seungbeom Choi, **Sunho Lee**, Yeonjae Kim, Youngjin Kwon, Jongse Park, “Machine Learning Inference Time-spatial SW Scheduler Based on Multiple GPU”, *Korean Patent*
- **[Pending]** Jaehyuk Huh, **Sunho Lee**, and Seonjin Na, “Hardware-based Security Architecture for Trusted Neural Processing Unit”, *Korean Patent* (with Samsung Electronics)
- **[10-2365263-0000]** Jaehyuk Huh, Seonjin Na, **Sunho Lee**, Yeonjae Kim, and Jongse Park, “Efficient Encryption Method and Apparatus for Hardware-based Secure GPU Memory”, *Korean Patent* (with Samsung Electronics)

## RESEARCH EXPERIENCES

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**KAIST**, Daejeon, Republic of Korea

Mar 2019 -

*Ongoing Researches at CASYS (Computer Architecture and SYStem) Lab*

Advisor: Jaehyuk Huh

**Accelerator Hardware-based Security**

- Memory protection optimization for GPU: Common counters for duplicate counters (Published in **HPCA 2021**)
- Memory protection optimization for multi-tenant GPU
- Trusted execution environment for NPU: Tensor-granularity counters (Published in **HPCA 2022**)
- Memory protection optimization for NPU: Partial memory protection (Published in **ICCD 2022**)
- Side-channel attack protection for NPU
- Dynamic secure-granularity management for heterogeneous processors

**Accelerator Performance**

- Multi-tenancy support for a multi-GPU system: Time and spatial sharing (Published in **USENIX ATC 2022**)
- Multi-tenancy support for NPU: Shared resources management

**Yonsei University**, Seoul, Republic of Korea

Sep 2017 - June 2018

*Undergraduate Research Intern at ELC (Embedded systems Languages and Compilers) Lab*

Advisor: Bernd Burgstaller

**Parallelism**

- Accelerating big-data streaming engine: Multi-thread and shared-memory
- Parallelization of SFA (Simultaneous Deterministic Finite Automata) construction: MPI and Huang's algorithm

## RECOGNITION

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**KAIST**, Daejeon, Republic of Korea

Outstanding Teaching Assistant Award - CS311 Computer Organization

Spring 2022, Fall 2019

**Yonsei University**, Seoul, Republic of Korea

Dean's List

Spring 2015, Spring 2018

Undergraduate Capstone Project Award (Third Place) - Project Leader

Spring 2018

Title: *Cloud SFA: Parallel Construction of Simultaneous Deterministic Finite Automata in Distributed System*

**Samsung Electronics**, Hwaseong, Republic of Korea

Best Paper Award (Third Place)

Summer 2022

Title: *TNPU: Supporting Trusted Execution with Tree-less Integrity Protection for Neural Processing Unit*

## PARTICIPATION

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**uArch** (in conjunction with **ISCA 2022**), New York City, United States of America

*Student Panel*

Life in Grad School

June 2022

## SKILLS

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**Programming Languages**

C, C++, Python

**NPU Simulators**

SCALE-Sim, MAESTRO, Gemmini

**GPU Programming**

CUDA, MPS

**Multi-core CPU Programming**

MPI, OpenMP

**Machine Learning Frameworks**

Pytorch, Tensorflow

## TEACHING EXPERIENCES

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**KAIST**, Daejeon, Republic of Korea

*Teaching Assistant*

CS230 System Programming

Fall 2021

CS311 Computer Organization

Spring 2022, Spring 2021, Fall 2019

CS211 Digital System and Lab

Spring 2019

**KAIST Education Center**, Daejeon, Republic of Korea

*Mentor & Lecturer*

Seocho AI College

Summer 2019, Summer 2021

Python for Beginners

Summer 2022, Summer 2021