# Seung-Hyeon Lim

Undergraduate Researcher | Compiler Engineer | Android Native (Mobile Application) Developer

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## SUMMARY

❒ Undergraduate researcher specializing in LLVM-based compiler optimization for FPGA High-Level Synthesis
❒ Designed and implemented a custom LLVM pass achieving 39.4% average LUT reduction on CHStone benchmarks, with cryptographic kernels previously unimplementable on target hardware made feasible through IR-level bit-width transformation
❒ Recognized at KSC 2025 (Encouragement Award). Fluent across the full C-to-RTL compilation pipeline and motivated to deepen expertise in compiler backends, program analysis, and hardware-software co-design

## EDUCATION

### ❒ Kyung Hee University — B.S. in Computer Science and Engineering

- Period : Mar. 2021 – Present (Expected Feb. 2027)
- GPA : 3.745 / 4.3 (4.04 / 4.5)

## RESEARCH EXPERIENCE

### ❒ Undergraduate Researcher — Compiler and System Software Lab, Kyung-Hee University

- Period : Mar. 2025 – Present
- Advisor: Prof. Seonyeong Heo

Designing and implementing a custom LLVM compiler pass for FPGA resource optimization through bit-level static analysis.
The core contribution is a two-phase algorithm: Enhanced Bit-Usage Analysis via backward dataflow traversal of LLVM IR def-use chains, followed by Data Width Optimization that reconstructs IR with minimal-width operators.
Integrated LLVM's Known-Bits API to extend the analysis to non-constant values, enabling application to real-world HLS workloads.

Please find below the key contributions:

- Average **39.4% LUT reduction** and **29.9% latency improvement** on CHStone benchmarks (Xilinx Arty A7-100T, 100 MHz)
- SHA: **74.4% LUT reduction** (259% -> 66% utilization) — enabled a previously infeasible design to meet timing constraints.
- Blowfish: **47.6% LUT reduction**, 45.3% latency improvement; pipeline interval reduced from 32 to 9 cycles/iteration.
- Optimization effectiveness correlated with bitwise operation density (SHA: 51.6%, Blowfish: 45.5%); validates hypothesis for bit-intensive workloads.

## PUBLICATIONS & AWARDS

### ❒ ◆ KSC (Korea Software Congress) 2025 Encouragement Award — Undergraduate/Junior Paper Competition

- Seung-Hyeon Lim, Seonyeong Heo. "비트 레벨 컴파일러 최적화를 통한 자원 효율적인 FPGA 합성". KSC 2025.

### ❒ IEEE Computer Architecture Letters — under submission

- Seung-Hyeon Lim, Seonyeong Heo. "Resource-Efficient High-Level Synthesis with Bit-Level Compiler Optimization." Achieves 39.4% average LUT reduction on CHStone

### ❒ Journal of Systems Architecture, Vol. 168, 2025 — contributing author

- S. Heo, J. Kim, W. Im, J. Moon, D. Jang, Bit-level compiler optimization for ultra low-power embedded systems, Journal of Systems Architecture 168 (2025) 103546. doi:10.1016/j.sysarc.2025.103546.

## PROJECTS (SERVICE)

### ❒ WhiteWand / AEye — Android Application for the Visually Impaired

◆ 1st Place, KHU Software Convergence College Club Competition (D.Com, Sep 2022) · 2022 KHU SW Festival AI/Big Data Track

◉ Participated as Android Developer · github.com/Dcom-KHU/AEye-Android

Developed an Android application enabling visually impaired users to identify pharmaceuticals and beverages via on-device object detection. YOLOv5 model trained on a custom dataset (background injection, rotation, cutout, noise augmentation) converted to TFLite and embedded in the app.

Interaction is designed exclusively for accessibility: swipe, volume button, and shake gestures; all feedback delivered via TTS API.

- On-device inference with TFLite-converted YOLOv5 (Kotlin 83.6% / Java 16.4%)
- MVVM architecture: Room local DB, ViewModel data binding
- Custom TextToSpeechManager and ShakeDetector (SensorEventListener) for gesture-driven UX; Undefined-class fallback prevents misclassification

### ❒ FarmUs — Agricultural Land Rental & Transaction Platform

◉ UMC 3rd Cohort Developer Matching · Android Developer · github.com/FarmUsProject

Contributed Android client development (Ktor, MVVM, Jetpack) as the team prepared Alpha Version release through UMC's in-program developer matching.

## LEADERSHIP & ACTIVITIES

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|---|---|---|
| ❒ D.Com | Vice President for KHU CS Dept. Academic Club | 2022.01 – 2022.12 |
| ❒ D.COM-KHU | GitHub Organization Owner | 2023.03 – Present |
| ❒ UMC | Uni MakeUs Challenge 3rd Cohort - KHU Android Track Lead | 2022.09 – 2023.02 |

## TECHNICAL SKILLS

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|---|---|
| ❒ Languages | : Kotlin, C/C++, Java, Python, LLVM IR, TypeScript, Dart |
| ❒ Compiler / System Software | : LLVM Pass Development, Vitis HLS, FPGA Synthesis (Xilinx) |
| ❒ Service Development | : Android Native Application, Kotlin Multiplatform, Ktor, React, Flutter |