

MINSOO KIM

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RESEARCH INTERESTS

Efficient Deep Learning, Model Compression, LLM Fine-Tuning, Interpretability of Generative Language Model

EDUCATION

Hanyang University, Seoul, South Korea

Mar. 2021 - Present

Artificial Intelligence Hardware & Algorithm lab

Ph.D. Student in Electronic Engineering

Advisor: Professor Jungwook Choi

Hanyang University, Seoul, South Korea

Feb. 2021

B.S in Electronic Engineering

Thesis: Improving training method for very low bit weight quantization of Light Deep Learning Model

Advisor: Professor Jungwook Choi

PUBLICATIONS

- **[NeurIPS 2023] Minsoo Kim**, Sihwa Lee, Jangwhan Lee, Sukjin Hong, Du-Seong Chang, Wonyong Sung and Jungwook Choi "Token-Scaled Logit Distillation for Ternary Weight Generative Language Models", *Thirty-seventh Conference on Neural Information Processing Systems*
[Paper]
- **[EMNLP 2023 main] Janghwan Lee***, **Minsoo Kim***, Seungcheol Baek, Seok Joong Hwang, Wonyong Sung and Jungwook Choi "Enhancing Computation Efficiency in Large Language Models through Weight and Activation Quantization", *Proceedings of the 2023 Conference on Empirical Methods in Natural Language Processing* (to appear)
- **[EACL 2023 main] Minsoo Kim**, Kyuhong Shim, Seongmin Park, Wonyong Sung and Jungwook Choi, "Teacher Intervention: Improving Convergence of Quantization Aware Training for Ultra-Low Precision Transformers", *The 17th Conference of the European Chapter of the Association for Computational Linguistics*
[Paper, Code Poster]
- **[EMNLP 2022 main] Minsoo Kim**, Sihwa Lee, Sukjin Hong, Du-Seong Chang, and Jungwook Choi, "Understanding and Improving Knowledge Distillation for Quantization-Aware Training of Large Transformer Encoders," *Proceedings of the 2022 Conference on Empirical Methods in Natural Language Processing*
[Paper, Code, Poster]
- **[DAC 2022] Joonsang Yu**, Junki Park, Seongmin Park, **Minsoo Kim**, Sihwa Lee, Donghyun Lee, Jungwook Choi, "NN-LUT: neural approximation of non-linear operations for efficient transformer inference," *Proceedings of the 59th ACM/IEEE Design Automation Conference*
[Paper]
- Hyeonseung Kim, **Minsoo Kim**, Jungwook Choi, "Improving training method for very low bit weight quantization of Light Deep Learning Model," Autumn Annual Conference of IEIE 2020

RESEARCH EXPERIENCE

Research Assistant, AI Algorithm & Hardware Lab, Hanyang University
Advisor: Professor Jungwook Choi

Mar 2021 - Present
Seoul, South Korea

- **Token-Scaled Logit Distillation for Ternary Weight Generative Language Models**
 - Innovative KD method designed for GLM QAT, providing superior learning from teacher
 - Conduct QAT KD experiments on up to 7B-sized GLM, achieving <1 PPL degradation
 - Analysis of the impact of KD on GLM, proposing memory-efficient and flexible adjustment KD for GLM
- **Enhancing Efficiency in LLMs via Weight & Activation Quantization**
 - PTQ method for 4-bit weight and 8-bit activation for LLM (up to 60B)
 - Simple scaling and calibration method for optimized PTQ, addressing combined weight and activation effects
 - Identify underflow in W4A8; propose hybrid data format and arithmetic unit with $2\times$ HW efficiency
- **Understanding and Improving KD for QAT of Large Transformer Encoders**
 - In-depth analysis of the mechanism of KD on attention recovery of quantized large Transformer encoders
 - Analyze quantization effect on attention behavior of transformer over various language understanding tasks
 - Improve accuracy drop in NLU for 2bit weight quantization QAT for large Transformer encoder with <1%
- **Improving Convergence of Quantization Aware Training for Ultra-Low Precision Transformers**
 - Proactive Teacher Intervention KD method for fast converging 2-bit QAT of Transformer encoders
 - Gradual Intervention Mechanism stabilizing the recovery of subsections of quantized Transformer layers
 - Achieve higher accuracy in BERT and ViT within up to 12.5x shorter fine-tuning time

SCHOLARSHIP AND AWARD

- **Qualcomm Innovation Fellowship South Korea (QIFK2023)**, Finalist, *Qualcomm* November 2023
- **Integrated PhD Course Scholarship**, Full Tuition, *Hanyang University* Spring 2021 - Spring 2024
- **Research Scholarship** USD 16K, *IoT System Semiconductor Research Center* Spring 2021 - Spring 2023
- **AI Grand Challenge**, *Korea Ministry of Science and ICT* Fall 2020
 - First place award in Model Compression Track (YOLOV5s Object Detection model 4x speed up)

SKILLS

- **Programming Languages:** Python, C, C++
- **Teaching Assistant:** SOC design (Spring 2021), Introduction to SW Optimization (Fall 2023)
- **DL Frameworks:** Pytorch, Huggingface
- **Cloud Computing Platform:** NAVER NSML Machine Learning platform, KT Genie Mars Server Platform
- **English:** Served in the US Army as a Korean Augmentation to the United States Army(KATUSA) for 21 months (Jul 2017 - Apr 2019), Certified Air Traffic Control (ATC) Operator of 8th Army.

ACADEMIC SERVICES

- Reviewer of EMNLP 2023