Assel Kembay

(last updated: Nov-20-2024)

Contact Information

University of California, Santa Cruz, USA
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Links: Homepage, Google Scholar, LinkedIn

Research Interests

Brain-Inspired AI, Spiking Neural Networks, Computer Vision, Continual Learning, Knowledge Distillation, Neural Network Interpretability

Education

University of California, Santa Cruz, USA

Ph.D., Electrical and Computer Engineering — Sep 2023 - **expected grad. Jun 2027**
Advisor: Prof. Jason Eshraghian
Current GPA: 3.95/4.00

University of Science and Technology, Seoul, South Korea

M.S., AI - Robotics — Mar 2021 - Feb 2023
Thesis: *"Inversion of Spiking Neural Networks, with application to Knowledge Distillation"*
Advisor: Prof. Suhyun Kim
GPA: 4.43/4.50

C-DAC's Advanced Computing Training School, Pune, India

Postgraduate Diploma in Advanced Computing — Aug 2018 - Feb 2019

L.N. Gumilyov Eurasian National University (ENU), Astana, Kazakhstan

B.S. (summa cum laude), Mathematical and Computer Modeling — Sep 2014 - Jul 2018
GPA: 3.86/4.00

Research Experience

Graduate Student Researcher — Oct 2023 - Present
University of California, Santa Cruz, USA
Member of the Neuromorphic Computing Group
Research directions: Spiking Neural Networks, Knowledge Distillation, Continual Learning
Advisor: Prof. Jason Eshraghian

- Developed new Knowledge Distillation techniques with top-K guided transfer, achieving +5.44% on CIFAR-100, +3.57% on ImageNet-1K, and surpassing state-of-the-art KD methods by +1.47%.
- Analyzed how Quantized Spiking Neural Networks (QSNNs) mitigate catastrophic forgetting through sparse activations, improving model stability in continual learning tasks.
- Designed and implemented an Adaptive Threshold Integrate-and-Fire (ATIF) neuron in silicon through TinyTapeout 05, achieving dynamic threshold mechanisms for enhanced biological realism in neuromorphic hardware.

Research Scientist Intern — Apr 2023 - Sep 2023
Korea University Medicine, Seoul, South Korea
Research topic: Wireless Brain Chip for Brain Computer Interface
Advisor: Prof. Il-Joo Cho

- Improved a wireless brain chip with a signal processing unit and communication module by implementing an algorithm to optimize data transfer.

Research Assistant — Sep 2020 - Mar 2023
Artificial Intelligence Research Group, Korea Institute of Science and Technology (KIST)
Research topic: Inversion of Spiking Neural Networks
Advisor: Prof. Suhyun Kim

- Developed inversion techniques for Spiking Neural Network models to enable data-free knowledge transfer using batch normalization statistics, facilitating efficient training of neuromorphic systems without original datasets.

Research Intern — Mar 2020 - Aug 2020

Computational Science Research Center, KIST
Advisor: Prof. Seungchul Kim

- Designed algorithms for material dimension determination and LDOS-map calculation, enhancing quantum dot characterization capabilities.

Research Assistant Dec 2019 - Jan 2020

Department of Mathematics, Nazarbayev University (NU), Astana, Kazakhstan
Project: Imaging in Seismic Exploration
Advisor: Durvudkhan Suragan, PhD

Research Assistant Mar 2018 - Oct 2019

Department of Computer and Software Engineering, ENU
Project: Development of algorithms and embedded software for determining the geoelectric section for geoinformation technology GPR

- Developed a non-iterative algorithm for precise electromagnetic wave source localization in GPR data interpretation using Finite Element Method (FEM), enabling accurate subsurface imaging and enhancing GPR data interpretation in noisy conditions.

Publications

*: equal contribution

[P11] ***A Quantitative Analysis of Catastrophic Forgetting in Quantized Spiking Neural Networks***
Kembay A.*, Aguilar K.*, and Eshraghian J., 2024, Under Review

[P10] ***Efficient Knowledge Distillation via Salient Feature Masking***
Kembay A., Zhu R.-J., and Eshraghian J., 2024, Under Review

[P9] ***Future-Guided Learning: A Predictive Approach To Enhance Time-Series Forecasting***
Gunasekaran S., **Kembay, A.**, Ladret H., Zhu R.-J., Kavehei O., and Eshraghian J., 2024, Under Review.

[P8] ***Leveraging Spiking Neural Networks for Solar Energy Prediction in Agriculture***
Kembay A., Zhu R.-J., Kuipers N., Eshraghian J., and Josephson C.
Bay Area Machine Learning Symposium **(BayLearn 2024)**

[P7] ***Frameworks that integrate Spiking Neural Networks: A Review***
Kembay A., Kim S.
The Journal of KINGComputing, 2022, vol. 18, no. 6, pp. 93 - 105

[P6] ***Simulation web platform for the electro-chemical oxygen reduction reaction***
Kim Sch., Lee Ch., Lee B., Seol D., Kim D., **Kembay A.**, Yun K., Jang S., Lee J.
The International Workshop on Computational Nanotechnology **(IWCN 2021)**

[P5] ***Web platforms for conventional simulations of matters***
Kim Sch., Kim D., **Kembay A.**, Kim S., Yun K., et al.
2021 KPS Spring Meeting Conference, Oral presentation.

[P4] ***A Simulation Web Platform for Analyzing Electronic Structures of Semiconductors***
Kim S., **Kembay A.**, Lee J., et al.
2021 KPS Spring Meeting Conference, Poster

[P3] ***Inverse source identification problem for the wave equation: an application for interpreting GPR data***
Mukanova B., Iskakov K., **Kembay A.**, Boranbaev S.
Scopus indexed: Eurasian Journal of Mathematical and Computer Applications, 2020, pp. 78-91.

[P2] ***Mathematical modeling of the source and response of environment for the equation of geoelectric***
Iskakov K., Mukanova B., Berdyshev A., **Kembay A.**, Tokseit D.
Web of Science indexed: Bulletin of the Karaganda University, 2019, pp. 129-141.

[P1] ***The study of the properties of the reflected signals according to the GPR ZOND-12e***
Kembay A., Mukanova B.
Materials of the International scientific conference "Theoretical and applied questions of Mathematics, Mechanics and Computer Science," 2019, pp. 135-136.

Patents (US only)

The electronic structure calculation web-program
Kim Sch., **Kembay A.**, Kim S.
share 20%, applied, Link

Awards & Honors

Divisional MIP Fellowship Mar 2024
Baskin Engineering School, UC Santa Cruz ($18800)

2023 POSCO Asia Fellowship Jan 2023
POSCO TJ Park Foundation, S. Korea (3 years of tuition and a monthly stipend of 1 mln KRW)

KIST-KT&G Scholarship Foundation's Global Scholarship Dec 2021
KT&G Scholarship Foundation, S. Korea (1 mln KRW)

Sur – Place Konrad Adenauer Foundation Scholarship Apr 2019
Konrad Adenauer Foundation, Germany (academic scholarship ∼800 EUR)

Scholarship ITEC programme Aug 2018
Ministry of External Affairs, Government of India (including all costs and monthly stipend)

Presidential Scholarship Mar 2017
Foundation of the First President of the Republic of Kazakhstan

Award of High-quality Performance Jun 2017
Summer School on "Mathematical Methods in Science and Technology", NU

Merit-Based Scholarship 2014 - 2018
Dept. Mechanics and Mathematics, ENU (awarded to top students of the department, 7 times)

Professional Services

Reviewer
2024 *NeuroAI @ Neural Information Processing System (NeurIPS)*
2024 *APL Machine Learning*
2024 *IEEE International Symposium on Circuits and Systems* (ISCAS)

Technical skills

Computer proficiency: Linux user, competent at Python, SQL (MongoDB), Maple, Advanced Web Programming and Database Technologies, JavaScript, HTML, PyTorch.
SNN-related frameworks: snnTorch, SpikingJelly, Norse, Brian2.

Languages

Kazakh (native), English (fluent), Russian (advanced), Korean (TOPIK-II)