Sangwu Lee

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Education

University of Rochester | Anticipated May 2024 | Rochester, NY | 4.0/4.0 GPA | Dean's List
Majors: BS in Computer Science | BS Honors in Mathematics

Research Interests

Multimodal learning, Transformers, Large Language Models, Information Retrieval, Web data mining,
Medical AI, Diffusion models, Image and Video generation, Distributed Training Strategies for HPC cluster

Publications

Publications under review

1. **VisReas : A Dataset for Complex Visual Reasoning with Unanswerable Questions**
   Under review for AAAI Conference on Artificial Intelligence (AAAI)
   *Syeda Akter, **Sangwu Lee**, Yingshan Chang, Srijan Bansal, Yonatan Bisk, Eric Nyberg*

2. **Unmasking Parkinson's Disease with Smile: An AI-enabled Screening Framework**
   Under review for New England Journal of Medicine (NEJM) [Paper]
   *Tariq Adnan, Md Saiful Islam, Wasifur Rahman, **Sangwu Lee**, et al.*

Published Papers

3. **A User-Centered Framework to Empower People with Parkinson's Disease**
   To appear in Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies (IMWUT) 2023
   *Wasifur Rahman, Abelrahman Abdelkader, **Sangwu Lee,** et al.*

4. **Using AI to measure Parkinson Severity at Home**
   Nature npj Digital medicine 2023 [Paper] [Demo]
   *Md. Saiful Islam, Wasifur Rahman, Abdelrahman Abdelkader, **Sangwu Lee** et al.*

5. **PARK: Parkinson's Analysis with Remote Kinetics Tasks**
   Affective Computing and Intelligent Interaction (ACII) 2023 Demo Track
   Md Saiful Islam, **Sangwu Lee***, Abelrahman Abdelkader, Sooyoung Park, Eshan Hoque*
   denotes equal contribution

6. **Detecting Parkinson's Disease Using a Web-Based Speech Task: observational Study**
   Journal of Medical Internet Research (JMIR 2021) [Paper]
   Wasifur Rahman, **Sangwu Lee***, Md Saiful Islam, et al*
   denotes equal contribution

7. **Humor Knowledge Enriched Transformer for Understanding Multimodal Humor**
   AAAI Conference on Artificial Intelligence (AAAI 2021) [Paper] [Code]
   *Md Kamrul Hasan, **Sangwu Lee,** Wasifur Rahman, Amir Zadeh, Rada Mihalcea, Louis-Philippe Morency, Ehsan Hoque*

8. **Integrating Multimodal Information in Large Pretrained transformers**
   Annual Meeting of the Association for Computational Linguistics (ACL 2020) [Paper] [Code]
   Wasifur Rahman, Md Kamrul Hasan, **Sangwu Lee***, Amir Zadeh, Chengfeng Mao, Louis-Philippe Morency, Ehsan Hoque*
   denotes equal contribution

9. **Facial expression based imagination index and a transfer learning approach to detect deception**
   Affective Computing and Intelligent Interaction (ACII 2019) [Paper]
   *Kamrul Hasan, Wasifur Rahman, Luke Gerstner, Taylan Sen, **Sangwu Lee**, Kurtis Glenn Haut, Ehsan Hoque*

10. **TextMI: Textualize Multimodal Information for Integrating Nonverbal Cues in Pretrained Language Models**
    arXiv preprint (2023) [Paper]
    *Md Kamrul Hasan, Md Saiful Islam, **Sangwu Lee**, Wasifur Rahman, Iftekhar Naim, Mohammed Ibrahim Khan, Ehsan Hoque*

Experience

Medical AI Engineer Dec 2018 - Present
ROC-HCI Lab, University of Rochester Rochester, NY

- Accelerated hyperparameter tuning experiment speed by 64× using HPC SLURM cluster, totaling 250,000+ trained Pytorch and scikit-learn models and 10,000+ training hours.
- Developed a Next.js application for video dataset collection using TypeScript, Prisma, TailwindCSS, and PlanetScale. Achieved a 500% growth in dataset count in 2 years, securing the largest video dataset in the field.
- Deployed 3+ ML API with Docker and FastAPI on Replicate.ai, establishing the team's inference infrastructure.
- Published 3 research papers in top journals, including npj Digital Medicine, JMIR, and ACII

Machine Learning Researcher Aug 2019 - Present
Language Technology Institute, Carnegie Melon University Pittsburgh, PA

- Enabled large-scale finetuning of Huggingface models with Weights and Biases, totaling 5000+ GPU hours.
- Attained 85.7% accuracy setting state-of-the-art performance on 2 multimodal datasets using BERT and XLNet.
- Developed a novel vision language model (VLM) by integrating InstructBLIP and ViT achitecture, reducing model parameters by 10× and cutting inference costs by 15×, while maintaining model performance.
- Authored 2 second author publications in top AI conferences at AAAI and ACL.

Machine Learning Projects

Pretraining Generative Models on Illustration Dataset [report]

- Implemented various GAN, diffusion, autoregressive models including ViT-VQGAN, MUSE, Stylegan, and DDPM. Models were trained on TPUv3 cluster for 100+ hours sponsored by Google Tensor Research Compute Program.
- Reduced training time by 4x using bf16 training, flash attention, and pipeline parallel GPU training.
- Released high-quality 2M illustration dataset to the open source community.
- Curated 4M multimodal illustration dataset involving RGB images, text captions, sketches, and depth map.

ArXiv Vectors [demo]

- Deployed an LLM embedding based vector search service for arXiv papers from 2010 to now.
- Indexed over 200K+ arXiv documents for vector embedding search.
- Improved search latency by 300% to achieve < 1 second search latency.

Neural Cellular automata [demo]

- Implemented neural cellular automata using JAX inside Google Colab environment.
- Deployed a working public demo on Vercel using tensorflow.js and SvelteKit.
- Reduced application's GPU RAM leakage from 30% to 0%.

Awards and Honors

- Phi Beta Kappa (2021) – Induction offered to Top 18 Students based on academic performance
- O'Brien Book Award (2020) - Awarded to Top 16 Students for excellence in academics and leadership
- Dean's List (Fall 2020 - Present)
- Dean's List (Fall 2018 - Fall 2019)
- Finalist at Y-Combinator (2020)
- Top 5% Most Active user on Weights and Biases (2023)
- 10,780 hours of model training on Weights and Biases (2023)

Teaching and Leadership

- Large scale model training and deployment | Workshop Leader |Saudi Authority for Data and AI | 2023 Summer
- Frontiers in Deep learning (Undergraduate) | Teaching Assistant | 2023 Spring
- AI and Deep Learning for Healthcare (Graduate) | Teaching Assistant | 2019 Fall
- Tools for Data science (Undergraduate) | Teaching Assistant | 2019 Fall
- Idle Systems | Technical Lead | 2020
- Undergraduate Data Science Club | Workshop Leader | 2019 - 2020
- Japanese Student Association (JSA) | President | 2019 - 2020

Coursework

Mathematics

Analysis Honors Series, Linear Algebra Honors, Real Analysis Honors, Complex Analysis Honors, Cryptography, Advanced Differential Equations, Graduate Number theory, Topology Honors, Combinatorics, Abstract Algebra Honors

Computer Science

Introduction to AI, Machine Vision, Computational introduction to statistics, Data structures and Algorithms, Computer Organisation, Programming language design & implementation, Game theory

Skills

- **Programming:** Python (5 years), HTML/CSS/JAVASCRIPT (6 years), React (5 years), Svelte (1 year)
- **Machine Learning:** Pytorch (5 years), Pytorch lightning (2 years), JAX (2 years), TPU (1 year) tensorflow.js (3 months)