

# Sangwu Lee

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## Education

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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

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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, Abdelrahman 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

**Sangwu Lee\***, Md Saiful Islam\*, Abdelrahman Abdelkader, Sooyoung Park, Eshan Hoque

\*denotes equal contribution

6. **Detecting Parkinson's Disease Using a Web-Based Speech Task: observational Study**

Journal of Machine Learning Research (JMIR 2021) [\[Paper\]](#)

**Sangwu Lee\***, Wasifur Rahman\*, 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, **Sangwu Lee\***, Md Kamrul Hasan\*, 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 Mellon 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 architecture, 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

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- 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

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- 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

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### 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

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- **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)