Sang-gil Lee

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I am a senior research engineer at Qualcomm AI Research.
I do deep generative models for sequence, with a particular focus on speech / audio.

RESEARCH INTERESTS

My research interest spans a wide range of deep generative models (AR, flow, GAN, diffusion, etc.) applied to sequential data. Specifically, I focus on time-domain waveform data (speech / audio) to push the boundaries of generative modeling for audio. I am also broadly interested in speech / audio applications, including text-to-speech, voice conversion, and music generation.

- **Keywords**: Deep generative models, speech & audio synthesis, sequence & language models

EXPERIENCE

- **Qualcomm AI Research**, Senior Research Engineer — Feb 2023 – Current
  - Research lead in audio generative AI
- **NVIDIA**, AI Application Team (manager: Wei Ping, Boris Ginsburg) — Sep 2021 – Jan 2022
  - Lead author of BigVGAN, the state-of-the-art conditional waveform synthesizer
- **Microsoft Research Asia**, Machine Learning Group (manager: Xu Tan, Tao Qin) — Dec 2020 – Jun 2021
  - Worked on diffusion-based generative models for speech synthesis
- **Kakao Corporation**, AI Laboratory (manager: Jaehyeon Kim, Jaekyoung Bae) — Jul 2019 – Sep 2019
  - Worked on improving speech synthesis and voice conversion models
- **Microsoft Research Asia**, Machine Learning Group (manager: Bin Shao) — Dec 2018 – Feb 2019
  - Worked on the Antigen Map Project by applying sequence models to predict antigens from genes

EDUCATION

Ph.D., Seoul National University, Seoul, South Korea

- Ph.D. in Electrical & Computer Engineering — Sep 2016 – Feb 2023
  - Dissertation: Deep Generative Model for Waveform Synthesis
  - Integrated M.S. / Ph.D. Program. Cumulative GPA: 3.83 / 4.3
- Dual B.S. in Electrical & Computer Engineering / Applied Biology & Chemistry — Mar 2010 – Aug 2016
  - Cumulative GPA: 3.7 / 4.3 (Cum Laude)

PUBLICATIONS

CONFERENCES

[1] S. Lee, W. Ping, B. Ginsburg, B. Catanzaro, and S. Yoon, "BigVGAN: A Universal Neural Vocoder with Large-Scale Training," in ***ICLR***, May 2023.

[2] S. Lee, H. Kim, C. Shin, X. Tan, C. Liu, Q. Meng, T. Qin, W. Chen, S. Yoon, and T. Liu, "PriorGrad: Improving Conditional Denoising Diffusion Models with Data-Dependent Adaptive Prior," in ***ICLR***, Apr 2022.

[3] S. Lee, S. Kim, and S. Yoon, "NanoFlow: Scalable Normalizing Flows with Sublinear Parameter Complexity," in ***NeurIPS***, Vancouver, Canada, Dec 2020.

[4] S. Kim, S. Lee, J. Song, J. Kim, and S. Yoon, "FloWaveNet : A Generative Flow for Raw Audio," in ***ICML***, Long Beach, CA, USA, Jun 2019.

[5] S. Lee, J.S. Bae, H. Kim, J.H. Kim, and S. Yoon, "Liver Lesion Detection from Weakly-labeled Multi-phase CT Volumes with a Grouped Single Shot MultiBox Detector," in ***MICCAI***, Granada, Spain, Sep 2018.

[6] S. Park, S. Lee, H. Nam, and S. Yoon, "An Efficient Method to Boosting Performance of Spiking Neural Network Training," in ***NIPS*** *Workshop on Computing with Spikes*, Barcelona, Spain, Dec 2016.

[7] S. Lee and S. Yoon, "Deep Deterministic Policy Gradients as a Proxy for Semi-supervised Deep Learning of Network Intrusion Detection," in ***Korea Computer Congress***, Jeju, Korea, Jun 2017.

[8] J. Lee, Y. Jeon, B. Na, S. Lee and S. Yoon, "Fine Dust Time Series Anomaly Detection using Transfer Entropy and Network Similarity," in ***Korea Computer Congress***, Jeju, Korea, Jun 2017.

JOURNALS

[1] S. Lee*, E. Kim*, J.S. Bae*, J.H. Kim, and S. Yoon, "Robust End-to-End Focal Liver Lesion Detection using Unregistered Multiphase Computed Tomography Images," *IEEE Transactions on Emerging Topics in Computational Intelligence* ***(IEEE TETCI) (Impact Factor: 8.28)***, Dec 2021.

[2] T. Kim, J.H. Park, S. Lee, S. Kim, J. Kim, J. Lee, and C. Shin, "Small RNA Transcriptome of Hibiscus Syriacus Provides Insights into the Potential Influence of microRNAs in Flower Development and Terpene Synthesis," ***Molecules and Cells (Impact Factor: 5.03)***, vol. 40, no. 8, pp. 587, Aug 2017.

ARXIV

[1] C. Shin, H. Kim, C. Lee, S. Lee, and S. Yoon, "Edit-A-Video: Single Video Editing with Object-Aware Consistency," in *arXiv preprint:2303.07945*, Mar 2023.

[2] D. Lee, J. Yoon, J. Song, S. Lee, and S. Yoon, "One-Shot Learning for Text-to-SQL Generation," in *arXiv preprint:1905.11499*, Apr 2019.

[3] S. Lee, U. Hwang, S. Min, and S. Yoon, "Polyphonic Music Generation with Sequence Generative Adversarial Networks," in *arXiv prepreint:1710.11418*, Oct 2017.

REPOSITORIES

FloWaveNet ★400+
A Pytorch implementation of "FloWaveNet: A Generative Flow for Raw Audio".

relational-rnn-pytorch ★200+
An implementation of DeepMind's Relational Recurrent Neural Networks (Santoro et al. 2018) in PyTorch.

WaveFlow ★100+
A PyTorch implementation of "WaveFlow: A Compact Flow-based Model for Raw Audio".

NanoFlow ★50+
PyTorch implementation of the paper "NanoFlow: Scalable Normalizing Flows with Sublinear Parameter Complexity."

grouped-ssd-pytorch
PyTorch implementation of MICCAI 2018 paper "Liver Lesion Detection from Weakly-labeled Multi-phase CT Volumes with a Grouped Single Shot MultiBox Detector".

seqgan-music
Implementation of a paper "Polyphonic Music Generation with Sequence Generative Adversarial Networks" in TensorFlow.

OPEN-SOURCE CONTRIBUTION

NVIDIA NeMo ★6000+
Contributed to an open-source implementation of UnivNet vocoder (Jang et al., 2021).

NVIDIA BigVGAN ★400+
Contains an open-source implementation of our work, BigVGAN (Lee et al., ICLR 2023).

Microsoft NeuralSpeech ★1000+
Contains an open-source implementation of our work, PriorGrad (Lee et al., ICLR 2022).

INVITED TALKS

"Deep Generative Model for Speech and Audio", Soongsil University, 2023
"Towards Universal Neural Waveform Synthesis", Naver, 2022
"On Neural Waveform Synthesis", Supertone, 2022
"Prior Enhancement for Deep Generative Models", Hyundai AIRS, 2022
"Neural Speech Synthesis: a 2021 Landscape", NVIDIA, 2021
"RNN Plus Alpha: Is RNN the False Prophet?", Naver CLOVA, 2018

HONORS

Student Conference Scholarship, Google, 2022
Gradate Student of the Year, DSAIL, Seoul National University, 2019
Best Paper Award, Hyundai AIR Lab (currently AIRS), 2019
Stars of Tomorrow (Excellent Intern), Microsoft Research Asia, 2019
Cum Laude, Seoul National University, 2016
Academic Performance Scholarship, Seoul National University, 2010 - 2016
Academic Scholarship (fully funded), SBS Foundation, 2010 - 2016

RESEARCH EXPERIENCE

Seoul National University, Seoul, South Korea

- Graduate Research Student, Electrical & Computer Engineering — Oct 2017 – Jun 2019
  - Project: FIM Core Technology and System Development for Data-intensive Applications
  - Supervisor: Prof. Sungroh Yoon
  - Provided deep learning-based speech synthesis benchmarks and optimized applications for a novel processing-in-memory hardware for analyzing performance characteristics.
- Graduate Research Student, Electrical & Computer Engineering — Apr 2017 – Apr 2019

- Project: Development of machine learning-based liver disease imaging diagnosis support system
- Supervisor: Prof. Sungroh Yoon
- Developed a novel variant of Single Shot MultiBox Detector (SSD), a renowned deep-learning based object detection model, for an accurate diagnosis of liver diseases. Results published in International Conference on Medical Image Computing & Computer Assisted Intervention (MICCAI) in 2018, and IEEE TETCI (Impact Factor: 8.28) as a journal article in 2021.

▪ Graduate Research Student, Electrical & Computer Engineering Mar 2017 – Dec 2017
- Project: AI-powered Network Intrusion Detection Systems
- Supervisor: Prof. Sungroh Yoon
- Developed an LSTM-based unsupervised clustering algorithm using firewall log data for network anomaly detection of sequential streaming data.

▪ Graduate Research Student, Electrical & Computer Engineering Aug 2016 – Aug 2017
- Project: Imaging Genetics using deep learning for detecting Alzheimer's disease risk gene
- Supervisor: Prof. Sungroh Yoon
- Developed a 3DCNN-based Alzhermer's disease classification model using ADNI, a multi-modal imaging genetics dataset, with a novel elastic distortion techniques for data augmentation.

▪ Graduate Research Student, Electrical & Computer Engineering Aug 2016 – Jun 2017
- Project: Application Technology for Neuromorphic Devices and Systems
- Supervisor: Prof. Sungroh Yoon
- Provided a deep learning application for a novel neuromorphic hardware using spiking neural networks (SNNs). Research on SNNs publised in NIPS workshop 2016.

▪ Undergraduate Research Student, Electrical & Computer Engineering Mar 2016 – Aug 2016
- Project: Pedestrian detection with convolutional neural networks
- Supervisor: Prof. Wonyong Sung
- Implemented a CNNs-based pedestrian detection model with sliding-window approach

▪ Undergraduate Research Student, Applied Biology & Chemistry Mar 2015 – Aug 2016
- Project: in-silico miRNA analysis of Hibiscus Syriacus
- Supervisor: Prof. Chanseok Shin
- Developed a rule-based miRNA discovery algorithm from whole genome sequence and RNA-seq data only (https://github.com/L0SG/miRNA_Project), which is suitable for analysis of miRNA of novel species. Participated as a co-author of the journal article. The excavated novel miRNA granted a KR patent (KR101669246B1).

LANGUAGES

▪ Korean: Native language.

▪ English: Fluent (speaking, reading, writing).

REFERENCES

▪ **Professor Sungroh Yoon**
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