Shih-Lun (Sean) Wu

Student, **M.Sc. of Language Technologies (MLT)**, School of Computer Science
Carnegie Mellon University (CMU), Pittsburgh, PA, United States
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EDUCATION

Master of Science (M.Sc.) | Carnegie Mellon University 08.2022 ~
Language Technologies major

Bachelor of Science (B.Sc.) | National Taiwan University 09.2017 ~ 06.2021
Computer Science major • **Economics** minor

- Cumulative GPA -- Overall: **4.28/4.30**, Major: **4.28/4.30**, **Rank: 1/176**
- Bachelor's thesis: **"Bridging Transformers and Latent Variable Models for User-Controllable Conditional Music Generation."** Committee members: Dr. Yi-Hsuan Yang, Dr. Yun-Nung Chen, Dr. Lin-shan Lee. [defense slides]

HONORS

Ssu-Nien Fu's Award (1st Prize), Best Bachelor's Thesis | National Taiwan University 06.2021
- Awarded to only 6 out of 3500+ students in the graduating class for outstanding research

1st Prize, Best Undergraduate Research | Dept. of CSIE, NTU 06.2020 & 06.2021
- Won twice with works on evaluation metrics for AI music, and deep music generation models (publ. [2] & [5])

Dean's List | National Taiwan University Fall '17, '18, '19 & Spring '18, '19, '21
- Awarded to students within top 5% of the class

PUBLICATIONS

[6] Yi-Jen Shih, **Shih-Lun Wu**, Frank Zalkow, Meinard Müller, and Yi-Hsuan Yang. "Theme Transformer: Symbolic Music Generation with Theme-Conditioned Transformer." *IEEE Transactions on Multimedia* ***(TMM)*** 2022. [pdf] [code] [project website]

[5] **Shih-Lun Wu** and Yi-Hsuan Yang. "MuseMorphose: Full-Song and Fine-Grained Music Style Transfer with One Transformer VAE." Submitted to *IEEE/ACM Transactions on Audio, Speech, and Language Processing (TASLP)*. [pdf] [code] [project website]

[4] Antoine Liutkus, Ondřej Cífka, **Shih-Lun Wu**, Umut Simsekli, Yi-Hsuan Yang, and Gaël Richard. "Relative Positional Encoding for Transformers with Linear Complexity." *International Conference on Machine Learning* ***(ICML)*** 2021. (**Long talk**, acceptance rate: **3.0%**) [pdf] [code] [presentation video] [project website]

[3] **Shih-Lun Wu**, Hsiao-Yen Tung and Yu-Lun Hsu. "Deep Learning for Automatic Quality Grading of Mangoes: Methods and Insights." *International Conference on Machine Learning and Applications* ***(ICMLA)*** 2020. [pdf] [presentation video]

[2] **Shih-Lun Wu** and Yi-Hsuan Yang. "The Jazz Transformer on the Front Line: Exploring the Shortcomings of AI-Composed Music through Quantitative Measures." *International Society for Music Information Retrieval Conference* ***(ISMIR)*** 2020. [pdf] [code] [poster] [presentation video]

[1] **Shih-Lun Wu***, Ching-Yuan Bai*, Kai-Chieh Chang, Yi-Ting Shieh, Chao Huang, Chung-Wei Lin, Eunsuk Kang and Qi Zhu. "Efficient System Verification with Multiple Weakly-Hard Constraints for Runtime Monitoring." *International Conference on Runtime Verification* ***(RV)*** 2020. (*: equal contribution) [pdf] [publisher page]

RESEARCH EXPERIENCE

ML Research Engineer | Taiwan AI Labs 08.2021 ~ 03.2022
Research Intern | Taiwan AI Labs 07.2020 ~ 07.2021
AI Music Team, Human-Computer Interaction Group

- Designed mechanisms to exert time-varying control on Transformers for sequence generation (see publication [5])
- Bridged Transformers, the mechanism above, and Variational Autoencoders for fine-grained style transfer of long musical pieces, allowing users to harness harmonic & rhythmic intensities down to the bar level (publ. [5])
- Proposed a 3-stage pipeline to generate well-structured pieces with recurring themes and proper development

RESEARCH EXPERIENCE (Cont'd)

Undergraduate Research Assistant | Academia Sinica 02.2020 ~ 06.2021

Music and AI Lab, Research Center for IT Innovation. *Advisor: Dr. Yi-Hsuan Yang*

- Collaborated with researchers @ *INRIA / Télécom Paris* on positional encodings for O(n) Transformers (publ. [4])
- Developed a set of musical feature-based quantitative metrics to assess the quality of AI music (publ. [2])
- Improved generative Transformers by inserting structure input tokens from WJazzD music database (publ. [2])

Undergraduate Research Assistant | National Taiwan University 02.2019 ~ 06.2020

Cyber-Physical Systems Lab, Dept. of CSIE. *Advisor: Dr. Chung-Wei Lin*

- Formulated the formal verification problem under multiple weakly-hard constraints on environmental faults
- Discovered and proved the mathematical properties between pairs of weakly-hard constraints
- Devised a lowest-cost-first heuristic using the properties, accelerating verification algorithm by up to 12x (publ. [1])

OTHER WORK EXPERIENCE

Teaching Assistant | National Taiwan University 09.2019 ~ 01.2020

Algorithm Design & Analysis (CSIE 2136). *Prof. Hsu-Chun Hsiao & Prof. Yun-Nung Chen*

- Designed homework problems for the rigorous course emphasizing on both theoretical depth & coding skills
- Held weekly TA hours to help students on coding problems and mathematical reasoning

Software Engineering Intern | Asus Inc. 07.2019 ~ 08.2019

Cloud Infrastructure Team, Asus Intelligent Cloud Services (AICS) Center

- Gained experience with CI/CD tools: Travis CI, Sonar Cloud, and MS Azure Pipelines
- Co-developed a Kubernetes + Python (Flask) template for launching containerized, cloud-based ML solutions
- Integrated Azure Key Vault, Mutual TLS auth & Azure App Insights to the template to streamline model deployment

OTHER SELECTED PROJECTS

MuseOptimus: Interactive AI Composition Webapp | *ReactJS · PyTorch* 01.2021

- Realized a dynamic user interface for my music generation model developed @ Taiwan AI Labs
- Implemented comprehensive features, including dynamic note display, song rating, and song recommendation
- Scored the highest among 100+ final projects in NTU's Web Programming course (by Prof. Ric Huang) [slides]

CSIE Multi-Player Online Gaming Platform | *Python · SQLAlchemy · Socket.IO* 06.2020

- Took charge of the system design; modularized the project and assigned tasks to individual team members
- Designed database schema and used SQLAlchemy to achieve database CRUD using Python native APIs
- Handled concurrency in multi-player games with Socket.IO, a real-time, bi-directional communication library

EXTRACURRICULAR ACTIVITIES & SERVICE

Pianist, Violist, & Director of General Affairs 09.2018 ~ 06.2021

Symphony Orchestra, National Taiwan University

- Participated actively in concerts [playlist] and handled procurement, musical scores, and transportation affairs

Peer Reviewer

- Conferences: **ICMLA** (2020), **ISMIR** (2021, 2022)
- Journals: **TISMIR** (2021)

SKILLS & QUALIFICATIONS

- GRE: **332** (V: **162**, Q: **170**, AW: **4.5**); TOEFL: **107** (R: **30**, L: **28**, S: **24**, W: **25**)
- Programming Languages & Infrastructure: *Python · C/C++ · JavaScript · ReactJS · LaTeX · Linux · Kubernetes*
- Machine Learning Frameworks*: PyTorch · Keras · Tensorflow*
- Selected Coursework: **Straight A+'s** in the following courses
  -- CS fundamentals: Data Structures & Algorithms, Algorithm Design & Analysis, Operating Systems, Discrete Math, Linear Algebra, Probability, Formal Language & Automata Theory
  -- ML-/DL-related: ML Techniques, Special Topics on ML, Deep Learning for Human Language Processing