Cheng-Yu (Mike) Tsai

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Education

Georgia Institute of Technology
Atlanta, Georgia, USA

Doctor of Philosophy in Electrical and Computer Engineering — *Aug. 2024 - current*

- Advisor: Dr. Sung-Kyu Lim
- Experience: Electronic Design Automation (EDA), specialized in PDK development and parasitic extraction

National Taiwan University
Taipei, Taiwan

Master of Science in Computer Science and Information Engineering — *Feb. 2019 - Jun. 2021*

- Advisor: Dr. Chia-Lin Yang
- Thesis: A Performance Analytical Model for DNN Training with Focus on Memory Subsystem
- Key words: Deep Neural Network, training, bandwidth, cache capacity, analytical model, data reuse

National Taiwan University
Taipei, Taiwan

Double degree of B.S.E in Electrical Engineering & B.S. in Computer Science and Information Engineering — *Sep. 2014 - Jan. 2019*

- GPA: 3.96/4.3 (3.84/4.0)
- Rank: 49/190 (26%)
- Awarded Presidential Award (semester GPA within top 5%) twice

Research Interests

Primary Electronic Design Automation (EDA), Computer architecture, Soft/Hardware co-design, Software performance modeling, analysis and improvement

Secondary Distributed Computing, Emerging Memory

Research Projects

A Performance Analytical Model for DNN Training with Focus on Memory Subsystem
MS Thesis

Exploring the tradeoffs between cache capacity and memory bandwidth in DNN workloads — *Feb '19 - Jun '21*

- The first work to model data reuse across DNN layers in DNN workloads for 100+ MB cache (AMD has products with this scale already).
- Devised a novel software-controlled cache analytical scheme to approximate an optimal hardware design so that the architecture problem can be decoupled from low-level design issues.
- Analyzed tradeoffs between cache capacity and bandwidth in ResNet, MobileNet, GNMT, and Transformer and drew some insights from the experiment results.

Standard Cell Delay Calculator
Internal Project at TSMC

A model to swiftly estimate the delay of a post-layout standard cell (MOS + parasitic R/C) — *Jun '22 - Jul '23*

- More than 10x faster than SPICE transient simulation, 100x faster than bi-section setup time simulation, while maintaining more than 0.9 of correlation coefficient and sub-ps accuracy with SPICE.
- Integrated graph theory, transient pre-characterization, layout dependent effect (LDE) estimation, asymptotic waveform evaluation, calculation on RC network and simplification, etc., into a single program to estimate propagation delay from a detailed standard parasitic format (DSPF) file.
- Leveraged parallel programming, scientific computing, inter-process communication and binding between C++ and Python, and various techniques to assure optimal efficiency and ease of use.
- Independently inquiring into influential factors while striking a balance between the model's efficiency and accuracy.

Publication

- Mao-Hsuan Chou, **Cheng-Yu Tsai**, Cheng-Hsiang Hsieh, Chih-Hsien Chang, Liang-Sheng Tsai, Taiwan Semiconductor Manufacturing Company, 2024. "System and Method for Checking Mismatches in Current Mirror Circuit," *U.S. Patent* (under review)

Working Experience

Taiwan Semiconductor Manufacturing Company (TSMC)

Hsinchu, Taiwan

Engineer, Custom Design Flow Development Department, Design Technology Platform (DTP), R&D *Jul. 2021 - Jul. 2024*

- Built a **delay calculator**, which takes DSPF as input and calculates the timing within a standard cell. This in-house method is more than 10x faster for delay or 100x faster for setup time than conventional spice simulation without commercial licenses while maintaining more than 0.9 of the ranking correlation coefficient.
- Built a **fully automated flow** to verify silicon photonics process design kit (PDK). This project integrates pre-layout simulation, schematic-driven layout, LVS, DRC, and RC extraction into a one-button task. At least 20x efficiency gain is expected than manual maneuver.
- Designed and maintained an **Automatic Quality Checking (QC) system** that runs specified scripts and generates an easy-to-read HTML report. This system assures developers and managers that the latest code can function as expected without them having to run their tests.

National Taiwan University

Taipei, Taiwan

Part-time worker, Division of Network Management, Computer & Information Networking Center *Apr. 2018 - Jan. 2021*

- Built and maintained **VisQWL**: a Visualization framework for monitoring the Quality of campus-wide WireLess service. The heat map can easily pinpoint the hot spot of Wi-Fi usage, guide the system administrators about resource arrangement, and provide a tool to deal with user complaints.
- Skills: SNMP, Kibana, Elasticsearch, data visualization, wireless network, map data processing
- The work is published in a regional conference TANet30, and is online serving at https://ccnet.ntu.edu.tw/wireless/ (Chinese only)

Teaching Experience

Computer Architecture

National Taiwan University

Three-credit mandatory course for third-year undergraduate students *Fall '19 and Fall '20*

- Offering a Verilog training lecture to enable students to be capable of working on their projects
- Introducing Verilog projects, clarifying students' confusion throughout the process, and grading their projects upon submission
- Drafting midterm and final exams and grading them
- Offering office hours for students to ask questions
- Setting up presentation and video recording devices for the instructor

Honors & Awards

2024	**DTP Best Patent Award**, TSMC	*Hsinchu, Taiwan*
2022	**DTP Outstanding Procedure Innovation Award**, TSMC	*Hsinchu, Taiwan*
2016	**Presidential Award**, National Taiwan University	*Taipei, Taiwan*
2015	**Presidential Award**, National Taiwan University	*Taipei, Taiwan*

Extracurricular Activities & Leadership & Teaching

Equipment Team, NTU Tainan Alumni Association (TAA)

Taipei, Taiwan

Long-term Support and Senior Consultant/Leader *Jul. 2015 - Apr. 2021*

- This team is responsible for all the hardware for hosting stage performances. The equipment comes in four major fields: stage lighting, public address (PA) system, photography, and video recording.
- Having mastered all four fields, I coordinated the crew assigned with various responsibilities and made sure they could 1) have smooth communication with performers before the event, 2) set up the equipment within often tight time budget, and 3) correctly operate the devices to meet the performers' requirements.
- Leading and training the staff of this team whose personnel is replenished on a yearly basis. My apprentices span over 6 generations
- Designed technical lectures and hands-on training to teach newcomers so that they can work independently during real events. I have taught at least 10+ lectures in this group.
- Built up a sustainable lecture and training framework that can be passed down for generations even after I left NTU
- I have a series of documentary videos on this team in my YouTube channel

NTU Public Address (PA) Team

Taipei, Taiwan

Network Administrator and Director of Equipment *Sep. 2017 - Aug. 2018*

- Built a radius server so that the shared Wi-Fi could be more secure, manageable, and traceable.
- Enhanced the logging system to better handle network security events.
- Managing, maintaining, and purchasing new equipment for this team
- Taught 7 lectures, including “Decibel and Phase” (3 times), “Introduction to the Systems in the Auditorium”, “Introduction to the Network System of PA Team”, “Introduction to X32 (a digital mixer)”, “Introduction to Photography”

NTUEE badminton department team

Taipei, Taiwan

Coach *Sep. 2017 - Jan. 2021*

- Taught new members badminton skills and served balls to them.
- Taught experienced members tactics about the plays and pointed out their weaknesses and possible ways of improvement.

Night of NTU Tainan Alumni Association

Taipei, Taiwan

Event General Coordinator *Oct. 2015 - Mar. 2016*

- Ranked as one of the top three nights in NTU, famous for its high-quality drama, this event consists of about 80 drama performers, 20 dancers, and 70 workers. I was one of the three highest leaders of this event.
- The main responsibility was to arrange resources and the schedule to ensure the event could be held successfully