

# Fan-Keng Sun

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## Research Interests

Machine learning and deep learning for sequence modeling, including time series analysis and natural language processing.

## Education

### Massachusetts Institute of Technology (MIT)

Ph.D. in Electrical Engineering and Computer Science

Cambridge, MA

09/2019 - PRESENT

- Courses: Machine Learning, Algorithms for Inference, Advanced Natural Language Processing, Optimization Methods
- GPA: 5.0/5.0

### National Taiwan University (NTU)

B.S. in Electrical Engineering (major) and Computer Science (minor)

Taipei, Taiwan

09/2014 - 06/2019

- GPA: 3.96/4.00, Major GPA: 3.99/4.00

## Research Experiences

### Research Assistant, Statistical Metrology Group, Prof. Duane Boning

09/2019 - PRESENT

Machine Learning for Time Series [arXiv-21]

- Proposed a method to adjust for autocorrelated errors in neural networks for time series regression and forecasting.
- Adding our method to existing state-of-the-art models improves performances across a wide range of datasets by 5% on average.

### Research Assistant, Speech Processing and Machine Learning Lab, Prof. Hung-yi Lee

09/2016 - 08/2019

Lifelong Language Learning [ICLR-20]

- Proposed a method that trains a GPT-2 model with both question-answering and language model objectives to tackle the lifelong language learning problem.
- Outperformed previous methods by a large margin yet being simple and extensible.

Multivariate Time Series (MTS) Forecasting [Journal track of the ECML/PKDD-19]

- Proposed the temporal pattern attention for MTS forecasting, which use CNNs to extract temporal patterns across multiple time steps instead of a single time step as in traditional attention mechanisms.
- Achieved state-of-the-art performance on a wide range of MTS datasets, including polyphonic music notes.

Reviewed paper for ICASSP 2019 and TASLP 2019

### Research Assistant, Electronic Design Automation Lab, Prof. Yao-Wen Chang

02/2016 - 12/2018

Bivariate Gradient-based Wirelength Model [DAC-19]

- Proposed a novel bivariate gradient-based wirelength model for global placement that combines the advantages of bivariate and multivariate functions.
- Outperformed previous bivariate and state-of-the-art multivariate wirelength models.

Topology-Matching Bus Routing [DAC-19]

- Proposed and implemented the DAG-based topology-matching bus routing engine and won the top 10 at 2018 ICCAD CAD contest.
- Outperformed all participants of 2018 ICCAD CAD contest, where the 1st place router resulted in 145% higher cost.

Initial Detailed Routing [ICCAD-18]

- Proposed the multithreaded initial detailed routing engine considering global guides and won the 3rd place at the 2018 ISPD contest.
- Outperformed the winner of 2018 ISPD contest by 23%.

### Undergraduate Researcher, Speech Processing Lab, Prof. Lin-shan Lee

09/2017 - 09/2018

Reinforcing Reinforcement Learning by Rule-based Teacher

- Applied computer vision technique to guide a rule-based Slither.io agent.
- Researched the combination of a rule-based teacher to guide a Slither.io agent by Asynchronous Advantage Actor Critic (A3C) which surpassed rule-based model.

### Software Engineering Intern, Synopsys, Inc.

07/2016 - 08/2016

Single-Layer Global Routing

- Researched and implemented a single-layer global routing algorithm based on a mixture of previous literature and own design.

## Publications

(\* indicates equal contribution)

1. **Fan-Keng Sun**, Christopher I. Lang, Duane S. Boning. Adjusting for Autocorrelated Errors in Neural Networks for Time Series Regression and Forecasting. *arXiv preprint arXiv:2101.12578*, 2021. (under review)
2. Kyongmin Yeo, Dylan E. C. Grullon, **Fan-Keng Sun**, Duane S. Boning, Jayant R. Kalagnanam. Variational inference formulation for a model-free simulation of a dynamical system with unknown parameters by a recurrent neural network. *arXiv preprint arXiv:2003.01184*, 2020. (under review)
3. **Fan-Keng Sun\***, Cheng-Hao Ho\*, Hung-yi Lee. LAMOL: LAnguage MOdeling for Lifelong Language Learning. In *International Conference on Learning Representations (ICLR)*, 2020.

4. Chen-Hao Hsu, Shao-Chun Hung, Hao Chen, **Fan-Keng Sun**, Yao-Wen Chang. A DAG-Based Algorithm for Obstacle-Aware Topology-Matching On-Track Bus Routing. *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD)*, 2020.
5. Shun-Yao Shih\*, **Fan-Keng Sun\***, Hung-yi Lee. Temporal Pattern Attention for Multivariate Time Series Forecasting, Journal track of the *European Conference on Machine Learning & Principles and Practice of Knowledge Discovery in Databases (ECML/PKDD)*, 2019.
6. **Fan-Keng Sun**, Yao-Wen Chang. BiG: A Bivariate Gradient-Based Wirelength Model for Analytical Circuit Placement. In *Proc. of ACM/IEEE Design Automation Conference (DAC)*, 2019.
7. Chen-Hao Hsu, Shao-Chun Hung, Hao Chen, **Fan-Keng Sun**, Yao-Wen Chang. A DAG-Based Algorithm for Obstacle-Aware Topology-Matching On-Track Bus Routing. In *Proc. of ACM/IEEE Design Automation Conference (DAC)*, 2019.
8. **Fan-Keng Sun**, Hao Chen, Ching-Yu Chen, Chen-Hao Hsu, Yao-Wen Chang. A Multithreaded Initial Detailed Routing Algorithm Considering Global Routing Guides. In *Proc. of IEEE/ACM International Conference on Computer-Aided Design (ICCAD)*, 2018.

## Teachings

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<b>Teaching Assistant, Algorithm Design and Analysis (Fall 2018)</b> , Prof. Yun-Nung Chen & Hsu-Chun Hsiao	09/2018 - 01/2019
<b>Teaching Assistant, Machine Learning and Having It Deep and Structured (Spring 2018)</b> , Prof. Hung-yi Lee	02/2018 - 06/2018
<b>Teaching Assistant, Machine Learning (Fall 2017)</b> , Prof. Hung-yi Lee	09/2017 - 01/2018

## Honors & Awards

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- 2019 **AI Research Grant (with Prof. Hung-yi Lee)**, Salesforce
  - 2018 **Outstanding Performance Scholarship**, National Taiwan University
  - 2018 **3rd Place (first pure-undergraduate team in top 3 in 14 years)**, ISPD Contest
  - 2017 **Research Project Grant**, Taiwan Ministry of Science and Technology
  - 2017 **National Technology and Science Scholarship**, CTCI Foundation
  - 16,17 **3rd Place (2 times)**, NTU ACM ICPC Ranking
  - 2017 **3rd Place**, National Collegiate Programming Contest
  - 2017 **Silver Medal**, ACM ICPC Regional Contest
  - 2016 **1st Place**, ACM ICPC Regional Contest
  - 2016 **1st Place out of 2000 participants from 45 countries**, Calculus World Cup
  - 2016 **2nd Place**, Newcomers for ACM-ICPC Taiwan Online Programming Contest
  - 2012 **Silver Medal**, International Geography Olympiad

## Selected Projects

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- AI Traffic Control System [CTCI Scholarship]** 11/2017
- Designed and implemented a low-cost and real-time traffic signal system on NVIDIA Jetson TK1 using Fast-RCNN to detect the traffic flow and reinforcement learning to train the traffic signal switching interval model.
  - Our system is effective on simple traffic simulation, and thus won the 2017 National Technology and Research Scholarship presented by CTCI Foundation.
- Solving Multi-Armed Bandits by Upper Confidence Bound (UCB) Algorithms** 06/2018
- Survey several important UCB algorithms: starting from the original UCB, to improved versions (UCBV, improved-UCB), and end at the state-of-the-art method (EUCBV).
  - Introduced the lower bound for consistent algorithms and showed the optimality of KL-UCB in special cases.

## Extracurricular Activities

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- Director, Academic Department of NTUEE Student Association** 09/2016 - 06/2017
- Led a team of over 30 students to provide academic services to the 700+ undergraduates, including, but not limited to, the followings:
  - EExplore: an event where professors introduce all research areas in EE department to freshmen.
  - Lab Intro: a week of continuous lab introduction by the corresponding professor to recruit interested undergraduate researchers.
- Chair, MakeNTU Makeathon**, [website], [FB fan page], [Recap video] 08/2016 - 02/2017
- Organized the largest nationwide student Makeathon in Taiwan with 200 participants, 70k USD arrangement, and 60 volunteers.
  - Collaborated with the Taipei City and 22 international companies, including Google, Microsoft, Dell, TSMC, Intel, ARM, Asus, etc.

## Skills

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<b>Natural Languages</b>	Chinese (Mandarin), English, Taiwanese
<b>Programming Languages</b>	Python, C/C++, Java, R, SQL, Julia, Shell, Matlab, $\LaTeX$ , Git
<b>Deep Learning Libraries</b>	Tensorflow, PyTorch, Keras
<b>Web Scraping Libraries</b>	Beautiful Soup, Selenium, Scrapy