

# Michael Chin-Chia Yeh

<https://mcyeh.github.io/> ♦ [myeh003@ucr.edu](mailto:myeh003@ucr.edu)

## PROFESSIONAL EXPERIENCE

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### Visa Research

*Staff Research Scientist*

Foster City, California

2018/09 –

- Time Series Data Mining

Time series data generated from transaction databases can provide critical insights for payment processing companies. To effectively utilize this information, I have developed machine learning models tailored for transactional time series data across various contexts. The following topics were studied in this area: matrix profile, deep learning, foundation models, time series forecasting, spatial-temporal forecasting, time series classification/regression, multi-future prediction, multi-model learning, online learning, motif/discord mining, and anomaly detection.

- Embeddings and Representation Learning

Embedding learning technologies are essential for unlocking deep insights into entities within databases. My research in this area has focused on three directions for analyzing Visa's data: 1) developing embedding learning frameworks, 2) mitigating the impact of undesirable information within embeddings, and 3) enhancing the scalability of embedding learning. The outcomes of these studies have enabled the development of embeddings for entities such as merchants, merchant categories, and countries, which have been successfully applied to various analytical tasks.

- Machine Learning for Tabular Data

Transaction data is typically stored as sequential tabular data, which presents unique challenges and opportunities for machine learning applications. My research and prototype efforts have been dedicated to advancing technologies in foundation models and sequential modeling, specifically tailored for tasks such as recommendation, stand-in processing, and fraud detection. By leveraging time series data mining, embedding learning, and sequential modeling techniques, I have developed innovative approaches that enhance the accuracy and efficiency of these tasks. This work has involved not only designing and implementing models but also rigorously evaluating their performance in real-world transactional environments, ensuring their robustness and scalability for large-scale applications.

I published *50 peer-reviewed papers* and *31 patents* at Visa as of 10/17/2024.

Supervisor: Wei Zhang, Mahashweta Das

### University of California, Riverside (UCR)

*Research Assistant*

Riverside, California

3 Years

- All Pairs Similarity Search for Time Series Subsequences (Matrix Profile)

The all-pairs-similarity-search (or similarity join) problem has been extensively studied for text and a handful of other data types. However, there has been little progress on similarity joins for time series subsequences. The goal of the project is to develop an efficient/scalable algorithm solving the similarity join problem for time series data and show the utility of such algorithm when it's treated as a primitive operation for time series. The application of time series join includes visualization, motif/discord mining, clustering, etc.

I published *19 peer-reviewed papers* at UCR.

Supervisor: Prof. Eamonn Keogh

- Audio Word Representation of Audio Signals

Audio word (AW) representation symbolizes any local audio event as a codeword within a pre-constructed dictionary. Over the course of the project, I have conducted a systematic evaluation with various AW extracting configurations on audio classification/auto-tagging systems. Based on the result of the systematic evaluation, I have proposed a framework that aims to standardize the modularization of the AW representation extraction. I have also examined the possibility of incorporating various ideas (e.g., multi-scale feature learning, bagging) into the AW extraction process to learn better AW representation.

I published 8 *peer-reviewed papers* at CITI.

Supervisor: Prof. Yi-Hsuan Yang

## HONORS, AWARDS, AND SERVICE

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- Honorable mention for 2019 SIGKDD doctoral dissertation award.
- First place in AALTD' 16 time-series classification challenge
- Travel Award: SDM 2018, KDD 2017, ICDM 2016.
- Program Committee: KDD 2019-2022, MiLeTS 2020-2022, AAAI 2021, ECML-PKDD (ADS) 2020.

## EDUCATION

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### University of California, Riverside (UCR)

Ph.D. in Computer Science

### University of California, Los Angeles (UCLA)

M.S. in Mechanical Engineering, Systems and Control

### Virginia Polytechnic Institute and State University (Virginia Tech)

B.S. in Mechanical Engineering

## PUBLICATION

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- **Chin-Chia Michael Yeh**, Yujie Fan, Xin Dai, Uday Singh Saini, Vivian Lai, Prince Osei Aboagye, Junpeng Wang, Huiyuan Chen, Yan Zheng, Zhongfang Zhuang, Liang Wang, and Wei Zhang, “RPMixer: Shaking Up Time Series Forecasting with Random Projections for Large Spatial-Temporal Data,” *ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (KDD)*, 2024.
- **Chin-Chia Michael Yeh**, Audrey Der, Uday Singh Saini, Vivian Lai, Yan Zheng, Junpeng Wang, Xin Dai, Zhongfang Zhuang, Yujie Fan, Huiyuan Chen, Prince Osei Aboagye, Liang Wang, Wei Zhang, and Eamonn Keogh, “Matrix Profile for Anomaly Detection on Multidimensional Time Series,” *IEEE International Conference on Data Mining (ICDM)*, 2024.
- Maryam Shahcheraghi, **Chin-Chia Michael Yeh**, Yan Zheng, Junpeng Wang, Zhongfang Zhuang, Liang Wang, Mahashweta Das, and Eamonn Keogh, “Matrix Profile XXXI: Motif-Only Matrix Profile: Orders of Magnitude Faster,” *IEEE International Conference on Knowledge Graph (ICKG)*, 2024.
- Audrey Der, **Chin-Chia Michael Yeh**, Xin Dai, Huiyuan Chen, Yan Zheng, Yujie Fan, Zhongfang Zhuang, Vivian Lai, Junpeng Wang, Liang Wang, Wei Zhang, and Eamonn Keogh, “A Systematic Evaluation of Generated Time Series and Their Effects in Self-Supervised Pretraining,” *ACM International Conference on Information and Knowledge Management (CIKM)*, 2024.
- Jiarui Sun, Yujie Fan, **Chin-Chia Michael Yeh**, Wei Zhang, and Girish Chowdhary, “Revealing the Power of Masked Autoencoders in Traffic Forecasting,” *ACM International Conference on Information and Knowledge Management (CIKM)*, 2024.

- Uday Singh Saini, Zhongfang Zhuang, **Chin-Chia Michael Yeh**, Wei Zhang, and Evangelos E Papalexakis, “Analysis of Causal and Non-Causal Convolution Networks for Time Series Classification,” *SIAM International Conference on Data Mining (SDM)*, 2024.
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- Yiran Li, Junpeng Wang, Prince Aboagye, **Chin-Chia Michael Yeh**, Yan Zheng, Liang Wang, Wei Zhang, and Kwan-Liu Ma, “Visual Analytics for Efficient Image Exploration and User-Guided Image Captioning,” *IEEE Transactions on Visualization and Computer Graphics (TVCG)*, 2024.
- Huiyuan Chen, Zhe Xu, **Chin-Chia Michael Yeh**, Vivian Lai, Yan Zheng, Minghua Xu, and Hanghang Tong, “Masked Graph Transformer for Large-Scale Recommendation,” *International ACM SIGIR Conference on Research and Development in Information Retrieval (SIGIR)*, 2024.
- **Chin-Chia Michael Yeh**, Xin Dai, Huiyuan Chen, Yan Zheng, Yujie Fan, Audrey Der, Vivian Lai, Zhongfang Zhuang, Junpeng Wang, Liang Wang, and Wei Zhang, “Toward a Foundation Model for Time Series Data,” *ACM International Conference on Information and Knowledge Management (CIKM)*, 2023.
- **Chin-Chia Michael Yeh**, Huiyuan Chen, Xin Dai, Yan Zheng, Junpeng Wang, Vivian Lai, Yujie Fan, Audrey Der, Zhongfang Zhuang, Liang Wang, Wei Zhang, and Jeff M. Phillips, “An Efficient Content-based Time Series Retrieval System,” *ACM International Conference on Information and Knowledge Management (CIKM)*, 2023.
- Yujie Fan, **Chin-Chia Michael Yeh**, Huiyuan Chen, Yan Zheng, Liang Wang, Junpeng Wang, Xin Dai, Zhongfang Zhuang, and Wei Zhang, “Spatial-Temporal Graph Boosting Networks: Enhancing Spatial-Temporal Graph Neural Networks via Gradient Boosting,” *ACM International Conference on Information and Knowledge Management (CIKM)*, 2023.
- Dongyu Zhang, Liang Wang, Xin Dai, Shubham Jain, Junpeng Wang, Yujie Fan, **Chin-Chia Michael Yeh**, Yan Zheng, Zhongfang Zhuang, and Wei Zhang, “FATA-Trans: Field And Time-Aware Transformer for Sequential Tabular Data,” *ACM International Conference on Information and Knowledge Management (CIKM)*, 2023.
- **Chin-Chia Michael Yeh**, Yan Zheng, Menghai Pan, Huiyuan Chen, Zhongfang Zhuang, Junpeng Wang, Liang Wang, Wei Zhang, Jeff M. Phillips, and Eamonn Keogh, “Sketching Multidimensional Time Series for Fast Discord Mining,” *IEEE International Conference on Big Data (BigData)*, 2023.
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- **Chin-Chia Michael Yeh**, Huiyuan Chen, Xin Dai, Yan Zheng, Yujie Fan, Vivian Lai, Junpeng Wang, Audrey Der, Zhongfang Zhuang, Liang Wang, and Wei Zhang, “Temporal Treasure Hunt: Content-based Time Series Retrieval System for Discovering Insights,” *IEEE International Conference on Big Data (BigData)*, 2023.
- Audrey Der, **Chin-Chia Michael Yeh**, Yan Zheng, Junpeng Wang, Huiyuan Chen, Zhongfang Zhuang, Liang Wang, Wei Zhang, and Eamonn Keogh, “Time Series Synthesis Using the Matrix Profile for Anonymization,” *IEEE International Conference on Big Data (BigData)*, 2023.
- **Chin-Chia Michael Yeh**, Xin Dai, Yan Zheng, Junpeng Wang, Huiyuan Chen, Yujie Fan, Audrey Der, Zhongfang Zhuang, Liang Wang, and Wei Zhang, “Multitask Learning for Time Series Data with 2D Convolution,” *IEEE International Conference on Machine Learning and Applications (ICMLA)*, 2023.

- Yujie Fan, **Chin-Chia Michael Yeh**, Huiyuan Chen, Liang Wang, Zhongfang Zhuang, Junpeng Wang, Xin Dai, Yan Zheng, and Wei Zhang, “Spatial-Temporal Graph Sandwich Transformer for Traffic Flow Forecasting,” *Joint European Conference on Machine Learning and Knowledge Discovery in Databases (ECML-PKDD)*, 2023.
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- Yiran Li, Junpeng Wang, Xin Dai, Liang Wang, **Chin-Chia Michael Yeh**, Yan Zheng, Wei Zhang, and Kwan-Liu Ma, “How Does Attention Work in Vision Transformers? A Visual Analytics Attempt,” *IEEE Transactions on Visualization and Computer Graphics (TVCG)*, 2023.
- Vivian Lai, Huiyuan Chen, **Chin-Chia Michael Yeh**, Minghua Xu, Yiwei Cai, and Hao Yang, “Enhancing Transformers without Self-supervised Learning: A Loss Landscape Perspective in Sequential Recommendation,” *ACM Conference on Recommender Systems (RecSys)*, 2023.
- Huiyuan Chen, Xiaoting Li, Vivian Lai, **Chin-Chia Michael Yeh**, Yujie Fan, Yan Zheng, Mahashweta Das, and Hao Yang, “Adversarial Collaborative Filtering for Free,” *ACM Conference on Recommender Systems (RecSys)*, 2023.
- Huiyuan Chen, Kaixiong Zhou, Kwei Heng Lai, **Chin-Chia Michael Yeh**, Yan Zheng, Xia Hu, and Hao Yang, “Hessian-aware Quantized Node Embeddings for Recommendation,” *ACM Conference on Recommender Systems (RecSys)*, 2023.
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- Prince Osei Aboagye, Yan Zheng, Jack Shunn, **Chin-Chia Michael Yeh**, Junpeng Wang, Zhongfang Zhuang, Huiyuan Chen, Liang Wang, Wei Zhang, and Jeff Phillips, “Interpretable Debiasing of Vectorized Language Representations with Iterative Orthogonalization,” *International Conference on Learning Representations (ICLR)*, 2022.
- Archit Rathore, Sunipa Dev, Jeff M. Phillips, Vivek Srikumar, Yan Zheng, **Chin-Chia Michael Yeh**, Junpeng Wang, Wei Zhang, and Bei Wang, “VERB: Visualizing and Interpreting Bias Mitigation Techniques Geometrically for Word Representations,” *ACM Transactions on Interactive Intelligent Systems (TiIS)*, 2022.
- Audrey Der, **Chin-Chia Michael Yeh**, Renjie Wu, Junpeng Wang, Yan Zheng, Zhongfang Zhuang, Liang Wang, Wei Zhang, and Eamonn Keogh, “Matrix Profile XXVII: A Novel Distance Measure for Comparing Long Time Series,” *IEEE International Conference on Knowledge Graph (ICKG)*, 2022.
- Jiarui Sun, Mengting Gu, **Chin-Chia Michael Yeh**, Yujie Fan, Girish Chowdhary, and Wei Zhang, “Dynamic Graph Node Classification via Time Augmentation,” *IEEE International Conference on Big Data (BigData)*, 2022.
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- Archit Rathore, Sunipa Dev, Vivek Srikumar, Jeff M Phillips, Yan Zheng, **Chin-Chia Michael Yeh**, Junpeng Wang, Wei Zhang, and Bei Wang, “An Interactive Visual Demo of Bias Mitigation Techniques for Word Representations From a Geometric Perspective,” *NeurIPS 2021 Competitions and Demonstrations Track*, Proceedings of Machine Learning Research (PMLR), 2022.
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- Bo Dong, Yuhang Wu, **Chin-Chia Michael Yeh**, Yusan Lin, Yuzhong Chen, Hao Yang, Fei Wang, Wanxin Bai, Krupa Brahmksri, Yimin Zhang, Chinna Kummitha, and Verma Abhisar, “Semi-supervised Context Discovery for Peer-Based Anomaly Detection in Multi-Layer Networks,” *International Conference on Information and Communications Security* (ICICS), 2022.
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- **Chin-Chia Michael Yeh**, Zhongfang Zhuang, Junpeng Wang, Yan Zheng, Javid Ebrahimi, Ryan Mercer, Liang Wang, and Wei Zhang, “Online Multi-horizon Transaction Metric Estimation with Multi-modal Learning in Payment Networks,” *ACM International Conference on Information and Knowledge Management* (CIKM), 2021.
- Huiyuan Chen, Lan Wang, Yusan Lin, **Chin-Chia Michael Yeh**, Fei Wang, and Hao Yang, “Structured Graph Convolutional Networks with Stochastic Masks for Recommender Systems,” *International ACM SIGIR Conference on Research and Development in Information Retrieval* (SIGIR), 2021.
- Prince Osei Aboagye, Yan Zheng, **Chin-Chia Michael Yeh**, Junpeng Wang, Wei Zhang, Liang Wang, Hao Yang, and Jeff Phillips, “Normalization of Language Embeddings for Cross-Lingual Alignment,” *International Conference on Learning Representations* (ICLR), 2021.
- Junpeng Wang, Wei Zhang, Hao Yang, **Chin-Chia Michael Yeh**, and Liang Wang, “Visual Analytics for RNN-Based Deep Reinforcement Learning,” *IEEE Transactions on Visualization and Computer Graphics* (TVCG), 2021.
- Jingzhu He, **Chin-Chia Michael Yeh**, Yanhong Wu, Liang Wang, and Wei Zhang, “Mining Anomalies in Subspaces of High-dimensional Time Series for Financial Transactional Data,” *Joint European Conference on Machine Learning and Knowledge Discovery in Databases* (ECML-PKDD), 2021.
- **Chin-Chia Michael Yeh**, Zhongfang Zhuang, Yan Zheng, Liang Wang, Junpeng Wang, and Wei Zhang, “Merchant Category Identification Using Credit Card Transactions,” *IEEE International Conference on Big Data* (BigData), 2020.
- **Chin-Chia Michael Yeh**, Zhongfang Zhuang, Wei Zhang, and Liang Wang, “Multi-future Merchant Transaction Prediction,” *Joint European Conference on Machine Learning and Knowledge Discovery in Databases* (ECML-PKDD), 2020.
- **Chin-Chia Michael Yeh**, Dhruv Gelda, Zhongfang Zhuang, Yan Zheng, Liang Gou, and Wei Zhang, “Towards a Flexible Embedding Learning Framework,” *IEEE International Conference on Data Mining Workshop on Multi-Source Data Mining* (MSDM), 2020.

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- **Chin-Chia Michael Yeh**, Yan Zhu, Hoang Anh Dau, Amirali Darvishzadeh, Mikhail Noskov, and Eamonn Keogh, “Online Amnestic DTW to allow Real-Time Golden Batch Monitoring,” *ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (KDD)*, 2019.
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- Hoang Anh Dau, Anthony Bagnall, Kaveh Kamgar, **Chin-Chia Michael Yeh**, Yan Zhu, Shaghayegh Gharghabi, Chotirat Ann Ratanamahatana, and Eamonn Keogh, “The UCR Time Series Archive,” *IEEE/CAA Journal of Automatica Sinica*, 2019.
- **Chin-Chia Michael Yeh**, “Towards a Near Universal Time Series Data Mining Tool: Introducing the Matrix Profile,” University of California, Riverside, 2018.
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- **Chin-Chia Michael Yeh**, Yan Zhu, Liudmila Ulanova, Nurjahan Begum, Yifei Ding, Hoang Anh Dau, Zachary Zimmerman, Diego F. Silva, Abdullah Mueen, and Eamonn Keogh, “Time Series Joins, Motifs, Discords and Shapelets: a Unifying View that Exploits the Matrix Profile,” *Data Mining and Knowledge Discovery (DMKD)*, 2018.
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- **Chin-Chia Michael Yeh**, Yan Zhu, Liudmila Ulanova, Nurjahan Begum, Yifei Ding, Hoang Anh Dau, Diego F. Silva, Abdullah Mueen, and Eamonn Keogh, “Matrix Profile I: All Pairs Similarity Joins for Time Series: A Unifying View that Includes Motifs, Discords and Shapelets,” *IEEE International Conference on Data Mining (ICDM)*, 2016.
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- **Chin-Chia Michael Yeh**, Ping-Keng Jao, and Yi-Hsuan Yang. “AWtoolbox: Characterizing Audio Information Using Audio Words,” *ACM International Conference Multimedia (MM)*, 2014.
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- Ping-Keng Jao, **Chin-Chia Michael Yeh**, and Yi-Hsuan Yang, “Modified LASSO Screening for Audio Word-based Music Classification Using Large-scale Dictionary,” *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2014.
- **Chin-Chia Michael Yeh** and Yi-Hsuan Yang, “Towards a More Efficient Sparse Coding Based Audio-word Feature Extraction System,” *Asia Pacific Signal and Information Processing Association Annual Summit and Conference (APSIPA ASC)*, 2013.
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## PATENT

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## RELEVANT SKILL

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### *Programming Language*

- Proficient: MATLAB, Python, and L<sup>A</sup>T<sub>E</sub>X
- Familiar: Java, C#, and C++

### *Natural Language*

- Bilingual Proficiency: English, Mandarin Chinese