Title: Time-Series Forecasting with Meta-Learning: Basics and Applications

Abstract (300-500 words)

Time series problems such as time series forecasting, identification, and detection exist in many real-world fields. Accurate performance on time series problems is of critical importance for the safe and efficient operation of industrial systems. For example, accurate electric load forecasting is critical for the efficient operation of power grids. There are mainly two categories of methods that can be leveraged to tackle time series problems, i.e., statistical methods and machine learning methods. Machine learning models, such as support vector regression, long-short-term memory networks, and transformer-based methods, have shown impressive performance for time series problems. However, in the real world, we may not have enough data to learn a reliable machine learning model. For example, for newly built houses and buildings, we may only have a very limited amount of data. On the other side, the data distribution may also keep on evolving, which also undermines the performance of trained machine learning models. Meta learning, also referred to as learning to learn, can help accelerate the learning process and has shown impressive promise in few-shot learning settings. In this tutorial, we aim to: 1) introduce the basics of meta learning algorithms including gradient-based methods, metric based methods, and memory based methods, 2) introduce the recent progress of meta learning such as how to address the out of distribution challenges, 3) introduce classic time series problems and related insutrial applications, 4) introduce a few case studies to showcase how we can use meta learning for real-world time series problems, 5) general discussions on potential interesting research directions.

Objectives:

- Introduce the basic algorithms of meta learning
- Introduce the recent progress of meta learning
- Introduce time series problems and related insutrial applications
- Introduce applications of meta learning for time series problems
- Introduce potential interesting research directions

Goals:

Introduce the recent basics, recent progress of meta learning and applications of meta learning algoirthms for time series problems.

Audience:

Researchers and engineers from all electrical and computer engineering related fields who are interested in time series problems.

Presenters:

Di Wu (McGill Univesity)

Di Wu is currently a senior staff research scientist at Samsung AI center Montreal and an Adjunct Professor at McGill University. Before joining Samsung, he did postdoctoral research at Montreal MILA and Stanford University. He received the Ph.D. degree from McGill University, Montreal, Canada, in 2018 and the MSc degree from Peking University, Beijing, China, in 2013. Di's research interests mainly lie in designing algorithms (e.g., Reinforcement learning, operation research) for sequential decision-making problems and data-efficient machine learning algorithms (e.g., Transfer Learning, Meta-Learning, and

Multitask Learning). He is also interested in leveraging such algorithms for applications in real-world systems (e.g., Communications Systems, Smart Grid, and Intelligent Transportation Systems).

Arnaud Zinflou (Hydro Quebec)

Arnaud Zinflou has an extensive history working with AI projects in the fields of industrial manufacturing, logistics, finance, and online retail. He holds both a Bachelor and Master of Computer Science, as well as a Ph.D. in Computer Engineering. He currently principal research scientist at Hydro-Québec research institute and leads projects in many areas of machine learning such as computer vision, time series forecasting or representation learning. He is also the author and coauthor of more than 40 papers, 7 book chapters and 3 patents. He has been an IEEE senior member since 2015.

Benoit Boulet (McGill Univesity)

Benoit Boulet, P.Eng., Ph.D., is Professor in the Department of Electrical and Computer Engineering at McGill University which he joined in 1998, and Director of the McGill Engine, a Technological Innovation and Entrepreneurship Centre. He is Associate Vice-Principal of McGill Innovation and Partnerships and was Associate Dean (Research \& Innovation) of the Faculty of Engineering from 2014 to 2020. Professor Boulet obtained a Bachelor's degree in applied sciences from Université Laval in 1990, a Master of Engineering degree from McGill University in 1992, and a Ph.D. degree from the University of Toronto in 1996, all in electrical engineering. He is a former Director and current member of the McGill Centre for Intelligent Machines where he heads the Intelligent Automation Laboratory. His research areas include the design and data-driven control of electric vehicles and renewable energy systems, machine learning applied to biomedical systems, and robust industrial control.