# THREE CLASSES RELATED TO MACHINE LEARNING

## Multi-Armed Bandits and Its Application in Wireless Networks

**2021/11/19(Fri.) 10:00-12:00(Taipei Time)**

**Join WEBEX Meeting:**

**https://reurl.cc/V5WkXR Meeting ID: 2559 773 3118**

## Distributionally Robust Optimization and Machine Learning for Communication Networks

**2021/12/10(Fri.) 10:00-12:00(Taipei Time)**

**Join WEBEX Meeting:**

**https://reurl.cc/emk1WR Meeting ID: 2553 347 3323**

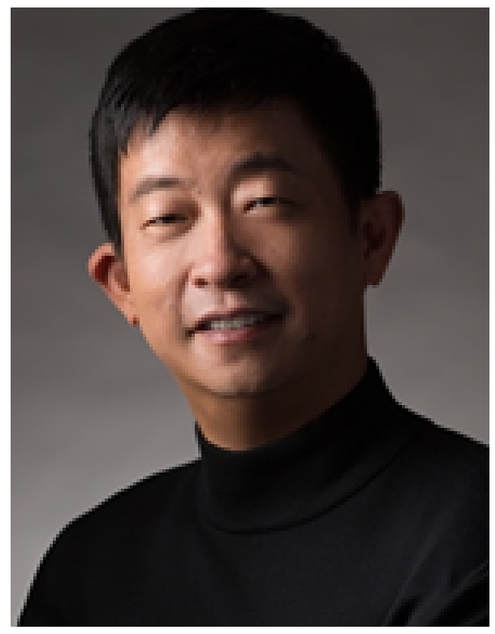
## Federated Learning and Analysis with Multi-access Edge Computing

**2021/12/17(Fri.) 10:00-12:00(Taipei Time)**

**Join WEBEX Meeting:**

**https://reurl.cc/Yj3y8o Meeting ID: 2556 881 4406**

**【Registration】 https://forms.gle/4vxoZ9BJSCUoNNr6A**



**SPEAKER: Prof. Han Zhu**
**University of Houston**

**【Bio】**

**Zhu Han received the B.S. degree in electronic engineering from Tsinghua University, in 1997, and the M.S. and Ph.D. degrees in electrical engineering from the University of Maryland, College Park, in 1999 and 2003, respectively. From 2000 to 2002, he was an R&D Engineer of JDSU, Germantown, Maryland. From 2003 to 2006, he was a Research Associate at the University of Maryland. From 2006 to 2008, he was an assistant professor in Boise State University, Idaho. Currently, he is a John and Rebecca Moores Professor in Electrical and Computer Engineering Department as well as Computer Science Department at University of Houston, Texas. His research interests include security, wireless resource allocation and management, wireless communication and networking, game theory, and wireless multimedia. Dr. Han is an NSF CAREER award recipient of 2010. Dr. Han has several IEEE conference best paper awards, and winner of 2011 IEEE Fred W. Ellersick Prize, 2015 EURASIP Best Paper Award for the Journal on Advances in Signal Processing and 2016 IEEE Leonard G. Abraham Prize in the field of Communication Systems (Best Paper Award for IEEE Journal on Selected Areas on Communications). Dr. Han is the winner 2021 IEEE Kiyo Tomiyasu Award. He has been an IEEE fellow since 2014, AAAS fellow since 2020 and IEEE Distinguished Lecturer from 2015 to 2018. Dr. Han is a 1% highly cited researcher according to Web of Science since 2017.**

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NYCU-IBM iIoT Research Center

CHT-NYCU Innovation Research Center

Department of Electrical and Computer Engineering

Host:
Prof. Li-Chun Wang
王蒞君教授

# ONLINE COURSE

# MULTI-ARMED BANDITS AND ITS APPLICATION IN WIRELESS NETWORKS

**2021/11/19(Fri.)**

**10:00-12:00**

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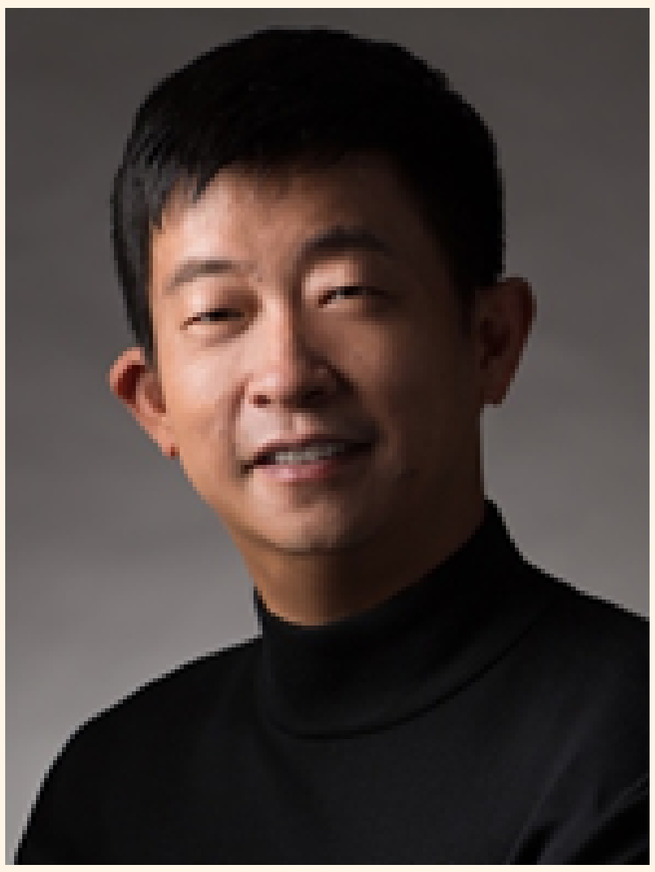

## SPEAKER: PROF. HAN ZHU

University of Houston

【Registration】 https://forms.gle/4vxoZ9BJSCUoNNr6A

## 【Abstract】

In recent years, multi-armed bandit (MAB), which can effectively tradeoff the well-known exploitation and exploration (EE) dilemma in online sequential decision problems, has gained an increasing attention in the recommend systems, clinic trial, economic, and communications due to the development of storage capability and computing power in devices. Compared with the traditional machine learning (ML) techniques, MAB has rigorous theoretical analysis (i.e., the regret bound), low computational complexity, and easy to apply. This talk supposes to establish an overall framework of MAB problems in the literature, consisting of the bandit models, classical algorithms, regret bounds, and applications. Specifically, we first introduce the background of the MAB and define different types of MAB models, such as stochastic bandits, adversary bandits, Markovian bandits, contextual bandits, Lipschitz bandits, and the recent advance in multi-player bandits. Then, we present the pseudocode of some classical algorithms (i.e., UCB, Thompson sampling, EXP3, EXP4, LinUCB, and zooming algorithm) to each type of MAB model. Meanwhile, we analyze the corresponding regret bounds of the above algorithms and unify them for comparison. In addition, we give five examples in wireless communications to better understand how MAB can apply to various applications. Finally, we conclude the main features and limitations of MABs.

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Department of Electrical and Computer Engineering

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# ONLINE COURSE

# DISTRIBUTIONALLY ROBUST OPTIMIZATION AND MACHINE LEARNING FOR COMMUNICATION NETWORKS

**2021/12/10(Fri.)**

**10:00-12:00**

**(Taipei Time)**

**Join WEBEX Meeting:**

**https://reurl.cc/emk1WR**

**Meeting ID: 2553 347 3323**

**【Registration】https://forms.gle/4vxoZ9BJSCUoNNr6A**

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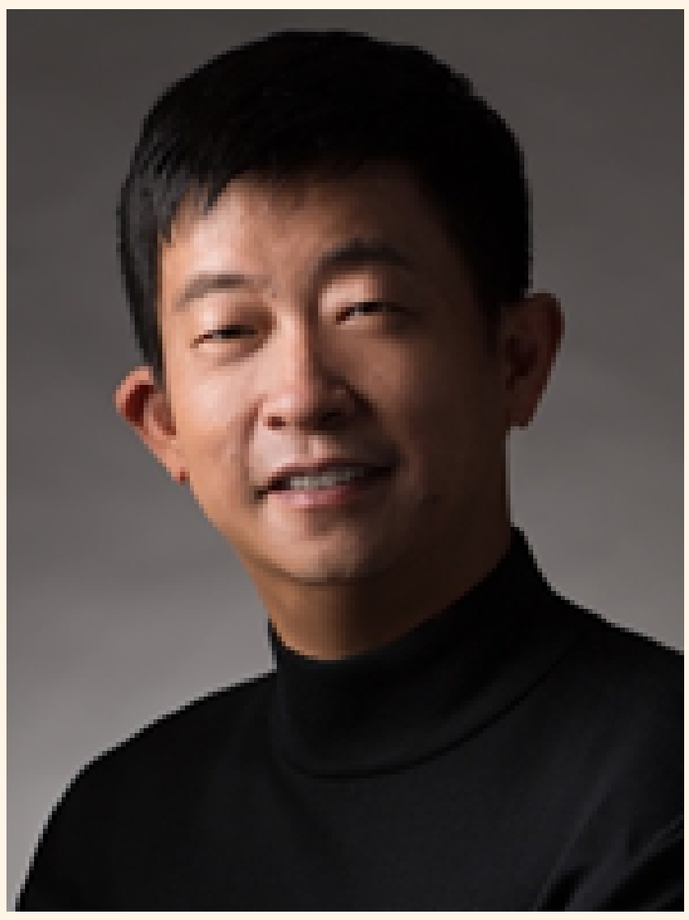

## SPEAKER: PROF. HAN ZHU

**University of Houston**

**【Abstract】**

Recently, distributionally robust optimization theory is introduced to overcome the shortcomings of these two approaches, which assumes that the distribution of the random variable is within an ambiguity set. This talk will give a detailed introduction to distributionally robust optimization techniques including the mathematic foundations and their applications in the wireless communication area. First, this talk will briefly explain the decision under uncertainty and the background of the distributionally robust optimization.Second, this talk will explain the concept of uncertainty set and how to choose and build up an uncertainty set based on the statistic learning techniques and historical data samples. Third, this talk will discuss the discrepancy-based distributionally robust optimization approach with Wasserstein distance. Fourth, this talk will discuss the distributionally robust reinforcement learning method which can make the agent more robust when it makes the decision in a high noise environment. In addition, this talk will introduce various communication applications by distributionally robust optimization and distributionally robust machine learning techniques including ultra-reliable communication, age of information minimization in healthcare IoT, computation offloading in space-air-ground integrated networks, etc. Finally, this talk will discuss the conclusions and future work.

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# ONLINE COURSE

# FEDERATED LEARNING AND ANALYSIS WITH MULTI-ACCESS EDGE COMPUTING

**2021/12/17(Fri.)**
**10:00-12:00**
**(Taipei Time)**

**Join WEBEX Meeting:**
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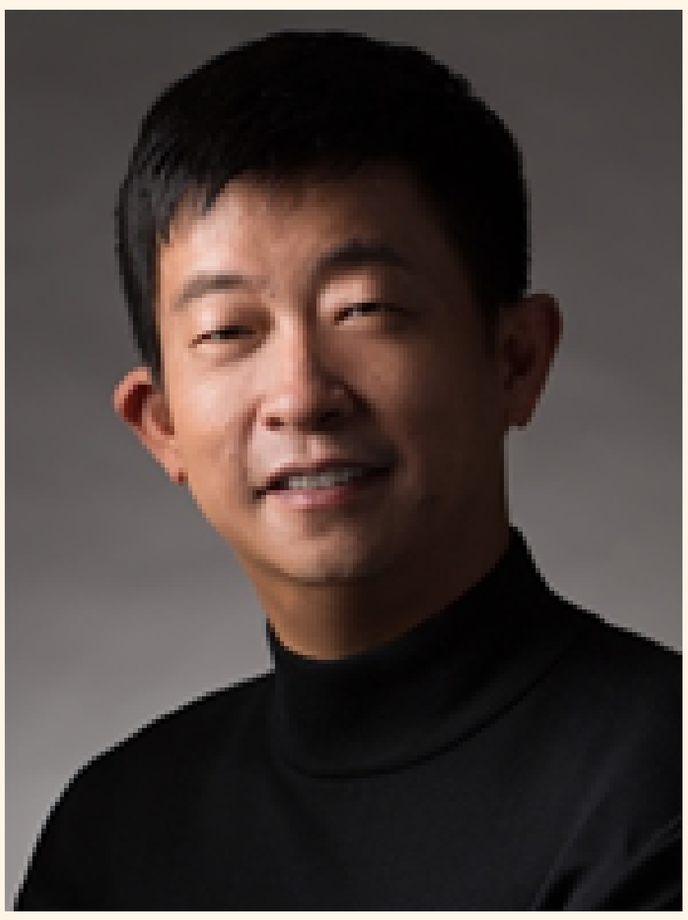

## SPEAKER: PROF. HAN ZHU

**University of Houston**

**【Registration】https://forms.gle/4vxoZ9BJSCUoNNr6A**

**【Abstract】**

In recent years, mobile devices are equipped with increasingly advanced computing capabilities, which opens up countless possibilities for meaningful applications. Traditional cloud-based Machine Learning (ML) approaches require the data to be centralized in a cloud server or data center. However, this results in critical issues related to unacceptable latency and communication inefficiency. To this end, multi-access edge computing (MEC) has been proposed to bring intelligence closer to the edge, where data is originally generated. However, conventional edge ML technologies still require personal data to be shared with edge servers. Recently, in light of increasing privacy concerns, the concept of Federated Learning (FL) has been introduced. In FL, end devices use their local data to train a local ML model required by the server. The end devices then send the local model updates instead of raw data to the server for aggregation. FL can serve as enabling technology in MEC since it enables the collaborative training of an ML model and also enables ML for mobile edge network optimization. However, in a large-scale and complex mobile edge network, FL still faces implementation challenges with regard to communication costs and resource allocation. In this talk, we begin with an introduction to the background and fundamentals of FL. Then, we discuss several potential challenges for FL implementation. In addition, we study the extension to Federated Analysis (FA) with potential applications.

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