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Tutorial I

Title: Artificial Intelligence, Machine Learning, and Statistical Signal Processing in Financial Technology (FinTech)

Speakers: Prof. Wei-Ho Chung, National Tsing Hua University
Prof. Che Lin, National Taiwan University

Chair: Prof. Yeong-Luh Ueng

Abstract: Financial technology (Fintech), a broad category that refers to the innovative use of ICT technology in the design and delivery of financial services and products, as revolutionized the financial industry or even more broadly the service industry. Artificial intelligence (AI) is the intelligence demonstrated by machines, in contrast to the natural intelligence (NI) displayed by humans and other animals. The tremendous success of AI and machine learning algorithms in the area of computer vision and natural language processing has demonstrated great potential of further applications into other disciplines. One of the most promising areas is the use of AI, machine learning, and financial data analytics in FinTech. In this tutorial, we will first introduce the financial concepts in the context of ICT and then aim to provide an overview of the recent trends in Fintech, machine learning and statistical signal processing approaches for tackling important challenges in FinTech, and how such approaches can be applied to solve real-world problems. We will discuss the challenges, constraints, and opportunities in this fascinating research area.

Short Bio:

Dr. Wei-Ho Chung received the B.Sc. and M.Sc. degrees in Electrical Engineering from the National Taiwan University, Taipei, Taiwan, in 2000 and 2002, respectively, and the Ph.D. degree in Electrical Engineering from the University of California, Los Angeles, in 2009. From 2002 to 2005, he was with ChungHwa Telecommunications Company. In 2008, he worked on CDMA systems at Qualcomm,

associate research fellow in 2014 in Academia Sinica. Since 2018, he has been a full Professor in Electrical Engineering, National Tsing Hua University. He leads the Wireless Communications Lab in National Tsing Hua University, Taiwan.

Dr. Che Lin received the B.S. degree in Electrical Engineering from National Taiwan University, Taipei, Taiwan, in 1999. He received the M.S. degree in Electrical and Computer Engineering in 2003, the M.S. degree in Math in 2008, and the Ph.D. degree in Electrical and Computer Engineering in 2008, all from the University of Illinois at Urbana-Champaign, IL. In 2008, he joined the Department of Electrical Engineering at National Tsing Hua University as an assistant professor, and has been an associate professor since August 2014. Dr. Lin received a two-year Vodafone graduate fellowship in 2006, the E. A. Reid fellowship award in 2008, and holds a U.S. patent, which has been included in the 3GPP LTE standard. In 2012, he received the Excellent Teaching Award for the college of EECS, NTHU. He won the best paper award for 2014 GIW-ISCB-ASIA conference. In 2015, he received the CIEE outstanding young electrical engineer Award. In 2017, he received the Young Scholar Innovation Award from Foundation For The Advancement Of Outstanding Scholarship. He is a senior member of IEEE. His research interests include deep learning, data mining and analytic, signal processing in wireless communications, optimization theory, systems biology, and FinTech.

Tutorial II

Title: Optical Mobile Communications

Speaker: Prof. Zaichen Zhang, Southeast University

Chair: Prof. Fei Qiao

Abstract: The 6G mobile communication system will be an integrated information system covering deep space, air, terrestrial, sea surface, and undersea communications. All frequency spectrum will be exploited to cater the needs of high-speed and full-coverage information transmission. The optical spectrum, which has huge frequency spectrum resources, will play a more and more important role in the development of the next generation mobile communication systems. In this tutorial, we will introduce state-of-the-art optical wireless communication (OWC) technologies, including free space optical (FSO) communications, visible light communications (VLC), as well as a newly proposed optical mobile communication (OMC) technology. Further development of OWC technologies in 6G scenario will be addressed, with emphasis on how the OWC technologies will be incorporated into the mobile communication architecture.

Short Bio:

Professor Zaichen Zhang received B.S. and M.S. degrees in electrical and information engineering from Southeast University, Nanjing in 1996 and 1999, respectively, and Ph.D. degree in electrical

is senior member of the IEEE. He served as IEEE ICC 2015 Keynote Chair, IEEE ICNC 2015 and PIMRC Symposium Chairs, and IEEE ICC 2019 Operation Chair. He was the Distinguished Visiting Fellow of Royal Academy of Engineering, UK, 2017 and the invited speaker of IEEE ICC 2017. His current research interests include 6G mobile information systems, optical wireless communications, and quantum information technologies.

Tutorial III

Title: Internet of Things (IoT): Signals, Communications, Applications, Challenges, and Future Research

Speaker: Prof. Ahmed Abdelgawad, Central Michigan University

Chair: Prof. Pei-Yun Tsai

Abstract: Internet of Things (IoT) is the network of physical objects or “things” embedded with electronics, software, sensors, and network connectivity. It enables the objects to collect, share, and analyze data. The IoT has become an integral part of our daily lives through applications such as public safety, intelligent tracking in transportation, industrial wireless automation, personal health monitoring, and health care for the aged community. IoT is one of the latest technologies that will change our lifestyle in coming years. Experts estimate that as of now, there are 23 billion connected devices, and by 2020 it would reach to 30 billion devices. This tutorial aims to introduce the design and implementation of IoT systems. The foundations of IoT will be discussed throughout real applications. Challenges and constraints for the future research in IoT will be discussed. In addition, research opportunities and collaboration will be offered for the attendees.

Short Bio:

Dr. Ahmed Abdelgawad received his M.S. and a Ph.D. degree in Computer Engineering from University of Louisiana at Lafayette in 2007 and 2011 and subsequently joined IBM as a Design Aids & Automation Engineering Professional at Semiconductor Research and Development Center. In Fall 2012 he joined Central Michigan University as a Computer Engineering Assistant Professor. In Fall 2017, Dr. Abdelgawad was early promoted as a Computer Engineering Associate Professor. He is a senior member of IEEE. His area of expertise is distributed computing for Wireless Sensor Network (WSN), Internet of Things (IoT), Structural Health Monitoring (SHM), data fusion techniques for WSN, low power embedded system, video processing, digital signal processing, Robotics, RFID, Localization, VLSI, and FPGA design. He has published two books and more than 82 articles in related journals and conferences. Dr. Abdelgawad served as a reviewer for several conferences and journals, including IEEE WF-IoT, IEEE ISCAS, IEEE SAS, IEEE IoT Journal, IEEE Communications Magazine, Springer, Elsevier, IEEE Transactions on VLSI, and IEEE Transactions on I&M. He served in the technical committees of IEEE ISCAS 2007, IEEE ISCAS 2008, and IEEE ICIP 2009 conferences. He served in the administration committee of IEEE SiPS 2011. He also served in the organizing committee of ICECS2013 and 2015. Dr. Abdelgawad was the publicity chair in North America of the IEEE WF-IoT 2016/18/19 conferences. He was the finance chair of the IEEE ICASSP 2017. He is the TPC Co-Chair of I3C'17, the TPC Co-Chair of GIOTS 2017, and the technical program chair of IEEE MWSCAS 2018. He was the keynote speaker for many international

conferences and conducted many webinars. He is currently the IEEE Northeast Michigan section chair and IEEE SPS Internet of Things (IoT) SIG Member. In addition, Dr. Abdelgawad served as a PI and Co-PI for several funded grants from NSF.

Tutorial IV

Title: Generative Adversarial Network and its Applications to Speech Signal and Natural Language Processing

Speaker: Prof. Hung-yi Lee, National Taiwan University

Chair: Prof. Che Lin

Abstract: Generative adversarial network (GAN) is a new idea for training models, in which a generator and a discriminator compete against each other to improve the generation quality. Recently, GAN has shown amazing results in image generation, and a large amount and a wide variety of new ideas, techniques, and applications have been developed based on it. Although there are only few successful cases, GAN has great potential to be applied to text and speech generations to overcome limitations in the conventional methods. There are three parts in this tutorial. In the first part, I will give an introduction of GAN and provide a thorough review about this technology. In the second part, I will focus on the applications of GAN to speech signal processing. In the third part, I will describe the major challenge of sentence generation by GAN and review a series of approaches dealing with the challenge.

Short Bio:

Hung-yi Lee received the M.S. and Ph.D. degrees from National Taiwan University (NTU), Taipei, Taiwan, in 2010 and 2012, respectively. From September 2012 to August 2013, he was a postdoctoral fellow in Research Center for Information Technology Innovation, Academia Sinica. From September 2013 to July 2014, he was a visiting scientist at the Spoken Language Systems Group of MIT Computer Science and Artificial Intelligence Laboratory (CSAIL). He is currently an assistant professor of the Department of Electrical Engineering of National Taiwan University, with a joint appointment at the Department of Computer Science & Information Engineering of the university. His research focuses on machine learning (especially deep learning), spoken language understanding and speech recognition. He owns a YouTube channel teaching deep learning (in Mandarin) with more than 3M views and 39k subscribers (<https://www.youtube.com/channel/UC2ggjtuuWvvrHHHiaDH1dlQ/playlists>).

Tutorial V

Title: Making Healthcare More Accessible via AI: Extension of Telemedicine

Speaker: Prof. Gwo Giun (Chris) Lee, National Cheng Kung University

Chair: Prof. Yuan-Hao Huang

Abstract: This tutorial will focus on innovative digital health ecosystem and analytics system which fosters extension of telemedicine through the transfer of comprehensive medical expertise and experiences via Artificial Intelligence (AI) from tertiary medical centers to remote care facilities in making healthcare more accessible! Cancer is among the most important issues of healthcare worldwide. However, under current medical systems, diagnosis of these severe diseases is commonly delayed, especially in remote locations with limited medical resources. Hence it is necessary to facilitate early screening at these distant care units using Computer-Aided-Diagnostic (CAD) tools possessing tertiary centers' experiences accumulated through AI. In attempts to reform and advance the digital health environment, using skin care as example, this tutorial introduces an ecosystem, by which integration of remote care facilities is substantiated, through utilization of high accuracy and efficiency of AI as extension of telemedicine! Being an exemplary, this AI medical networking model is readily extensible to global medical and biotech communities! This tutorial will also introduce the speaker's reconfigurable edge system for the detection of Skin Cancer on mobile devices with more than 95% accuracy.

Short Bio:

Chris Gwo Giun Lee is an investigator in the field of signal processing systems including multimedia and bioinformatics. His endeavors in system design, based on analytics of algorithm concurrently with analytics architecture, has made possible computations on System-on-Chip and cloud platforms in resolving complex problems with both accuracy and efficiency. Having previously held leading and managerial positions in the industry such as System Architect in former Philips Semiconductor in Silicon Valley, Lee was recruited to NCKU in 2003 where he found and is currently directing the Bioinfotonics Research Center.

Lee received his B.S. degree in electrical engineering from National Taiwan University and both his M.S. and Ph.D. degrees in electrical engineering from University of Massachusetts. He has contributed more than 130 original research and technical publications with the invention of 60+ patents worldwide.

Lee serves as the AE for IEEE TSP and Journal of Signal Processing Systems. He was formerly the AE for IEEE TCSVT for which he received the Best Associate Editor's Award in 2011.

Tutorial VI

Title: Tensor Subspace Analysis in Signal Processing

Speaker: Prof. Yipeng Liu, University of Electronic Science and Technology of China

Chair: Prof. Wei-Ho Chung

Abstract: The standard matrix computation can not fully exploit the global data structure in higher-order signal processing. The recent advances in tensor computation allow us to move from classical matrix based methods to tensor based methods for many signal processing techniques. This tutorial focuses on different tensor decompositions for tensor subspace analysis in signal processing. Firstly, a basic coverage of tensor notations, preliminary operations, and main tensor

decompositions is briefly provided. Based on them, a series of tensor subspace analysis methods are presented, as the multi-linear extensions of classical sparse signal recovery, principle component analysis, matrix completion, non-negative matrix factorization, linear regression, subspace cluster, etc. The experimental results for some signal processing applications are given, e.g., image reconstruction, denoising, illumination normalization, background extraction, and classification. Finally, some deep tensor networks are discussed for possible tensor signal processing applications.

Short Bio:

Yipeng Liu received the B.Sc. degree in biomedical engineering and the Ph.D. degree in information and communication engineering from University of Electronic Science and Technology of China (UESTC), Chengdu, in 2006 and 2011, respectively. From 2010 to 2011, he was a visiting PhD student in Tsinghua University, Beijing, China. In 2011, he was a research engineer at Huawei Technologies, Chengdu, China. From 2011 to 2014, he was a postdoctoral research fellow at University of Leuven, Leuven, Belgium. Since 2014, he has been an associate professor with University of Electronic Science and Technology of China (UESTC), Chengdu, China.

His research interest is tensor signal processing. He has authored or co-authored over 50 publications on these areas. One of the co-authored papers received the ISMRM MERIT AWARD of Magna cum laude at ISMRM 2015. He also holds more than 10 patents. He has been a principal investigator (PI) or Co-PI for a number of R&D projects (funded by government and industry) on tensor signal processing theory and its applications. He has given and will give tutorials on a number of international conferences, such as ISCAS 2019, APSIPA ASC 2019.

He serves as managing guest editor of the Special Issue on Tensor Image Processing of the journal *Signal Processing: Image Communication*. As an expert on tensor signal processing, he has served 4 international conferences as a technical/program committee member. He is an IEEE senior member, a member of the Multimedia Technology Technical Committee of Chinese Computer Federation, and a member of China Society of Image and Graphics on Youth Working Committee. He is the scientific advisor of Beiton AI. He has been teaching the course optimization theory and applications for graduates since 2015, and got the first prize of the 8th University Teaching Achievement Award in 2016.