**Machine Learning for Communications**

**Agenda**

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| 10th January 2022 | |
| 13:30 – 13:40 | **Introduction and welcome**  *Victoria Nockles, The Alan Turing Institute* |
| 13:40 – 14:00 | **Passive Communications Network Topology Reconstruction using Graph Neural Networks**  *Callum Court, BAE Systems*  In this talk I will describe a novel methodology for reconstructing the topology of a communications network (who is talking to whom) using only passive observation of the network transmissions. The method utilises state-of-the-art graph neural networks (GNNs) to accurately reconstruct the structure of simulated networks and then characterise/identify important nodes. These initial results present a promising avenue for further research, with the potential for great utility in an Electronic Surveillance (ES) context. |
| 14:00 – 14:20 | **Machine learning empowered 6G and computing**  *Shuangyi Yan, University of Bristol*  The developing networking concepts in 5G and beyond networks, such as service-based architecture, network function virtualisation (NFV), dynamic RAN function splitting, and end-to-end orchestration, increase the complexity of network management significantly. The latest advance in Machine-learning (ML) technologies provides a plethora of tools to drive the innovations of networks in terms of network management and network operations. This talk will review several application scenarios of ML technologies with the recognised new challenges in 6G networks. Taking advantage of our cutting-edge field trial testbed with RAN telemetry, the developed emulation platform, the talk will report our latest work on Deep Reinforcement Learning (DRL) based network and computing optimisation, including RAN deployment, UE access optimisation and computing offloading. |
| 14:20 – 14:40 | **What is meta-learning and how can it be studied via comms?**  *Rui Li, Samsung*  Meta-learning provides a popular and effective family of methods for data-efficient learning of new tasks. However, several important issues in meta-learning have proven hard to study thus far. For example, performance degrades in real-world settings where meta-learners must learn from a wide and potentially multi-modal distribution of training tasks; and when a distribution shift exists between meta-train and meta-test task distributions. These issues are typically hard to study since the shape of task distributions, and shift between them are not straightforward to measure or control in standard benchmarks. I will present our work using the channel coding problem as a benchmark for meta-learning. Channel coding is a classical comms problem and an important practical application where task distributions naturally arise, and fast adaptation to new tasks is practically valuable. We use our benchmark to study several aspects of meta-learning, including the impact of task distribution breadth and shift, which can be controlled in the coding tasks. Going forward, our benchmark provides a tool for the meta-learning community to study the capabilities and limitations of meta-learning, and to drive research on practically robust and effective meta-learners. |
| 14:40 – 15:10 | **Coffee Break** |
| 15:10 – 15:30 | **Learning-based design for the physical layer of wireless communication systems**  *Christos Masouros, UCL*  What are the scenarios where classical signal processing approaches underperform? How to move from block-by-block transceiver design, towards data-driven and model-driven approaches? The basis of the research is the advancement of signal processing for physical layer wireless communication design, to address complex scenarios, and this is underpinned by the EPSRC LeanCom project:  ([https://gow.epsrc.ukri.org/NGBOViewGrant.aspx?GrantRef=EP/S028455/1](https://eur01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fgow.epsrc.ukri.org%2FNGBOViewGrant.aspx%3FGrantRef%3DEP%2FS028455%2F1&data=04%7C01%7Cvnockles%40turing.ac.uk%7C552ba1b2bcb441dd482908d9bb1d725a%7C4395f4a7e4554f958a9f1fbaef6384f9%7C0%7C0%7C637746557408534276%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000&sdata=YGso%2B5e5AP6dq4j4T3fKB6kEehPJcEmBDXZOEBPzFi4%3D&reserved=0) ) |
| 15:30 – 15:50 | **Deep Learning for mmWave Beam Selection using LiDAR and images**  *Kaushik Chowdhury, Northeastern University*  Beam selection for millimeter-wave links in a vehicular scenario is a challenging problem, as an exhaustive search among all candidate beam pairs cannot be assuredly completed within short contact times. We demonstrate a solution to this problem via expediting beam selection by leveraging multi-modal data collected from sensors like LiDAR, camera images, and GPS, publicly available from the Raymobtime dataset. This talk summarizes the approaches and key performance results from the recently concluded ITU ML Challenge competition. We propose individual modality and distributed fusion-based deep learning architectures that can execute locally as well as at a mobile edge computing center, with a study on associated tradeoffs. We also formulate and solve an optimization problem that considers practical beam-searching, processing and sensor-to-mobile edge data delivery latency overheads. The talk identifies a number of open challenges and approaches that will accelerate the development of high-bandwidth communication links for applications like self-driving cars. |
| 15:50 – 17:00 | **Discussion** |