Lecture Title: A Primer on AI/ML for Communication Networks

Lecture Abstract (250 words): In recent years, we have witnessed a progressive introduction of sophisticated technologies in the radio interface. This includes Terahertz communications, ultra-massive and holographic radio, scalable cell-free MIMO networking, intelligent reflecting surfaces, or non-orthogonal multiple and massive random access, to name a few. This provides fundamental performance advantages and enables futuristic use cases. However, their introduction also entails that complex management solutions are needed to meet the stringent requirements associated to those services. Such complexity can only be addressed by introducing increasing levels of network automation which can be largely facilitated by the adoption of Artificial Intelligence/Machine Learning (AI/ML). For the design of 6G networks, it is generally agreed that AI-native air interface designs, that is, where the inclusion of data-driven approaches is done from the onset, rather than as an add-on, are preferable.

This talk is aimed to provide the audience with an introduction to AI/ML techniques and their application to the design of xG communication networks. First some fundamental concepts like AI/Machine Learning/Deep Learning, the pros and cons of engineering vs. data-driven approaches, when to use AI/ML, or a taxonomy of learning approaches will be discussed. This will be followed by an introduction to the concepts of supervised, unsupervised and reinforcement learning approaches, along with a high-level description of key algorithms belonging to each of those families. Complementarily, several examples illustrating how AI/ML techniques have been successfully applied to the (re)design of functionalities in the air-interface of wireless communication systems will be presented as well.