Introduction to Intelligent Edge Computing in Pervasive Environments Minitrack

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This minitrack focuses on software development, where more power is given to computational edges and potentially creating an intelligent edge computing paradigm. Accepted papers focus on the power of computational edge. They look at situations in which the feasibility of accommodating complex computing at the edge, affects expectations we have from the edge computing, and questions tendencies of moving away from the cloud computing paradigm. One paper deals with the problem of accommodating AI computational burden at the edge and the other proposes a software architectural model for software as a device, by placing its software applications at the computational edge.

The paper "Exploring Spiking Neural Networks (SNN) for Low Size, Weight, and Power (SWaP) Benefits" clearly states concerns that SWaP must be considered because it affects performance of AI applications in edge computing. The authors chose to look at SNN and neuromorphic edge processors, which in turn may come closer to "biological intelligence" and exhibit efficient computations. The paper investigates whether spike-based operations can result in lower-SWaP, compared to traditional Artificial Neural Networks (ANN). In other words, if SNN secures "firing/spiking" when needed, it is reasonable to assume that they would exhibit SWaP benefits compared to ANN. To prove this assumption, the authors included experiments with both, classical and neuromorphic edge hardware, and compared the results. When teaming SNN with neuromorphic edge, applications of computer vision performed at 1/10 power compared to ANN. However, the authors emphasize that this is particularly visible when a neuromorphic edge device is combined with neuromorphic SNN algorithms. Interestingly, the ANN-to-SNN converted models provided better accuracy and needed less power than both ANNs and SNNs. This can be the result of either training SNNs natively, or having a unique advantage from ANN-to-SNN conversion. This research also promotes the idea of relying on dedicated AI/ML hardware at the edge and creating additional network structures where edge computing resides.

The paper "Software as a Device in Edge Computing" debates the creation of sustainable edge computing where software may play the role of a device. The idea of "seeing" software as a device is triggered by the proliferation of new devices with proprietary software, which often deliver almost identical services and thus create heterogeneities of hardware and software and adversely affect edge computing. This in turn creates the problem of decoupling proprietary software from devices, defined by devices' manufacturers. The inability to decouple software from such devices creates a lack of transparency of software solutions which deliver services. It also shows our dependence on hardware manufacturers, which restricts understanding/ choosing software we wish to run. On the other hand, this raises the question of whether device manufacturers could afford to create their innovative products if they cannot oversee software which delivers services through their products. In this paper, the authors show that it is feasible to create a generic software architecture which generates software applications for any device, delivers required services and places computing of these software applications at the edge. At the time of advances in sensory technologies, existence of a data source continuum and appearance of continuous software engineering, enriched with intelligent edge-based service provisioning, there is no need to manufacture more hardware for delivering services through software, and thus decoupling software from devices is essential for empowering edge computing. The illustration of the proposal is placed in the domain of software as a medical device, which helps in explaining the need for conceptualizing software development at the edges. It also follows the vision of the US FDA for delivering healthcare services using software as a medical device.

URI: https://hdl.handle.net/10125/107292
978-0-9981331-7-1