Supporting Efficient Workflow Deployment of Federated Learning Systems on the Computing Continuum

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Context

Comuting Continuum

Applying complex workflows over Cloud-Fog-Edge Continuum

Federated Learning

Directly training over edge devices on sensitive data

Motivating Use Case

Applying FL to Smart Living using thousands of smart devices

Problems

Heterogeneous devices
IoT objects relying on different architectures require extra efforts to be supported in a same application (supporting different standards)

Hyperparameter tuning
Federated Learning introduces several additional hyperparameters in contrasts with standard ML, requiring deeper optimization

Inconsistent performance
Devices with very different usage result in data drift and inconsistent performance of the model among clients

Our Proposal

A Workflow for Efficient FL Deployment and Model Optimization

How to improve interoperability across IoT platforms?

How to automatically deploy and monitor FL solutions?

How to ensure good model performance on each client?

Early Results

Performing FL training over smartphone data from 8 users for recognition of Daily Living Activities

Impact of client learning rate and number of local epochs on training

Impact of data drift on model performance

Takeaways

We provided a solution to automatically deploy and optimize FL workflows in heterogeneous environments using formal description of the underlying infrastructure, hyperparameter optimization and model retraining in case of data drift.

Open Questions

How to determine which model is performing better considering several conflicting metrics and clients with different data distribution? (e.g optimizing energy consumption, accuracy of the model and bandwidth usage)

Considering constrained devices, how often should models be trained? (minimizing battery usage of the device)