Independent Measurement Platform for Federated Learning (FL) Models on Android Devices

Michael Cho, Dr. Afra Mashhadi

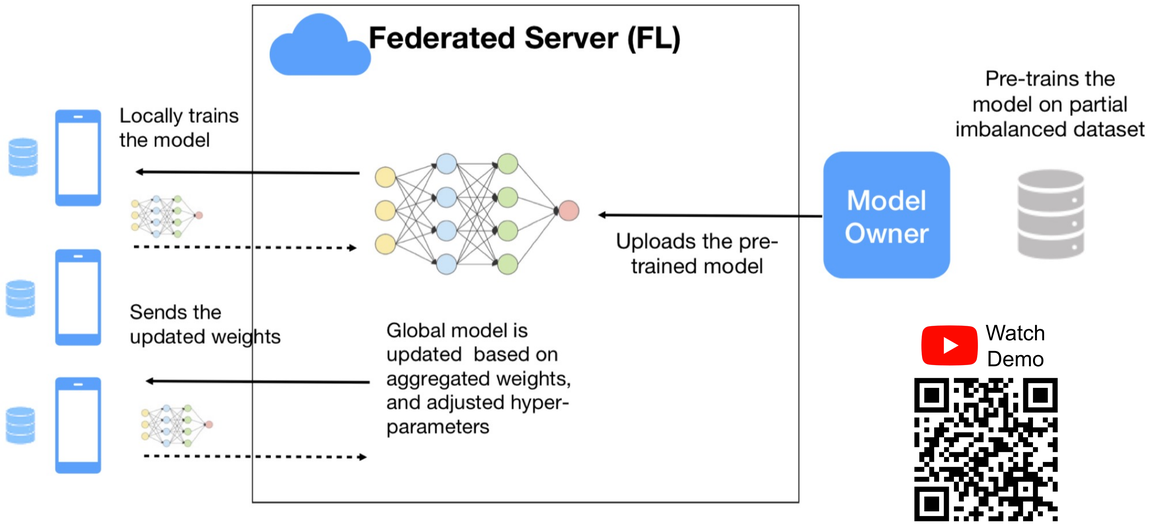
Ubiquitous Computing Laboratory, University of Washington Bothell | mikec87@uw.edu

Introduction

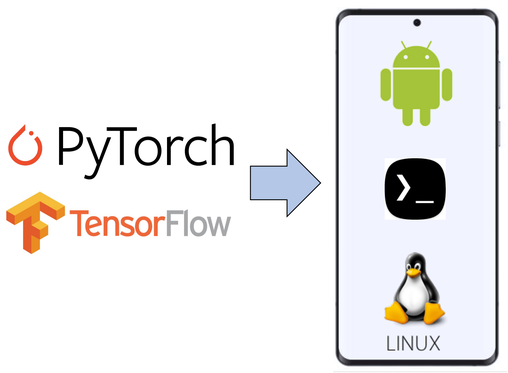
Machine Learning (ML) is a powerful tool that allows us to effectively use data to make predictions and improve algorithms. However, traditional **ML requires expensive centralized hardware and data, is prone to algorithmic biases, and has privacy concerns surrounding the use of data.**

Federated Learning

Federated Learning aims to address various downsides and challenges that face many traditional centralized machine learning approaches. **This research delivers a platform for Federated Learning on Android devices that distributes the training process to heterogenous edge clients.**



Training on Android



- **Native** FL training on Android devices
- **Efficient** use of compute and energy resources
- **Adaptable** for a variety of ML models
- **Accessible** to mainstream users
- **Maintains privacy** by localizing user data
- **Diversity of data** potentially reduces algorithmic biases

Model	Time (per one round)	Max Memory
MobileNet (TL)	180 s	728 MB
MobileNet (No TL)	340 s	2.8 GB
SqueezeNet (TL)	7 s	384 MB
SqueezeNet (No TL)	32 s	1.2GB

Table 1. Training time and max memory usage for MobileNet and Squeezenet on a Samsung S21 Ultra

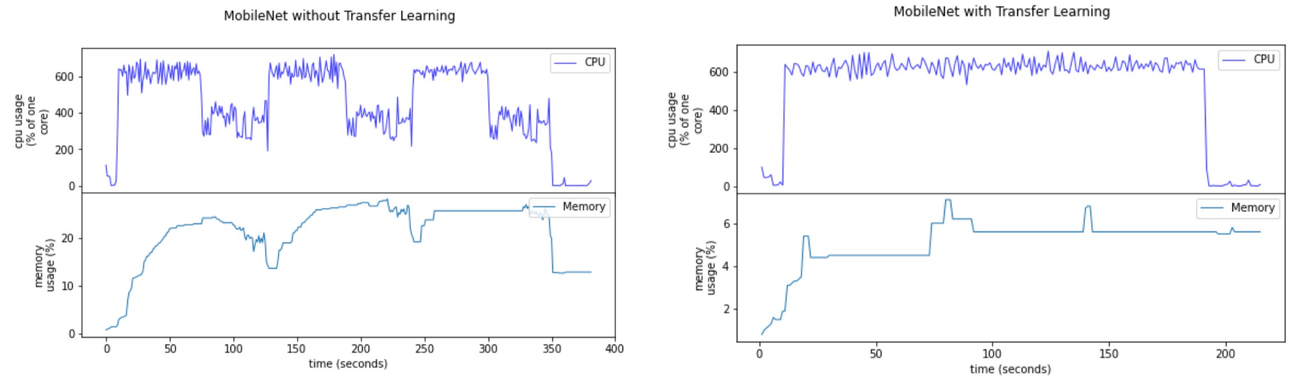


Figure 1. Federated Learning model training on an Android phone. Results show CPU and Memory usage for one round of training (MobileNet) on a Samsung S21 Ultra with and without Transfer Learning.

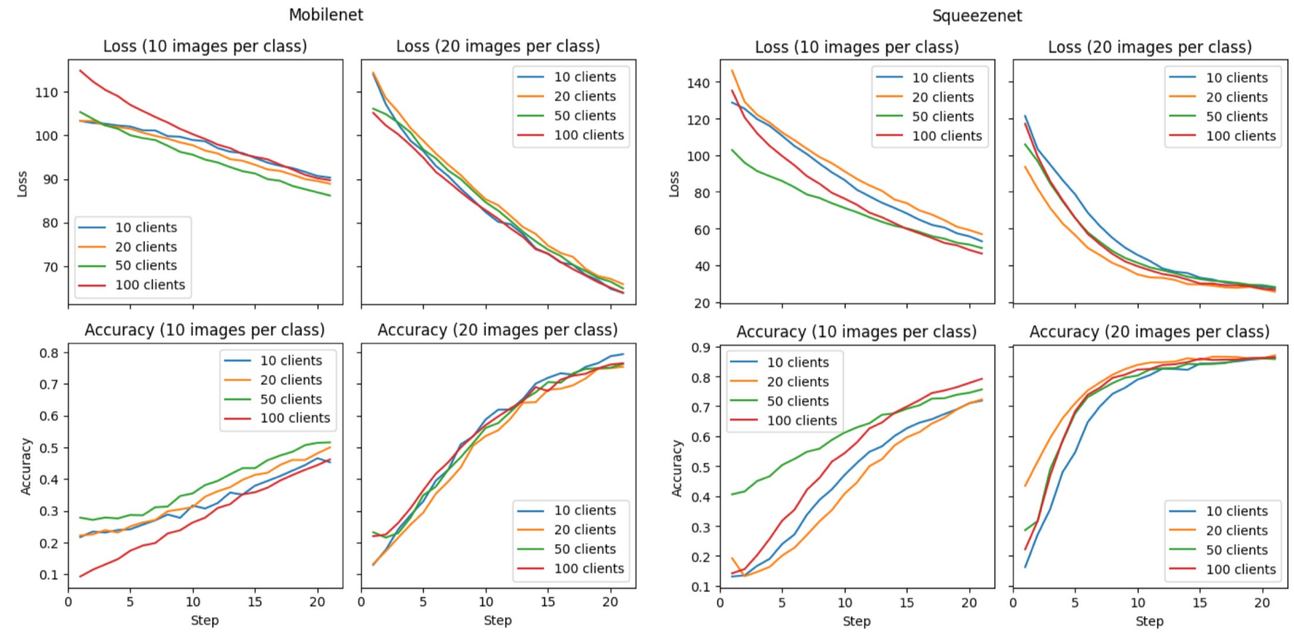


Figure 2. Training simulation of Federated Learning using varying number of clients. Results show the algorithmic performance for accuracy and loss with MobileNet and Squeezenet using training datasets containing 10 and 20 images per class.

Implications

- This Federated Learning platform has been used in research for a proposed Mobile Crowdsensing Framework and a Long-short Term Memory (LSTM) abnormal heartbeat detection model.
- Enables researchers to move from simulations to real-world analysis.
- Demonstrates novel methods for using Federated Learning techniques to **address topics of accessibility, privacy, algorithmic bias, and hardware limitations** inherent in traditional centralized machine learning applications.

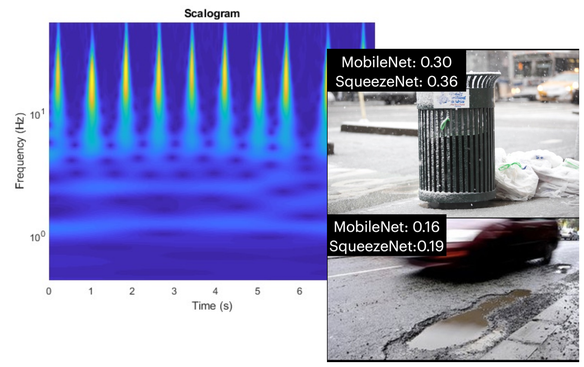


Figure 3. Examples of obstacle detection and LSTM training that may take advantage of FL.