

Federated Learning

Idea, Applications, and

Daniel Schalk

October 19, 2018



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Federated/Decentralized Learning

Federated Learning of Gradient-Based Methods

Challenges

Federated/Decentralized Learning

Federated Learning as learning on decentralized data with the following properties:

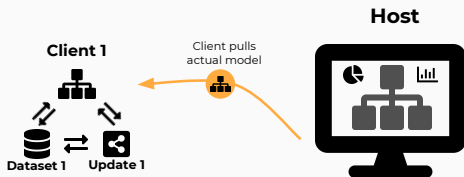
- **Non-IID** The training data on a given client is typically based on the usage of the mobile device by a particular user, and hence any particular user's local dataset will not be representative of the population distribution.
- **Unbalanced** Similarly, some users will make much heavier use of the service or app than others, leading to varying amounts of local training data.
- **Massively distributed** We expect the number of clients participating in an optimization to be much larger than the average number of examples per client.
- **Limited communication** Mobile devices are frequently offline or on slow or expensive connections.

What is it About?

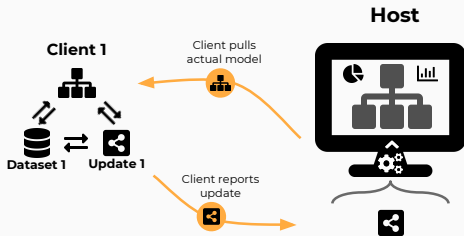
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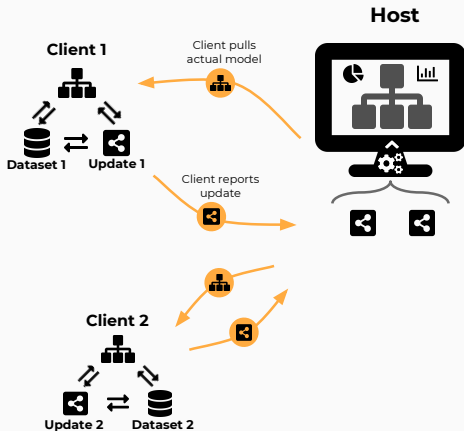
What is it About?



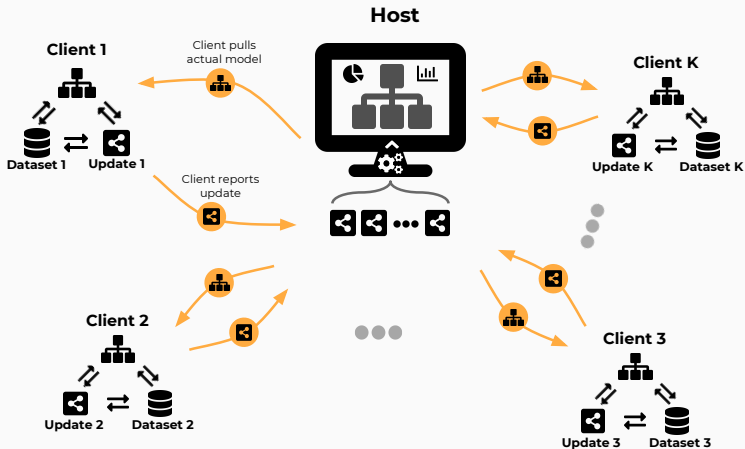
What is it About?



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What is it About?



Federated Learning of Gradient-Based Methods

- Problems

Federated Averaging

Challenges

Communication Costs vs. Training Costs

Evaluation of Federated Learning Systems