

FedGTST: Boosting Global Transferability of Federated Models Via Statistics Tuning

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Motivation

Background

- ❖ Transfer Learning Requires Vast Data
 - Challenging for Individual Learner
- ❖ Federated Learning as a solution
 - Mitigate Individual Burdens
 - Safeguard Data Privacy

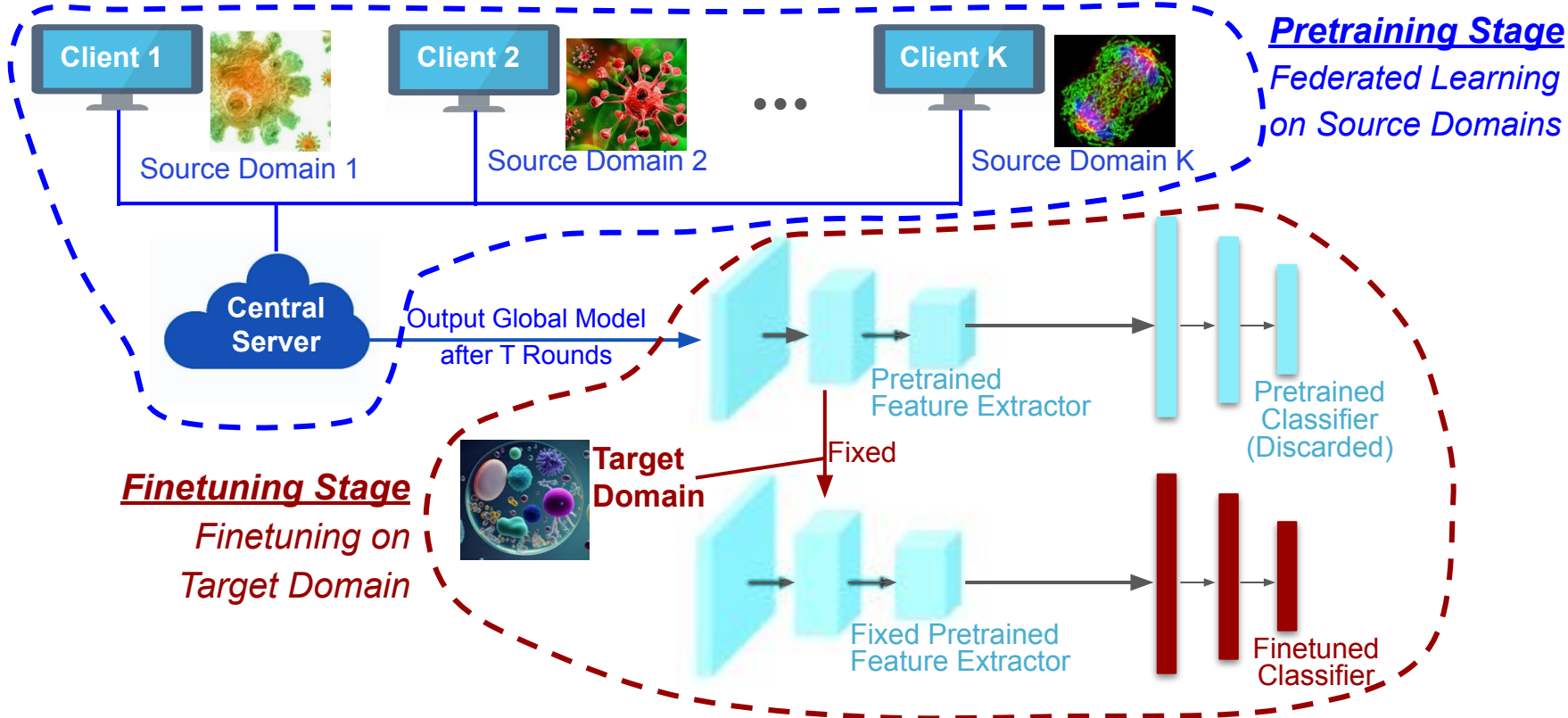
Challenges

- ❖ Privacy Leakage
- ❖ Local Overfitting
- ❖ Communication Complexity
- ❖ Lack explicit theoretical analysis

Goal

- ❖ Enhances FL transferability;
- ❖ Addresses Prior Challenges.

Problem Formulation



Theoretical Insights: Tune Cross-Client Statistics

Enlarge cross-client averaged gradient norm

$$\|J_p\|_2 = \left\| \frac{1}{K} \sum_k J_p^{(k)} \right\|_2$$

Tighten the upper bound on \widehat{L}_{tgt}^* → Better transferability

Decrease cross-client gradient variance

$$\sigma_p^2 = \frac{1}{K} \sum_k \|J_p^{(k)}\|_2^2 - \left\| \frac{1}{K} \sum_k J_p^{(k)} \right\|_2^2$$

FedGTST Algorithm: Regularized Local Objective

Standard Source Loss of Local Client k

Local Gradient of Client k

$$L_{\mathcal{D}_S^{(k)}}(h) + \xi \cdot \left(\|J^{(k)}(h)\|_2 - \gamma \right)^2$$

Guiding Norm Broadcast By Central Server

Penalty Term on Local Gradient Norm

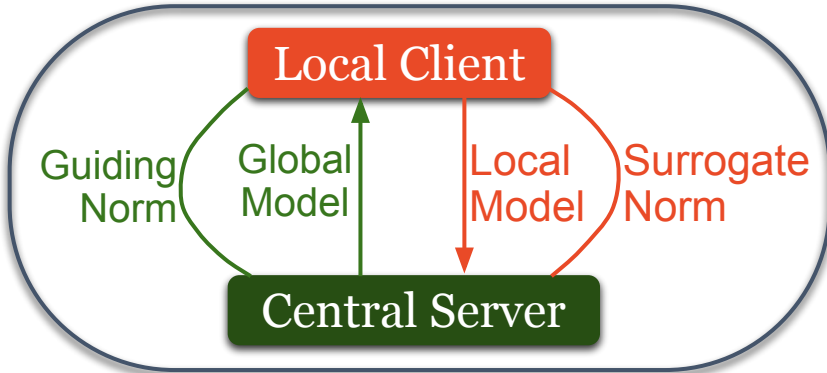
$$\gamma := \max_k \gamma^{(k)}$$

Surrogate Norm Submitted by Local Client k

$$\gamma^{(k)} := \max(\|J^{reg,(k)}(h)\|_2, \|J^{(k)}(h)\|_2)$$

Regularized Local Gradient of Client k

Standard Local Gradient of Client k



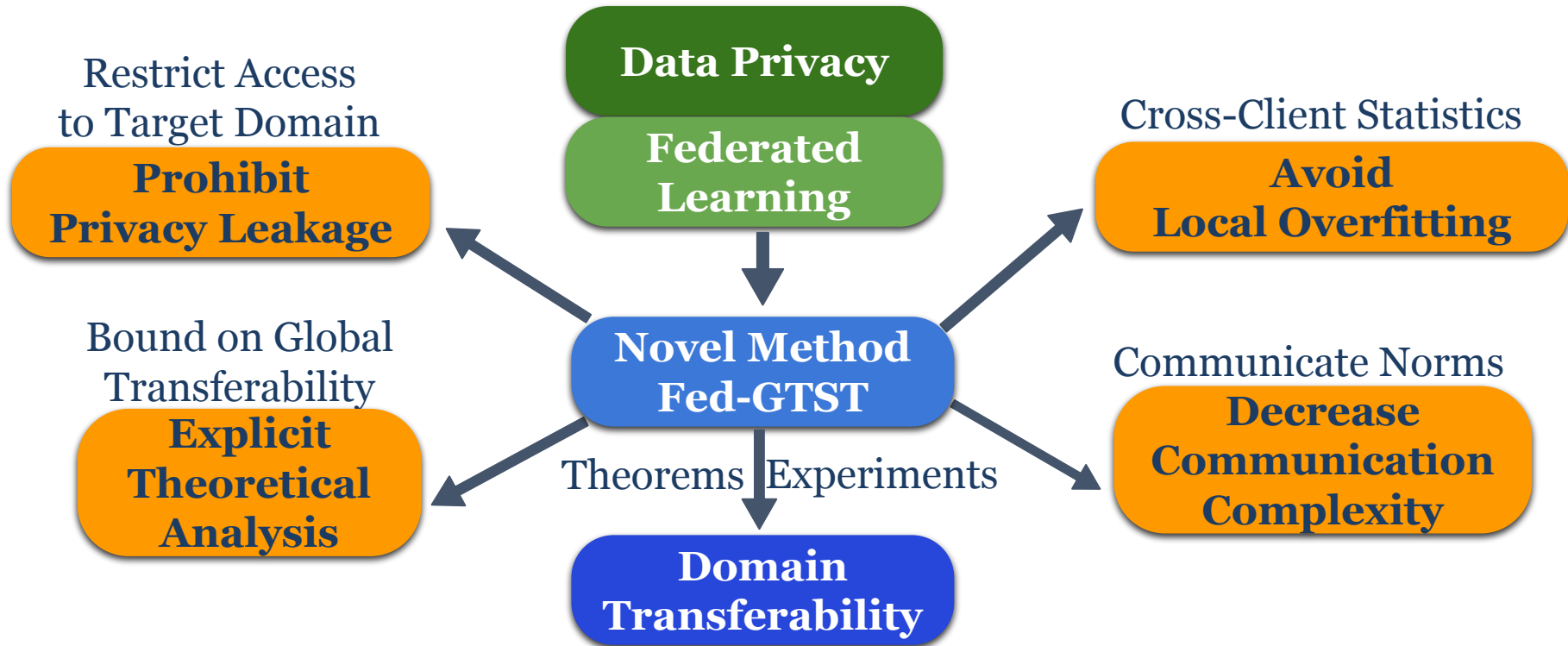
Align Local Gradient Norm with Guiding Norm

- ❖ Decrease Cross-Client Gradient Variance
- ❖ Enlarge Cross-Client Averaged Gradient Norm

Selected Experiment Results

Method	MNIST \rightarrow MNIST-M		CIFAR10 \rightarrow SVHN		Average
	LeNet	ResNet	LeNet	ResNet	
FedAVG	48.7 \pm 0.1	61.1 \pm 0.3	41.2 \pm 0.2	51.7 \pm 0.5	50.7
FedSR	49.2 \pm 0.2	59.8 \pm 0.3	42.6 \pm 0.1	52.0 \pm 0.3	50.9
FedIIR	51.9 \pm 0.4	61.3 \pm 0.1	44.8 \pm 0.4	55.8 \pm 0.2	53.4
Fed-GTST	57.5\pm0.3	67.6\pm0.2	52.4\pm0.1	63.1\pm0.2	60.2

Takeaway



THANK YOU!

