

Vishnu v1: Prototype-Oriented Distillation for Federated Continual Self-Supervised Vision

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Abstract

Vishnu-v1 is a privacy-preserving framework enabling continuous self-supervised learning on edge devices. It consolidates evolving knowledge across heterogeneous domains, effectively preserving past representations while reducing communication overhead.

Problem Statement

Current AI systems fail to adapt in real-world scenarios because they rely on static, centralized training that cannot process unlabeled, private data streams without suffering from catastrophic forgetting.

Existing Problems

- Catastrophic forgetting
- Data heterogeneity
- Privacy constraints
- Limited label availability
- Inefficient adaptation

Literature Review

Paper Title & Venue	Dataset Used	Key Contributions	Other Observations
Communication-Efficient Learning of Deep Networks from Decentralized Data (AISTATS 2017)	MNIST, CIFAR-10, Shakespeare	Introduced FedAvg (Federated Averaging), the baseline algorithm for training across decentralized devices without sharing data.	Catastrophic forgetting
iCaRL: Incremental Classifier and Representation Learning (CVPR 2017)	CIFAR-100, ImageNet	Proposed using Prototypes (class means) and distillation to prevent forgetting new classes.	Violates privacy
A Simple Framework for Contrastive Learning of Visual Representations (SimCLR) (ICML 2020)	ImageNet, CIFAR-10	Proved that simple data augmentation and contrastive loss can learn powerful visual features without labels.	Computationally expensive
Federated Continual Learning with Weighted Inter-Client Transfer (FedWeIT) (ICML 2021)	Split CIFAR-100, mini-ImageNet	Decomposed model weights into global and sparse task-specific parameters to reduce interference between clients.	Minimizes interference
Resource-Aware Federated Self-Supervised Learning with Global Class Representations (NeurIPS 2023)	CIFAR-10, CIFAR-100	Uses knowledge distillation to align diverse client representations with a global anchor model.	Handles non-IID data

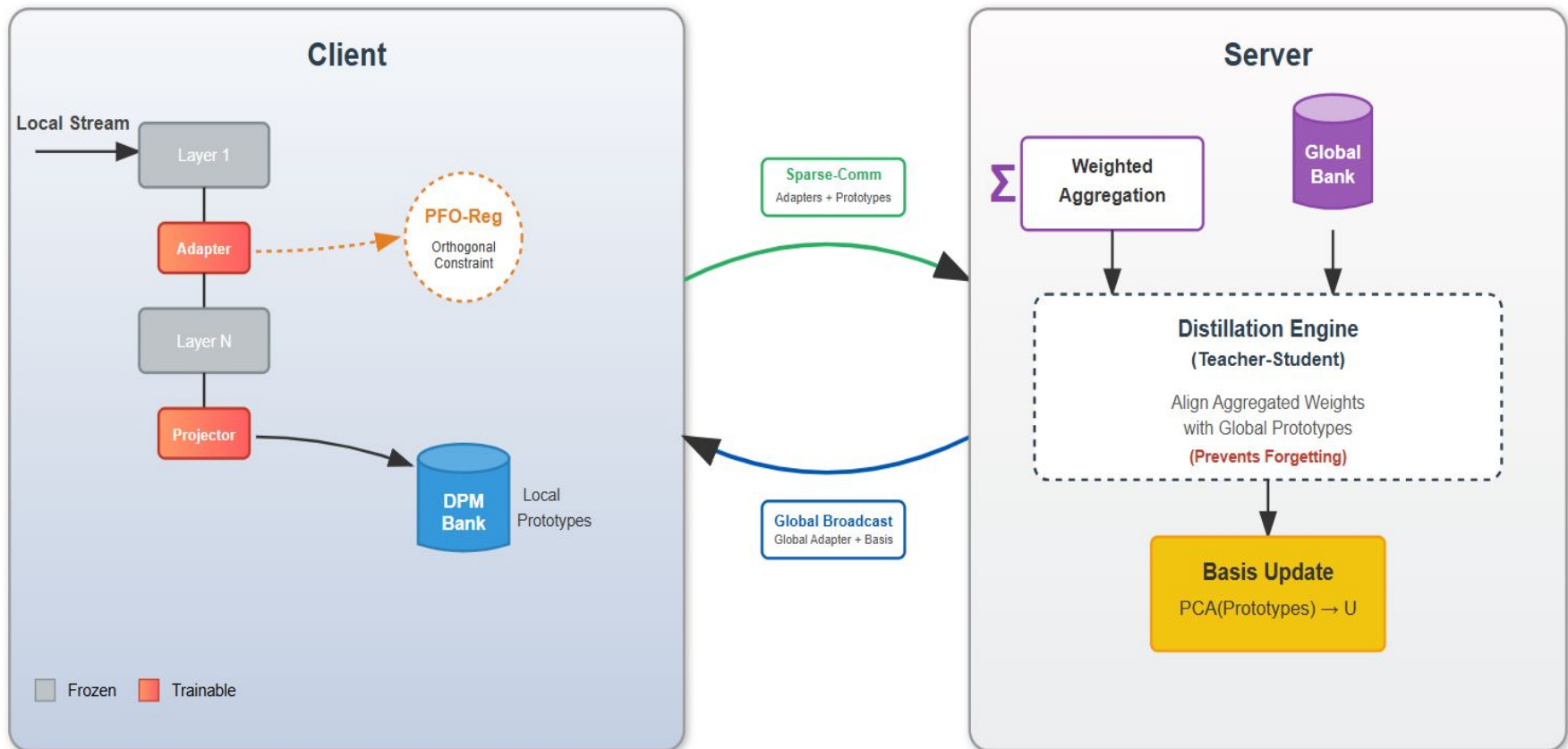
Objectives

- Develop a framework that enables scalable and privacy-preserving learning.
- Achieve robust learning across evolving data distributions.
- Ensure efficient long-term knowledge retention while minimizing catastrophic forgetting.

Proposed Architecture

Vishnu v1 Architecture

Prototype-Oriented Distillation for Federated Continual Self-Supervised Vision



Proposed Module

- Information-Bottlenecked Adapter Module
- Projective Feature Orthogonalizer
- Distributed Prototype Memory Bank
- Prototype-Oriented Distillation Engine
- Variational Compression Interface

Timeline

- Dec: Build IBA-Local Adapters & DPM-Bank Memory
- Jan: Implement PFO-Reg & POD-Consolidator Logic
- Feb: Validation and Ablation Studies
- Mar: Finalize Report & Submission

Thank You

DataSet Description

Proposed Methodology

Algorithm Used

Implementation Details

Results and Discussion

Paper Submission Details

Conclusion

Future Work

References