Department of Electrical Engineering and Information Technology

Research Project/Master

SS2024

Optimisation of split learning for resource-constrained edge devices

Project type: ✓ Software ✓ Simulation

Project description:

The growth of data generation at the edge, coupled with increasing privacy concerns and resource constraints, requires innovative approaches to machine learning (ML) implementation. Distributed collaborative machine learning (DCML) techniques such as split learning (SL) have emerged as prominent paradigms. SL enables model training across distributed devices without sharing raw data, thus ensuring privacy while leveraging collective data.

Deploying Split Learning (SL) on resource-constrained edge devices poses significant challenges related to computational and communication efficiency. Edge devices, such as smartphones, IoT devices, and embedded systems, often have limited processing power, memory, and energy resources. Therefore, optimizing SL for these environments requires innovative approaches to minimize overhead while maintaining high model accuracy.The main goal is to reduce computational and communication overhead while maintaining high model accuracy, making SplitNN viable for environments with limited resources.

Keywords:

Split learning, distributed machine learning, resource constraints, edge computing, optimization

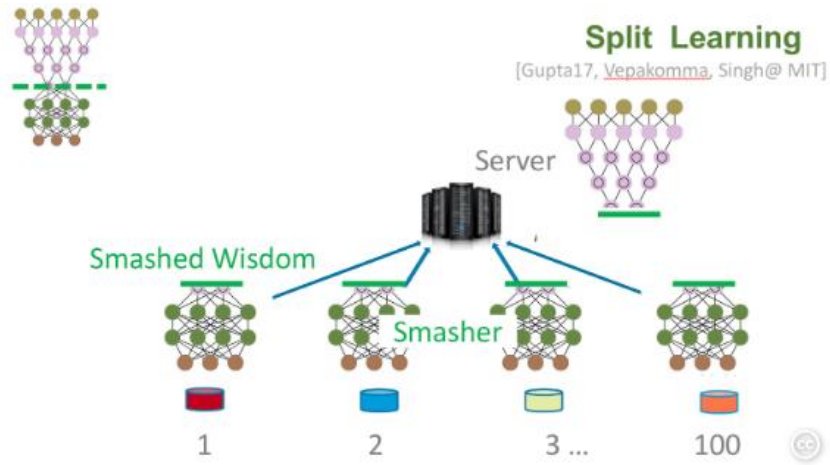

Illustration of Split Learning Architecture with Edge Devices and Central Server

Tasks:

- **Literature Review:** Conduct a comprehensive review of existing Split Learning literature, identifying research gaps and open challenges
- **Experimental Framework:** Design a flexible and extensible experimental framework to evaluate SplitNN under various conditions, incorporating diverse datasets, model architectures, and a simulation environment for distributed settings.
- **Dataset Selection and Preprocessing:** Select and preprocess datasets with different distributions and characteristics for experimentation
- **Implementation and Optimization**: Implement and optimize SplitNN algorithms for chosen model architectures, focusing on minimizing computational and communication overhead
- **Comparative Analysis:** Perform a comprehensive comparative analysis of the optimized SplitNN, evaluating dimensions like privacy, communication efficiency, scalability, and robustness
- **Hybrid Approache**s: Investigate and develop novel hybrid approaches that combine SplitNN with other techniques to overcome existing limitations
- **Performance Evaluation**: Evaluate the performance of hybrid approaches in simulated resource-constrained environments and compare them to traditional techniques
- **Documentation**

Competences:

- **Distributed Systems Knowledge**: Understanding of distributed system architectures, communication protocols, and network topologies. Familiarity with data/model parallelism and distributed optimization
- **Programming and Software Engineering**: Knowledge of Python and ML libraries (TensorFlow Lite, TensorFlow, PyTorch)
- **Creative Thinking and Problem-Solving Skills**: Scientific curiosity and the ability to develop innovative solutions for complex problems

Contact:

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