

Weekly Report (August 1, 2023 - August 10, 2023)

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Abstract

1 Introduction

2 Related Works

3 Experiments

In this part, I tested both CLP in [2] and CLP using pre-trained models on the CIFAR-10 dataset and LIMUC dataset from [3].

3.1 CLP on CIFAR-10 dataset

In this section, I tested CNN from [2] on the CIFAR-10 dataset to verify the phenomenon of CLP in federated learning.

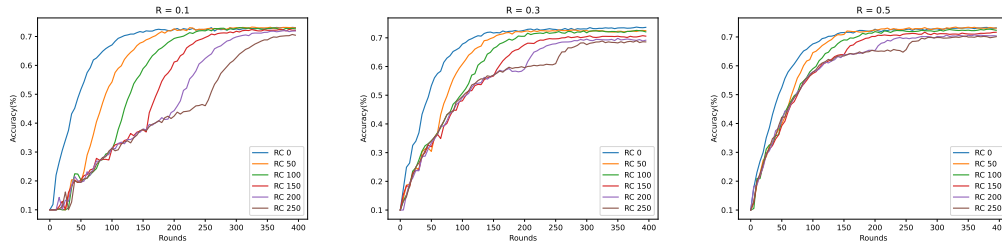


Figure 1: CLP for CNN on CIFAR-10

As shown in Fig. 1, for different ratios of the partial dataset, CLP all exists. However, even using the same hyper-parameters as in [2] for the left figure in Fig. 1, the CLP is not as significant as claimed in the paper. It could be due to the different initialization in models. However, [2] doesn't provide seed for their experiments, so it's hard to reproduce the experiments. To verify this, I ran the same code one more time to eliminate the problem of randomness as shown in Fig. 2.

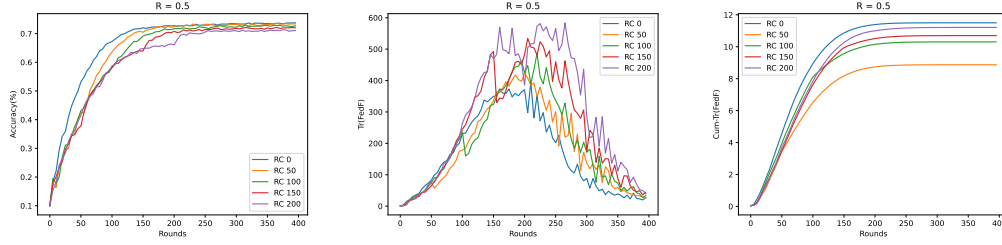


Figure 2: CLP for CNN on CIFAR-10 (R=0.5)

3.2 CLP for transfer learning

In this section, I tested whether CLP exists for transfer learning/fine-tuning.

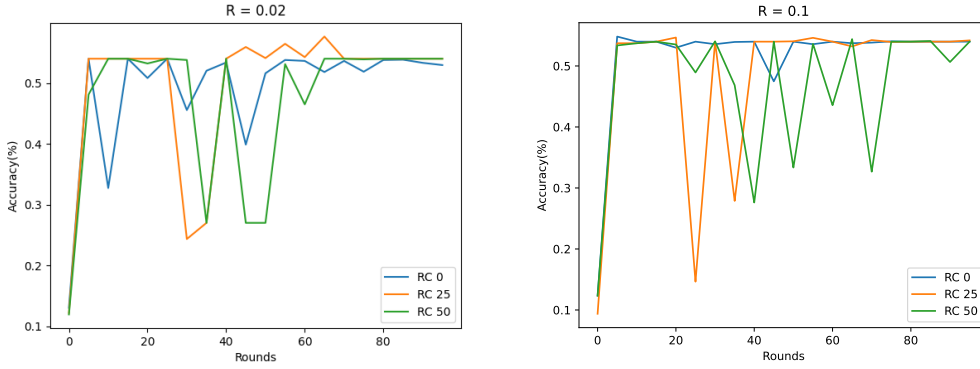


Figure 3: CLP test for pre-trained ResNet-18 on LIMUC

As indicated in Fig. 3, for models that are not well-designed, it's hard to detect CLP in this federated setting. In Fig. 4, we can find out that CLP seems to exist (from 81% to 78% for RC=50 to RC=250). On the other hand, when RC=0, the accuracy curve is unstable, I ran this four times, and only one got decent performance.

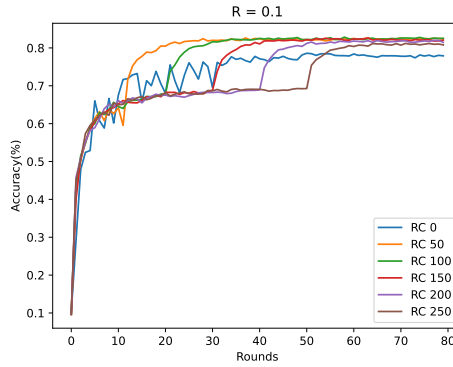


Figure 4: CLP test for pre-trained ResNet-18 on CIFAR-10

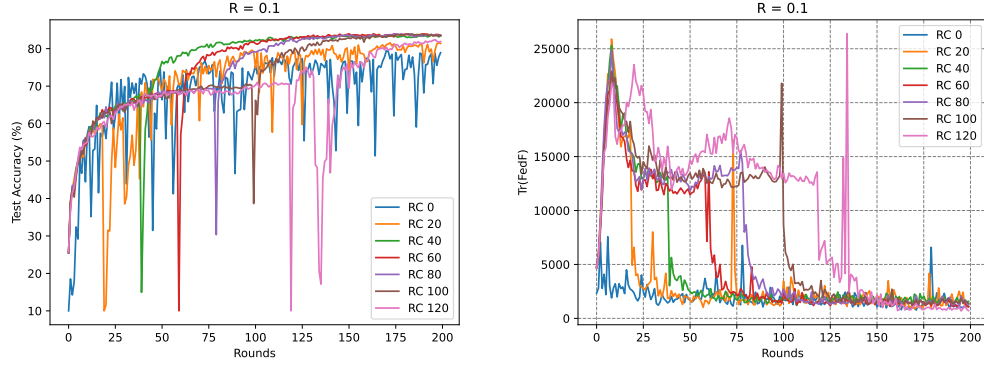


Figure 5: CLP test for pre-trained ResNet-18 on CIFAR (R=0.1)

In Fig. 5, I stopped the training process when communication rounds reached 50, 100, 150, and 170 to eliminate the influence of the scheduler for local model optimization. When RC=0, the accuracy curve for fine-tuning is not stable as found in Fig. 4, and the CLP seems to exist.

Since models from torchvision.models are pre-trained on the ImageNet dataset from [4], I also resized all images from the CIFAR-10 dataset to (224, 224), which is the same image size in the ImageNet dataset. All other settings are listed as follows: (1). FedAvg will select 12 clients from 64 clients; (2) Local optimizers are SGDs with 0.01 as the learning rates, alongside 0.0005 as the weight decay; (3). Recover rounds are varied as 0, 120, and 150 for cases where the local ratio for the partial dataset is 0.01; For cases where the local ratio is 0.1, recover rounds are varied as 0 and 90.

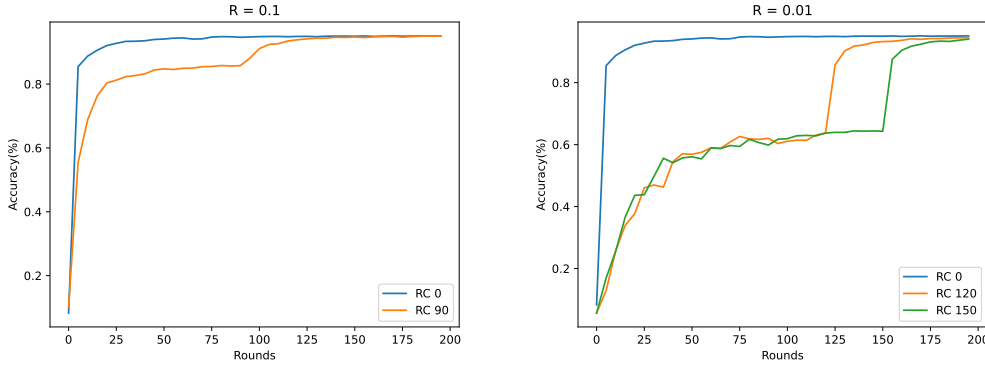


Figure 6: CLP test for pre-trained ResNet-18 on CIFAR (resized to (224, 224))

The results are shown in Fig. 6. It's obvious that CLP doesn't exist when the pre-trained model is fine-tuned to its best performance, even when in extreme cases where the local ratio is 0.01 and the recovery rounds (RC values in the figure) are 150, the difference of accuracy is relatively small ($< 2\%$). Statistically, this variance can be eliminated. What's more, as shown in Fig. 7, the trace of the fish matrix for RC = 0 starts to drop from the beginning, indicating that we might miss the critical point for fine-tuned models that are suitable for the job.

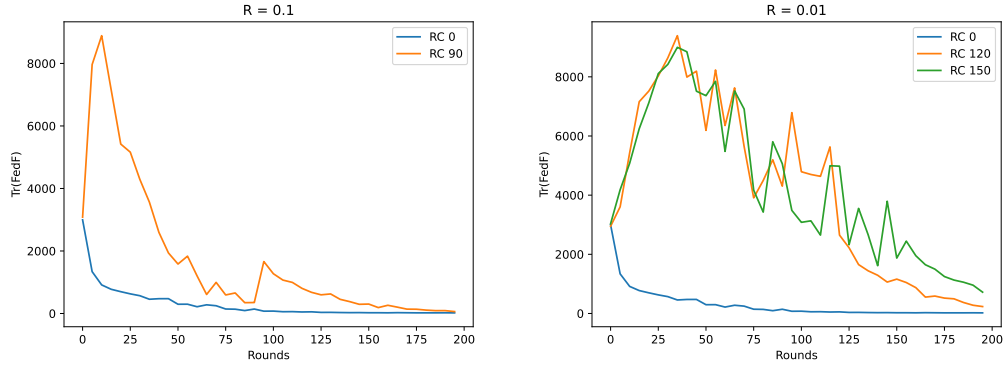


Figure 7: Trace of fish matrix on CLP test for pre-trained ResNet-18 on CIFAR (resized to (224, 224))

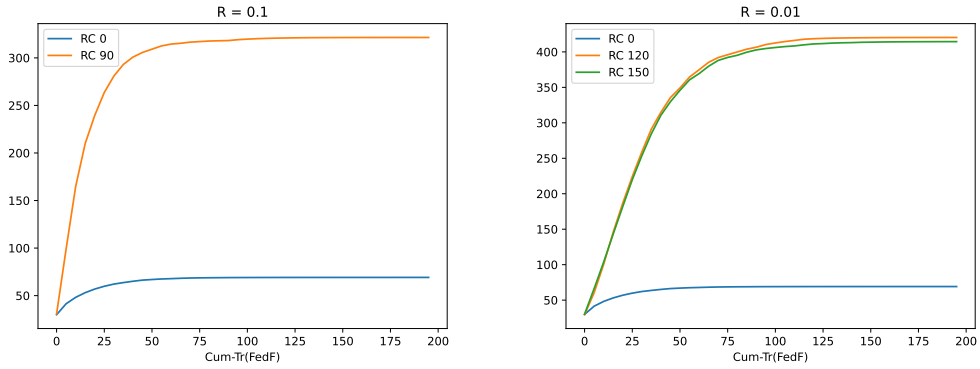


Figure 8: Accumulated trace of fish matrix on CLP test for pre-trained ResNet-18 on CIFAR (resized to (224, 224))

4 Future Plan

References

- [1] McMahan, B., Moore, E., Ramage, D., Hampson, S., & y Arcas, B. A. (2017, April). Communication-efficient learning of deep networks from decentralized data. In Artificial intelligence and statistics (pp. 1273-1282). PMLR.
- [2] Yan, Gang, Hao Wang, and Jian Li. "Critical learning periods in federated learning." arXiv preprint arXiv:2109.05613 (2021).
- [3] Gorkem Polat, Haluk Tarik Kani, Ilkay Ergenc, Yesim Ozen Alahdab, Alptekin Temizel, Ozlen Atug. (2022). Labeled Images for Ulcerative Colitis (LIMUC) Dataset [Data set]. In Inflammatory Bowel Diseases (Version 1, Vol. 2022, Number 11). Zenodo. <https://doi.org/10.5281/zenodo.5827695>
- [4] Deng, J., Dong, W., Socher, R., Li, L.-J., Li, K., Fei-Fei, L. (2009). Imagenet: A large-scale hierarchical image database. In 2009 IEEE conference on computer vision and pattern recognition (pp. 248-255).