A federated anti-forgetting representation method based on hybrid model architecture and gradient truncation

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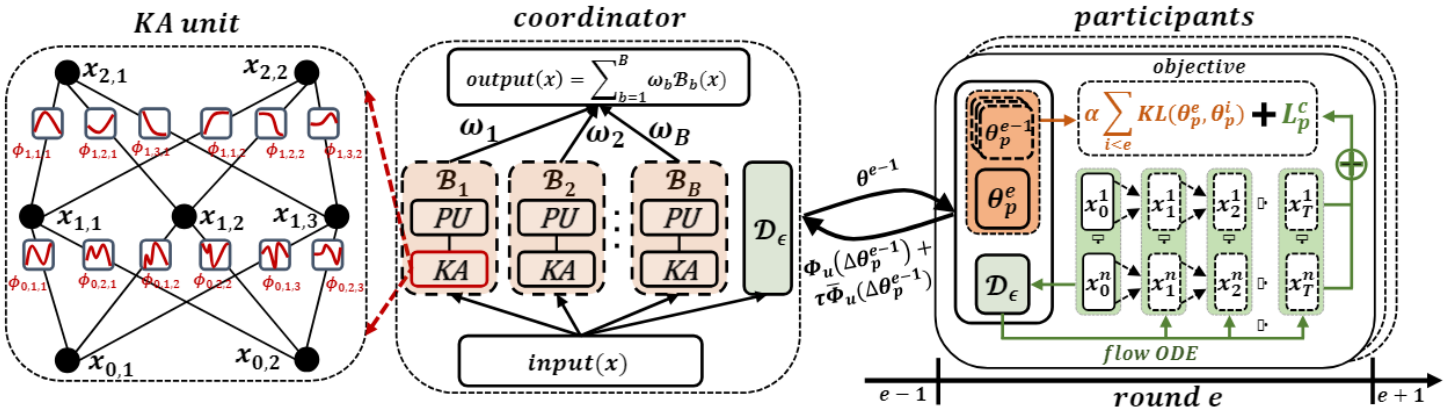
Problems & Ideas

- Problems of decreased model representation performance in unsupervised federated learning:
  - The limited memory capacity of the federated model limits its ability for continuous learning.
  - The weight gradient aggregation mechanism in the federated learning paradigm can interfere with federated model memory.
- Ideas: Designing a new hybrid federated model architecture and truncate the weight gradient in optimization.



The overview of proposed method

Main Contributions

- Contributions:
  - We propose a new model architecture based on Kolmogorov-Arnold and pluggable structures, which can effectively improve the model's memory capacity and anti-forgetting ability.
  - We design a gradient truncation technique to reduce the interference of weight aggregation on model memory and use an ordinary differential equation (ODE) sampler to augment the representation performance.
  - We carry out experiments to compare our method against the state-of-the-art representation methods in FL.

Method	CMNIST		CCIFAR10		FFHQ		MiniImageNet	
	Acc ↑	*Forgetting* ↓	*Acc* ↑	*Forgetting* ↓	*Acc* ↑	*Forgetting* ↓	*Acc* ↑	*Forgetting* ↓
SimSiam	87.73 ± 0.13	13.39 ± 1.23	49.70 ± 1.24	10.09 ± 1.02	59.17 ± 0.36	09.42 ± 0.87	82.57 ± 0.83	07.12 ± 1.62
RELIC	86.36 ± 0.62	12.01 ± 0.43	48.11 ± 0.78	08.11 ± 0.33	60.61 ± 0.12	08.11 ± 0.53	81.63 ± 0.62	08.01 ± 1.22
FedCLR	88.46 ± 0.41	10.11 ± 1.85	51.06 ± 0.78	07.51 ± 0.42	60.09 ± 0.78	10.22 ± 0.85	83.17 ± 0.49	09.11 ± 1.07
FedCA	87.63 ± 0.89	10.84 ± 0.87	50.61 ± 0.73	06.21 ± 0.53	59.37 ± 0.79	09.81 ± 0.67	84.17 ± 0.86	08.07 ± 1.71
FedWeIT	89.16 ± 0.76	06.09 ± 0.31	52.12 ± 0.79	03.71 ± 0.43	63.77 ± 0.82	04.62 ± 0.61	85.71 ± 0.62	04.11 ± 0.12
FedAFR	**90.52** ± 0.41	**03.11** ± 0.08	**53.67** ± 0.56	**03.11** ± 0.13	**65.05** ± 0.43	**04.32** ± 0.31	**88.41** ± 0.26	**02.21** ± 0.13

Comparison of the model accuracy and forgetting.

u	FFHQ			MiniImageNet		
	Round	*Acc*	*Forgetting*	*Round*	*Acc*	*Forgetting*
0.9	393	64.93 ± 1.1	09.74 ± 0.8	452	87.25 ± 1.2	09.21 ± 0.5
0.7	481	65.07 ± 1.3	07.98 ± 0.7	582	87.31 ± 1.1	06.17 ± 0.2
0.5	559	65.16 ± 1.8	04.27 ± 0.3	691	88.31 ± 0.7	02.27 ± 0.6
0.3	701	66.21 ± 1.1	03.13 ± 0.2	759	88.66 ± 1.3	02.23 ± 0.7
0.1	952	67.85 ± 1.3	02.23 ± 0.1	884	89.01 ± 0.8	01.76 ± 0.9

The impact of u on forgetting.