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# Nonconvex Federated Learning

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## Abstract

1 To be completed

2 **1 SAGA like FL**

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**Algorithm 1** SAGA Local SGD

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1: **Input:** Local learning rate  $\gamma$  and global learning rate  $\eta$  and communication period  $p$ .

2: **Init:**  $g^{(k)} = \frac{1}{n} \sum_{i=1}^n g^{(0)}$ .

3: **for**  $k = 0, 1, \dots, K$  **do**

4: Draw two independent and distinct indices  $i_k$  and  $j_k$

5: **for**  $\tau = k, \dots, k + p - 1$  **do**

6: Compute the following quantity

$$v_{i_k}^{(\tau)} = v_{i_k}^{(\tau-1)} - \gamma(\nabla f_{i_k}(x^{(k)}) - \nabla f_{i_k}(\alpha_{i_{(k)}}^t)) + g^{(k)}$$

7: **end for**

8:  $v_{i_k}^{(k)} \leftarrow v_{i_k}^{(k+p-1)}$

9: Update the global model

$$x^{(k+1)} = x^{(k)} - \eta v_{i_k}^{(k)}$$

10: Update  $\alpha_{j_k}^{(k+1)} = x^{(k)}$  and  $\alpha_j^{(k+1)} = \alpha_j^{(k)}$  for  $j \neq j_k$

11: Update  $g^{(k+1)} = g^{(k)} - \frac{1}{n} \left( \nabla f_{j_k}(\alpha_{j_k}^{(k)}) - \nabla f_{j_k}(\alpha_{j_k}^{(k+1)}) \right)$

12: **end for**

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3 **2 Numerical Examples**