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**Algorithm 1:** component matrices computing

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**Input:**  $\mathcal{X} \in \mathbb{R}^{l_1 \times l_2 \times \dots \times l_N}, \varepsilon, \lambda, \delta, R$

**Output:**  $A^{(j)}_s$  for  $j = 1$  to  $N$

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1 Initialize all  $A^{(j)}_s$  //which can be seen as the  $0^{th}$  round iterations;
2  $l'' = L$  //if we need to judge whether (11) is true then  $l''$  denotes
    $L|_{t-1}$ ;
3 for each  $A^{<!-->j}_{i_j r}$  ( $1 \leq j \leq N, 1 \leq i_j \leq I_j, 1 \leq r \leq R$ ) do
4   //1st round iterations;
5    $g^{(j)'}_{i_j r} = g^{(j)}_{i_j r}$ ;
6    $A^{(j)'}_{i_j r} = A^{(j)}_{i_j r}$  //if the rollback shown as (12) is needed,  $A^{(j)'}_{i_j r}$  denotes
      $A^{(j)}_{i_j r}|_{t-1}$ ;
7    $A^{(j)}_{i_j r} = A^{(j)}_{i_j r} - <!--> \mathbf{sign} \left( g^{(j)}_{i_j r} \right) \cdot \delta^{(j)}_{i_j r}$ ;
8 repeat //other rounds of iterations for computing component
   matrices
9    $l' = L$  //if we need to judge whether (11) is true then  $l'$  denotes
      $L|_t$ ;
10  for each  $A^{<!-->j}_{i_j r}$  ( $1 \leq j \leq N, 1 \leq i_j \leq I_j, 1 \leq r \leq R$ ) do
11    if  $g^{(j)}_{i_j r} \cdot g^{(j)'}_{i_j r} > 0$  then
12       $A^{(j)'}_{i_j r} = A^{(j)}_{i_j r}$ ;
13       $g^{(j)'}_{i_j r} = g^{(j)}_{i_j r}$ ;
14       $\delta^{(j)}_{i_j r} = \min \left( \delta^{(j)}_{i_j r} \cdot \eta^+, Max\_Step\_Size \right)$ ;
15       $A^{(j)}_{i_j r} = A^{(j)}_{i_j r} - <!--> \mathbf{sign} \left( g^{(j)}_{i_j r} \right) \cdot \delta^{(j)}_{i_j r}$ ;
16    else if  $g^{(j)}_{i_j r} \cdot g^{(j)'}_{i_j r} < 0$  then
17      if  $l' > l''$  then
18         $g^{(j)'}_{i_j r} = g^{(j)}_{i_j r}$ ;
19         $A^{(j)}_{i_j r} = A^{(j)'}_{i_j r}$  // if (11) is true then rollback as (12);
20         $\delta^{(j)}_{i_j r} = \max \left( \delta^{(j)}_{i_j r} \times \eta^-, Min\_Step\_Size \right)$ ;
21      else
22         $A^{(j)'}_{i_j r} = A^{(j)}_{i_j r}$ ;
23         $g^{(j)'}_{i_j r} = g^{(j)}_{i_j r}$ ;
24         $\delta^{(j)}_{i_j r} = \max \left( \delta^{(j)}_{i_j r} \cdot \eta^-, Min\_Step\_Size \right)$ ;
25         $A^{(j)}_{i_j r} = A^{(j)}_{i_j r} - <!--> \mathbf{sign} \left( g^{(j)}_{i_j r} \right) \cdot \delta^{(j)}_{i_j r}$ ;
26      else
27         $A^{(j)'}_{i_j r} = A^{(j)}_{i_j r}$ ;
28         $g^{(j)'}_{i_j r} = g^{(j)}_{i_j r}$ ;
29         $A^{(j)}_{i_j r} = A^{(j)}_{i_j r} - <!--> \mathbf{sign} \left( g^{(j)}_{i_j r} \right) \cdot \delta^{(j)}_{i_j r}$ ;
30     $l'' = l'$ ;
31 until  $L \leq \varepsilon$  or maximum iterations exhausted;
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