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**Algorithm 1:** Ordering Simplified IR Groups

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**Input** : Simplified subcircuit list *sbs*

**Output:** Reconfigured circuit components list *cfg*

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1 cfg  $\leftarrow \emptyset$ ; bsf  $\leftarrow$  BSF(pls); cliffs_with_locals  $\leftarrow \emptyset$ ;  
2 while bsf.TOTALWEIGHT() > 2 do  
3   local_bsf  $\leftarrow$  bsf.POPLOCALPAULIS();  
4   C  $\leftarrow \emptyset$ ; // Clifford2Q candidates  
5   B  $\leftarrow \emptyset$ ; // Each element of B results from applying each  
   Clifford2Q candidate on bsf  
6   costs  $\leftarrow \emptyset$ ; // Cost functions calculated on each element of  
   B  
7   for cg in CLIFFORD_2Q_SET do  
8     for i, j in COMBINATIONS(RANGE(n), 2) do  
9       cliff  $\leftarrow$  cg.ON(i, j); // qubits to act on  
10      bsf'  $\leftarrow$  bsf.APPLYCLIFFORD2Q(cliff);  
11      cost  $\leftarrow$  CALCULATEBSFCOST(bsf');  
12      C.APPEND(cliff);  
13      B.APPEND(bsf');  
14      costs.APPEND(cost);  
15     end  
16   end  
17   bsf  $\leftarrow$  BSFWITHMINCOST(B, costs);  
18   cliff  $\leftarrow$  CLIFFORDWITHMINCOST(C, costs);  
19   cliffs_with_locals.APPEND((cliff, local_bsf));  
20 end  
21 cfg.APPEND(bsf);  
22 for cliff, local_bsf in cliffs_with_locals do  
   // Clifford2Q operators are added as conjugations, with  
   local Pauli strings removed before each search epoch  
23   cfg.PREPEND(cliff);  
24   cfg.APPEND(local_bsf);  
25   cfg.APPEND(cliff);  
26 end
```

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