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**Algorithm 1** BTI-MVCSL

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**Input:**

- Number of Epochs  $E$ ;
- Brain Features  $X$ ;
- Prior Topology  $A_p$  or  $A_I$  (optional);
- Decay Rate  $\mu$ ;
- Update Interval  $n$ ;
- Instructor / Learner Feature Masking Ratio  $p(X)_I / p(X)_L$ ;
- Topological Masking Ratio  $p(a)$ ;
- Contrastive loss temperature  $t$

**Output:**

- Learned Brain Topology  $A_{Learner}$
- 1: Initialize parameters  $w$  (graph learner),  $F_{GNN}$  (GNN encoder),  $F_{MLP}$  (MLP projector);
  - 2: **if** A is available **then**
  - 3:   Initialize “instructor”-view topology  $A_{instructor}$  as  $A_p$ ;
  - 4: **else**
  - 5:   Initialize “instructor”-view topology  $A_{instructor}$  as  $A_I$ ;
  - 6: **end if**
  - 7: **for** each  $i \in [1, 2, 3, \dots, E]$  **do**
  - 8:   Calculate  $A_{BTI} \leftarrow$  BTI by Eq. (1) or Eq. (2);
  - 9:   Calculate  $A_{norm}$  by Eq. (7) - Eq. (9);
  - 10:   Generate two views  $G_I, G_L$ ;
  - 11:   Calculate spatial brain representations  $H_I^{GNN}$  and  $H_L^{GNN}$  by  $F_{GNN}$ ;
  - 12:   Calculate brain projections  $H_I^{MLP}$  and  $H_L^{MLP}$  by  $F_{MLP}$ ;
  - 13:   Calculate whole contrastive loss  $L_{total}$ ;
  - 14:   Update parameters  $w, F_{GNN}, F_{MLP}$ ;
  - 15:   **if**  $e \bmod n = 0$  **then**
  - 16:     Update  $A_{norm}$  by Eq. (10) (Self-Learning Mechanism, SLM);
  - 17:   **end if**
  - 18: **end for**
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