Algorithm 1: UMIETM batch learning algorithm

initiate the topic label and the statistics
for $i = 1 : I_1$ **do**
  for u *in user set* U **do**
    for $n = 1 : P_u$ **do**
      sample profile's hidden topic s_{un} by (1)
      update s_{un}, $c_{u,k}^{(p)}$ and $c_{k,v}^{(p)}$
for *iteration* $i = 1 : I_2$ **do**
  for $t = 1 : T$ **do**
    for u *in user set* U_t **do**
      for $d = 1 : D_u$ **do**
        sample y_{ud} and z_{ud} by (2), (3)
        if $y_{ud} = 0$ **then**
          update z_{ud}, y_{ud}, $c_u^{(0)}$, $c_{u,k}^{(0)}$, $c_{k,v}^{(0)}$
        else
          update z_{ud}, y_{ud}, $c_u^{(1)}$, $c_{t,k}^{(1)}$, $c_{t,k,v}^{(1)}$
        for n *in* $1, \cdots, N_{ud}$ **do**
          sample x_{udn} by (4), (5)
          if $x_{udn} = 0$ **then**
            update x_{udn}, M_0^{ρ}, $c_v^{(B)}$
          else
            update x_{udn}, M_1^{ρ}, $c_{k,v}^{(0)}$, $c_{t,k,v}^{(1)}$

Algorithm 2: UMIETM online learning algorithm

for all $u \in \mathcal{U}$, load $\boldsymbol{p_u}$ and $\boldsymbol{w_u}$
for all $u \in \mathcal{U}$, k, v, load M_0^{ρ}, M_1^{ρ},$c_{u,k}^{(p)}$, $c_{k,v}^{(p)}$, $c_u^{(0)}$, $c_u^{(1)}$, $c_{u,k}^{(0)}$, $c_{k,v}^{(0)}$, $c_v^{(B)}$ from trained Model $\mathcal{M}$.
for $t = 1 : T$ **do**
  update the vocabulary for profile and tweet
  for *iteration* $i = 1 : I_1$ **do**
    for u *in user set* $\mathcal{U} \cup U_t$ **do**
      do operation as line 5 to line 6 in Algorithm 1
  $\mathcal{U} = \mathcal{U} \cup U_t$
  for *iteration* $i = 1 : I_2$ **do**
    for u *in user set* U_t **do**
      do operation as line 10 to line 21 in Algorithm 1.