x是$n\times h$维 x_i是$1\times h$ $u, w,$ 是$h\times h$. V是$n\times h$ V_i是$1\times h$.

h是$1\times h$. $\cancel{x_u}$

$$L = -\sum_{u}\sum_{正} \ln(\sigma(\hat{x}_{u,i,j})) + \frac{\lambda}{2}\|\theta\|^2$$

$$\hat{X}_{u,i,j}(\theta) = h(t)\,V_{i(t)}^T - h(t)\cdot V_{j(t)}^T$$ 数字.

$$h(t) = \sigma(b(t)) \qquad 1\times h.$$

$$b(t) = x_{i(t)}\cdot U(t) + h(t-1)\,W(t) \qquad 1\times h.$$

求导:
$$\frac{\partial L}{\partial x_i(t)} = \frac{\partial L}{\partial b(t)}\cdot (U(t))^T = \frac{\partial L}{\partial h}\times\frac{\partial h}{\partial b}\cdot (U(t))^T =$$

$$= \cancel{\frac{\partial L}{\partial X_{uij}}\cdot V_i(t)}\ \frac{\partial L}{\partial X_{uij}} \times \frac{\partial X_{uij}}{\partial h(t)} \times \frac{\partial h(t)}{\partial b(t)}\cdot\frac{\partial b(t)}{\partial x_i}$$

$$= \left[-(1-\sigma(x_{uij}))\right]\times(V_{i(t)} - V_{j(t)})\times(\sigma(b(t))\times(1-\sigma(b(t))))\cdot(U(t))^T + \lambda|x_i(t)|$$

$$\frac{\partial L}{\partial V_i} = \cancel{\frac{\partial L}{\partial X_{uij}}}\left((h(t))^T\cdot\frac{\partial L}{\partial X_{uij}}\right)^T + \lambda|V_i(t) = \frac{\partial L}{\partial x_{uij}}\times h(t) + \lambda|V_i(t)|.$$

$$\frac{\partial L}{\partial V_j} = -\frac{\partial L}{\partial x_{uij}}\times h(t) + \lambda|V_j(t)|.$$

$$\frac{\partial L}{\partial U(t)} = x_{i(t)}^T\cdot\left[-(1-\sigma(x_{uij}))\right]\times(V_{i(t)} - V_{j(t)})\times(\sigma(b(t))\times(1-\sigma(b(t))))$$

$$= x_i^T(t)\cdot\frac{\partial L}{\partial x_{uij}}\times\frac{\partial x_{uij}}{\partial h}\times\frac{\partial h}{\partial b} + \lambda|U(t)|$$

$$\frac{\partial L}{\partial W} = h(t-1)^T\cdot\frac{\partial L}{\partial x_{uij}}\times\frac{\partial x_{uij}}{\partial h}\times\frac{\partial h}{\partial b} + \lambda|W(t)|.$$