combine Graph Embedding and reinforcement learning

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1 Method

for a single node

$$u_v^{t+1} = relu(\theta_1 x_v + \theta_2 s_v + \theta_3 \Sigma_{u \in N(v)} u_u^t + \theta_4 \Sigma_{u \in N(v)} relu(\theta_5 w(u,v)))$$

1. u_v^{t+1} is a vector and it means a node or vertex at index v in $t+1$ iteration
2. $\theta_1, \theta_2, \theta_5 \in R^p$ and $\theta_3, \theta_4 \in R^{pxp}$
3. v means current node, $u \in N(v)$ means that u is a neighborhood of v
4. $w(u,v)$ is the edge weight of u and v
5. x_v is the status of x, if $x_v \in S$ and then $x_v = 1$, otherwise, $x_v = 0$
6. s_v means the size of current node

for all nodes

$$\hat{Q}(h(S), v, d; \Theta) = \theta_6^T relu([\theta_7 \Sigma_{u \in V} u_u^{(T)}, \theta_8 u_v^{(T)}, \theta_9 u_d^{(T)}])$$

1. $h(S)$ means current state of the graph, for example, how many nodes still in our graph.
2. Θ includes all θ_i, $\theta_6 \in R^{2p}$ and $\theta_7, \theta_8, \theta_9 \in R^{pxp}$
3. V represents all vertexes, u_v represents current node and u_d represents which of node to throw. If in current state no node should be thrown, the u_d will be 0 vector.
4. $[,,]$ means concatenation operation
5. the number of iterations T for the graph embedding is usually small, such as $T = 4$

loss function

$$loss = (y - \hat{Q}(h(S_t), v_t, d_t; \Theta)^2$$

1. where $y = \gamma max_{v',d'} \hat{Q}(h(S_{t+1}, v', d'; \Theta) + r(S_t, v_t, d_t)$