



Given: $\vec{x}_A, \vec{x}_B, \vec{x}_C, \vec{x}_D$

Goal: predict y_A, y_B, y_C, y_D

Model #1: GNN with no neighbor info

$$\vec{h}_{v_j} = \sigma(W^T \vec{x}_{v_j} + \vec{b})$$

Model #2: GNN w/ neighbors only

$$\vec{h}_{v_j} = \sigma\left(\sum_{v_i \in N(v_j)} W^T \vec{x}_{v_i} + \vec{b}\right)$$

Model #3: GNN w/ nbrs + self-loops

Assume $\vec{h}_{v_i}^{(0)} = \vec{x}_{v_i}$

Multiple levels

$$\vec{h}_{v_j}^{(k)} = \sigma(W^T \vec{h}_{v_j}^{(k-1)} + \vec{b})$$

$$\vec{h}_{v_j}^{(k)} = \sigma\left(\sum_{v_i \in N(v_j)} W^T \vec{h}_{v_i}^{(k-1)} + \vec{b}\right)$$



$$\vec{h}_{v_j}^{(k)} = \sigma\left(W_{\text{self}}^T \vec{h}_{v_j}^{(k-1)} + \sum_{v_i \in N(v_j)} W_{\text{other}}^T \vec{h}_{v_i}^{(k-1)} + \vec{b}\right)$$