

Summary

Co - GNN

Two main problems of standard GNN's \rightarrow over-squashing \rightarrow over-smoothing.

Sol:

Each node is a player with q actions each layer

- Two GNN's
 - Action (θ): Decides which action each node should take
 - Environment (ϵ): Update node repr. based on actions.

STANDARD: USen & Breadth
USen
Breadth
Isolate

Step by Step:

i) $u_{\pi}^{(w)}$: Node repr at layer w

ii) Action Net \rightarrow Decides action

$$p_{\pi}^{(w)} = \theta(u_{\pi}^{(w)}, \{\{u_u^{(w)} \mid u \in N_{\pi}\}\}) \rightarrow \text{Prob DISTR. over actions}$$

(sample $a_{\pi}^{(w)}$)

iii) ENV Network: Based on $a_{\pi}^{(w)}$, update each node

$$u_{\pi}^{(w+1)} = \epsilon^{(w)}(u_{\pi}^{(w)}, \{\{\}\}) \text{ if } a_{\pi}^{(w)} = I \text{ or } B$$

$$u_{\pi}^{(w+1)} = \epsilon^{(w)}(u_{\pi}^{(w)}, \mu) \text{ if } a_{\pi}^{(w)} = L \text{ or } S$$

\Rightarrow ADV: where $\mu = \{\{u_u^{(w)} \mid u \in N_{\pi}, a_u^{(w)} = S \text{ or } B\}\}$
TASK Specific \rightarrow Relevant nodes linking
Directed flow

Architecture

$$G = (V, E, X)$$

$$u_{\pi}^{(0)} = x_v \quad \forall v \in V$$

For each layer $w = 0$ to $L-1$:

i) Action Network (θ) \rightarrow TOPOLOGY OPTIMIZER

- INPUT: $u^{(w)}$
- OUTPUT: $p^{(w)}$ (Action DISTR)
- SAMPLE ACTIONS $a^{(w)}$ FROM $p^{(w)}$

ii) INDUCED COMPUTATIONAL GRAPH $G^{(w)}$:

- DERIVED FROM ORIGINAL GRAPH G
- EDGES DETERMINED BY NODE ACTIONS

iii) ENV NETWORK (ϵ):

- INPUT: $u^{(w)}$ & INDUCED GRAPH $G^{(w)}$
- OUTPUT: UPDATED $u^{(w+1)}$

\rightarrow final Node Representation $u^{(L)}$

Idea:

Can we use the DIVERGENCE of action as uncertainty and ISOLATED $>$ threshold for waiting?

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\Rightarrow if $P(\text{isolate}) >$ threshold
+ / or $\text{SOME ENTROPY}(P_{\pi}^L)$ for UNCERTAINTY MEASUREMENT