We mind your well-being: Preventing depression in uncertain social networks by sequential interventions

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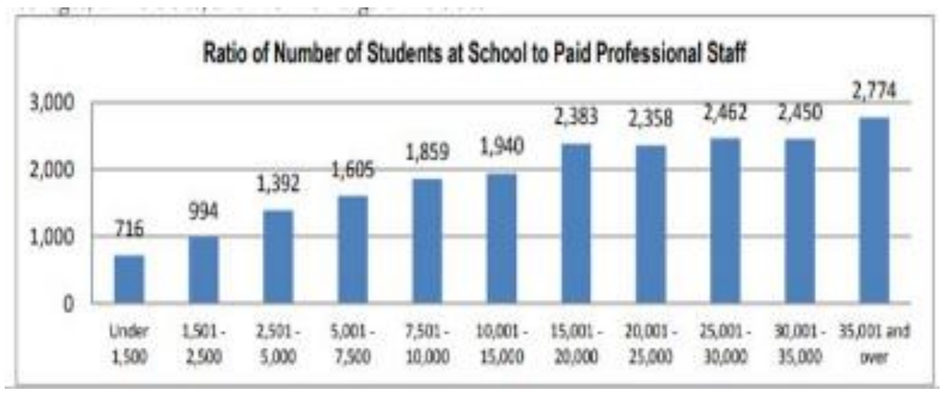
Significance and Challenges

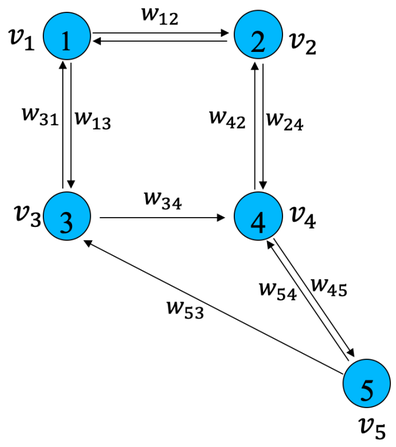
- Depression and other mood disorders are becoming a major concern
- In universities, only 6-7% of the students seek for counselling
- Not enough capacity to invite everyone



How can we improve to effectively provide counselling to students?

Model

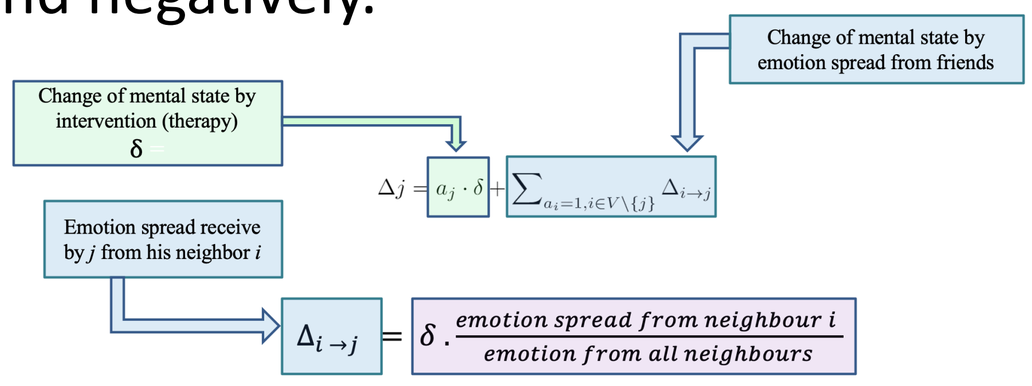
a) Student Network Dynamics



- $G = \langle V, E \rangle$
- Node set V
- Edge set E
- $(i,j) \in E, (j,i) \in E$
- Metal State Values
  $v_i \in M = \{0,1,\dots,\mu\}$
- Influence Values
  w_{ij}, w_{ji}
  - $0 \le w_{ij} \le 1$
  - $w_{ii} = 0$

b) Emotion Propagation Model

- A student's mental state can affect other students' mental states both positively and negatively.



c) POMDP Formulation

$$\mathrm{P} = \langle S, A, O, T, \Omega, R, b^0 \rangle$$

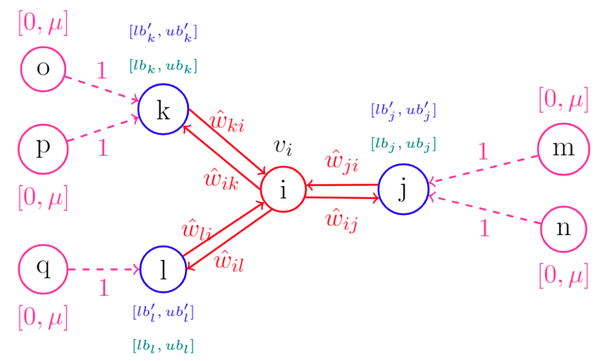
- By considering the mental state value and the influence value uncertainties in the network.

Solution Approach: MLPRAP

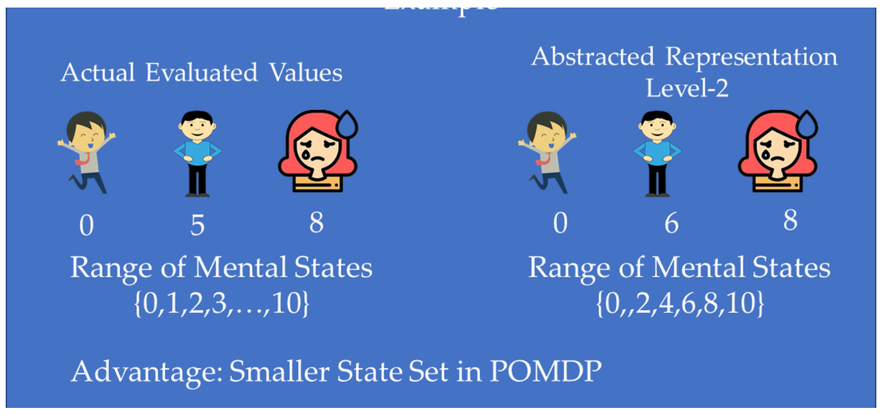
a) Reasoning: State Relationship Rule

$$lb_j = \lfloor \frac{\sum_{i \in N^{in}(j)} lb_i \cdot \hat{w}_{ij}}{\sum_{i \in N^{in}(j)} \hat{w}_{ij}} \rfloor$$

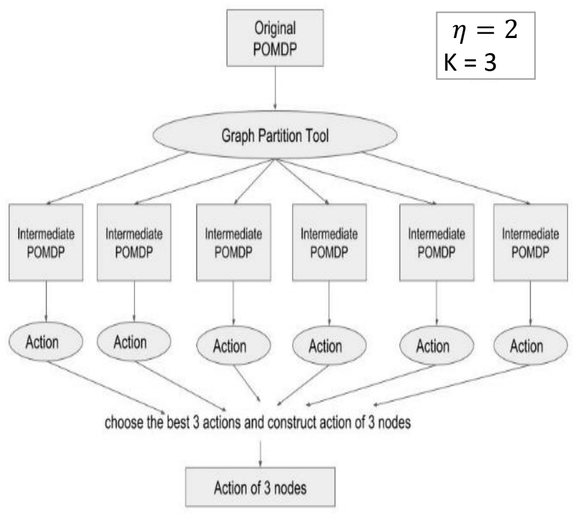
$$ub_j = \lceil \frac{\sum_{i \in N^{in}(j)} ub_i \cdot \hat{w}_{ij}}{\sum_{i \in N^{in}(j)} \hat{w}_{ij}} \rceil$$



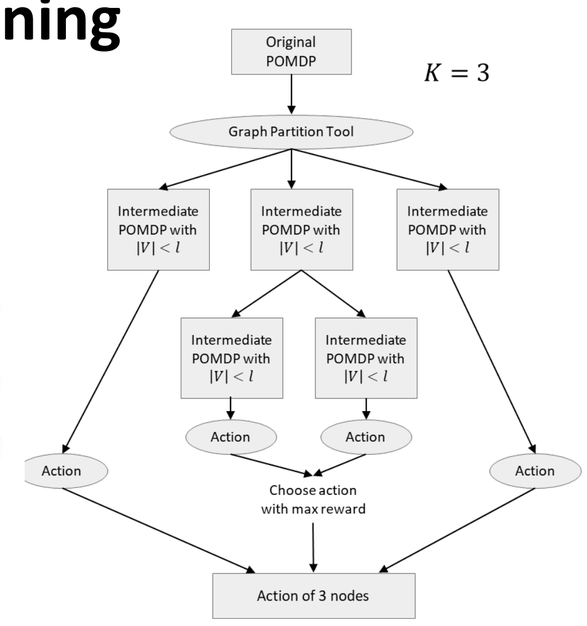
b) Abstraction: Define abstraction level σ



c) Multi-level Partitioning

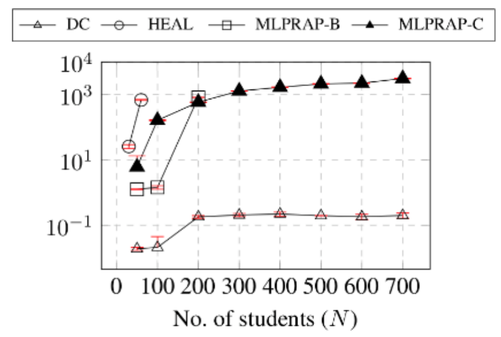


Balanced (MLP-B)

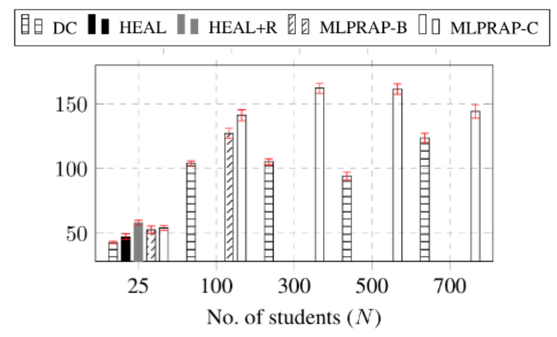


Clustered (MLP-C)

Experiments



Scalability



Solution Quality

Conclusion

Effective Counselling for large networks

- Consider network dynamics, emotion propagation and formulate as POMDP to address uncertainties

Solving POMDP with large networks

- Apply reasoning, abstraction of states and multi-level partitioning of graphs to increase scalability while maintaining solution quality