Expressive and Flexible Simulation of Information Spread Strategies in Social Networks Using Planning

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Summary

- In the digital age, understanding the dynamics of information spread and opinion formation within networks is paramount. Our research introduces an innovative framework that combines the principles of opinion dynamics with the strategic capabilities of Automated Planning.
- Our novel numeric PDDL model, designed for opinion dynamics, serves as the foundation for this research. This model, in tandem with our interactive online platform, enables users to both visualize and strategically influence opinion shifts.
- While the traditional models of opinion dynamics capture the essence of how beliefs evolve, AI planning offers a blueprint to influence this evolution in a directed manner. The granularity and adaptability of planning techniques enable targeted interventions, ensuring that specific objectives within a network are met efficiently.

PDDL Formulation

The primary action of our PDDL model, **spread-info-from**, models the process of information spread from an *agent* or *source* to all its connected *agents*. When the action takes place, all connected agents adopt the opinion from the disseminating source/agent following equation shown below
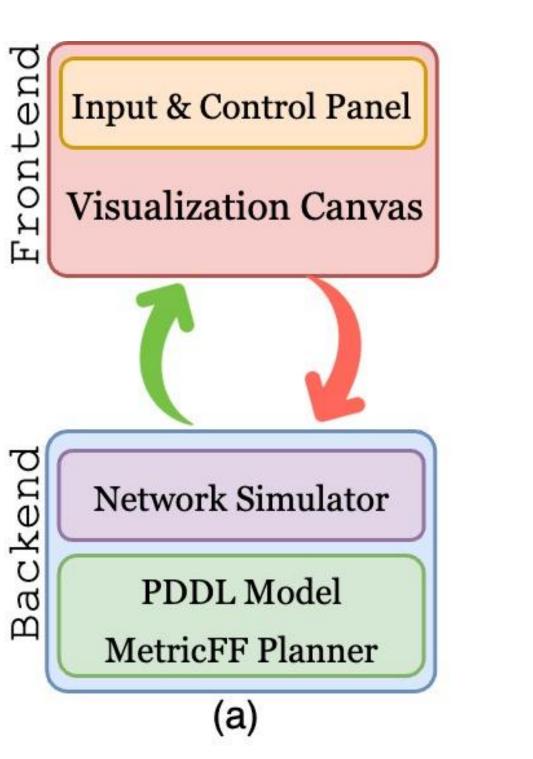
$$a_i(t+1) = a_i(t) + \mu_{ik}(a_k(t) - a_i(t))$$

Where,
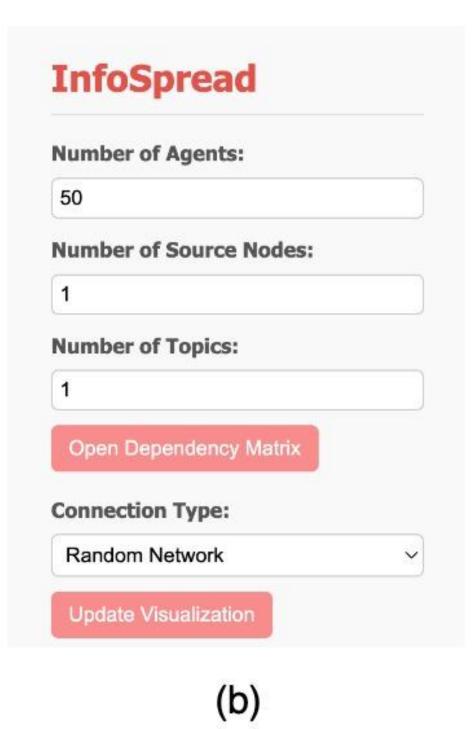
- $a_i(t+1)$ is the updated opinion of agent i at time $t+1$.
- $a_i(t)$ is the current opinion of agent i at time t.
- μ_i represents the trust level between agent i and the disseminating source/agent k.
- $a_k(t)$ is the opinion of the disseminating source/agent k at time t.

Platform for Simulating Information Spread

- Platform users are shown a menu (Figure 1(b)) for choosing the network structure and opinion dynamic model to be simulated.
- Each node and connection is displayed with node color intensities (red to blue) showcasing opinions on a selected topic.
- Users can set opinion goals for specific nodes and generate propagation plans (Figure 1(c)), using the PDDL model and MeticFF Planner to create action sequences for desired outcomes.
- The plan allows users to incrementally execute strategies, observing the spread of information across the network to achieve set goals.
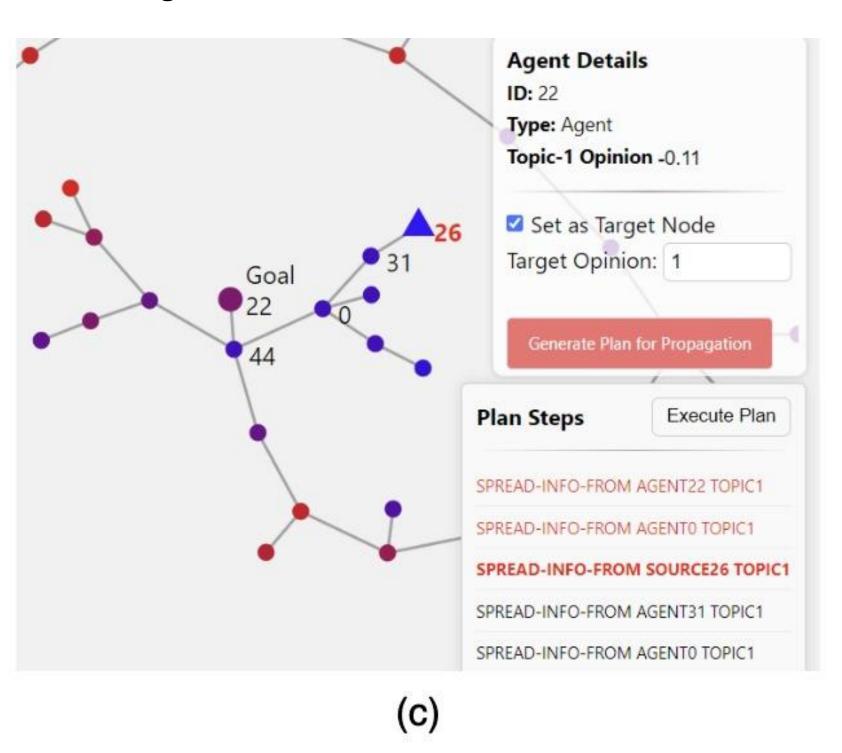

Figure 1: An overview of the project components. (a) System architecture, (b) Side panel interface showcasing network customization options, and (c) Network visualization showcasing the generated plan execution for opinion propagation. We show an example of input and output (b & c) where information flows from Nodes 26 to 22; a partially executed plan is shown in red.

```
(:action spread-info-from
  :parameters (?a - (either agent source) ?t - topic)
  :precondition (and)
  :effect (and
    (forall (?a2 - agent)
      (when (connected-agent ?a ?a2)
        (increase (have-opinion ?a2 ?t) (/ (* (have-trust ?a2 ?a) (- (have-
          opinion ?a ?t) (have-opinion ?a2 ?t))) 100))
      )
    )
    (forall (?a2 - agent)
      (when (and (connected-agent ?a ?a2) (< (+ (have-opinion ?a2 ?t) (/ (* (have
        -trust ?a2 ?a) (- (have-opinion ?a ?t) (have-opinion ?a2 ?t))) 100))
        -100))
        (assign (have-opinion ?a2 ?t) -100)
      )
    )
    (forall (?a2 - agent)
      (when (and (connected-agent ?a ?a2) (> (+ (have-opinion ?a2 ?t) (/ (* (have
        -trust ?a2 ?a) (- (have-opinion ?a ?t) (have-opinion ?a2 ?t))) 100))
        100))
        (assign (have-opinion ?a2 ?t) 100)
      )
    )
  )
)
```

Figure 2: Action Modeling for Information Spread Equation using Numeric PDDL

Resources

- For additional details contact - bharath@email.sc.edu

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Scan this QR code for the Demonstration Video