# HEALER: POMDP Planning for Scheduling Interventions among Homeless Youth (Demonstration)

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## ABSTRACT

Adaptive software agents like HEALER have been proposed in the literature recently to recommend intervention plans to homeless shelter officials. However, generating networks for HEALER's input is challenging. Moreover, HEALER's solutions are often counter-intuitive to people. This demo paper makes two contributions. First, we demonstrate HEALER's Facebook application, which parses the Facebook contact lists in order to construct an approximate social network for HEALER. Second, we present a software interface to run human subject experiments (HSE) to understand human biases in recommendation of intervention plans. We plan to use data collected from these HSEs to build an explanation system for HEALER's solutions.

## 1. INTRODUCTION

Homeless youth are extremely prone to HIV-AIDS because of their propensity to engage in high-risk behavior such as unprotected sex, sharing needles while using drugs etc. In fact, statistics collected over several years show that homeless youth are 10 times more likely to get HIV infection than stably housed populations [1]. Moreover, HIV is extremely lethal among homeless youth as most youth lack basic resources needed to control and manage the disease (e.g., access to regular medical care, hygienic surroundings).

Therefore, minimizing rates of HIV infection among homeless youth is an extremely important problem. One potential solution is to raise awareness about HIV prevention and treatment measures among homeless youth. To that end, many homeless shelters conduct intervention programs among youth to raise awareness about HIV prevention and treatment practices [3]. These intervention programs typically consist of day long educational sessions where a select group of homeless youth are trained as "peer leaders" and are given information about how the HIV virus spreads. As "peer leaders", the youth are encouraged to raise awareness about HIV among their social circles via word-of-mouth spread [4]. The homeless shelter conducts several of these intervention programs sequentially. However, due to manpower constraints, the shelter can only intervene upon a small number of youth ($\sim$ 3-6 youth) in each intervention. Therefore, the agency needs to choose the attendees (or "peer leaders") for each of their interventions. The agency's goal is to maximize the number of youth who get influenced (i.e., they find out about HIV prevention and treatment measures) over the course of all the interventions that they conduct [6].

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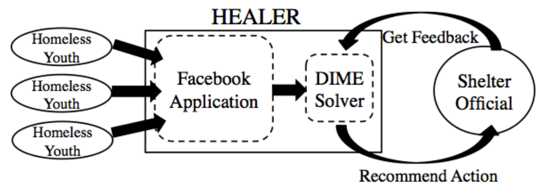


Figure 1: HEALER's Design

This leads to the following *algorithmic question*: Given the friendship based social network of homeless youth, the number of attendees in each intervention ($K$) and the number of interventions ($T$) as input, find a sequential plan for choosing $K$ intervention participants for $T$ rounds so that the expected number of people who find about HIV prevention measures (or "get influenced") over the course of $T$ rounds is maximized.

Developed in collaboration with Safe Place for Youth (a homeless shelter which provides food and lodging to homeless youth aged 12-25), HEALER (**H**ierarchical **E**nsembling based **A**gent which p**L**ans for **E**ffective **R**eduction in HIV Spread) is an adaptive software agent which solves the aforementioned algorithmic question by recommending sequential plans for selecting intervention attendees to homeless shelter officials [5]. HEALER uses Partially Observable Markov Decision Process (POMDP) [2] style reasoning to evaluate different choices of intervention attendees over a long time period. HEALER finds the best solution by reasoning about uncertainties in network structure and evolution of influence spread (as both these uncertainties are very common in homeless youth social networks). HEALER is currently being tested in a pilot study with 60 homeless youth at Safe Place for Youth to assess its performance in the field.

Since the optimization problem solved by HEALER involves calculations of long term expectations, the homeless shelter officials found HEALER's solutions very counter-intuitive. This represents a potential barrier to HEALER's widespread acceptability and use. Thus, we propose to build an *explanation system* to justify HEALER's solutions to officials in an intuitive manner.

Against this background, the demonstration presented in this paper introduces two contributions. First, we present HEALER's Facebook application, which parses the Facebook contact lists of homeless youth in order to construct an approximate social network. This social network is fed as input to the DIME solver [5] in order to generate recommendations for intervention attendees. Second, we present a software interface to run human subject experiments (HSE) to understand the way humans make decisions in this domain and evaluate the potential effect of human biases in

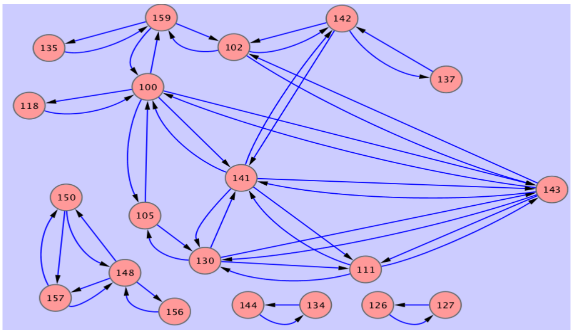

Figure 2: A portion of the raw network generated using HEALER's Facebook application

decision-making. By conducting these HSEs, we can (i) understand the intuitions that people (including officials) use while selecting attendees for interventions in social networks and relate them to biases they may have; and (ii) use these intuitions and the understanding of the biases to guide the development of HEALER's explanation system. This paper also presents a short overview of HEALER's design in order to provide proper context.

The demonstration aims to engage audiences by asking them (i) to use HEALER's Facebook application so that they can see the network that connects them and their fellow audience members; and (ii) to participate in the HSEs.

## 2. HEALER

HEALER consists of the following two components: (i) a Facebook application for gathering information about social networks; and (ii) a DIME Solver, which solves the algorithmic question posed in Section 1.

**Facebook Application:** Homeless youth are asked to register into HEALER's Facebook application. This is reasonable as [3] show that almost 50% of homeless youth are active on Facebook. Once all youth are registered, the application parses the Facebook contact lists of all the registered youth to construct a social network from Facebook friendships between the registered youth. Specifically, the application adds an edge between two youth if (i) they are friends on Facebook; and (ii) they are registered into the application. Figure 4 shows a portion of the actual homeless youth social network that we have generated using HEALER during our pilot study. Each youth (represented by a network node) has a personal identification number (PID) which protects the anonymity of the youth.

**DIME Solver:** The network generated by the Facebook application is input into the DIME solver [5]. HEALER provides the solution of this DIME solver as a series of recommendations (of intervention participants) to homeless shelter officials. Upon the intervention's completion, HEALER *senses* feedback about the conducted intervention from the officials. This feedback includes new observations about the network (e.g., new edges may be found as intervention participants are interviewed by the shelter officials). HEALER uses this feedback to update and improve its future recommendations.

## 3. THE SIMULATION GAME

Demo: https://www.youtube.com/watch?v=0g4aStj3z9I

We aim to build an explanation system for HEALER that justifies its solutions in an intuitive manner. As a first step, we have built a software interface for conducting HSEs to collect data on how people select intervention attendees in networks. The data collected from these HSEs will aid us in understanding biases and intuitions that people use in selecting intervention participants. We can then use these inferred intuitions to guide the development of our explanation system.


Figure 3: First Phase of HSE Game

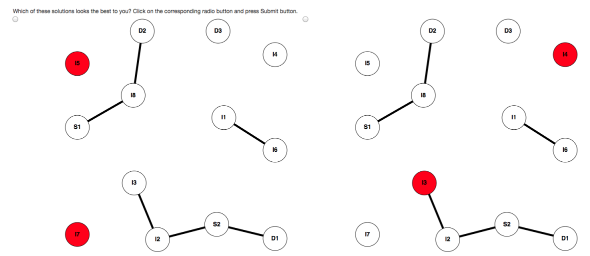


Figure 4: Second Phase of HSE Game

During our demonstration, the audience will be able to directly participate in our HSE. First, they will be presented with a high-level description of the influence spread problem and detailed instructions on how to play the HSE game. Next, they will play the game which consists of two phases.

### 3.1 First Phase

In the first phase, the audience will be shown pictures of eight different networks one by one. In each of these networks, they will be asked to select a set of 2 nodes which they think will spread the most influence. Their choices will be recorded on all 8 networks. This data will help us understand the biases that affect the choice of nodes selected by humans.

### 3.2 Second Phase

In the second phase, data is collected to find out if people are better at verifying correct solutions than coming up with correct solutions. Recall that in the first phase of our game, each human subject was shown a set of eight different networks and they were asked to select a set of nodes for maximizing influence spread. In the second phase, for each of these eight networks, the audience is shown four different solutions for that network and he/she will be asked to select the solution which they think is best.

Data collected from the second phase will help us in analyzing the need for an explanation system for HEALER. For example, if the collected data shows that people are very good at recognizing that the correct solution (out of the 4 solutions) is HEALER's solution, then that would negate the need for HEALER's explanation system. Thus, using data from the second phase, we plan to empirically validate the need for an explanation system.

### 3.3 Awards

To promote competition, there will be an award that will be given to the audience member whose solution is closest to the optimal solution in terms of influence spread. A live leaderboard will also be maintained to track the current winner of the award.

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