Intelligent Machines

Due: April 12, 2015, 11.59 in the submission folder

In this assignment, you will use an MDP to model a fictional medical decision-making scenario. We note that the scenario is purely fictional and none of the medical or health information is accurate or even realistic.

The Scenario

The MDP you are designing will provide decision support for a primary care physician (PCP).

For your baseline model, assume the PCP has office hours from 9:00am until 2:00pm daily. Every appointment lasts exactly an hour. (Note: We said this was fictional!)

On average, the patients who come fall into the following groups:
- 80% have the flu
- 10% have whooping cough
- 10% have Ebola

Also for the baseline, assume that the PCP diagnoses all patients accurately. The role of the decision support system is to assist him in determining whether to send a patient to the hospital for treatment. An analysis of previous cases shows the following:

- A patient with Ebola will survive only if sent to the hospital, and even when sent, the patient has a 25% survival rate.
- A patient with whooping cough has 50% chance of surviving if treated at home, and 100% chance if sent to the hospital.
- A patient with flu has 100% chance of survival whether sent to the hospital or not.

Unfortunately, the only hospital in the area in which this PCP practices is very small, and can treat at most one patient at a time. Treating a patient (regardless if the patient survives or not) in the hospital requires one hour in 50% of the cases and two hours in the other 50%.

The PCP would like a policy that tells him when to send a patient to the hospital. His goal is, of course, to save as many patients as possible.

After the baseline is working, consider the following alternative scenarios:

A. **Handling a bigger load**: Assume the PCP works beyond 2pm
B. **More beds in the hospital**: Assume that the hospital can treat more than a single patient at a time. In this alternative, assume that a patient may stay in the hospital for up to 24 hours: the number of hours that a patient stays in the hospital is a random integer number between 1 and 24, drawn uniformly.

Your Assignment

You need to do the following five tasks.

T1. Define the baseline decision-making problem as an MDP problem.

T2. Implement and run an MDP solver using Value Iteration to find the find the best policy for a single day. You do not need to implement Value Iteration, but can use an existing implementation. You can find implementations in several languages on the following web site: http://aima.cs.berkeley.edu/code.html

T3. Compute the number of patients on average who will survive if the optimal policy is used.

T4. Model one of the alternative scenarios A or B, and use this MDP to answer the following questions:
How does the average number of surviving patients change as a function of the size of the hospital (i.e., the number of patients who can be hospitalized in parallel) or the number of patients that the PCP sees a day.

What to submit

A report containing the following:

- For Task 1: Your definition of the MDP problem (states, actions, etc.)
- For Tasks 2 & 3: the optimal policy computed by your MDP and the average number of surviving patients that result from following this policy. The optimal policy should be presented as an action for every possible state.
- Show this policy by showing as a table where each The computed policy

In addition, for Task 2, you must submit bug-free source code for the MDP solver, along with easy-to-follow execution instructions.

How to submit

Work in PAIRS. The report and source code should be submitted via the submission folder. All the source code should be compressed to a single ZIP file with the following format ID1_ID2.zip. All write-ups should be PDFs. I will not open/grade word documents.