

Dynamic Disease Reporter

Performance Measure: Curtail the spread of highly contagious, serious diseases. Provide appropriate treatment guidelines.

Environment: World Health Organization and health clinics throughout the world. The clinics vary greatly in terms of the resources available to detect and to report disease, as well as in terms of personnel, equipment, and medicines available to treat disease.

Actuators:

Correlate reports: Search for patterns in the disease reports.

Identify epidemics: When the cumulative reports from a region match one of the recognized patterns in terms of number of cases of a disease or percentage of the population affected, notify local health authorities of a significant medical event. This can be a report of a suspected epidemic, notification of a suspected epidemic in a neighboring region, or a prediction that an epidemic will likely occur.

Supply disease protocols: When an epidemic is identified, or certain diseases are reported, send health authorities in the affected areas the latest information on the detection, containment, and treatment of the disease. This information must be tailored to the particular geographic, social, and economic environment to which it is being sent.

Identify drug-resistant strains of diseases: When a pattern of drug-resistance is identified, notify health authorities.

Disease identification: When a "new" disease is reported, attempt to map it to a known disease, and report findings to the reporting agency.

Correlate reports of new diseases: When a match is made between reports from different regions of unrecognized "new" diseases, notify regional health authorities of the possible discovery of a "new" disease.

Sensors: Memos from health clinics throughout the world reporting the incidence of certain known communicable diseases, as well as the symptoms and mortality of new, unrecognized diseases. Memos contain information about the age of the victim, source of contagion, symptoms, incubation period, treatment provided, and response (or lack thereof) to treatment.

Agent-6. Consider the PEAS description of an agent that reports on communicable diseases as shown in figure 1. Determine what type of agent architecture is most appropriate (table lookup, simple reflex, goal-based, or utility-based). Give a detailed explanation and justification of your choice

The patterns that the agent uses are matched against sets of events that occur over time. Therefore, the agent needs to maintain knowledge of the past, and, thus, cannot be either a table lookup or simple reflex agent. If you assume that the patterns do not overlap and are clearly distinguishable from one another, then the agent could be viewed as goal-based. On the other hand, if you assume that the patterns do overlap, and that one must consider such factors as the likelihood of one event occurring over another, then the agent would be viewed as utility-based.

Agent-7. Describe the evaluation function that might be used by the *Dynamic Disease Reporter*. Is it a static or a dynamic evaluation function?

(R&N p.51) The Dynamic Disease Reporter (DRR) needs to look at several reports over a period of time to make a decision. The cumulative nature of the reports requires a dynamic evaluation function, rather than a static one.

Agent-8. Assume that you designed a utility-based agent for the *Dynamic Disease Reporter* (whether or not the problem warrants it). Describe the utility function that it might use.

The utility function is internal to the agent. It selects action(s) to take after considering the tradeoffs among a set of possible actions that it can take, given the current problem state. Some tradeoffs to consider: Effectiveness of treatment vs. cost vs. expected patient support of treatment vs. medical staff required to implement treatment vs. availability of treatment vs. effects of not treating.

Agent-9. What performance measures would you recommend for your *Dynamic Disease Reporter*?

(R&N p. 35) The performance measure exists outside the agent to determine the agent's overall effectiveness. Possible measures for the DDR: number of fatalities or number of lives saved, percent of total population affected and/or cured, and regions affected.

Agent-10. Describe the properties of the environment of the *Dynamic Disease Reporter* in terms of the principal distinctions we discussed in class (accessible vs. inaccessible, deterministic vs. stochastic (or nondeterministic), episodic vs. sequential (or nonepisodic), static vs. dynamic vs. semidynamic, discrete vs. continuous). That is, *identify in detail* which properties are characteristic of the environment described, and *give a detailed justification of your description*.

Accessible vs. inaccessible or fully vs. partly observable: Does the agent have access to the entire relevant environment?

Inaccessible: The agent sees only one report at a time, whereas the relevant state includes past reports. The agent needs to maintain an internal state to keep track of how the current event fits into the patterns evolving from previous events.

Deterministic vs. Stochastic: Is the next state fully determined by the current state plus the agent's action on the current state?

Partly deterministic: The agent can predict what the next state is likely to be in a particular region with some probability of being correct. For example, a typhus incident in an area with poor sanitation facilities is likely to be an indicator of a future typhus outbreak. However, the agent will be unable to predict the majority of incidents and their outcome.

Episodic vs. Sequential: Can the agent make a decision based solely on the current state, without considering past states?

Sequential (or No episodic): While each report might be considered an event, classification of a report as indicative of an epidemic depends upon a pattern of events that has evolved over time.

Static vs. Dynamic: Can the environment change while the agent is deliberating?

Dynamic: New disease events can occur at any time, and can effect the classification of events currently being considered.

Discrete vs. Continuous: Is the input received in a continuous stream? Is the environment constantly changing? Are the actions which the agent can take distinct/separable from one another?

Mostly Discrete: Here, the sensors (memos) are discrete, the environment is continuously changing, and the actions which the DRR can take are discrete. The clinicians are the sensors; the memos from the clinicians are the percepts. The training of the clinicians can vary widely, but the reporting mechanism can restrict the bulk of the report to checking off predefined values. One would also want to allow a free text format to record new diseases or unanticipated details related to existing diseases.