Norms Conflict and Emergence

Multiagent Systems - Lab II

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Overview

- Build on Week 7's lab (MAS Lab I) on multiagent simulation of a pandemic scenario
- Explore social norm compliance and introduce sanctioning
- Explore norm learning and emergence

Example of Norms in the Pandemic Scenario

- Wear masks
- Maintain social distance

Norm Type

Which norm type is appropriate to capture mask wearing and maintaining social distancing norms?

Building on the Pandemic Scenario: Attributes of an Agent

- Position: Location of the agent
  - Home, park, grocery store, quarantine center, vaccination center
- Health: Infection state of the agent
  - Healthy or not infected, infected (asymptomatic, symptomatic, critical), recovered, deceased
  - Recovered agents can get reinfected
  - Healthy and recovered could be considered the same state
- Vaccination state: Boolean value indicating whether an agent is vaccinated or not
- Compliance attitude: Probability $(0 - 1)$ indicating whether an agent is norm compliant or not. 0 indicates not at all compliant; 1 indicates fully compliant

Agent's Actions in the Pandemic Scenario

Moving between places (based on the mobility model in MAS Lab 1)

- Stay at home
- Visit park
- Visit grocery store
- Isolate in quarantine center, when infected
- Get vaccinated

While at those place

- Decide to wear a mask (based on an agent's compliance attitude attribute)

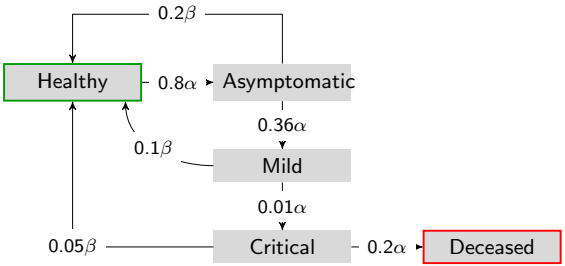
Probabilities for Mobility

	Home	Park	Grocery
Home	0.7	0.1	0.2
Park	1.0	0.0	0.0
Grocery	1.0	0.0	0.0

- An agent who is not vaccinated and who decides to stay at home, goes to a vaccination center based on its compliance attitude
- An agent who is infected and symptomatic, goes to a quarantine center based on its compliance attitude
- An agent who is infected and critical, is taken to a quarantine center (p=1), if there is vacancy at the center

Disease Model: Transition between States

Adapted from Yang and Wang 2020, Annas et al. 2020



- Healthy is "not-infected" state; Asymptomatic, Mild, and Critical are "infected" states
- Healthy to Asymptomatic occurs when an agent comes in contact with an infectious agent.
- α to 0.5 for vaccinated agents; 1.0 for unvaccinated agents
- $\beta = 1.0$ for agents not staying home and $\beta = 2.0$ for agents staying home
- Probability of remaining in the state is 1− the probability of evolving to the next state

Task 1: Incorporating the New Disease Model

- Replace the existing infection model with the new model
  - Compare the results with those from Week 7 lab (note that we do not have a vaccination center yet)
- Add a place — Vaccine Center
  - Vaccine center can vaccinate 10 people each day
  - Add an attribute in the agent model to represent vaccination state
  - Revise the mobility probabilities to allow going to the vaccination center (Assume a fixed probability of going a vaccination center; say 10%)
  - Compare the new results with the previous results

Hint: You may need to revise *move* function

Task 2: Modeling Norm Compliance Attitude

Whether an agent gets vaccinated or wears a mask depends of the agent's compliance attitude

- Add an attribute in the agent model to compliance attitude of an agent
- Initialise agents with a uniform distribution of compliance attitude
- Revise the mobility probabilities to consider compliance attitude when visiting a vaccination center
- Rerun the simulation and compare the new results with the previous results

Hint: You may need to revise *infect* and *updateHealth* functions

Task 3: Modeling Sanctions

When agents violate a norm, others observing the violation may sanction the violator agent. Sanctions serve as a hint to the violator that they are not in compliance. In future interactions, agents can select actions based on past sanctions

- Add an attribute in the agent model to capture sanctions (could be a list or a data frame)
- Give sanctions during interaction (meeting at a place)
  - an agent who wears a mask, gives a positive sanction (+1) to others wearing mask
  - an agent who wears a mask, gives a negative sanction (–1) to others not wearing mask
  - an agent who does not wear a mask, does not sanction
    - Alt: an agent who does not wear a mask, gives a positive sanction to others who do not wear a mask and a negative sanction to others who wear a mask
- Record sanctions in history: For each timestep, save the aggregated sanction received from others

Task 4: Norm Emergence via Learning Based on Sanctions

As agents act in an environment, they receive payoff in terms of personal satisfaction and any perceived norm satisfaction or violation by other agents in the society. Agents learn from these payoffs and modify their actions in future.
In this task, you will add a learning mechanism in agents.

- Revise the compliance attitude based on the sanctions received
  - Increase by 10% if the payoff in last 10 steps is positive
  - Decrease by 10% if the payoff in last 10 steps is negative
- Plot average compliance of agents over a period of time