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1 Scenario: Safe Shopping During COVID-19 Outbreak

During the challenging times of the coronavirus (COVID-19) outbreak, the UK government has announced the guidance for employers to make sure a safe working environment. Individuals are required to follow the Public Health England guidelines on **social distancing** and hygiene and some other rules [1]. For example, customers in shops are expected to keep at least 2-metre distance away from others. Also, the staff should manage the flow of customers to ensure a sufficiently large distance between customers [2]. The shop porter is required to **control the number of customers** who are shopping inside by having people waiting outside. The case also follows the tips on **sanitation** or hygiene measures. Staff in shops are also needed to clean the objects and surfaces, remove the waste more than regularly [2].

In the MAS of Safe shopping during COVID-19 outbreak, the environment is a shop called Tesco Express and the porter of which is *Mike* (agent name: *staff*). Initially, there is a customer called *John* (agent name: *customer1*) who is believed to be infected with the coronavirus SAR-COV-2. The other customer called *Rachel* (agent name: *customer2*) who is believed not to be infected, is about to enter into the shop. More details to interpret the MAS are as follows:

1. *Mike* knows the maximum number of customers, the current number of customers, the customer who is already in the shop and knows whether there are sanitation requirements.

2. In the case when the shop is full and if *Rachel* asks for the entry for the first time, *Mike* will tell her to wait outside. However, if *Rachel* asks more than once, *Mike* will check the shop and remind *John* of a new request of the entry (which is simplified and may not take place in real life).

3. In the case when the shop is not full and if *Rachel* asks to enter in, *Mike* will allow her to enter into the shop and remind *John* that a new customer has come (which is also simplified and may not take place in real life).

4. If *Rachel* arrives at the shop, she will ask *Mike* if she can enter in. If she has asked before, she then makes a new request to *Mike*. When allowed to enter in, *Rachel* also has the information about whether the shop is in excellent sanitation status or not.

5. In the case when *John* coughs and if *Rachel* is not doing social distancing from him, she is believed to get infected with the virus. If *Rachel* is keeping sufficient distance from *John*, she will not get infected (which may not happen in real life because social distancing does not stop the viral spread).

6. If the shop is not in excellent sanitation status (when *John* has coughed before), *Rachel* is believed to get infected with the virus that remains in the air.

7. Whether or not *John* coughs depends on a belief and a threshold. If the belief of cough is greater than the threshold, *John* will cough, make the air contaminated and then leave the shop. If not, *John* will directly finish shopping and leave the shop.

8. *Mike* knows when *John* leaves and will update the number of customers in the shop.

9. When *John* coughs, if *Rachel* is in the shop, she will check if she may get infected based on the belief of social distancing and simultaneously, *Mike* will realise that the sanitation status is poor. And if *Rachel* is not in the shop, only *Mike* will be reminded of the deteriorated sanitation status.

2 Requirements

2.1 Key features of the MAS

Initial base beliefs. e.g. for *customer1*: `infected(coronavirus)`, `bel_cough(1.0)`. For *customer2*: `bel_social_distancing(1.0)`. For *staff*: `limit(2)`, `sanitation(tescoExpress)`.
Initial achievement goals. e.g. for both customers:`!shop(tescoExpress)`. For *staff*: `!check_and_clean(tesco)`.
Rules. e.g. for *customer1*: `do_cough(Bel)`. For *customer2*: `social_distancing(john,Bel)`. For *staff*: `full(tescoExpress)`.
Belief change triggering events. e.g. for *customer1*:
`+another(Customer, Place)[source(Staff)]`. For *customer2*:
`+infect(Place,Virus)[source(Customer)]`. For *staff*:
`+hear_cough(Place,Virus)[source(Customer)]`.
Goal change triggering events. e.g. for *customer1*: `+!cough(Place)`. For *customer2*: `+!shop(Place)`. For *staff*: `+!check_and_clean(Place)`.
Contexts with conjunction. e.g.
for *customer1*: `do_cough(Bel) & (new_customer(Customer) | new_coming(Customer))`.
For *customer2*: `porter(Staff) & not wait(Place)[source(Staff)]`.
For *staff*: `aircontaminated(Place, Virus) & sanitation(Place)`.
Contexts with negation. e.g. for *customer1*: `not new_customer(Customer)`. For *customer2*: `not wait(Place)[source(Staff)]`. For *staff*: `not aircontaminated(Place,Virus)`.
Test (sub) goals. e.g. for *customer1*: `?infected(Virus)`. For *customer2*: `?bel_social_distancing(Bel)`. For *staff*: `?now(Num)`.
Standard internal actions. e.g. for *customer1*: `.print("Ah-choo!")`. For *customer2*: `.print("Get infected with the ",Virus)`. For *staff*: `.print("Letting in ",Place)`.
Belief change actions. e.g. For *customer1*: `+new_customer(Customer)`. For *customer2*: `+infected(Virus)`. For *staff*: `-aircontaminated(Place,Virus)`.
Jason annotations. e.g. for *customer1*: `[source(Staff)]`. For *customer2*: `[source(Customer)]`. For *staff*: `[source(Customer)]`.

2.2 Variations

The base beliefs of the MAS: all protective measures (Social distancing, timely sanitation and the number of customers at 2) are taken. Variations are made based on these base beliefs.
No sanitation and one customer at a time. Expressed as: `limit(1).now(1).` `//sanitation(tescoExpress).` Result: *[rachel] Get infected with the coronavirus*
One customer at a time. Expressed as: `limit(1).` Result: *[rachel] Shop is clean. Believed not to be infected yet.*
No social distancing. Expressed as: `thresh_social_distancing(0.5).`, `bel_social_distancing(0.0).` Result: *[rachel] Not following social distancing from john. Get infected with the coronavirus*

References

[1] Hse.gov.uk. *Social Distancing, Keeping Businesses Open And In-Work Activities During Coronavirus Outbreak.* Available at: https://www.hse.gov.uk/news/social-distancing-coronavirus.htm. [Accessed 27 May 2020].

[2] Gov.uk. *Shops And Branches - Working Safely During Coronavirus (COVID-19).* Available at: https://www.gov.uk/guidance/working-safely-during-coronavirus-covid-19/shops-and-branches. [Accessed 27 May 2020].