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CSCI 261 - Section B
8 April 2022

Contagious Disease Simulator

In early 2020, the outbreak of COVID-19 around the world striked suddenly in part due to our misinterpretations of the spread of the disease. This project will simulate the spread of COVID-19 within a random origin country, and use population data as a metric of how many people will contract COVID-19 per day. As time goes on, different functions for the rate of vaccination and herd immunity will then reduce the number of individuals capable of becoming sick [1]. The purpose of this project is not to be an accurate indicator of the spread of COVID, but to observe the trends of infectious diseases over time. The program will run until everybody on Earth gets COVID-19, or enough people have immunity that it can no longer spread. The program will work by selecting a random country from a list of countries, and calculating a rate of transmission based on population metrics within a file. Then, the user can press enter to move to the next day, where the statistics will be updated. Depending on the rate of transmission, the likelihood that somebody in any of the infected countries travels to another country and infects somebody increases, thereby adding another infected country. After a certain amount of time has passed, vaccination rates will also start to rise, which will prevent populations from becoming infected. If possible, other metrics such as herd immunity and new varients can be included. A doubly linked list will be the data structure of choice because of its efficiency at adding and removing new elements, and it's relative ease of traversing forward and backward. Right now, I foresee a linked list being utilized for storing all countries and countries that have been infected.

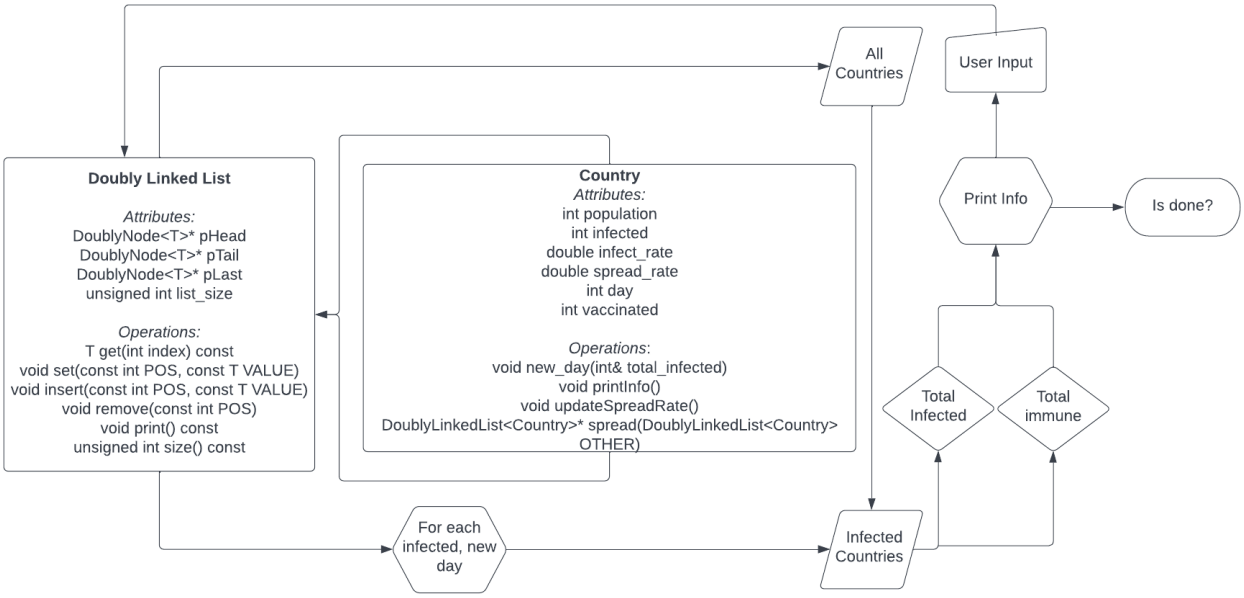

Figure 1. Class UML Diagram of Linked List and Country [2]

Each class has its respective attributes and operations. The DoublyLinkedList has attribuates that help keep track of it's size and position within the list, as well as the respective pointers. The country keeps track of population, the number of infected, the infection rate, the spread rate, and the day. The infection rate is a number between 0 and 1 that represents the average likelihood a given person in the country will contract COVID-19 that day. The spread rate is a number between 0 and 1 that represents the averag likelihood that the country will spread to a new country that day.

Using an internal csv file, the program will start by reading in information on country names and population, creating a new country object and adding it to a DoublyLinkedList. Each time a new country is infected, include it within a new DoublyLinkedList containing all infected countries.

The following is pseudocode for the simulation:

Load country csv file
Create empty DoublyLinkedList "countries"
For each country, create a country object
Set total world population
Add new country object to "countries" list
Create empty DoublyLinkedList "infected"
Pick a random country
Copy country from "countries" list to "infected" list

Set infection_rate of country in “infected” list above 0
Set infected of country to 1
notDone = true

While notDone:
Wait for user prompt
Increment day
For each infected country
Update infected
Update infection_rate
Update vaccinated
Update spread rate
Update total_infected
Update total_vaccinated
Pick a random number between 0 and 1
If spread rate is greater than number
Pick a random country to infect
End if
printInfo

End for
If (world_population - total_infected == 0) or (total_infected + total_immune == world_population)
Set notDone = false
End if
End while

One concern that I have is making time to work on this relatively ambitious assignment with all of the other sets due within the next couple of weeks. In addition, I am somewhat concerned on running into a stalemate, and figuring out how to end the program if nothing is advancing for extended periods of days.

References

[1] N. Achaiah, S. Subbarajasetty, and Rajesh Shetty, “R0 and Re of COVID-19: Can We Predict When the Pandemic Outbreak will be Contained?” *Indian J. of Crit Care Med,* vol. 24, no. 11, pp. 11, Nov. 2020, doi: 10.5005/jp-journals-10071-23649

[2] M. Pineiro, “Class UML Diagram of Linked List and Country, **”** April 2022.