INFO 6205 Final Report

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Introduction about the topic

Coronavirus disease 2019 (COVID-19), also known as the coronavirus or COVID, is a contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first known case was identified in Wuhan, China, in December 2019. The disease has since spread worldwide, leading to an ongoing pandemic[1]. As of writing this report, Covid-19 has infected more than 141 million people worldwide causing more than 3 million deaths[2]. Different means of preventing the spread of this disease has been introduced, including wearing masks, social distancing, quarantining, preventing travel, etc.
This project introduces a software that simulates the spread of this disease under several conditions. We look at the effectiveness of masks and quarantining as well as the r factor in our study.

Aim of the project

The goal of the project is to model and simulate how different factors combined affect the spread of an infectious disease. The simulation software runs the simulation under given parameters, visualizes the process and saves data for further analyzes.

Complete project details

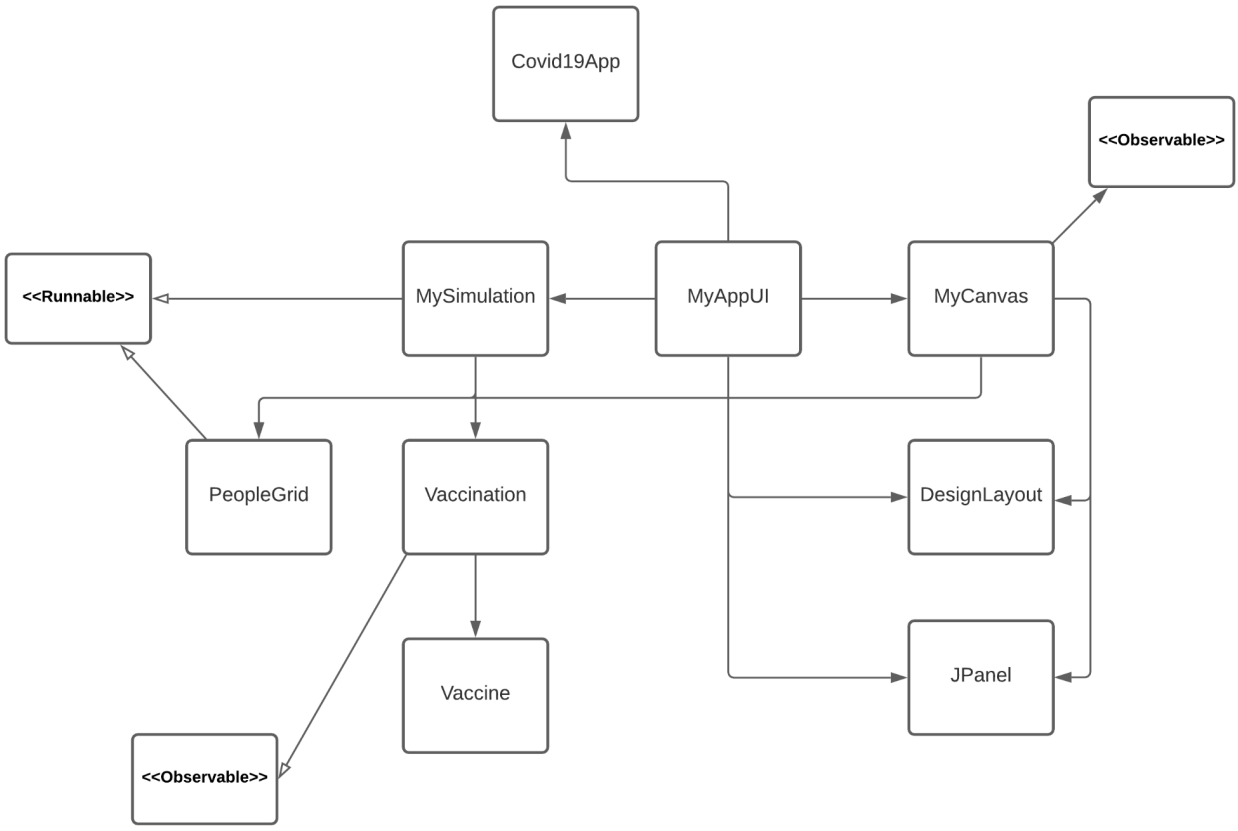
The software package has two components:

- Desktop Application with GUI (using Java Swing)
- Web Application (HTML, JavaScript, JQuery, Chart.js)

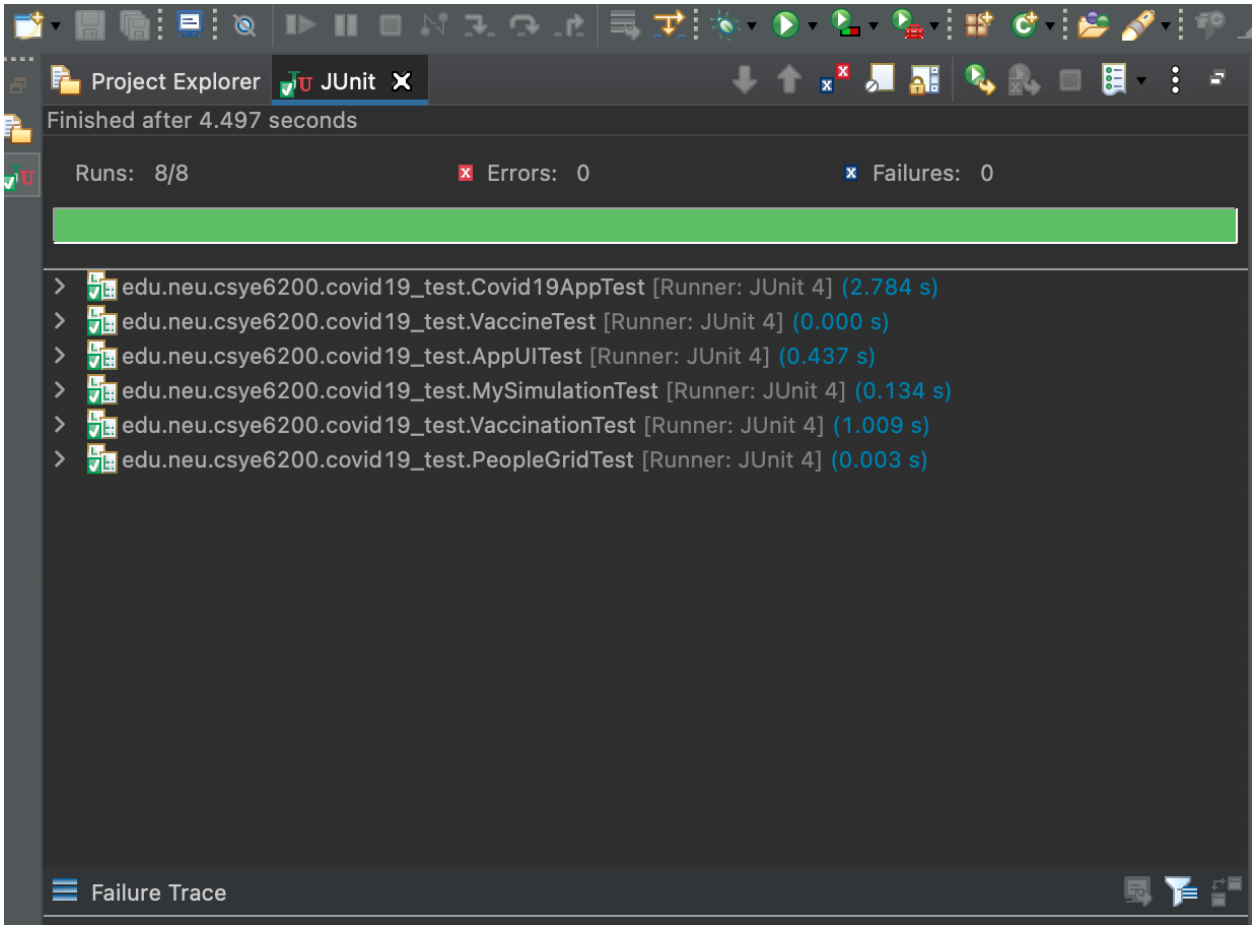
[1] Source: https://en.wikipedia.org/wiki/COVID-19
[2] Source: https://en.wikipedia.org/wiki/Template:COVID-19_pandemic_data

The desktop application is used to set parameters and run the simulation, as well as visualizing the process. The desktop app saves data of the simulation and a web application is used to view, chart and analyze the data.

UML

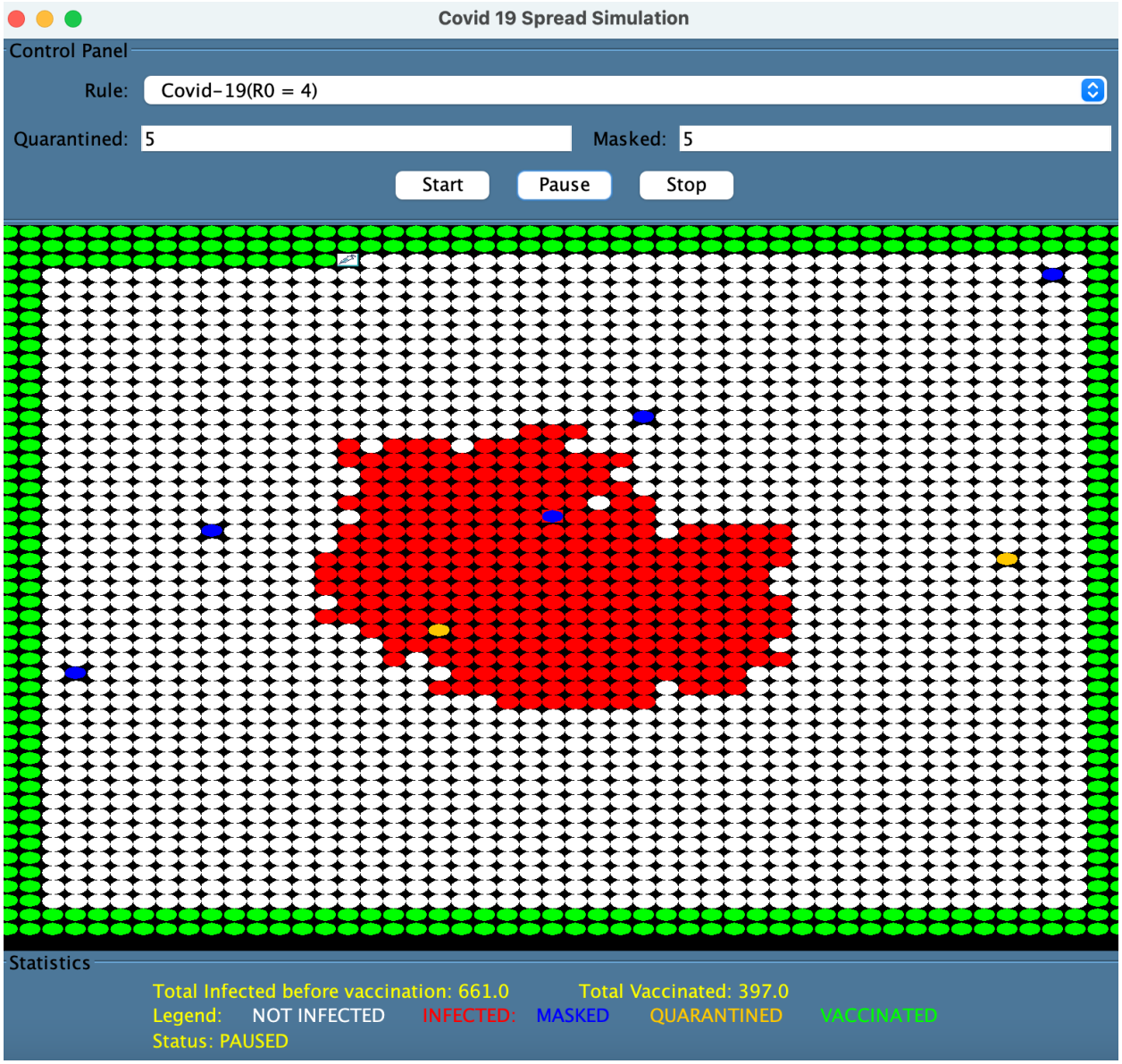


Test Cases



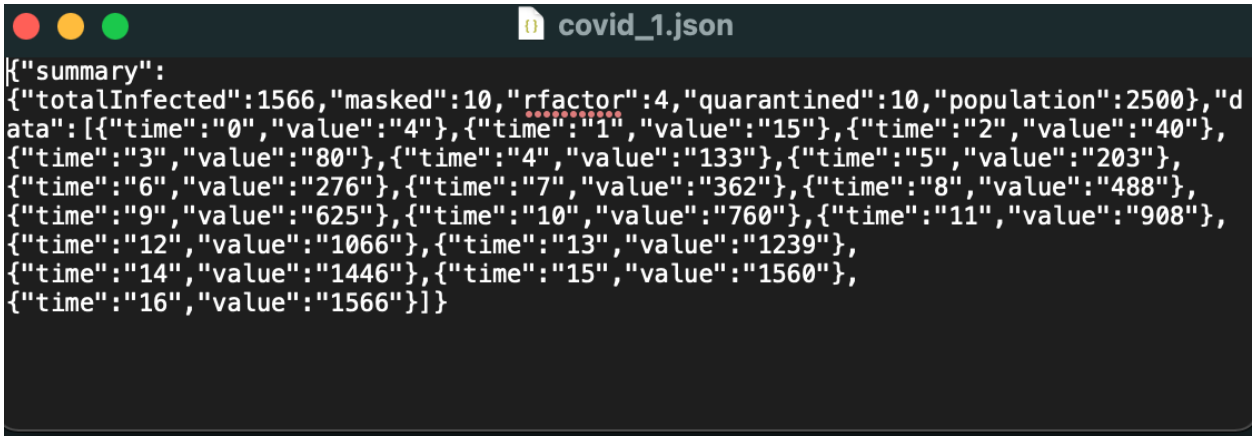
Implementation

GUI:



(Click to access simulation and explanation video)

Output



Mathematical analysis/evidence :

In our model we include 2500 people. Out of these a few will be quarantining and wearing masks. We loop through all the infected people and add their neighbours based on R factor, masks and quarantining.

Assumptions:

Every person has 8 neighbours.
Vaccinated person can't be infected
R factor for mask wearers is half. (we assume the infection rate is halved if mask is worn)
R factor for people quarantining is 0

Pseudo Code for Infection Spread:(simplified code for understanding)

```
for infected: infectedPeople
        if masked:
                Rfactor = 2;
        else if quarantined:
                Rfactor = 0;
        else:
                Rfactor=4;
        Infections = random(Rfactor);
        while(infections>0)
                Infections--;
                neighbour = random(8);// There are 8 neighbours per person
                //Infect neighbour and update grid
```

Explanation:

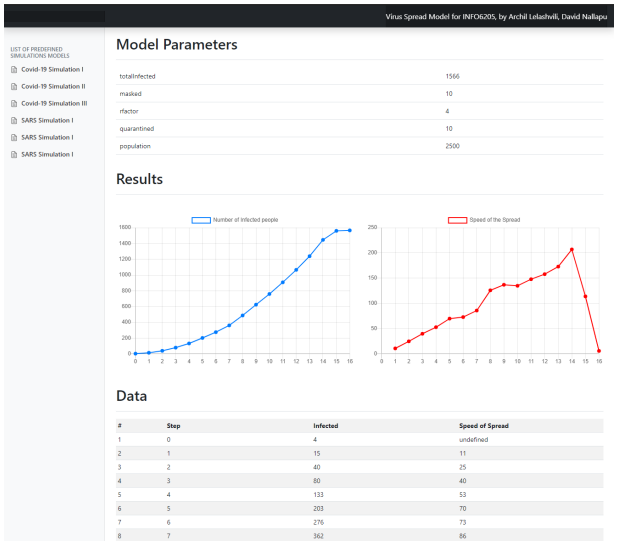
Spreading infection:

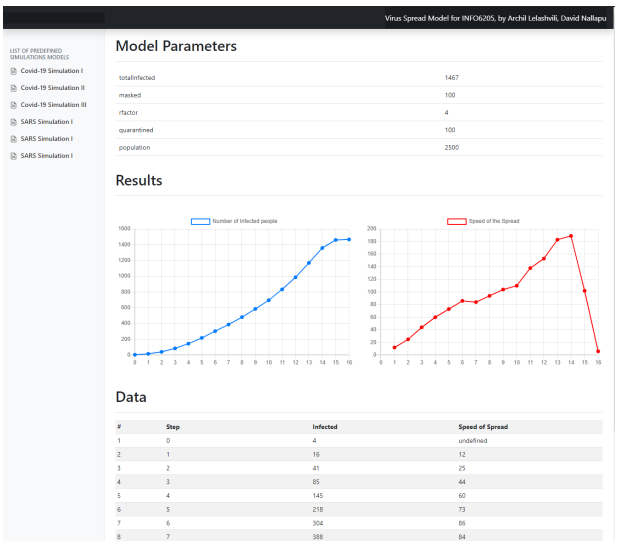
The pseudo code explains how we loop through all the infected people to infect their neighbours. We look at various parameters such as vaccination, R factor, quarantining, mask wearing before infection. To infect we choose any random 4(based on R Factor) neighbours out of 8 and infect them. After which we loop again with the updated ArrayList of infected people to infect the newly infected people's neighbours.

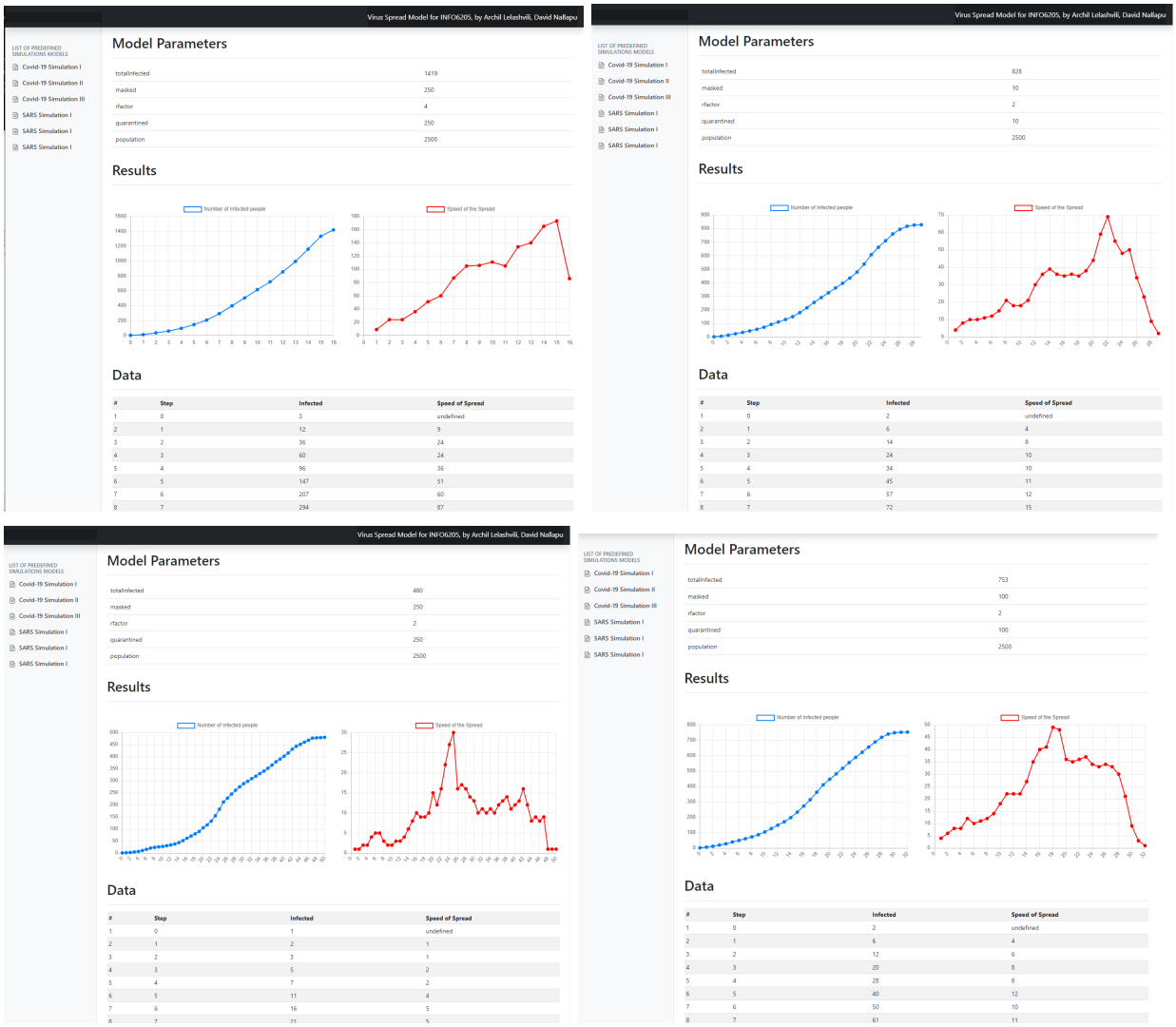
Vaccination:

This is a thread that loops around the grid in a clockwise manner and updates the grid to show that they are vaccinated. It aims to localize the spread and curb it by surrounding the infected area.

Charts Generated from Simulation Data:







Conclusion

We could conclude that masks and quarantining are paramount for reducing the total number of infections. Both SARS and COVID-19 infected less people as the number of people quarantining and wearing a mask increased. We do not see a large difference in COVID-19 data as the mask wearers and people quarantining are generated randomly. As the spread increases from the center of the grid, it didn't make a difference particularly as many mask wearers and people quarantining are generated near the border of the grid and are vaccinated almost immediately. We can also conclude from this that it is important for people in a hot zone to be the ones wearing a mask or quarantining to curb COVID-19 spread.