

# מטלה מס' 1 – ביולוגיה חישובית

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Running the app:

coronaSim.py was written in python and needs the following packages to run:

```
import sys

import time
import numpy as np
import pygame
from matplotlib import pyplot as plt

import random

from tkinter import *
from tkinter import messagebox
```

some of them handles the GUI which was a must in this assignment.

To make python code runnable with “double click” I’ve used py2exe to create an exe file with all needed dlls that can be located in:

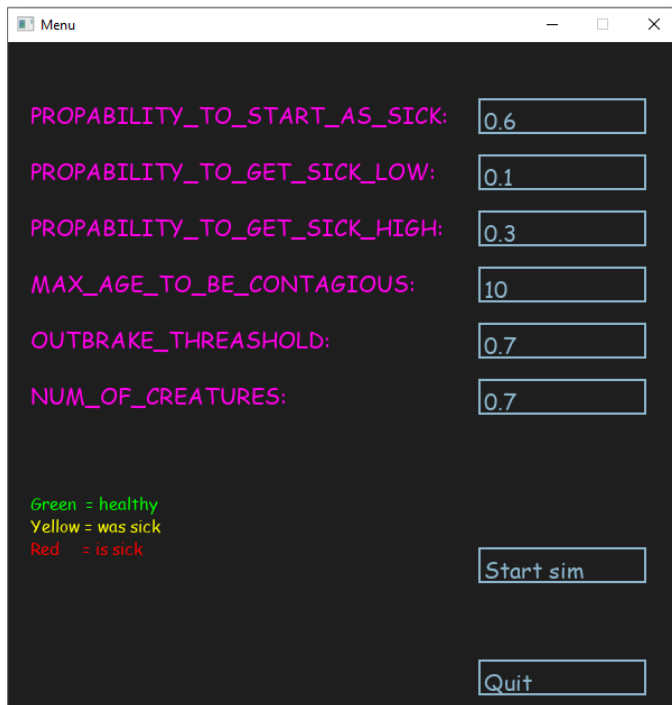
- 1) Download from this github link this coronaSim.zip
- 2) Extract zip
- 3) Enter folder
- 4) Double click on coronaSim.exe, you might need to download VC++ update from here:  
<https://www.microsoft.com/en-us/download/details.aspx?id=52685>

if exe still don’t work (which was tested on several windows pcs) or you are anxious to run my exe, you can locate in the same github my venv, download it and then you can it like this

venv/Scripts/python.exe <path/to/coronaSim.py>

About the app:

First screen will be:



Menu

PROPABILITY\_TO\_START\_AS\_SICK: 0.6

PROPABILITY\_TO\_GET\_SICK\_LOW: 0.1

PROPABILITY\_TO\_GET\_SICK\_HIGH: 0.3

MAX\_AGE\_TO\_BE\_CONTAGIOUS: 10

OUTBRAKE\_THRESHOLD: 0.7

NUM\_OF\_CREATURES: 0.7

Green = healthy  
Yellow = was sick  
Red = is sick

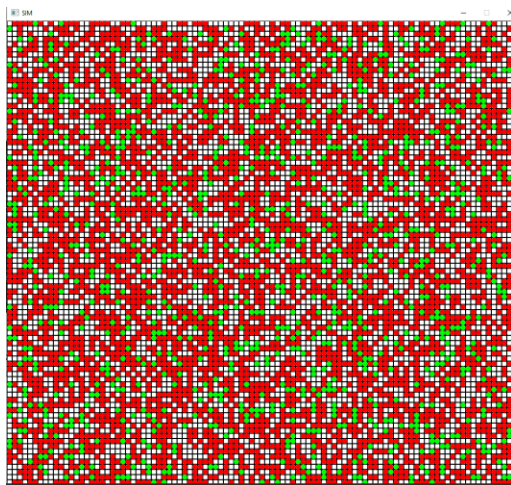
Start sim

Quit

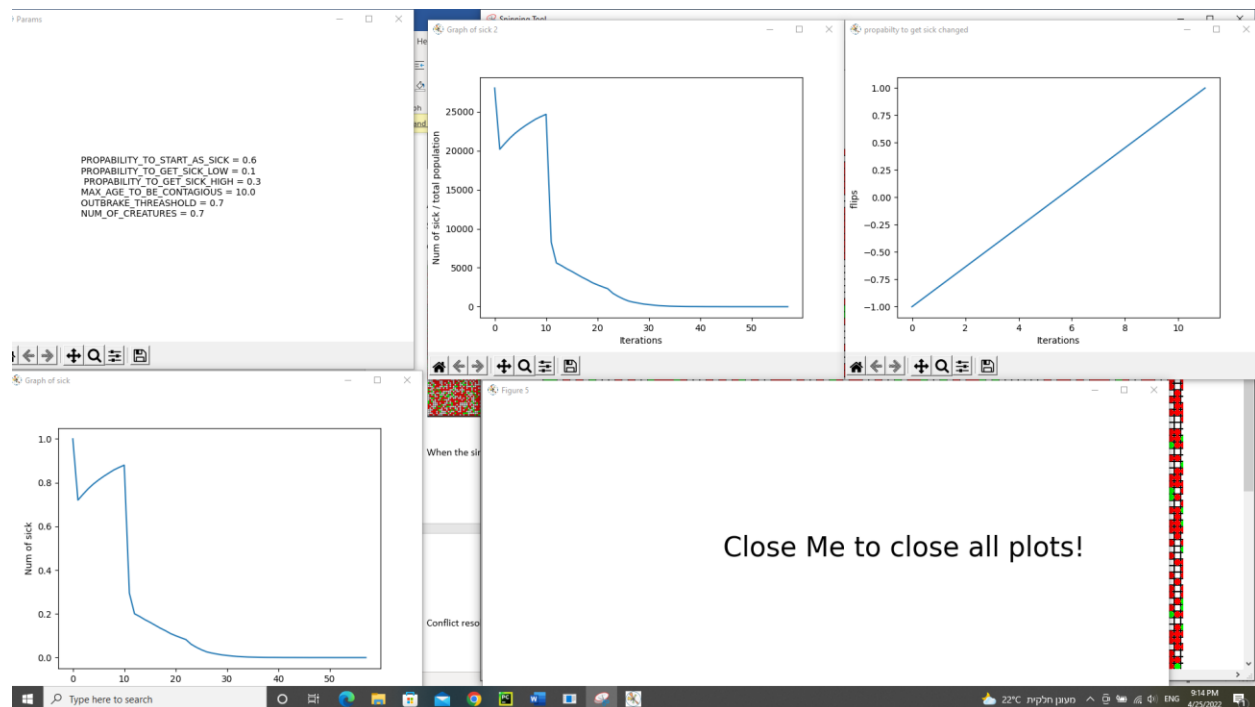
All parameters were arbitrarily chosen and can be changed by the user.

Start sim while start the simulation a 200X200 grid will pop with the following colors,

Green = healthy, Red = Sick, Yellow = was sick, white = empty cell



When the simulation is over you will get several plots for the statistics aggregated in the simulation, one of the plots is a close all button (each pyplot is blocker) and back to intro screen again.



Conflict resolution, assignment of two creatures to the same grid cell:

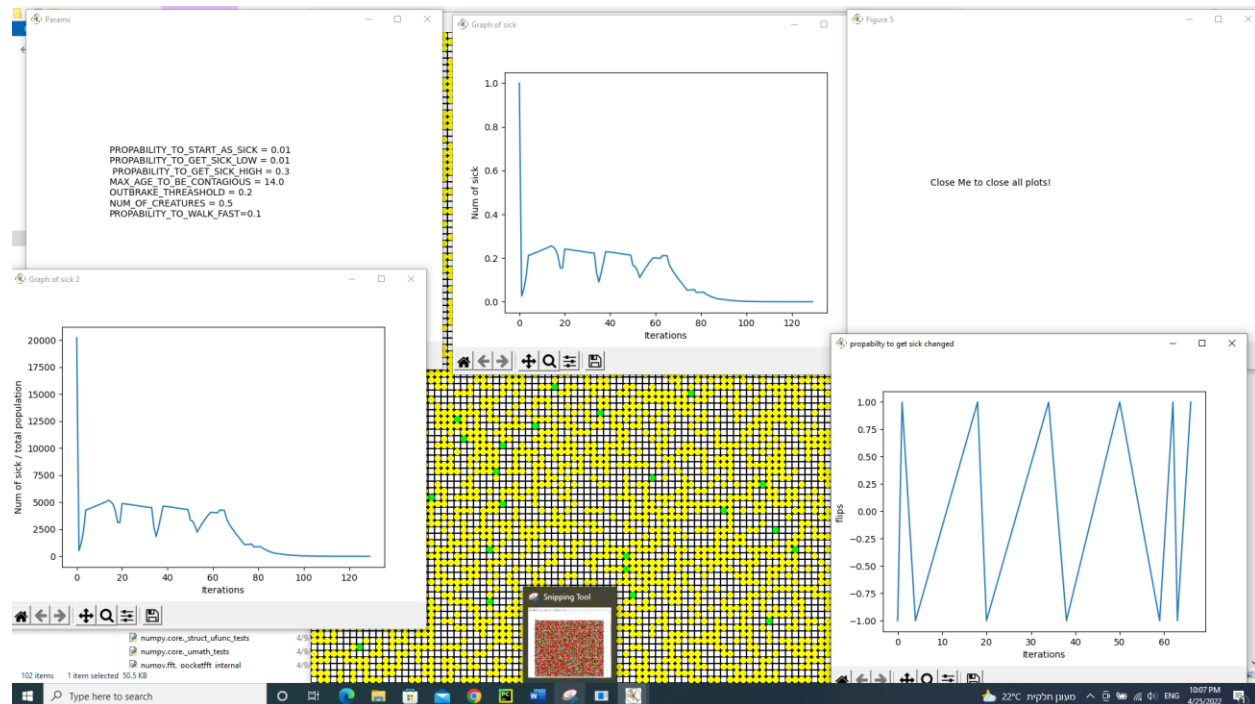
I've solved the conflict of assigning two creatures to the same cell by this algorithm:

- 1) First come first served
- 2) If we have a collision, choose one arbitrarily
- 3) With the one that didn't have been chosen, try:
- 4) Stay in old place, if can't randomly get up to 100 tries (half of the board) to go to any cell (brute force) if still don't have place go to the last corner there is now chance that we will hit someone there as we move row by row and until we get there the one that in there will move in his turn

Catching waves:

The parameters that can be changed in the corona simulation are:

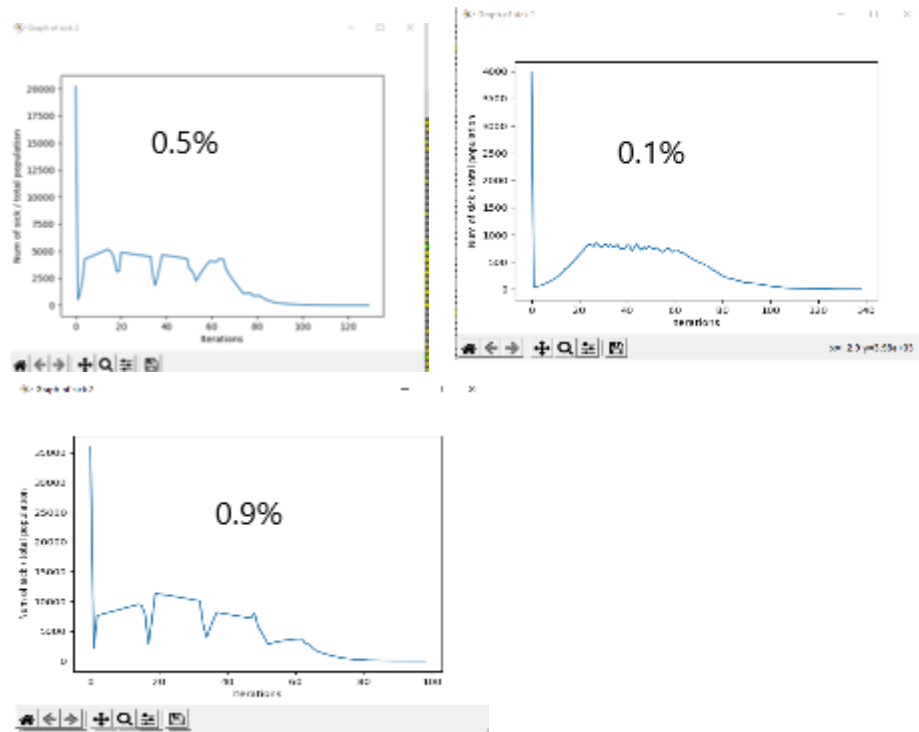
```
NUM_OF_CREATURES (N) = can be passed as percentage (density) or nominal
PROPABILITY_TO_START_AS_SICK (D)
MAX_AGE_TO_BE_CONTAGIOUS (X) = where age is the iteration #
OUTBRAKE_THRESHOLD (T) = when PROPABILITY_TO_GET_SICK changes from HIGH to
LOW and vise verse
PROPABILITY_TO_GET_SICK_HIGH (P)
PROPABILITY_TO_GET_SICK_LOW (P)
PROPABILITY_TO_WALK_FAST (R)
```



I've found that to get 3 and above waves I need to get my creatures to be contagious long enough and the "PROPABILITY\_TO\_GET\_SICK\_HIGH" much higher than "PROPABILITY\_TO\_GET\_SICK\_LOW". Also, it is very important to start with not so many sick creatures occupying the board as if this number is too high everybody just gets sick really quick, and the simulation is over.

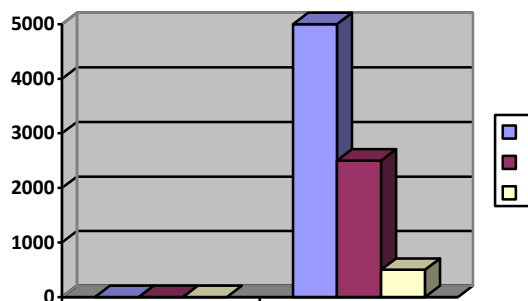
```
PROPABILITY_TO_START_AS_SICK = 0.01
PROPABILITY_TO_GET_SICK_LOW = 0.01
PROPABILITY_TO_GET_SICK_HIGH = 0.3
MAX_AGE_TO_BE_CONTAGIOUS = 14.0
OUTBRAKE_THRESHOLD = 0.2
NUM_OF_CREATURES = 0.5
PROPABILITY_TO_WALK_FAST = 0.1
```

## Changing only the NUM\_OF\_CREATURES



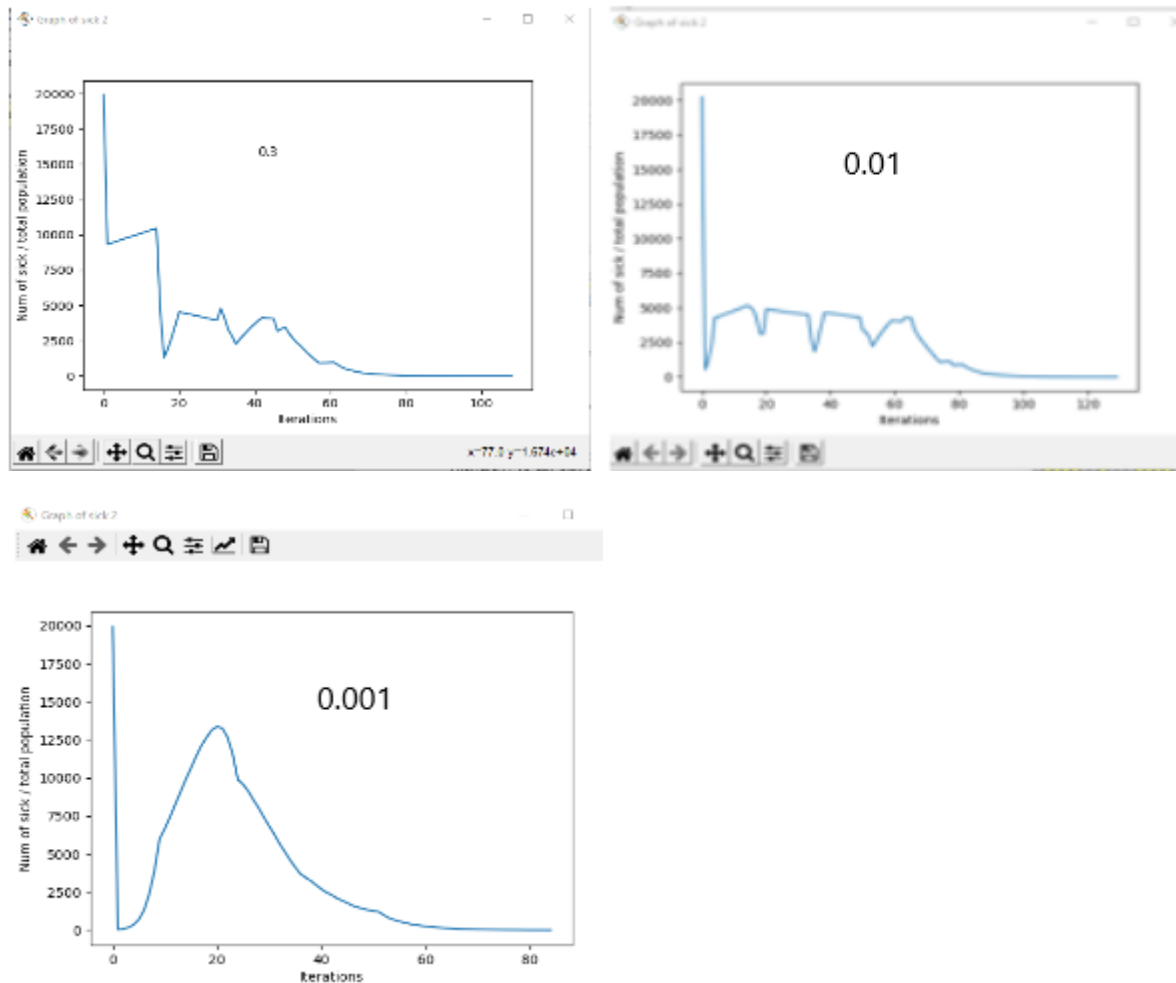
I've sampled few possibilities of number of creatures and saw that the average number of sick creatures decreases dramatically as the density decreases

0.9	5000
0.5	2500
0.1	500



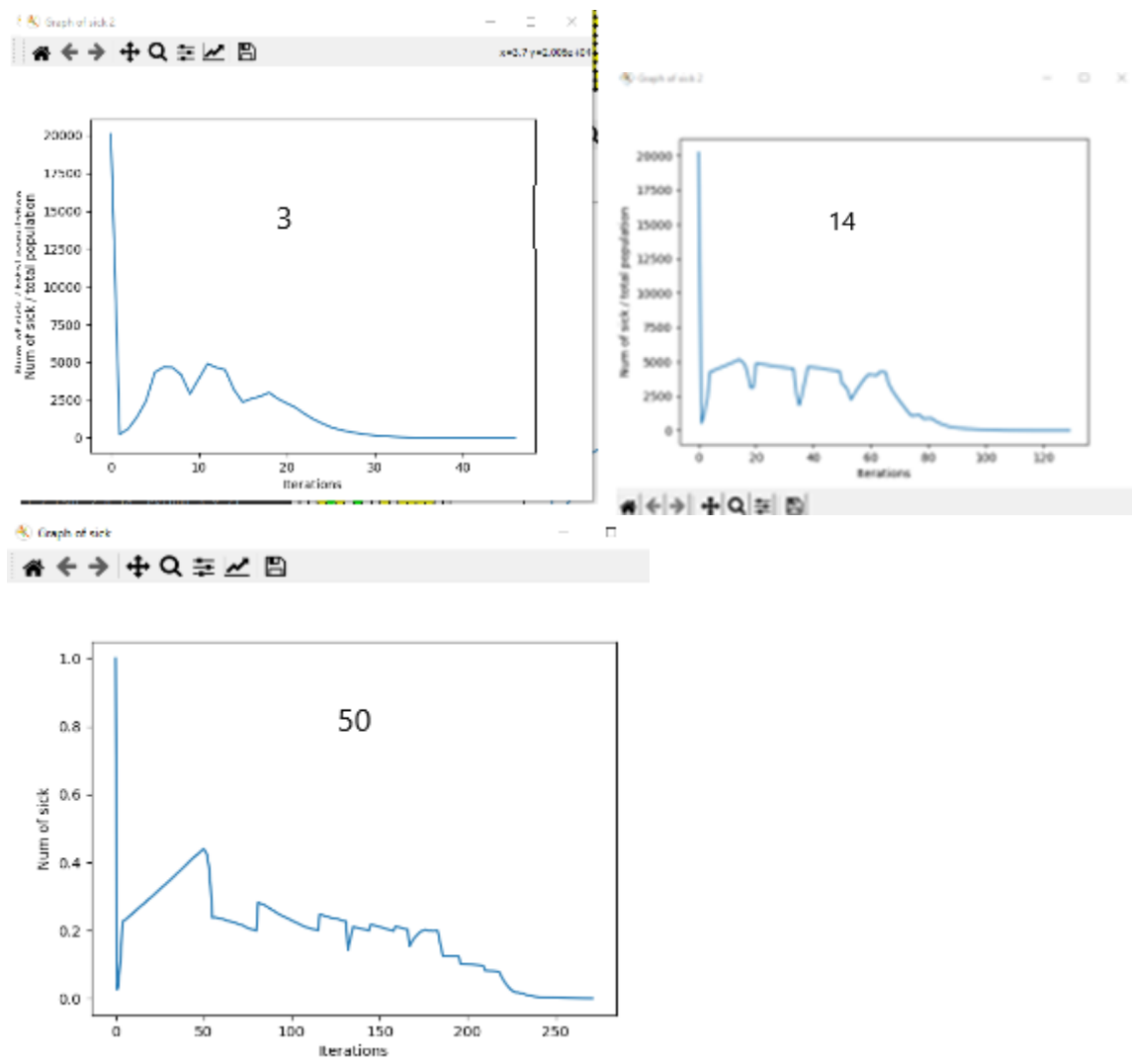
Maybe it implies to the rule that was enforced when we had the outbreak of max people gathering in close places

## Changing the PROPABILITY\_TO\_START\_AS\_SICK



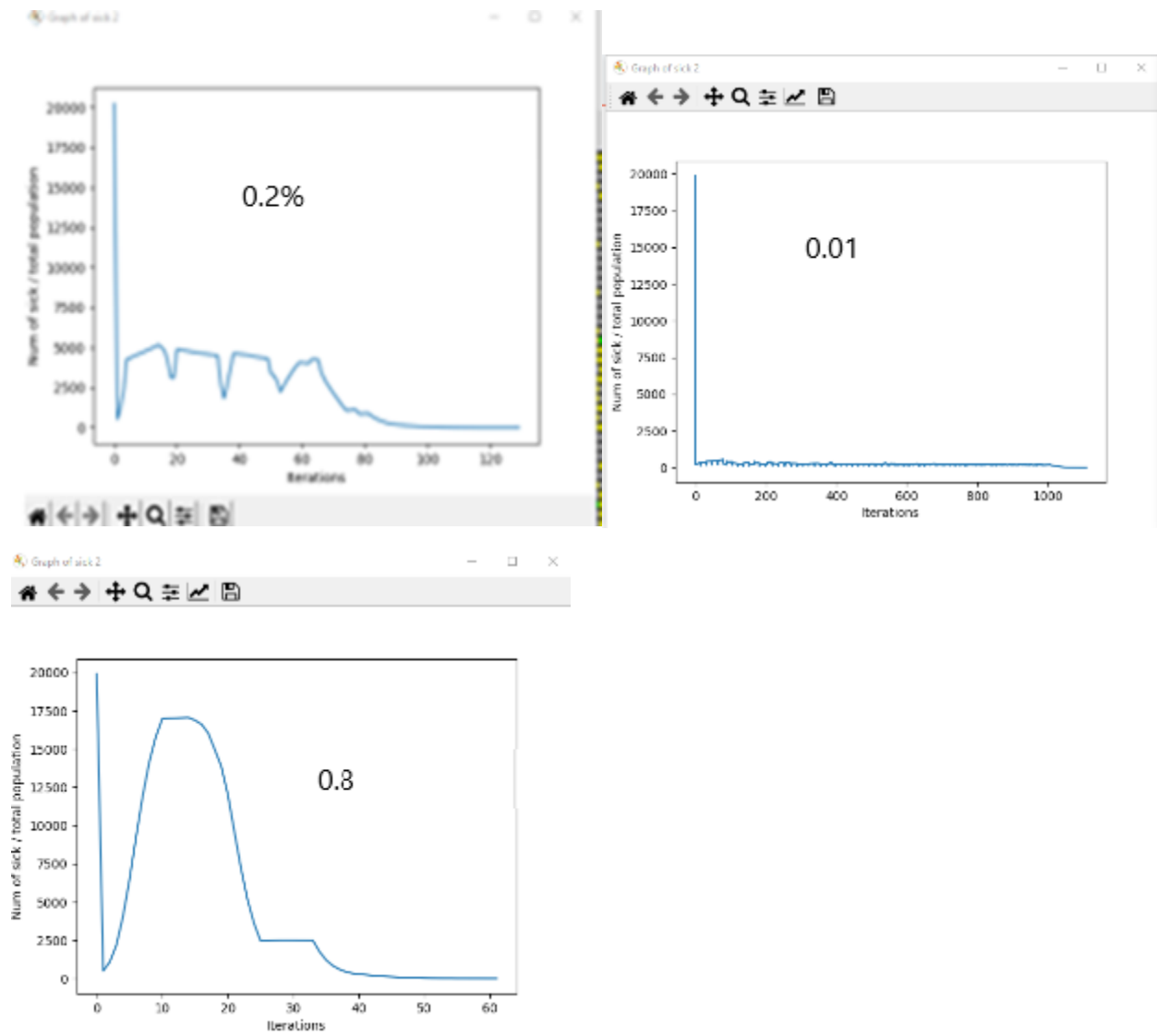
As lower the number of creatures starts as sick the shorter the simulation, the interesting part here is that you will need only one sick creature to infect many, when passed only 1% probability of start as sick you still got a wave form graph with a pick of around 0.5 of the population got sick.

Change the number of days creature is contagious



We can see that the more days that the creatures is contagious the more wave like graph of sick versus healthy we are getting.

## Changing the out-brake threshold



Simulation ends up really fast when creatures aren't "watching out" and everybody ends up being sick while when I set the threshold to 0.01 I managed to end the simulation with some creatures that wasn't sick as all!

Note: except dices being spread faster I didn't find any noticeable changes when changing the "can walk faster" parameter.



## Conclusion:

It seems that science works! When creatures didn't gather i.e. the density was quite low and when the out-brake threshold was low i.e. when I had "too many" sick people around me I watched myself. I've ended up the simulation with some of the creatures not being sick at all, but when those rules broke the simulation always ended with all creatures marked as "was sick". Just like in real life, where we overcome the corona waves when we didn't crowd, and everybody wore masks et cetera.

It was nice to see that coding this set of rules really simulated real-life-like events.