**Report on Infection Simulation**

For this experiment, I chose to run my simulation using a 255 x 65 grid filled with cell objects, which hold information such as the immunity and infection status of the cell, along with its position on the grid. At the start of the program, each cell is initialized with default information. After the initialization, a percentage of cells, given as a program argument, are chosen at random to become immune so that the simulated infection does not affect them. After the immunity selection, one cell is randomly chosen to become “Ground Zero”; this cell is the lucky winner of the pandemic lottery and is marked as infected to begin the infection simulation.

For each iteration of the simulation, current grid status for each cell and statistics for the simulation is displayed to the user; An ‘A’ represents an alive cell, a ‘!’ is an immune cell, a ‘V’ is a vaccinated cell (and thus immune), a ‘#’ is a recently infected cell, and a ‘.’ is a dead cell. Once current information is displayed, each infected cell is checked against each neighboring cell, and the neighboring cells are marked for infection, if applicable. Then, if vaccinations are enabled by the user, after 20 iterations, a random cell is chosen to be vaccinated. Vaccinations start in the corner of the quadrant with the most area in regards to Ground Zero (e.g. if Ground Zero is located close to the northeast corner, the first vaccination with occur in the southwest corner, or as close as possible if the most southwest cell is occupied). Vaccinations then slowly spread out in the assigned quadrant as the simulation progresses. Only alive, non-immune cells are eligible for vaccination; there’s no bringing the dead back to life in this simulation.

To gather information, simulations at beginning immunity levels of 0%, 10%, 20%, 30%, 40%, 50%, 55%, 60%, and 65%. These levels were ran with vaccines both enabled and disabled, and 5 passes were ran at each level, for a total of 90 individual, randomized simulations. For both vaccine and non-vaccine simulations, the results were pretty obvious and uninteresting at the start. For the non-vaccinated population, the infection killed off absolutely all non-immune cells from the 0% to 20% immunity ranges, at 30% there were 4 non-immune survivors average, and 40% about 24. However, the survivor count began to skyrocket at the 50% mark. For the non-vaccinated simulations, the non-immune survivor count shot up to 197 at 50%, 1024 at 55%, 4527 at 60%, and 5058 at 65%.

The vaccinated simulations seen similar numbers; however, there were a small number of survivors at the start and the survivor count began to jump up a little earlier at 40%. There were about 4 non-immune survivors at 0% starting immunity, only 1 survivor average at 10%, 4 again at 20%, 13 at 30%, and 67 at 40%. At 50% we have 296 survivors, 841 at 55%, 4860 at 60%, and 4971 at 65%.

While I was expecting a rise in survivor rates as immunity increased, I was not expecting such a steep increase beyond 50%. This can easily be seen and understood while watching the simulation, however; at 50%, it is very probable that the immune cells cluster up, preventing the infection from spreading far and protecting their non-immune neighbors. At 60% and 65%, it was hard to even get a simulation that lasted beyond the first few iterations. In fact, two of the vaccinated simulations ended before the vaccinated cells even had a chance to propagate.

One thing of note is that the vaccines didn't really affect numbers by much. When looking at a graph of total infected cells vs. total immune cells, the vaccinated graph is slightly shifted down and to the right compared to its non-vaccinated counterpart, but otherwise they look identical to one another. I have not had a chance to try it out, but I'm willing to guess that using a wall method to block off the infection would have been substantially more effective than the vaccine technique, based on my observations of the higher starting immunization percentages.