COSC 326 Etude 10 – Epidemic

Report

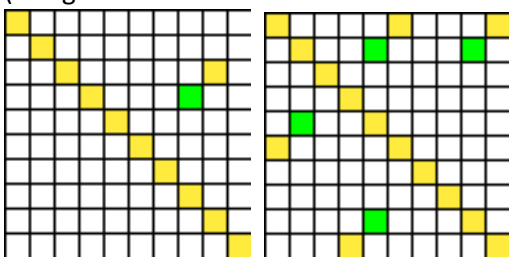
8548310 – Blake MacDade

For this report, we are tasked with analysing trends, solutions, and problems in relation to getting every vulnerable cell in the universe sick. From there, we need to calculate the minimum number of initially sick cells required to infect the entire vulnerable universe.

To start looking at this issue, we must first consider situations where a vulnerable person cannot possibly be infected. This would be the case where a vulnerable person isn't surrounded by at least two other vulnerable or sick persons, such as where they are surrounded by the edges of the universe and/or immune cells.

For a universe with edges of the same length (i.e., width same as height), and no Immune cells, we only need a line of diagonal sick cells to infect the whole universe. That is, give a universe size of n^2, we only need n number of sick cells to infect the whole universe.

I found that, if positioned correctly, for each Immune cell, you would only need as few as one extra sick cell to ensure the whole universe was infected. To do this, we need our diagonal row of sick cells, and then place an Immune cell down anywhere of your choosing, if you place it diagonally above the line of sick cells, place another sick cell to the top right of the immune cell. The situation is reversed for if you place the Immune cell diagonally below the line of sick cells, as you must instead place a sick cell one cell down, and to the left of the immune cell. As shown in the below examples (using the same colour scheme from the Etude 10 PDF – yellow = sick, green = immune), these are the basic requirements for a fully sick universe (except immune cells). It should be noted, that in the case that there is an immune cell in the place where you would want to put a sick cell on the diagonal, you must put both a sick cell above to the right, and below to the left.



This trick also works for universes that are not squares (that is, all sides not of the same length), just with a slight modification, we must include the same number of sick persons as the length of the longest side of the universe. That is if we have a universe of size Y * Z, where Y > Z, we must have N sick cells to infect the whole universe, plus one for every immune cell. The formula $N_{(Sick)} = Y + N_{(Immune)}$ gives us the **maximum** number of initially sick cells it would take to be guarenteed to infect the entire universe, assuming a diagonal line of sick cells as shown to the right. I have found that you can remove a few sick cells and replace then with vulnerable cells, in these such configurations. You may swap out one sick cell for a vulnerable cell on each alternating diagonal, e.g., the following two images both produce a result where the whole universe is infected. This holds as long as you don't swap out cells from differently aligned diagonal runs. The trick with immune cells also works here, just add another sick cell for each immune cell, in the same way as for the square universe.