Backtracking:

backtracking algorithm searches for a path from a starting node to an end node. In this assignment, I used backtracking starting from the Human Agent and ending with the Home agent. The DFS will start to look at all the neighbors to the current cell and try to visit them all one at a time repeating the process at each new cell.

The bases cases for this implementations are as follow:

- At any time if the current cell in the route is outside of the boundaries, or at a COVID infected cell when not protected yet (i.e. Didn't visit the doctor or the mask yet). Then, this route can't be a solution and a new route must be chosen. Hence, backtrack.
- Complexity optimization. One optimization I add to make the code run faster, is to backtrack at any current potential route if the number of steps remaining is less than the diagonal distance to the home from the current destination.
- If the coordinates of the current cell is equal to those of the home then it's a valid solution.

It's worth mentioning that this algorithm is not affected by variant change. DFA chooses one of all the possible neighbours at time. Know that some possible move will lead to having the current cell as a neighbour for a COVID infected cell won't change the way the algorithm works.

BFS:

BFS algorithm. will work by looking at all the current neighbours of the current cell in the route. And put all of them in a queue. Each cell has a parent cell(i.e. Previous cell in the route). At any moment when the Home agent is reached, we can retrace the parents cells to find the entire route from the Home agent to the Human original place.

The base cases for this implementations are as follow:

- At any time if the current cell in the route is outside of the boundaries, or at a COVID infected cell when not protected yet (i.e. Didn't visit the doctor or the mask yet). Then, this route can't be a solution and a new route must be chosen. Hence, backtrack.
- If the coordinates of the current cell is equal to those of the home then it's a valid solution.

It's worth mentioning that this algorithm is not affected by variant change. BFS puts all the possible neighbours in a queue. In this queue, it will look at all the elements and knowing that some possible move will lead to having the current cell as a neighbour for a COVID infected cell won't change the way the algorithm works.

Comparison between backtracking & BFS:

As mentioned before both algorithms are not affected by variant change so variant one and two are exactly the same, I run 10 random queries and I got:

Backtracking average time: 0.2526 seconds

BFS average time : 0.0181 seconds

PEAS description:

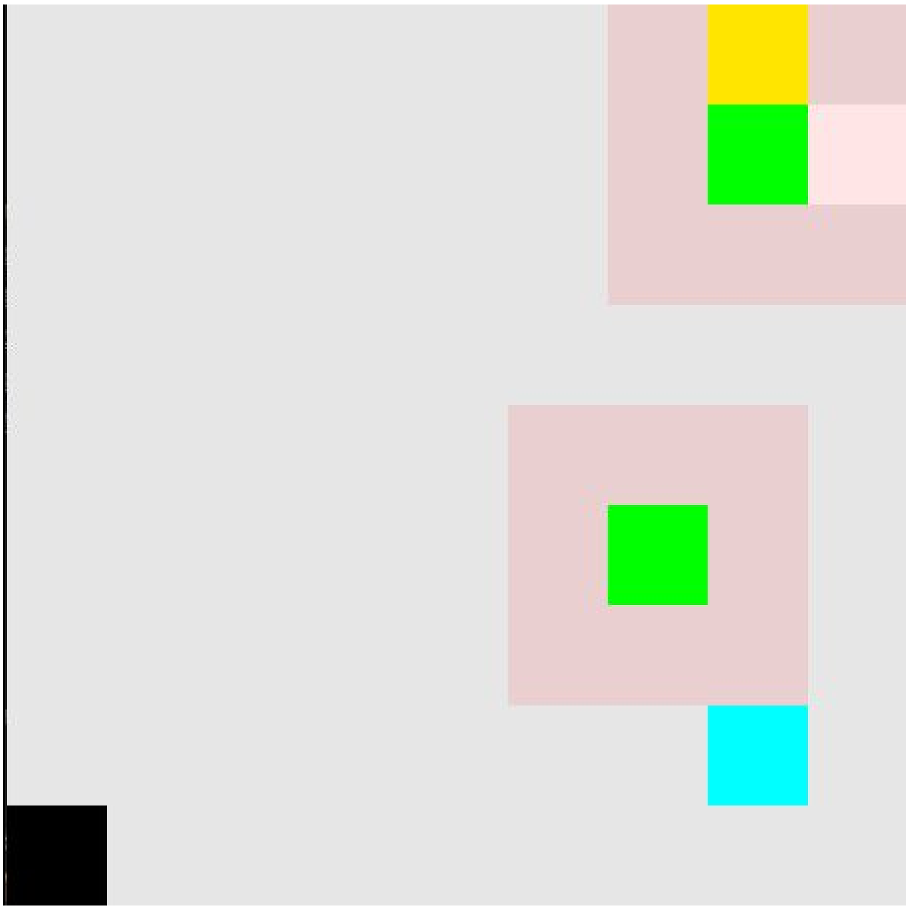
- Agents: Human, Doctor, Mask, Covid-1, Covid-2 and Home.

- performance measures: finding the shortest path to the home, the run time needed to find it.
- Environment: the N*N grid that contains all this agents
- Actuators: the Human can move to any neighbouring cell, the Mask and the Doctor agents gives protection to the human from covid infected cell
- Sensors: the Human agent can sense other agents and the Covid infected cells strictly when they share the same cell(i,e distance between them is equal to 0). But for the second variant the Human has the ability to sense the Covid infected cells if they share the same neighbours (i.e.the distance is equal to 1).

examples of unsolvable situations:

Yellow block is home and black block is the Human agent.
Green blocks are covid cells and pink blocks are covid infected.
Blue block is the mask agent and Doctor agent is the white block.

-First case a situation where there is an answer but the run time of the algorithms is too great it fails to generate a solution.



-Second case is when no route is possible and it is a losing situation.