Task 3: Evolution in Sugarscape

The simulation runs in turns, with each turn consisting of the following phases in this order

1. Sugar growth phase – triggered by ***`SugarGrowth()`*** function from the program.
2. Agent movement phase – triggered by ***`movement()`*** function from the program.
3. Consumption phase – triggered by ***`metabolism()`*** function from the program.

Design pattern:

1. The world has wrap-around borders. This effect applies to agent movement and sight. The sugar scape is a 20X20 grid world, and the number of agents is 20 at the initial stage.
2. Agent's sights are varied randomly between 2 and 5 with mutation during reproduction.
3. Agents can reproduce agent of their kind if there is space (north, south, west, east, northwest, northeast, southwest, southeast) around them. Agent reproduces if energy is greater than 20
4. Parent energy is split in two halves during reproduction.
5. **Note:** Death is allowed in first analysis. Agents get replaced after death.
6. Simulation without dead was also considered and discussed at the end of this report.

Visualization and Analysis

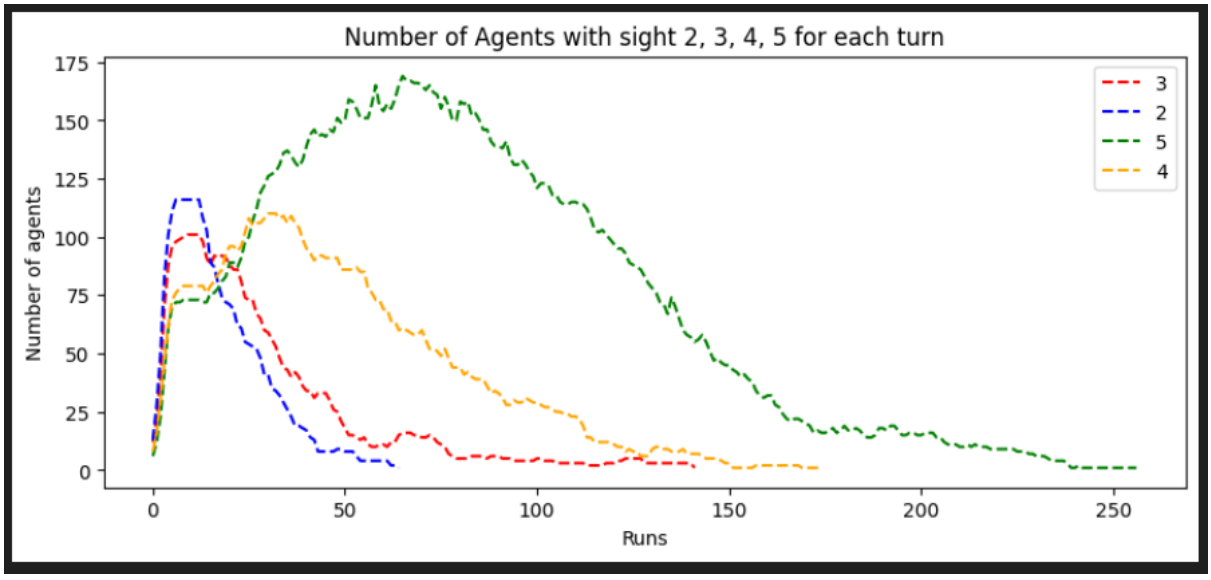

Fig1. Shows first four sight distribution for each agent and the number of turns.

Analysis 1:
Prior Hypothesis: *Agent with longer sight should survive longer.*
Analysis from simulation: Figure1 shows sight (2,3,4,5) distribution of agents for each turn. This analysis aligns with my prior hypothesis. It is clear that agents with longer sight had high survival rate compared to agents with shorter sight. This indicates that agents with longer sight had consumed more sugar giving them higher survival chance.

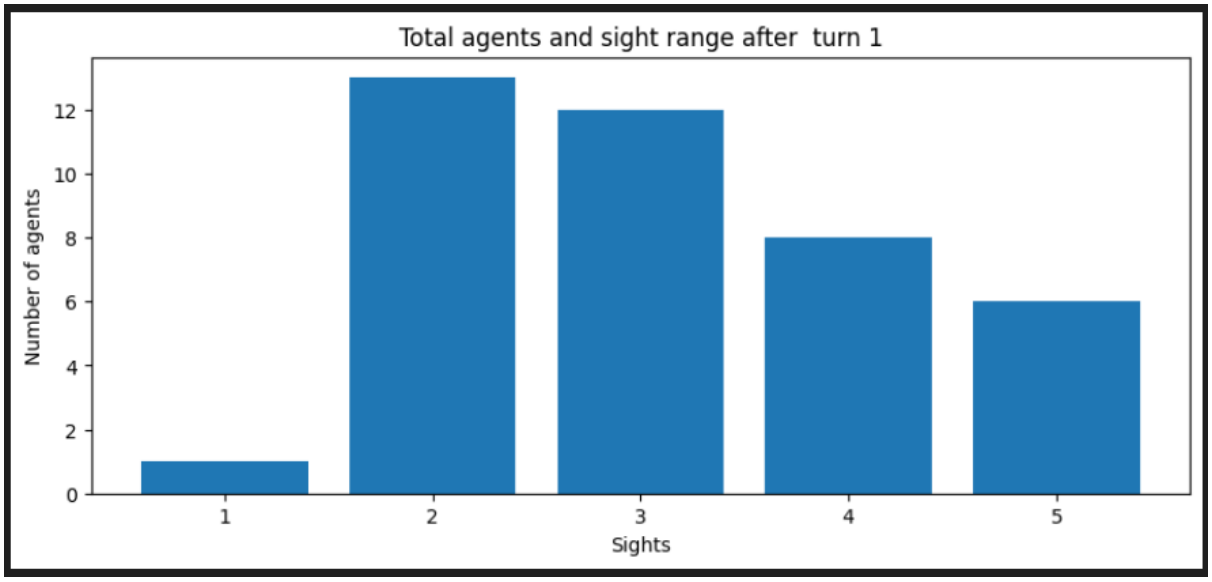

Fig2. Shows total number of agents and sight after turn 1

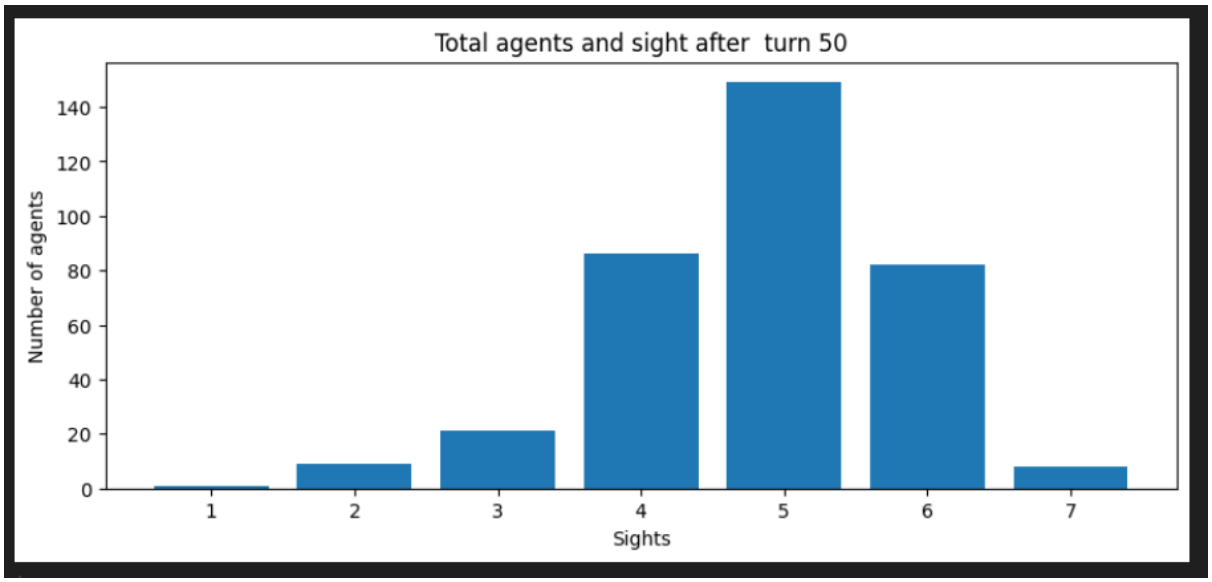

Fig3. Shows total number of agents and sight after turn 50

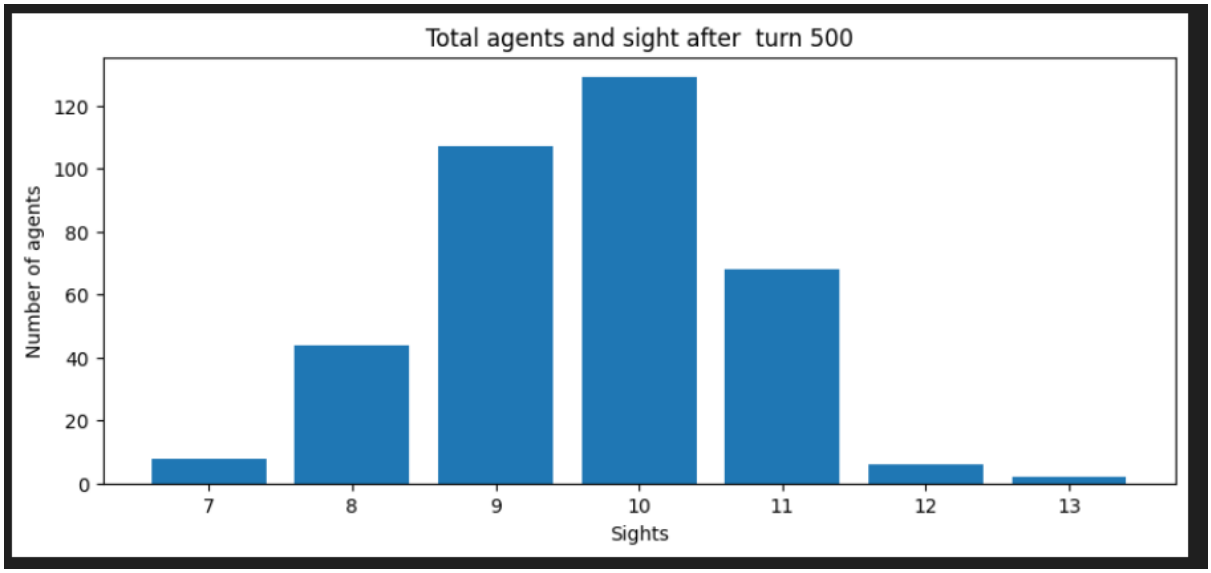

Fig4. Shows total number of agents and sight after turn 500

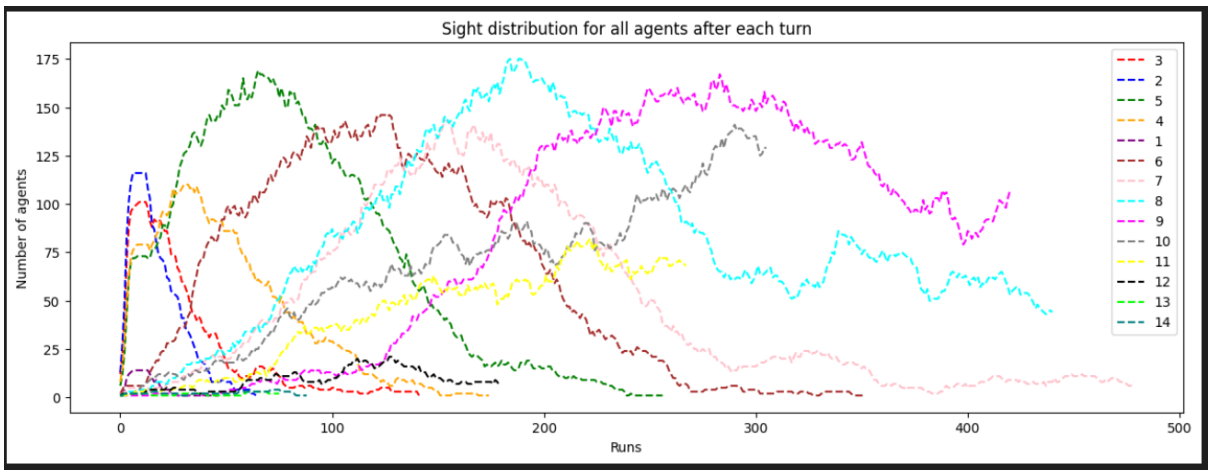

Fig5. Sight distribution for all agents after each turn

Analysis 2:

Figure 2,3&4 - Are bar plots representing numbers of agents at turn1, 50 and 500 and their sights. Figure2 is an early stage (turn 1), and the data is not just enough to make strong conclusions.

Figure3 - shows a decrease in number of agents with short sight but an increase in number of agents with longer sight which aligns with my first analysis. There are also new sights appearing due to **mutation.**

Figure4-shows the number of agents and their sights after 500 turns. Also, agents with shorter sight are low in number and agent with long sight are high.

It can also be seen that agent with very long sight (12, 13) are low in population. Since agents with average sight (9,10,11) were first reproduced into the world, and these agents have reproduced as well occupying more space in the world. Then came the agents with very long

sight due to mutation, but the number of spaces and sugar level are now reduced causing them a reduced life span and population.

I conclude from the data that the agent with longer sight have highest survival chance.

Figure5 - shows all sights distribution and the number agents. This also show that agents with sight in the middle distribution had survived more.

Simulation without Death

The main idea of this simulation is to capture the dynamics of the world without death to determine which agents have higher population. This can be done by refactoring line 34 and line 69 of sugarscape2 to:

- ***line 34: if loc:***
- ***line 69: return self.pos***

Prior Hypothesis: agents with longer sights will outnumber agents with shorter sight. But all agents will survive in this simulation, except agents place in 0,0 position.

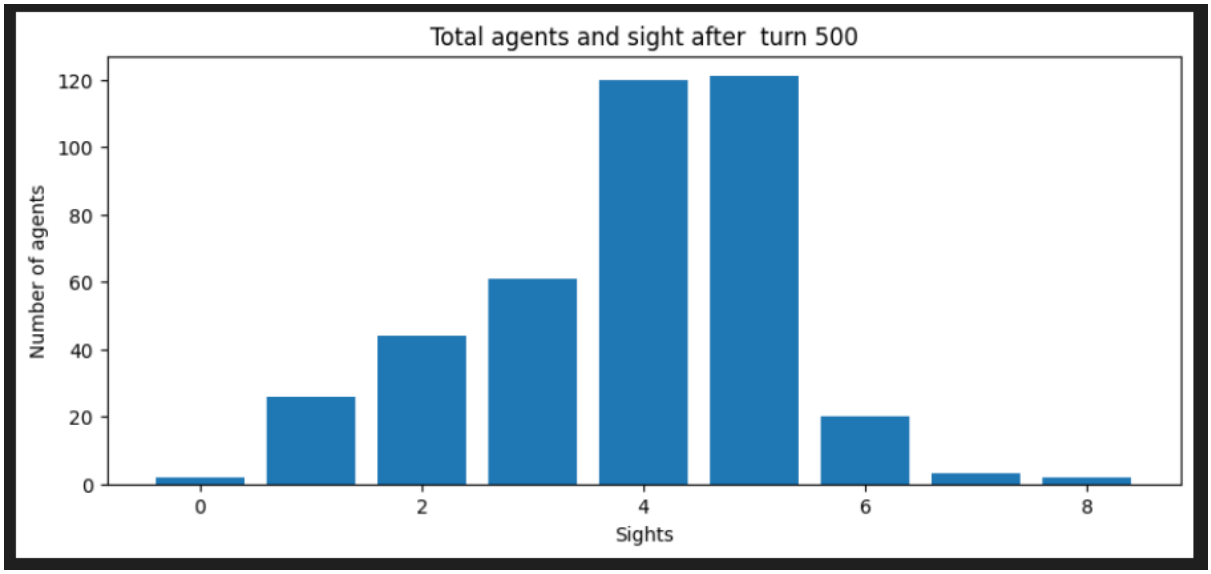

Fig6. Shows agents after 500 turns with no death factor

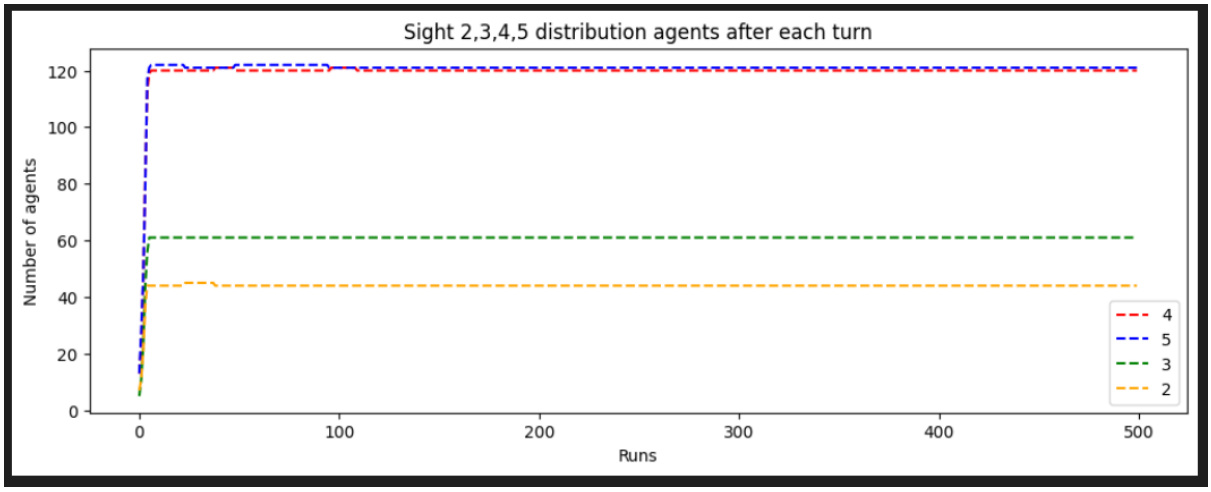

Fig 7. Showing agents with sight 2,3,4,5 for each turn with no death factor.

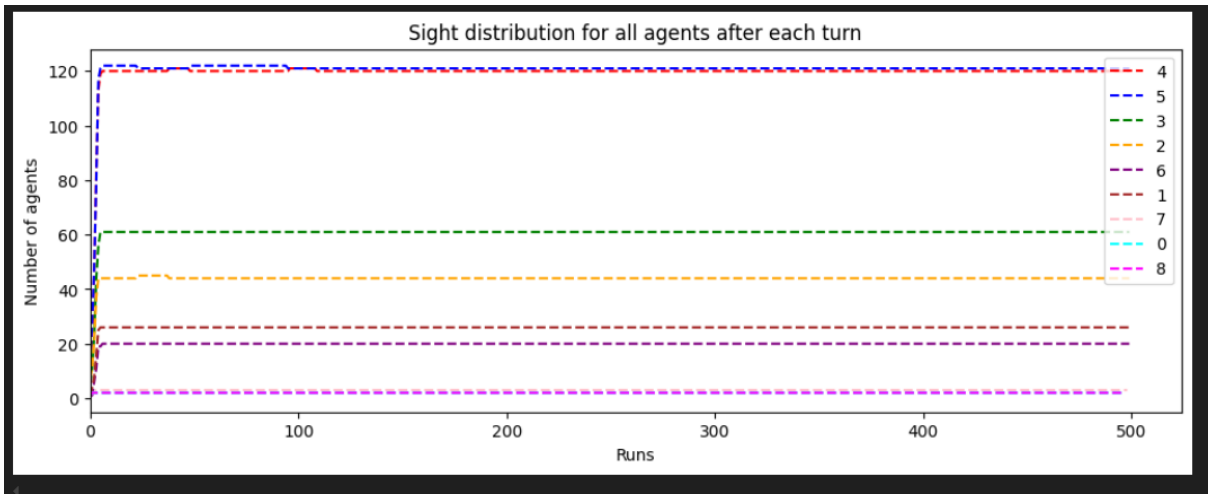

Fig 8. Showing agents with all sights for each turn with no death.

Analysis

Figure 6 also makes it clear that agents with longer sight have higher population. It is noticeable that mutation is reduced compared to simulation with death as only few new sights erupt. This is because agents are not dying.

Fig. 7&8 also shows the population of agents with higher sight to be greater in number with higher rounds of simulation. The flat surface shows that agents are not dying.