Task 4: Empowerment in Sugarscape

All main protocols are observed from earlier tasks. Further changes are outlined in the designed pattern

Design pattern:

1. **Note:** Death is allowed in this simulation. Agents get replaced after death.
2. Empowerment in this simulation for a state **t** is defined as the Log of the total number of new locations that can be reached from state **t** if agent is to move to all possible locations in its sight provided the locations are free.
3. To determine the TRADE-OFF for an agent between the sugar level and the empowerment of a state, I classified the agents into three classes namely, **POOR, MIDDLE, RICH.** I developed an algorithm that works such that agent can decided to either choose the simple move by just picking a location with higher sugar level or use the **Empowerment** function to consider the trade-off between the level of sugar and empowerment of a state. Agents are classified based on the threshold of their energy. For instance, in this simulation agents with 1-10 energy are considered poor. Agents with 11-20 are considered middle class and agent with energy above 20 are considered rich. All agents are poor when the world is created.

   POOR: agents have low energy; they always prioritise survival and will never run empowerment. Agents in this class will run the simple move. They are exploiters.
   MIDDLE: the middle agents are agents that prioritize both high sugar and high empowerment. They aim to get a state with highest sugar and hight empowerment. This trade-off sometimes has consequences because empowerment is not promised. Other agents may be reproducing at the time of movement.
   RICH: Rich agents do not prioritize sugar level. They only prioritize state with maximum empowerment they can see. They are explorers.

   The dynamics goes such that, the poor agents want to survive first, because empowerment is not always promise, if they get sufficient energy, they are move to the middle-class. Since the middle class agents prioritize both sugar level and empowerments, they get more energy to become rich, and they rich just want to explore.

Visualization and Analysis

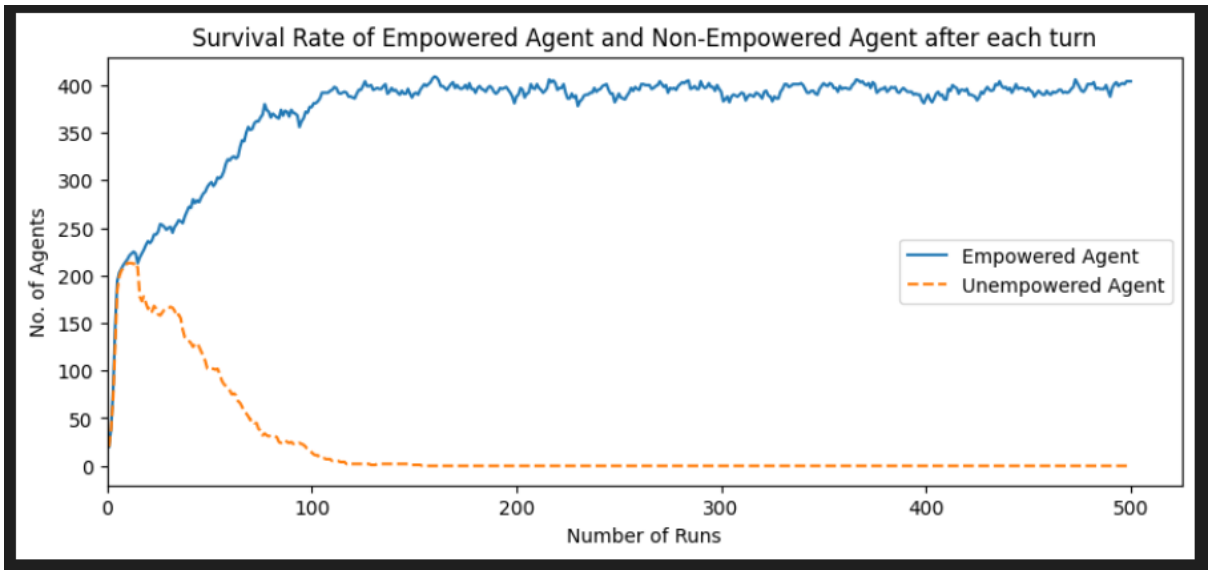

Fig1.-shows survival rate for both empowered and normal agent for each turn

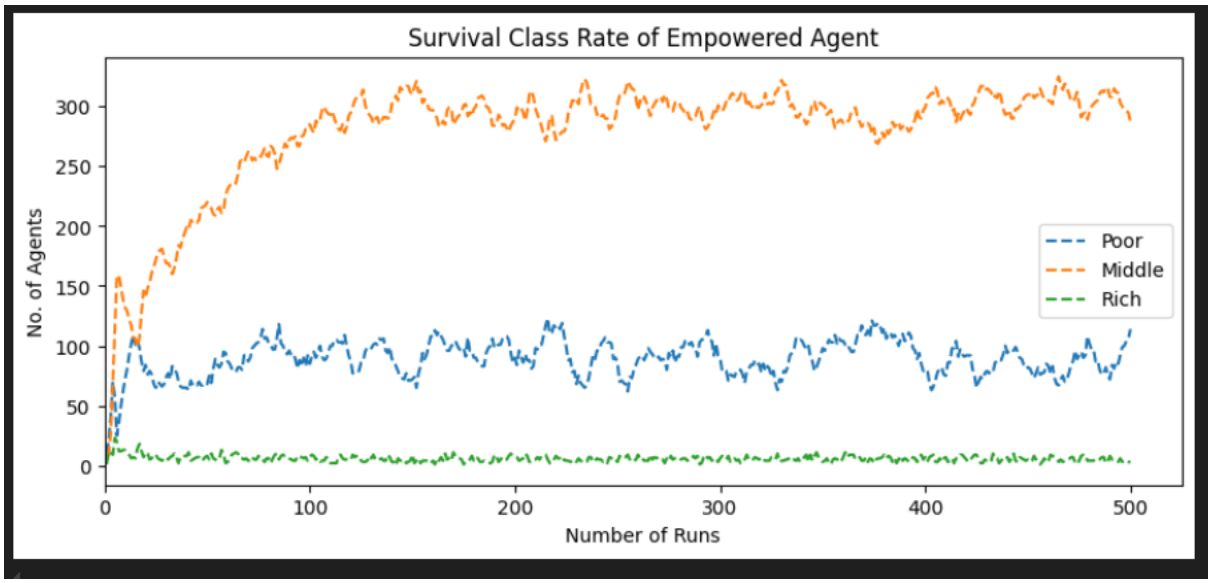

Fig2-shows how different classes of the empowered agents survived in the simulation.

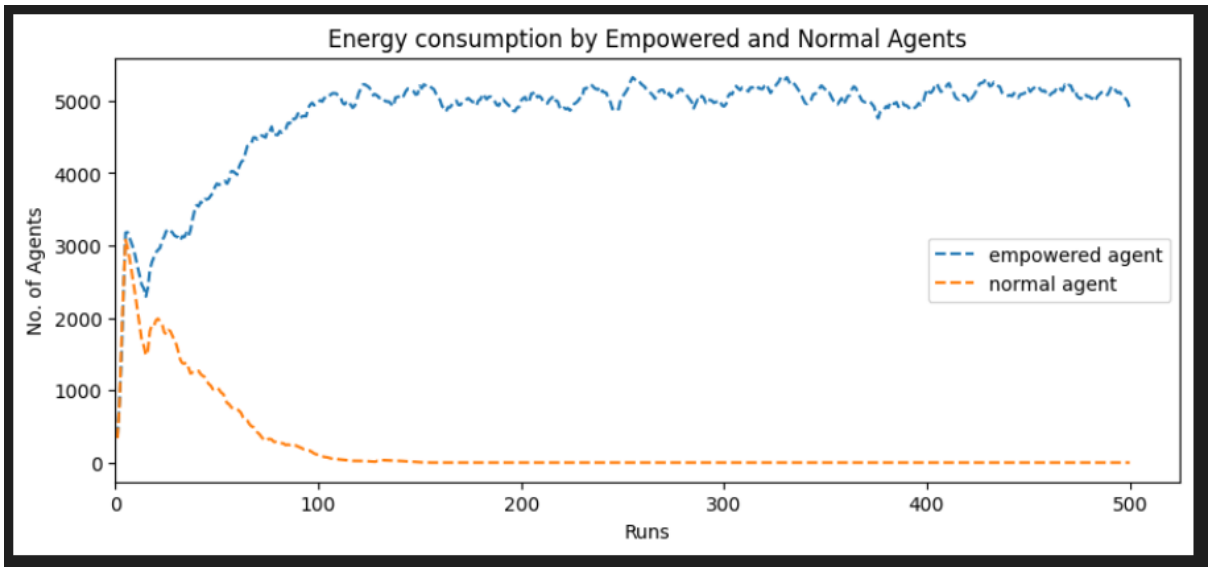

Fig3-shows energy consumption by empowered and normal agents per turn

Analysis

Prior Hypothesis: The empowered agents should have more survival chance than the normal agents.

Fig 1,2,3 are proofs to my hypothesis to be considered right. Since the empowerment agents combines simple move and empowered move, they should survive more.

Figure2- shows the how each class of the empowered agents survived. It is obvious that many empowered agents where in the middle class and because they consider empowerment in the middle class, they outnumber the unempowered agents. Also, not too many agents are in the rich class due to reproduction which always cut down agents' energy. In addition, empowerment is not always promised as agents around might be reproducing this could also be a challenge to the rich agents who just want to explore.

SIMULATION WITHOUT DEATH FACTOR

Here my intension is to capture the dynamics of the world if the agents are not dying.

This can be done by refactoring sugarscape3 to:

- ***line 38: if loc:***
- ***line 74: return self.pos***

Prior Hypothesis: The empowered agents should have more survival chance than the normal agents.

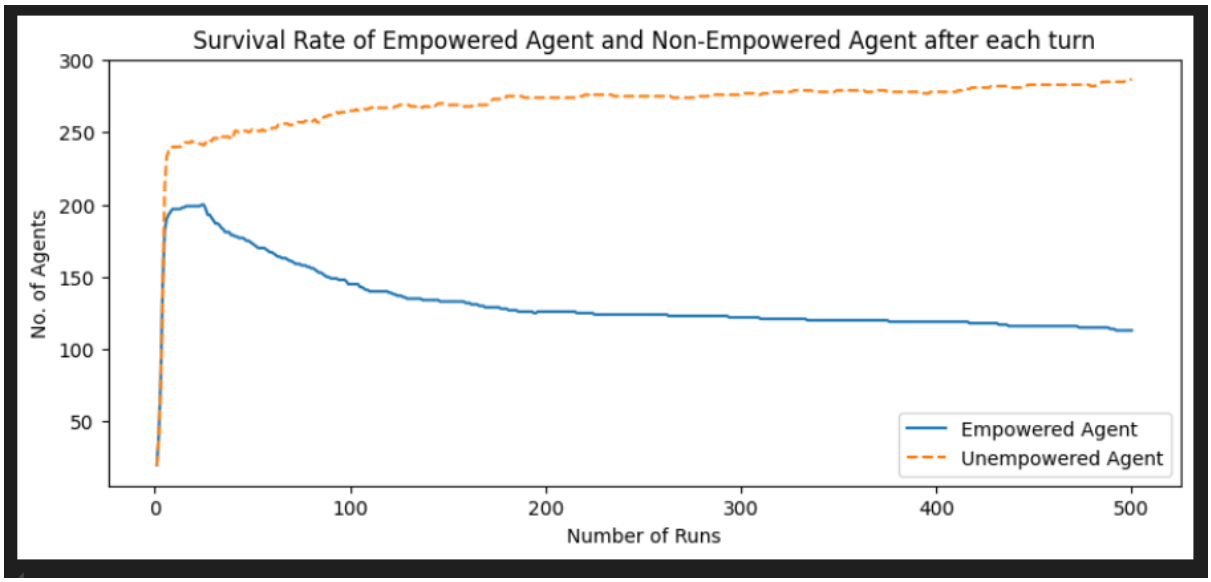

Fig4 shows survival rate for both empowered and normal agent for each turn without death

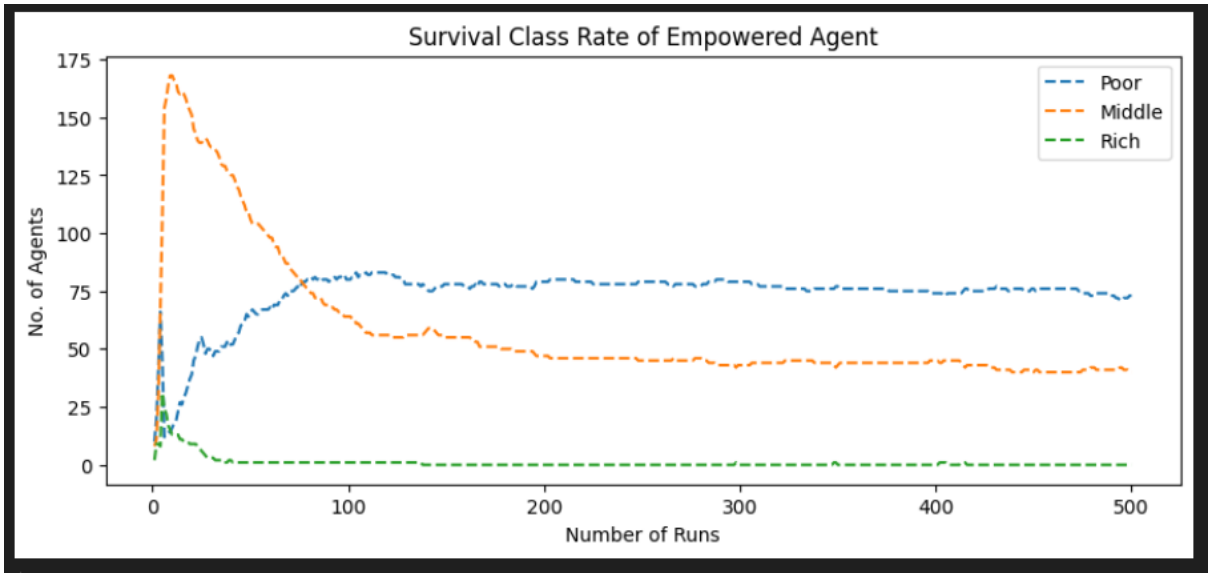

Fig5. shows survival class rate of empowered agents without death

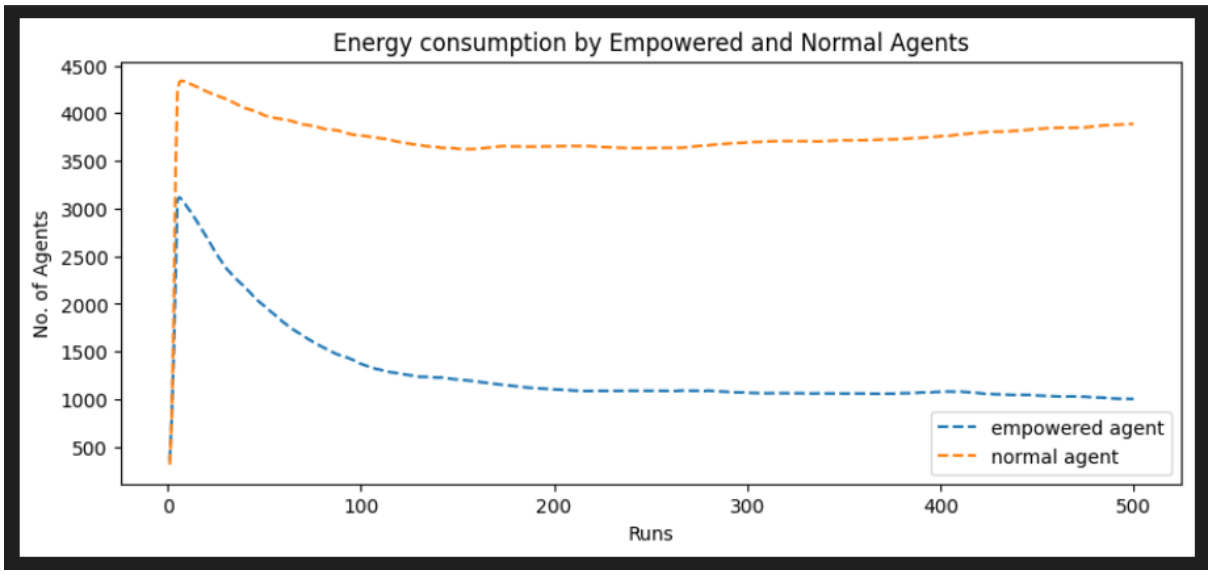

Fig6 shows energy consumption of empowered agents and normal agents without death

Analysis

The analysis contradicts with my proposed hypothesis for this simulation. Findings from fig5 shows that both agents were growing at the same rate until the world was full, then the empowered agent declined while the normal agent increased.