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ORGINISMS II

Onion Farming

Farming as a strategy is appealing because of the ability to secure a food source that if maintained correctly can sustain a colony of organisms for an extended amount of time. History has shown that organisms (specifically humans) have sustained life by working together. Civilizations have created an environment where humans can safely live with minimal physical endangerment, obtain food with little effort, and enjoy a relatively pleasurable life. Why not apply this idea to our organism simulation?

Our Onion Farming Strategy is based on a multi-layer farming colony. Each layer is a larger circular concentric layer of organisms that surrounds the previous layer of organisms. Beginning with the colonists, who initially create the first farm, each subsequent farming layer establishes itself around the previous farm layer. Much like a onion, which is composed of layers, built on layers, our strategy continually builds circular layers of farmers.

With this strategy there are advantages and drawbacks. The advantages are as follows. One major advantage is the ability to protect food sources. This is particularly important when food is scarce. A effectively run farm is able to withstand harsh famine situations by both efficiently allowing food to grow, while blocking the food source from other organisms.

Another advantage of farming is the ability of farming organisms to conserve energy. Since farmers are constantly only a few spaces from their food sources, relatively less energy is consumed when obtaining food. This is significant when the cost of energy for moving is high. A non-farming organisms that wanders around looking for food wastes significant amounts of energy.

In the Onion Farming strategy, each layer of the farm is 2-3 spaces from the previous layer. This 2-3 farming space is dedicated to the farmers of the higher-order layer. When a farmer gets hungry and needs food, he moves towards the center of the farming colony. Once he is sufficiently full, he returns back to his initial position. Onion Farming or use of concentric farming circles significantly minimizes the distance between farmers and food. In a normal farm that grows larger and larger as the farm is able to sustain more farmers, the distance from the middle (where this is most probably more food) and the circle of farmers becomes larger and larger. With concentric farming circles, the distance from food is always kept constant.

Another advantage of Onion Farming is the ability to establish multiple lines of defense from intruders. In the case that a farmer in the outer layer dies, a gap in the outer layer is formed, and an intruder enters, losses are minimized because the most food the farm can lose is the food between the outer layer and the layer one in from the outer layer. The majority of the farm is still intact, unscathed by the breach in a farm layer. Also, Onion Farming allows more flexibility for the integrity of the inner layers of the farm. If an farmer in a inner layer dies, and a gap in that farm layer is formed. It does not effect the overall integrity of the farm because the farm is protected by several outer layers.

The detriments of farming strategy is in the implementation. Communication is vital in maintaining an efficient farm. With the limitation of only being able to communicate with the organism next to you, it is difficult to coordinate all the actions of the farm as a whole. For example, if a farm layer has established itself, has an abundance of food, and is ready to reproduce and form another layer of the farm, it is difficult to 1) know when this state is reached and 2) coordinate the movements of all the organisms of the farm so that the production of another layer is seamless.

Player MutantX

This player is a hybrid player. This player ahs a very large brain and acts differently in different stages of its life. The Mutant X organisms all have the same mission at any given point, but that mission changes after 150 rounds.

General organism rules

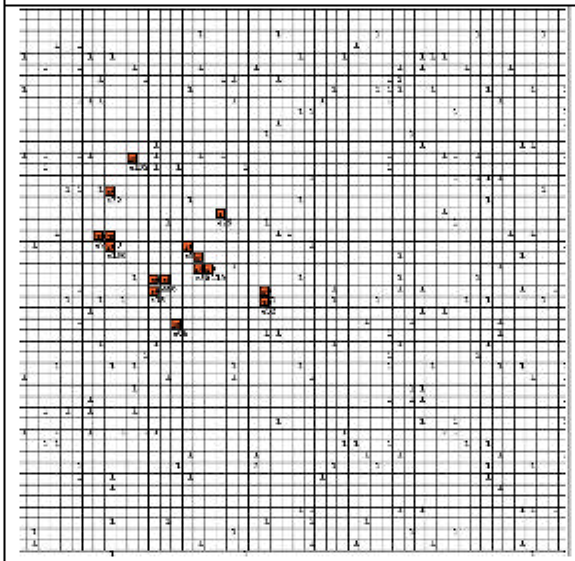
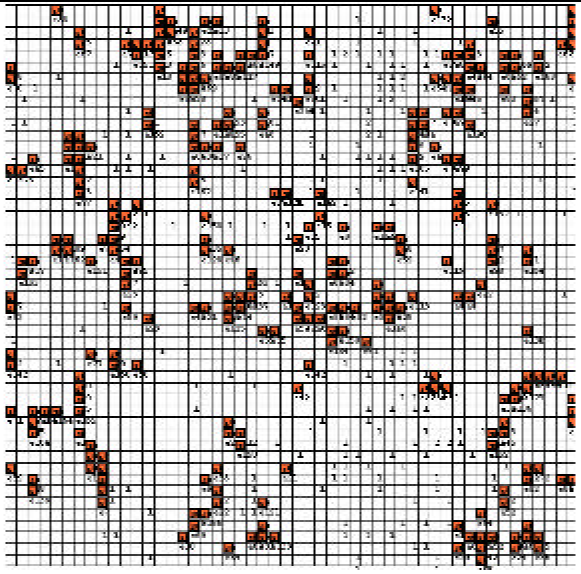
Reproduction: the parent reproduces, telling the child to walk in a clockwise perpendicular direction than itself. The child is passed along, through its key, board specific data. More specially, the child gets the round number, and the estimated values of p and q

Communication: There is no communication between organisms, only between parent and child during birth.

The initial mission

The mission in the first 100 rounds of the game is to cautiously spread quickly. More specifically, the organism always reproduces during the first move of the game. Again, the child organism is told to walk in a direction clockwise-perpendicular to the parent. Then the following is performed:
Every organism walks until if finds food. If the food in the square has enough energy (u*`foodleft`) to sustain a reproduction and with the energy of the child enough to walk 5 squares (5*v), then the organism reproduces. The child walks while the parent sits on the food replenishing its energy; more specifically, until it has enough energy to walk 8 squares (8*v).

The outcome of such an aggressive initial strategy is a quick spread around the board while minimizing the risk of overpopulation. In the following 2 pictures, you can see the quick spread of the organisms in round 24 and round 65 respectively.

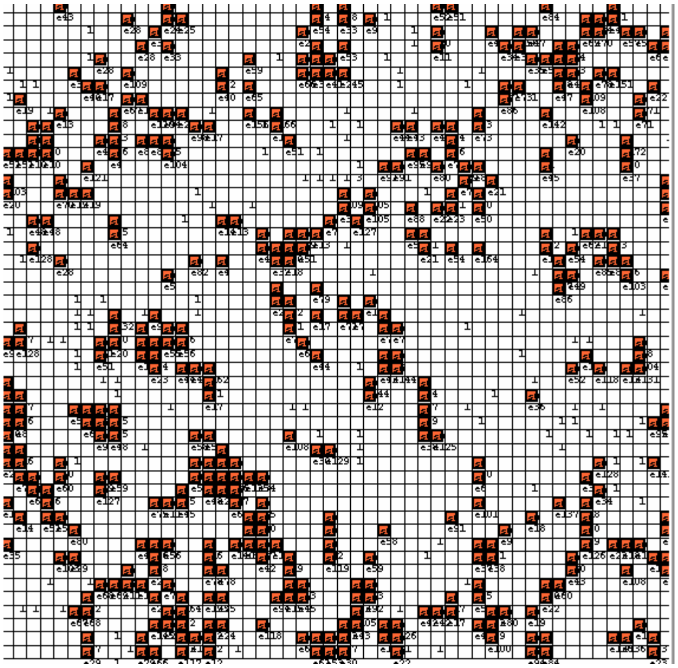
Round 24:	Round 65: All over the place
	

Steady State

Now that the organisms have spread to a reasonable population, the organisms take on a new mission. The mission is now similar to two strategies that were discussed often in class. The first is regulated birth based on estimated p and q, the next is farming.

Regulated birth and movement

The implementation of estimating p and q to control birth and movement was discussed in class and the implementation in or organism comes from the group 3 implementation. This strategy changes and estimated number of p and q based on how many squares around an organisms that have food. If there are more than 2 squares around an organism that have food then the organism is told to move less and reproduce more. This simple idea prevents overgrowth of a population with a normal amount of food. Furthermore, when food is scarce, this is what keeps the organism from wasting energy looking for more food.



In the picture to the left, taken from round 300 of a game where there is a normal amount of food, one can see the limited growth and the prevention of overgrowth.

Farming

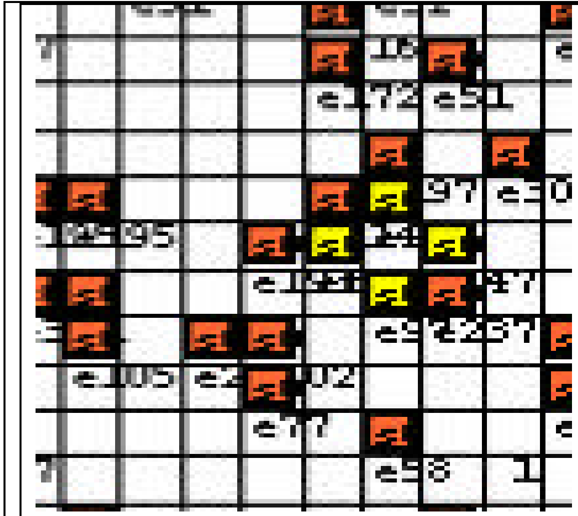
The organism, while in their regulated reproduction state, also look for opportunities to farm. This is a special farming that occurs only when an organism finds a cache of food with energy worth at least 11 * v and the organism has energyleft of at least 8.5*v. If these conditions are fulfilled then the following actions are used to build a farm:

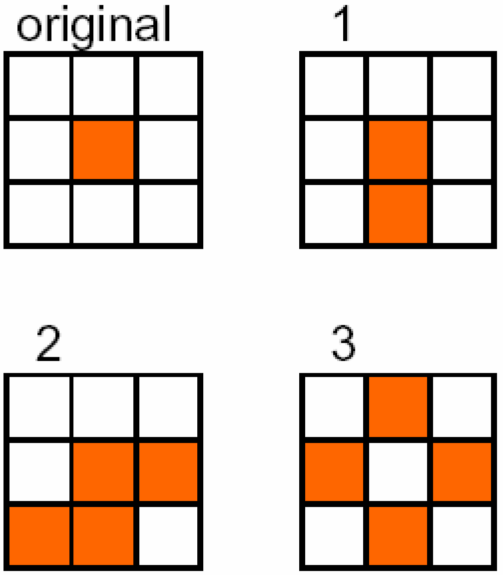
1- [Labeled as (1) in the picture to the lower right] the organism begins with reproducing south.
2- [Labeled as (2) in the picture to the lower right] the organism reproduces east the second reproduces west.
3- [Labeled as (3) in the picture to the lower right] the first and fourth organisms move north.

Assuming that the original organism has energyleft of E, then after step one the energies would be: $\{(\frac{E}{2}-\frac{v}{2}), (\frac{E}{2}-\frac{v}{2})\}$.

After step two they would be: $\{(\frac{E}{4}-\frac{3v}{2}), (\frac{E}{4}-\frac{3v}{2}), (\frac{E}{4}-\frac{3v}{2}), (\frac{E}{4}-\frac{3v}{2})\}$,and finally after the third step they would be: $\{(\frac{E}{4}-\frac{3v}{2}), (\frac{E}{4}-\frac{3v}{2}), (\frac{E}{4}-\frac{10v}{4}), (\frac{E}{4}-\frac{10v}{4})\}$.

Adding these together one obtains: $E-\frac{32*v}{4}=0$. With this we deduced the minimal energyleft required is 8.5 * v.





After the farm is built, the farms enter the farm one at a time until they fill up their fill, in which case they return to their positions. More specifically, the farmers need 3*v energy to be full. That means that after an organism settles on a farm and eats, it will move out after its energyleft passes 3*v.

Results- Player Mutant X

This strategy hard-coded much of the values that should be learned. For example, the organisms spread until the 100th round. This was a bad idea because in the case where the is a low p or q, the organism walk themselves to death looking for more food before they are able to regulate their reproduction. This is why in all 106 time of the single player games, when we did not survive, we died before round 100. That is, had we made it to round 100 we would have been more careful in reproduction and survived longer. It was necessary to integrate the responsible reproduction along with the aggressive reproduction in the beginning.

The maximize population goal in single player games:
The first goal of this project was to maximize your population under the given conditions. "The goal is to achieve the highest long-term stable population." Throughout the tournament, when we do survive, our organism does a great job in mass reproduction. During one game, the final populations were as follows:
X=23, Y=36, u=20, v=10, M=500, K=57, P=0.005, q=0.02
The average populations during the last 50% of the rounds were (with our own bolded):
79.61,71.78,36.23,69.49,85.38,67.52,556.57,169.71,163.06,95.99**,265.73**
Another example: for X=23, Y=36, u=100, v=10, M=500, K=57, p=0.005, q=0.02:
291.54,190.13,235.18,304.9,196.45,266.24,688.57,260.29,284.28,329.57,154.59,**503.85**
One can see from the examples above that only player 4 beats us. This is understandable as our reproduction algorithm is not as aggressive as the one that belongs to team 4.
The maximize your organism population goal in multiplayer games:
The goal: "The goal here is primarily to survive, and secondarily to survive in higher numbers than competing organisms"
In multiplayer games, our organism rarely lived past round 100, but when it did it fulfilled this goal well, in one example where there were several survivors in the end game, the final population results were as follows:
X=55, Y=93, u=100, v=10, M=500, K=57, p=0.01, q=0.002
132.64,0.0,137.97,1.12,196.23,142.12,**1557.43**. Clearly an overwhelming majority.
Another example: for X=55, Y=93, u=100, v=10, M=500, K=83, p=.01, q=0.000002
392.78,0.0,58.15,0.0,58.88,497.57,**1216.6**

Overall I am pleased with the performance of the organism in surviving situations. Though, clearly, the organism could be improved in regards to population control in the beginning of the game.

Results- Player Whirlwind

Because the purpose of this player was durability, our results clearly show its long lasting effects.
In single player games we see that the whirlwind organism survives under very tight conditions. For example, note the following trials:
X=23, Y=36, u=20, v=4, M=500, K=57, q=0.02000 decreasing p, survived until p=0.00023.
X=23, Y=36, u=20, v=10, M=500, K=57, p=0.002 decreasing q, survived until q=0.00063
However, in the following case:

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X=23, Y=36, u=20, v=4, M=500, K=83, p= 0.001000, decreasing q, lasted
only until 0.008760.
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We see from here that this organism doesn’t not last long with a low p. Because of the spreading feature of this organism, there is a fair amount of dependence on the spontaneous appearance of food.

In multiplayer games, this player rarely survived. In fact it was usually within the first half of players to die. This effect comes from this players vulnerability, that is, walking and not finding food. When there are other players looking for food and sitting on it. Our player does not look for more food, it tries to go back looking for unavailable food.