CIS 5590: Organisms Project

Team 4

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Initial Insights & Observations

What were we trying to do when we first started out?

Strategy & Reasoning

- Focused on making conditions for reproducing and moving
- We decided some basic ideas were the most straightforward logical assumptions to get a baseline of performance and strategy.

    1) staying put if the organism doesn't have enough energy
    2) moving towards food if current cell is empty
    3) reproducing to capture double the food

Limitations

- Didn't perform well in every environment as it was less adaptive to changes in food and enemies
- Didn't make use of any more advanced adaptive learning techniques

Strategies & Concepts

A high-level description of the intuition behind our solution

Memory

- Retain locations of multiple detected food for future reference
- Navigate towards an available direction stored in memory at random
- Reverse the last move to return to the previous location
- Explore alternative directions retained in memory
- Persist in back-and-forth move until all remembered locations are visited
- Instantly update memory upon discovering that a previously identified food location is now unavailable

P Estimation

- Calculation of probability of food spawning for information gathering
- P and q calculation could be advantageous if we have different algorithms for different settings

Implementation- MemoryOld

EXPLORING State:

- Default state, preform fundamental move and reproduce strategies if no more than one available food
- Updates the food memory stack when multiple directions are available, transitioning to the GOING_TO_FOOD state

GOING_TO_FOOD State:

- Navigates towards an available direction preserved in memory
- If the food memory stack is empty, switch to EXPLORING state; if not, switch to RETURNING state

RETURNING State:

- Returning to the previous location
- Switch to GOING_TO_FOOD state

Dynamic Food Memory Updates:

- Update the food memory stack immediately if a stay_put is detected under GOING_TO_FOOD or RETURNING state

Implementation- Memory

P Calculation:

$$P = \text{Food Seen}/\text{Squares Seen}$$

- Updating P is NOT done if the organism decides NOT to move (this is to prevent recounting)
- P is NOT passed down from organism's DNA, we wanted Organisms to move based on their current surroundings
- Update P when totalMovesMade < 150 because if there more organisms around us it interferes with calculations of P in our current implementation so we were trying to prevent that

Incorporating other teams' strategies

- We used the NotSoSlow strategy based on a p threshold if $p < 0.0125$ and the BH strategy on a threshold on $p > 0.0125$
- We were trying to balance performing well in a desert with performing well in a default or rainforest configuration

Results

Analysis of the results of the tournament (for our best player in each) and our own experiments

Desert: 24% survival regular I 34% survival singleton I 44% big regular

Default: 24% survival regular I 24% survival singleton I 66% big regular

Rainforest: 24% survival regular I 23% survival singleton I 33% big regular

- We did the best in the desert as compared to other teams.
- As conditions worsened from rainforest to desert, Memory performed increasingly better.
- MemoryOld survived better in the rainforest than Memory as we made the reproduce threshold lower for this player. Otherwise, MemoryOld did not perform well as we optimized for reproduction.
- Memory did well with the goldmines hidden configuration where food is likely to double, eac cell can store a lot of food, but appearance of food is low. We survived the most of any team at 61%.

Contributions

What is unique about our solution?

Dynamic P calculation + Reproduction Policy:

- We tried to use reinforcement learning ideas to guide our stratety
- We emphasized the importance of exploration vs exploitation trade off by always gathering information about the game in each move
- The information gotten at every move is then implemented in a learning policy that also updates with the information gathered

Memory- stack

- We implemented unique strategy to remember food instead of communication among organisms
- It associates with the dynamic p estimation for each individual organism to perform survival strategies independently

Future Directions & Limitations

Known problems of our solution, and other ideas we would've pursued with more time

Different configuration strategies:

- We had a general strategy for all situations, but no specific solution for each configuration
- A conservative algorithm that took advantage of boom and bust cycles in desert
- A fast reproduction strategy that made gardens of food so others can't invade

Better Configuration Variable Estimation:

- P estimation didn't account for remembering which food was already seen
- P estimation gets more and more inaccurate due to organisms interfering with calculations
- Q estimation requires being next to food uninterrupted (need a garden formation)

Better Policy Decision:

- Our policy was based on trial and error, and used very limited configuration variables
- Testing different policies and weights on these policies would improve the organisms decision making

Conclusions

Final thoughts and observations

Performance in Diverse Environments:

- Our new memory strategy excels in the desert scenario.
- Our old memory strategy chieves the second-place in the rainforest configuration.
- Overall, we achieved moderate results in the default setting.

Challenges & Adaptations:

- The p estimation phase concluded too close to the final iteration, leading to an overextension in our efforts to standardize performance across different configurations.
- The quest for a 'one-size-fits-all' parameter set was unattainable for us within the time we had to commit to the project. Given that other teams excelled in other conditions, it was harder to compete with an all inclusive strategy.

Memory Strategy & Food Availability:

- Our old memory-based navigation strategy thrives in food-abundant conditions, indicating a direct correlation between food availability and system efficiency.

Strategic Flexibility through p Estimation:

- The adaptive nature of our 'p' estimation model empowers the system to tailor strategies and parameters for each organism, paving the way for optimized performance tailored to diverse environmental nuances.

Acknowledgments

Ideas we used that weren't originally our own

Group 1's NotSoSlow:

- We took Group 1's strategy because they work particularly well in desert
- Conservative first before reproducing and moving a lot later when food builds up

Group 1's BH:

- We took also took their BH strategy because they do particularly well in a default configuration
- Fast reproduction means more food taken means more reproduction means swarming the board

Everyone else:

- We took more general ideas off everyone else's discussion, like p prediction, or developing early late game strategies