Evil-lution

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Thesis

- Through **simulating an ecosystem** over multiple generations, our group will **utilize parallelization techniques** to efficiently **determine the most valuable survival attribute** for a group of organisms.

Introduction

- Our project was to simulate a **multi-generational ecosystem** of organisms.
- Organisms were able to **survive** and **reproduce** by finding food.
- Upon reproduction, there was a small chance for either **positive or negative mutations.**
- We then **tracked** the **traits** that could be found most often in surviving populations.
- We **utilized parallelization** by having each processor represent a **physical subsection of the world**.
- Organisms could **move freely** through borders but **could not see** into neighboring sections.

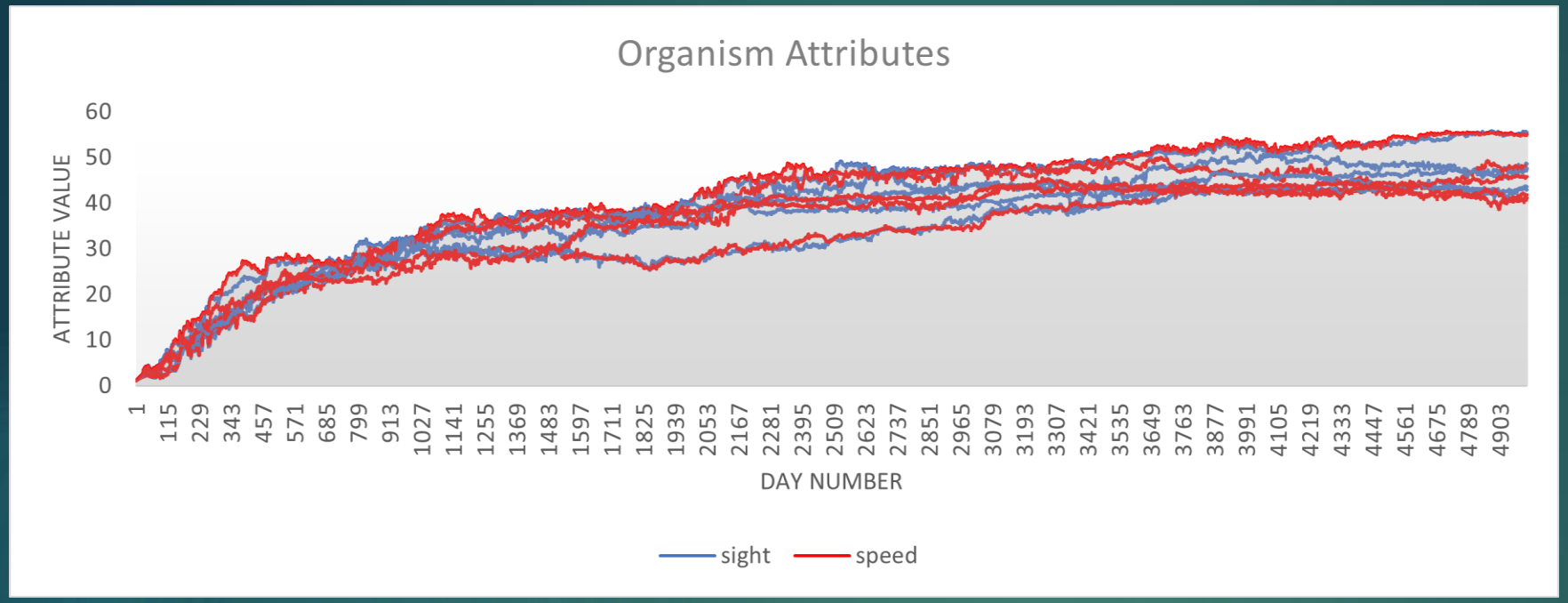
The Simulation

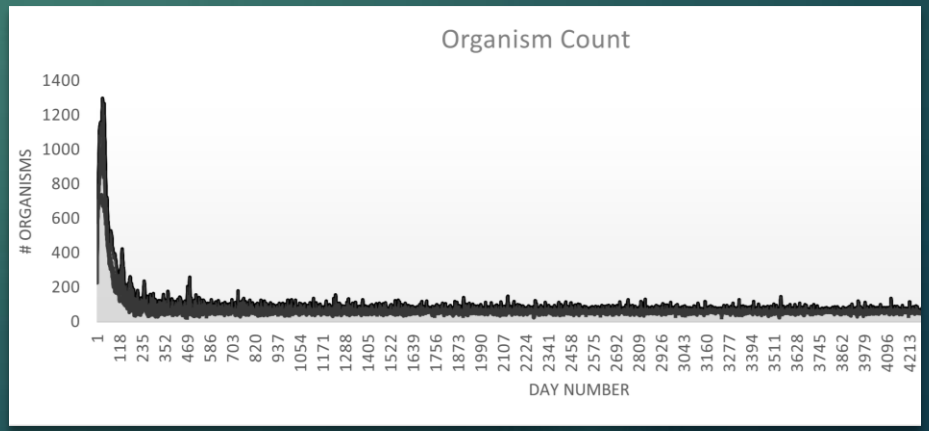
- We started by creating and initializing the ecosystem.
- Next, we would run many "***Generations***" of the ecosystem.
  - Each ***generation*** is comprised of several "***days***"
  - Each **day** the organisms search for food and interact with each other
  - If an organism doesn't find food for 2 days, it dies.
  - At the end of the **generation**, organisms that survive and have had enough food reproduce.
- By allowing **small mutations** to occur in between generations, we allowed for different traits to emerge over time in the organisms.
- We then tracked the **average trait values** across all organisms, to see which traits appear to be **most beneficial** to survival

The Simulation (cont.)

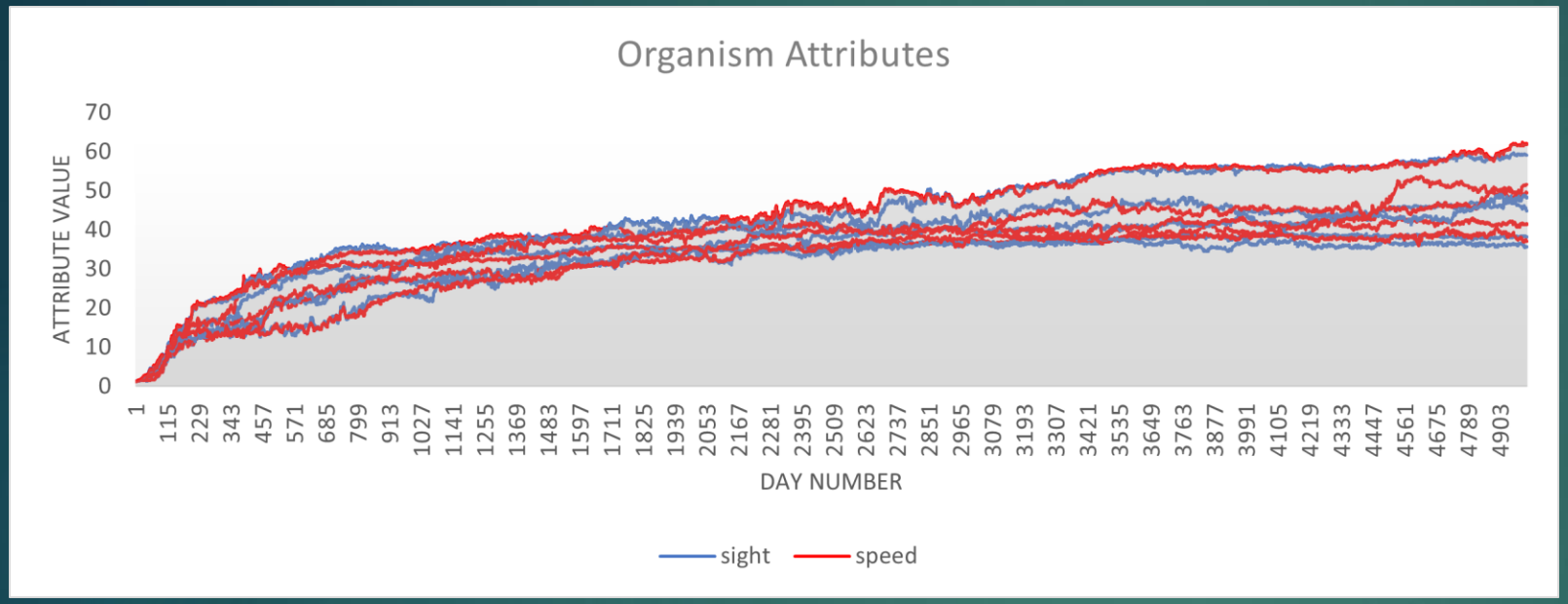
- We tested the effects of the ecosystem on the organisms by running various **simulations**, each with a different **configuration**. We tracked the results of modifying the following variables:
  - Board Size (100x100 ---> 200x200)
  - Food Spawn Rate (8 per day ---> 4 per day)
  - Food Needed (1 per day ---> 2 per day)
  - Low Mutation Rate (2.5% for large mutation, 12.5% for small mutation)
  - High Mutation Rate (10% for large mutation, 50% for small mutation)

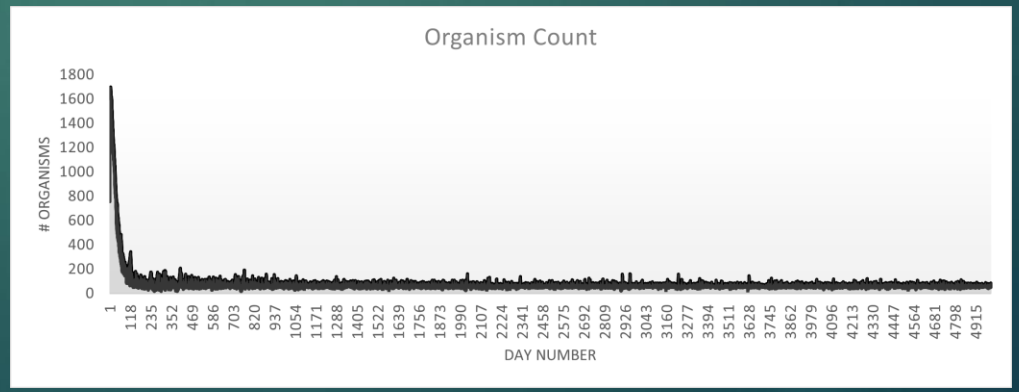
Base Configuration



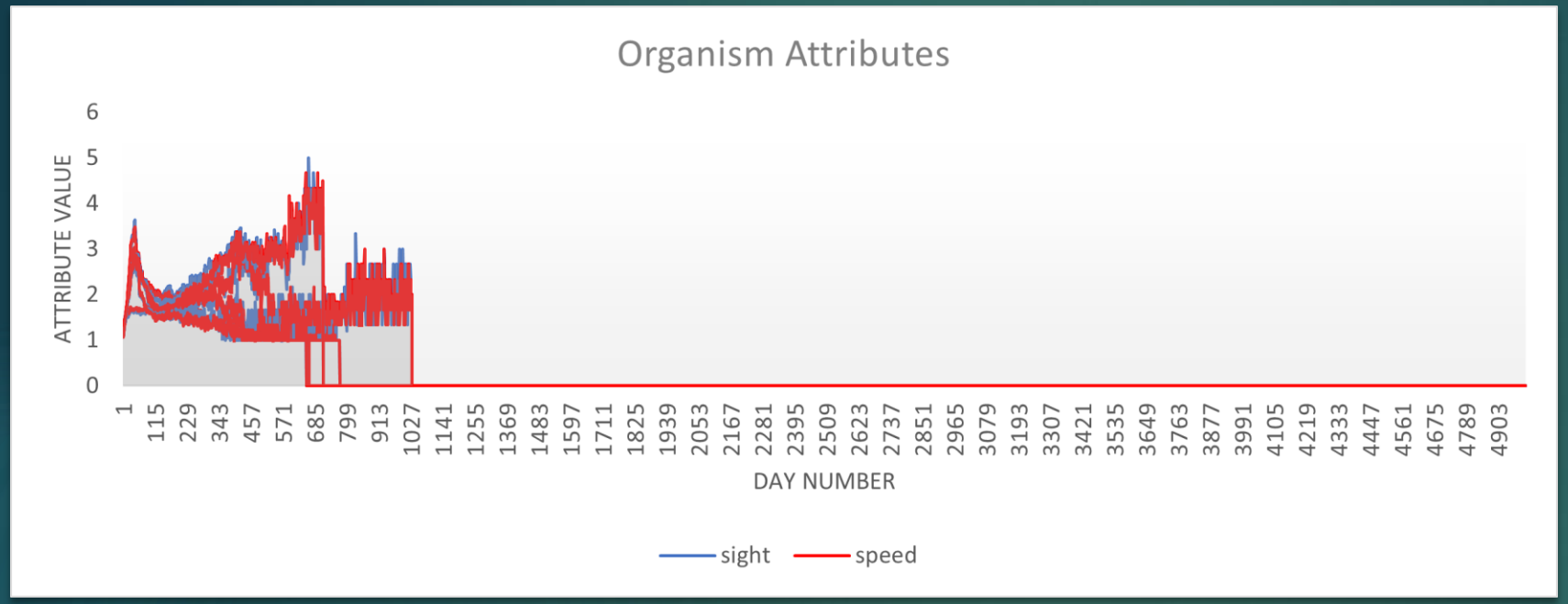


More Organisms





No New Food


Organism Attributes
ATTRIBUTE VALUE
0
1
2
3
4
5
6
1
115
229
343
457
571
685
799
913
1027
1141
1255
1369
1483
1597
1711
1825
1939
2053
2167
2281
2395
2509
2623
2737
2851
2965
3079
3193
3307
3421
3535
3649
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3991
4105
4219
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4447
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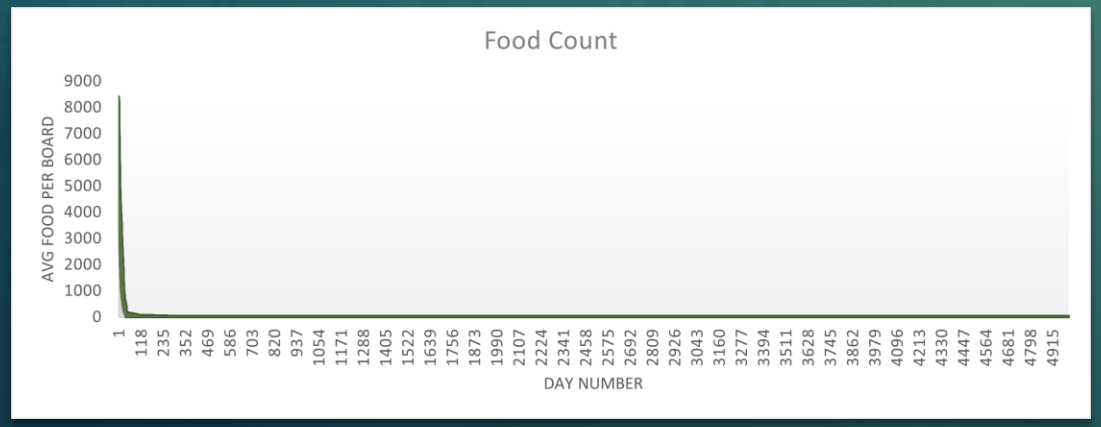
4675
4789
4903
DAY NUMBER
sight
speed


Food Count
AVG FOOD PER BOARD
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
1
118
235
352
469
586
703
820
937
1054
1171
1288
1405
1522
1639
1756
1873
1990
2107
2224
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2458
2575
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3043
3160
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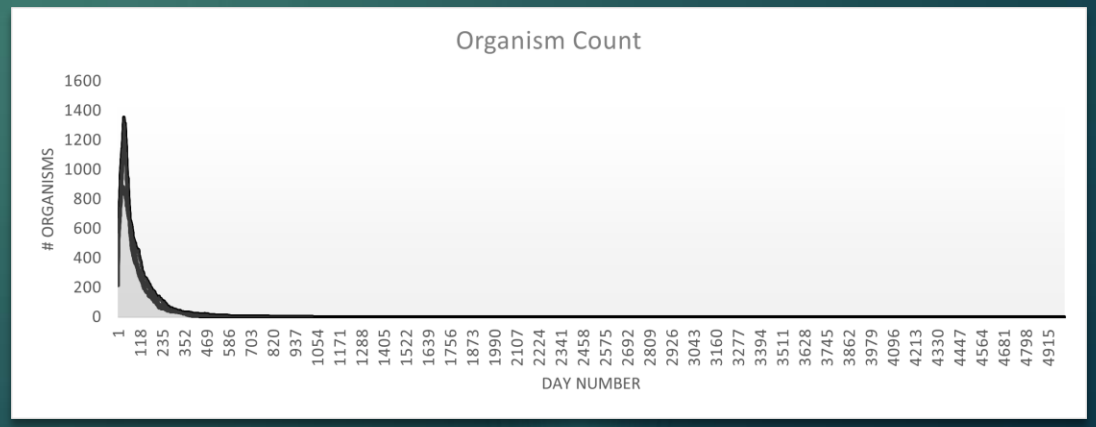
4798
4915
DAY NUMBER


Organism Count
ORGANISMS
0
200
400
600
800
1000
1200
1400
1600
1
118
235
352
469
586
703
820
937
1054
1171
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1405
1522
1639
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3394
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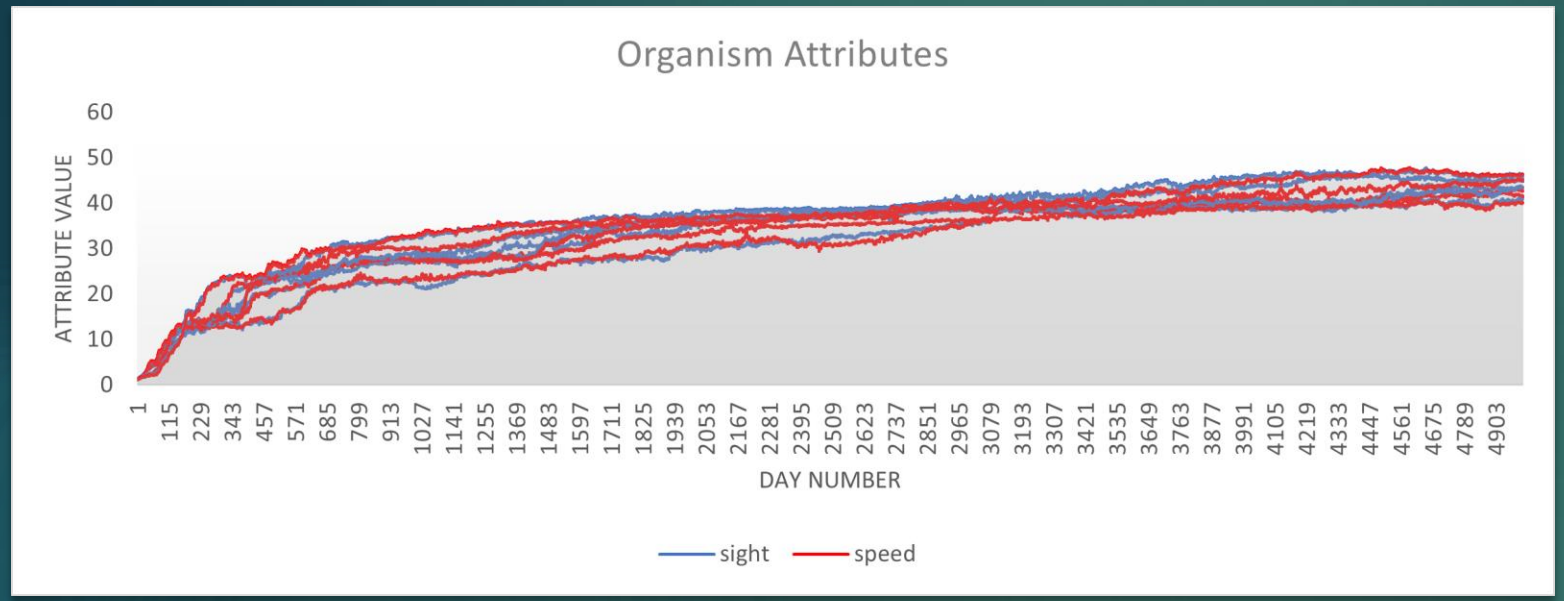
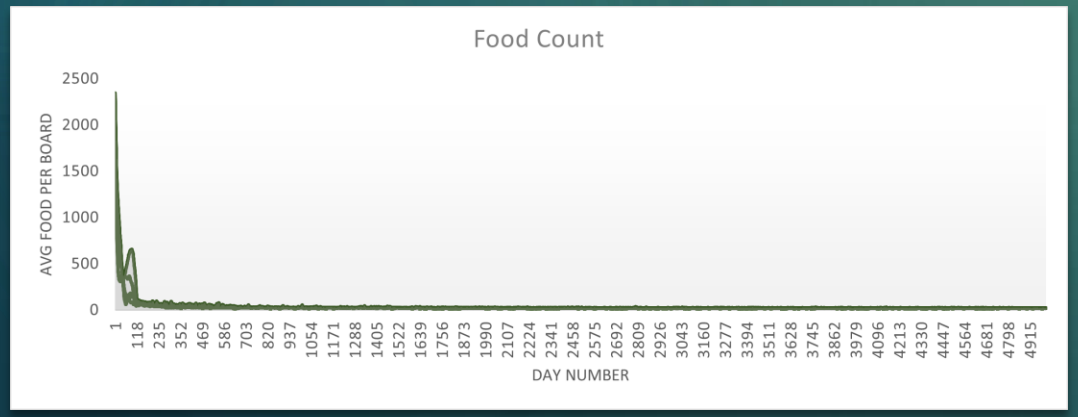
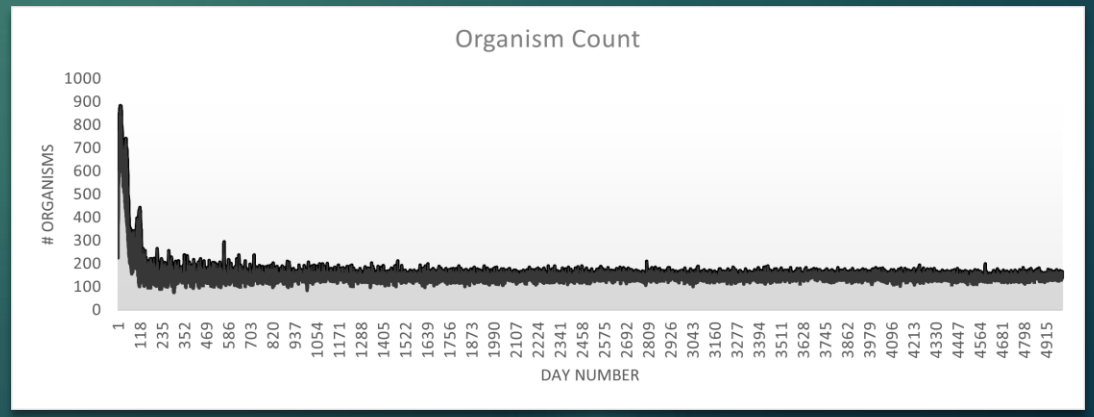
4915
DAY NUMBER

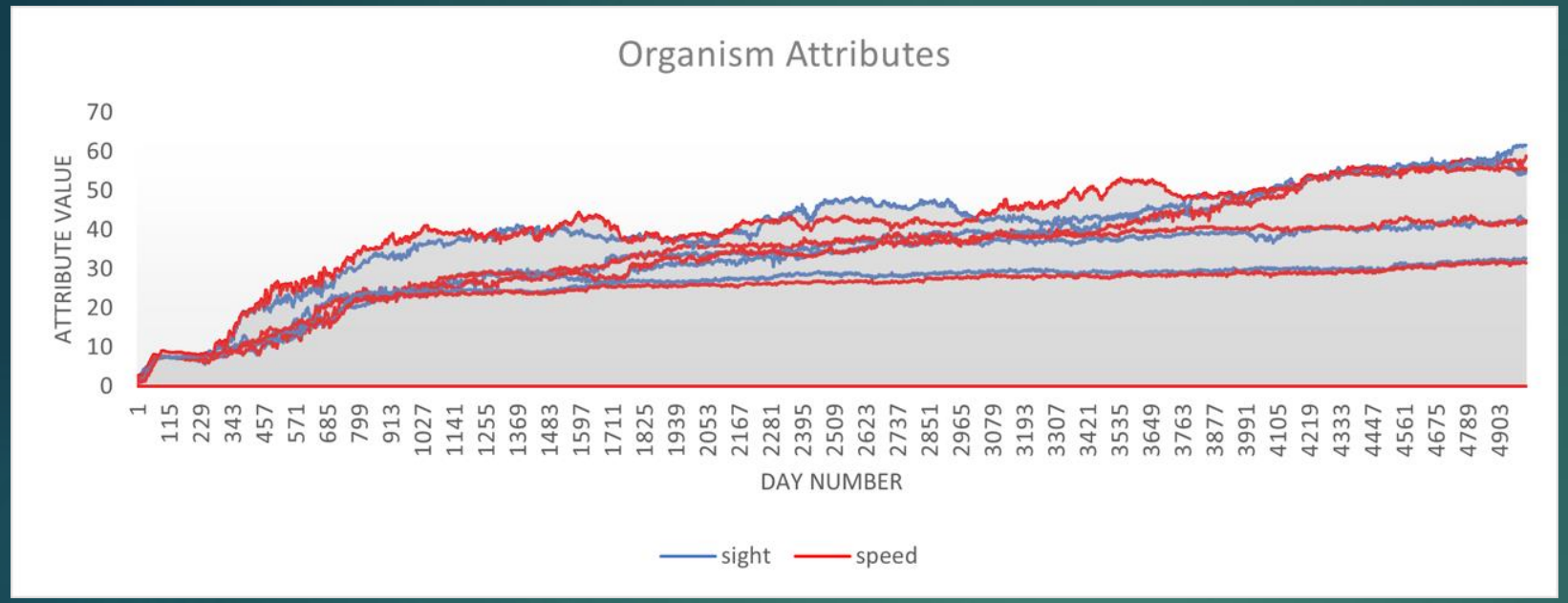
Less Starting Food







More Food


Organism Attributes
ATTRIBUTE VALUE
70
60
50
40
30
20
10
0
1
115
229
343
457
571
685
799
913
1027
1141
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1939
2053
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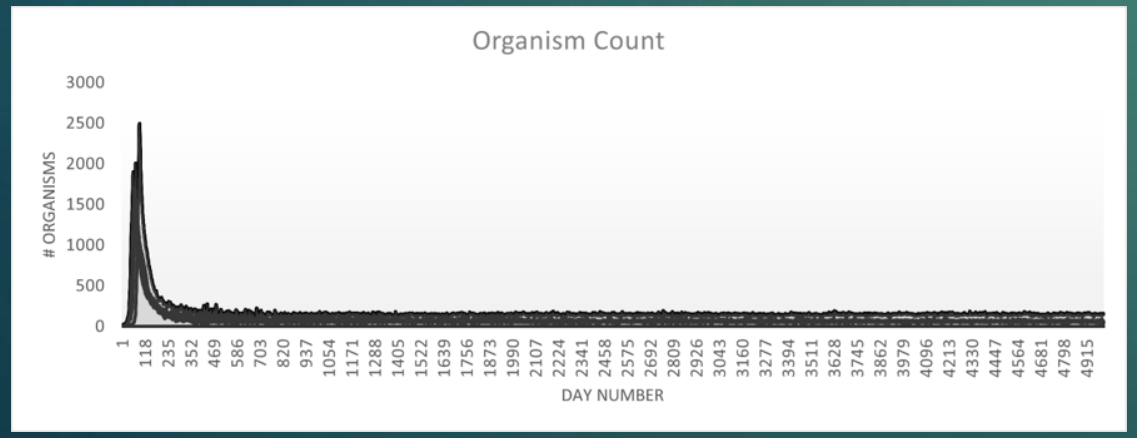
4903
DAY NUMBER
sight
speed


Organism Count
ORGANISMS
3000
2500
2000
1500
1000
500
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1
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1171
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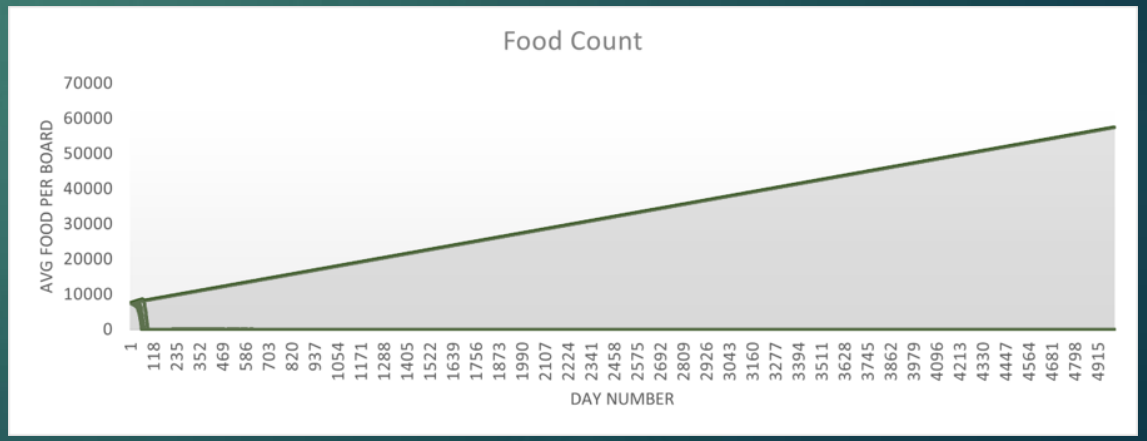
DAY NUMBER


Food Count
AVG FOOD PER BOARD
70000
60000
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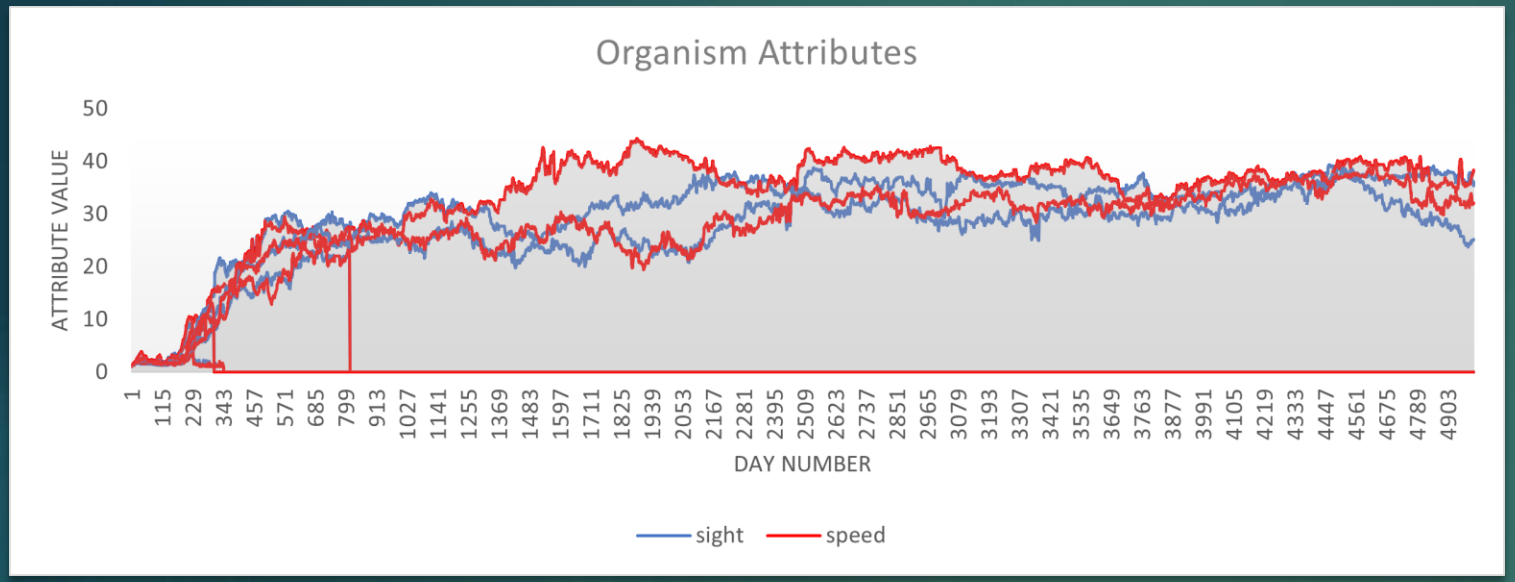
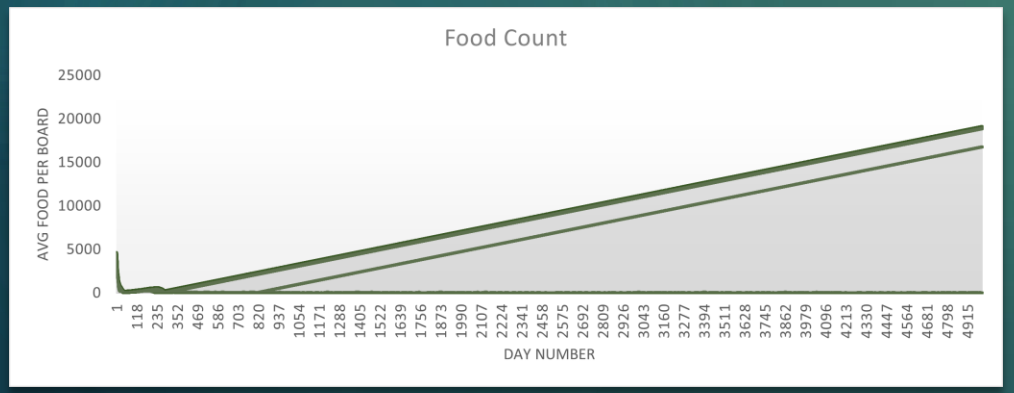
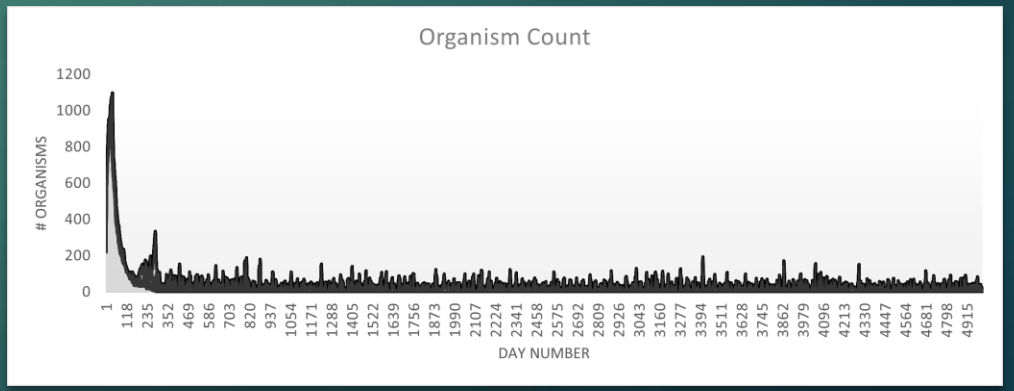
DAY NUMBER

Start with 1 Organism







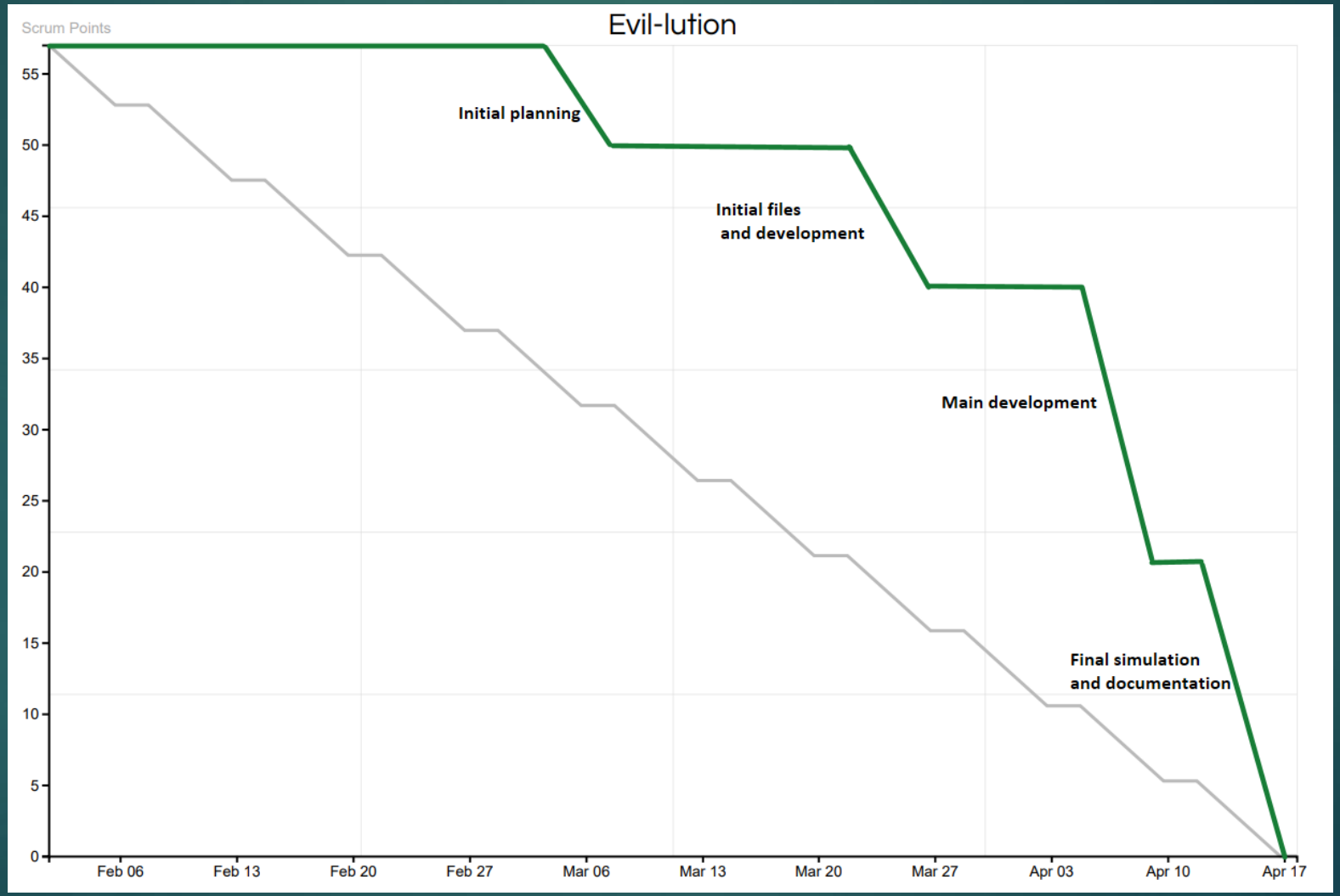
Conclusion

- Speed and sight tended to increase at the same rate, suggesting that they were of equal evolutionary value.
- There was consistently a carrying capacity for the number of organisms within the environment, which is ecologically realistic.
  - There was also a kind of carrying capacity on food when there were organisms left to eat it.
- Having many processors working in parallel to spread out the workload was very helpful, and allowed us to effectively simulate a large ecosystem

Project Tasks

Decide and assign tasks [5 pts]	(Brian, Trey, Kaden)
"Organism.cpp" [3 pts]	(Kaden)
"Board.cpp" [3 pts]	(Trey)
"Simulation.cpp" [3 pts]	(Brian)
Config File I/O [5 pts]	(Kaden)
"Time Passed" function [7 pts]	(Trey)
Border movement [5 pts]	(Kaden, Trey)
Final simulation polishing [5 pts]	(Brian, Trey)
Run final simulation [3 pts]	(Brian, Kaden Trey)
Draft final results and paper [5 pts]	(Kaden, Trey)
Draft final presentation [3 pts]	(Brian, Kaden)
Final edits on paper [7 pts]	(Brian, Kaden, Trey)
Final edits on presentation [3 pts]	(Brian, Kaden, Trey)

Burndown Chart



Future Work

- Add in predators, neutral organisms, and prey
  - Give additional traits, such as ability to escape or defend themselves
- Create a GUI, so we can better visualize the simulation as it runs
- Give the organisms some "intelligence"
  - Have small groups of them work together as they gather food
- Add in small disasters / disease outbreaks to see their influence