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Project #3 Functional Decomposition

Goal: Create a month-by-month simulation in which each agent of the simulation will execute in its own thread where it just has to look at the state of the world around it and react to it.

Note:
- It's about convenience of programming
- Add a variable that interacts with deer or grains
- Units of grain growth(inches), temperature(Fahrenheit), precipitation(inches)
- A year consists of 12 months of 30 days each
- 1st day of winter is January 1st.
- Temperature and precipitation follows cosine and sine wave patterns with some randomness.
- Once both grain and grainDeer functions hit DoneComputing barrier, watcher thread will print current set of global state variables, increment and then use new month to compute the new temperature and precipitation.
- Three levels of barriers, DoneComputing for Grain and GrainDeer, DoneAssigning for Watcher and DonePrinting for all three.
- Each thread should return when the year is 2025
- MyAgent – numGrassHopper – When height of grass reach 5, grasshopper population increases and height of grass decreases.

Questions/Results:

1. What your own-choice quantity was and how it fits into the simulation.

   The quantity I chose to add into my simulation is grasshopper. Grasshopper are predominantly herbivores and feeds on all parts of a plant. In the mid 19th century, grasshoppers were known to destroy crops, costing farmers millions in damage, especially the migrating type.

   Due to their history of multiplying in numbers during an especially fertile crop and plants year, I choose to increase grasshoppers whenever the height of the plants increases to more than 3 inches, it would result in increase in grasshoppers meanwhile decreasing the height of the plants by 2. However due to the fact that they are migrating insects and, in this example,, there is no human intervention or enemies simulated, they will just spread to different regions, therefore, resulting in the ever increasing number of them. They do however, affects the height of the plants regardless!

2. A table showing values for temperature, precipitation, number of grainDeer, height of the grain, and your own-choice quantity as a function of month number.

NowYear:	NowMonth:	NumHeight:	NowNumDeer:	Grasshoppers	Temp:	Precip:
2019	0	3.00789	2	0	25.867294	11.44072
2019	1	3.071162	3	0	34.83305	12.993634
2019	2	7.171625	4	0	45.18581	12.993634
2019	3	10.761164	5	1	54.151566	11.44072
2019	4	9.318779	6	6	59.32795	8.750994
2019	5	6.506678	7	11	59.32795	5.645164
2019	6	3.164561	6	16	54.151566	2.955439
2019	7	3.164561	5	15	45.18581	1.402524
2019	8	3.164561	4	14	34.83305	1.402524
2019	9	4.089582	3	13	25.867298	2.955438
2019	10	3.250484	4	12	20.690912	5.645166
2019	11	1.409522	3	11	20.690914	8.750994
2020	0	1.409522	2	10	25.867294	11.44072
2020	1	1.472795	1	9	34.83305	12.993634
2020	2	1.472795	2	8	45.18581	12.993634
2020	3	6.062333	1	7	54.151566	11.44072
2020	4	6.619948	2	12	59.32795	8.750994
2020	5	5.807847	3	17	59.32795	5.645164
2020	6	4.46573	4	22	54.151566	2.955439
2020	7	4.46573	5	21	45.18581	1.402524
2020	8	4.885046	4	20	34.83305	1.402524
2020	9	5.810067	5	19	25.867298	2.955438
2020	10	3.970969	6	24	20.690912	5.645166
2020	11	1.130007	5	23	20.690914	8.750994
2021	0	0	4	22	25.867294	11.44072
2021	1	0	3	21	34.83305	12.993634
2021	2	0	2	20	45.18581	12.993634
2021	3	4.589539	1	19	54.151566	11.44072
2021	4	5.147154	2	18	59.32795	8.750994
2021	5	4.335052	3	23	59.32795	5.645164
2021	6	2.992935	4	22	54.151566	2.955439
2021	7	1.650321	3	21	45.18581	1.402524
2021	8	1.650321	2	20	34.83305	1.402524
2021	9	1.650321	1	19	25.867298	2.955438
2021	10	1.811223	2	18	20.690912	5.645166
2021	11	0.97026	1	17	20.690914	8.750994
2022	0	0.659533	0	16	25.867294	11.44072
2022	1	1.722805	1	15	34.83305	12.993634
2022	2	6.823268	2	14	45.18581	12.993634
2022	3	11.412807	3	19	54.151566	11.44072
2022	4	10.970423	4	24	59.32795	8.750994
2022	5	9.158321	5	29	59.32795	5.645164
2022	6	6.816204	6	34	54.151566	2.955439
2022	7	3.816204	7	39	45.18581	1.402524
2022	8	3.23552	6	38	34.83305	1.402524
2022	9	3.160542	5	37	25.867298	2.955438
2022	10	1.321444	4	36	20.690912	5.645166
2022	11	0	3	35	20.690914	8.750994
2023	0	0	2	34	25.867294	11.44072
2023	1	0.063272	1	33	34.83305	12.993634
2023	2	5.163735	0	32	45.18581	12.993634
2023	3	10.753274	1	37	54.151566	11.44072
2023	4	11.310889	2	42	59.32795	8.750994
2023	5	10.498788	3	47	59.32795	5.645164
2023	6	9.156671	4	52	54.151566	2.955439
2023	7	7.814055	5	57	45.18581	1.402524
2023	8	4.814055	6	62	34.83305	1.402524
2023	9	4.739077	5	61	25.867298	2.955438
2023	10	2.899979	4	60	20.690912	5.645166
2023	11	1.059017	3	59	20.690914	8.750994
2024	0	0	2	58	25.867294	11.44072
2024	1	0	1	57	34.83305	12.993634
2024	2	5.100463	0	56	45.18581	12.993634
2024	3	2.100463	1	61	54.151566	11.44072
2024	4	2.658079	2	60	59.32795	8.750994
2024	5	2.658079	3	59	59.32795	5.645164
2024	6	1.315962	2	58	54.151566	2.955439
2024	7	0.973347	1	57	45.18581	1.402524
2024	8	3.392663	0	56	34.83305	1.402524
2024	9	6.317685	1	55	25.867298	2.955438
2024	10	3.317685	2	60	20.690912	5.645166
2024	11	2.476722	3	59	20.690914	8.750994

3. A graph showing temperature, precipitation, number of graindeer, height of the grain, and your own-choice quantity as a function of month number. Note: if you change the units to °C and centimeters, the quantities might fit better on the same set of axes.
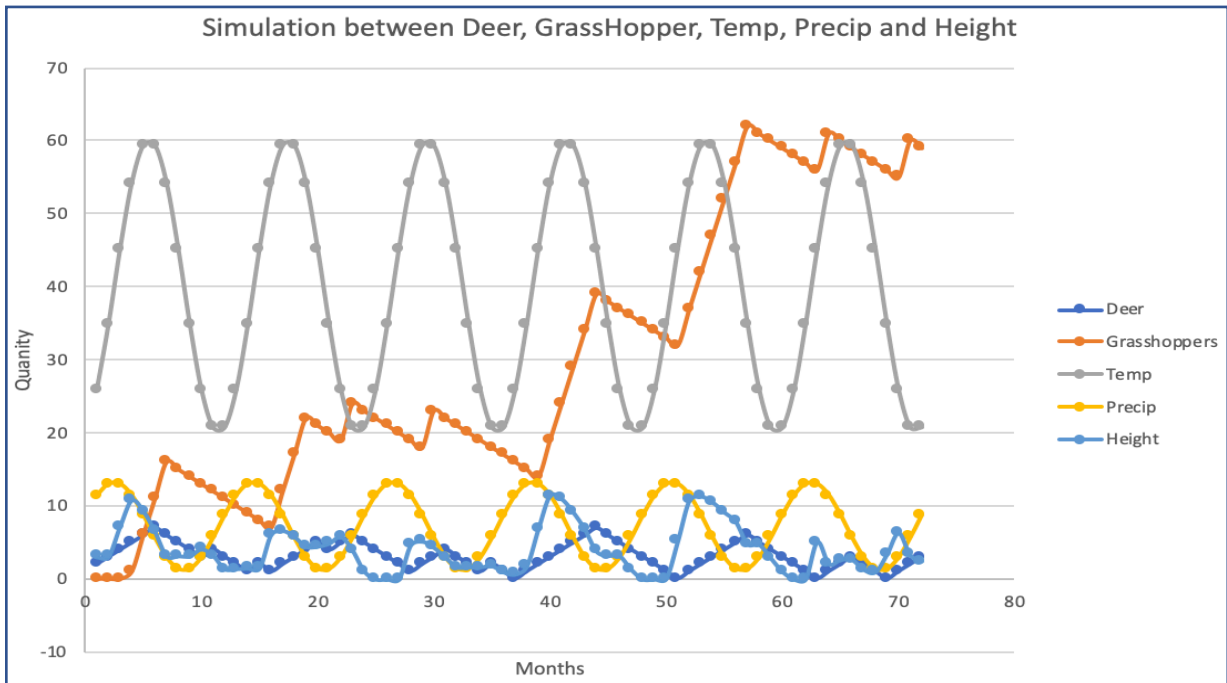
4. A commentary about the patterns in the graph and why they turned out that way. What evidence in the curves proves that your own quantity is actually affecting the simulation correctly?

      While the pattern for temperature and precipitation appear to stable and unaffected by the inclusion of grasshoppers into the simulation (as expected), the height of the plants is directly affected by myAgent function which simulates my new data type of grasshoppers.

      Whenever the height of the plants reaches 5, the number of grasshopper doubles. And whenever the height of the plants is below 2, the number of grasshoppers drop as a result. And due to the fact that grasshoppers migrate and the lack of factors such as natural enemies including human interventions, the number of grasshoppers will surely rapidly increases and spread as the months increase. (into real life regions outside of this simulation)

      Plant's height is directly affected by the grasshoppers, deers are also affected indirectly due to the fact that deer depends on the height of the plant in this simulation. By looking at the graph, we can see that at months value at 37 height reached 12, which triggered an increase in grasshopper in the following months and decreases heights as well.