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CS 475 Project 3 – Functional Decomposition
Due: May 6, 2019

This program is a simulation of grain, graindeer, and a graindeer predator (my agent) over 6 years (72 months). The grain grows according to temperature, precipitation and the amount of deer around to consume it, and the predators exist based on the deer population.

Each the grain and graindeer were set up according to the specs, and I used the results of an initial run to make reasonable numbers for the predator agent and to check against the example graph given to us. The predator population is reduced by 2 if their numbers there are just enough or not enough deer to sustain the population. If there is more than enough deer to consume and there is enough precipitation that month, then the predators can reproduce. I chose to start with 3 deer population and no predators. Predators eat 0.5 per month, the same as graindeer.

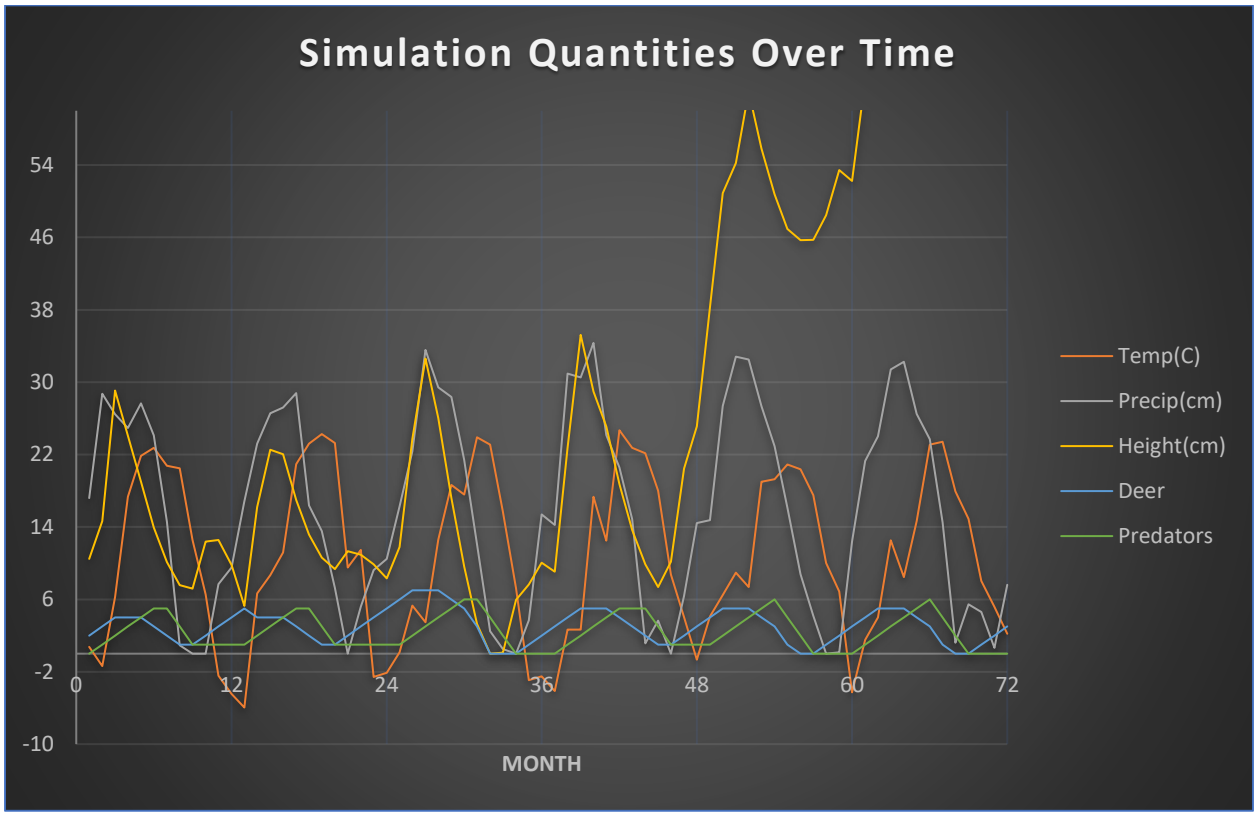
I ran my simulation on flip3. I compiled without -O3.

Below are my results:

Month	Year	Temp(C)	Precip(cm)	Height(cm)	Deer	Predators
0	2019	0.75	17.18	10.49	2	0
1	2019	-1.36	28.74	14.66	3	1
2	2019	6.26	26.47	29.08	4	2
3	2019	17.35	24.93	24.09	4	3
4	2019	21.88	27.65	19.01	4	4
5	2019	22.74	24.14	13.93	3	5
6	2019	20.76	14.57	10.13	2	5
7	2019	20.5	0.93	7.59	1	3
8	2019	12.58	0	7.19	1	1
9	2019	6.55	0	12.4	2	1
10	2019	-2.43	7.69	12.56	3	1
11	2019	-4.44	9.52	9.82	4	1
0	2020	-5.95	16.84	5.28	5	1
1	2020	6.64	23.22	16.19	4	2
2	2020	8.66	26.58	22.52	4	3
3	2020	11.2	27.19	22.04	4	4
4	2020	20.95	28.8	16.97	3	5
5	2020	23.2	16.38	13.16	2	5
6	2020	24.28	13.55	10.62	1	3
7	2020	23.26	7.27	9.35	1	1
8	2020	9.53	0	11.31	2	1
9	2020	11.48	5.2	10.95	3	1
10	2020	-2.59	9.24	9.86	4	1

11	2020	-2.13	10.48	8.33	5	1
0	2021	0.15	16.27	11.79	6	1
1	2021	5.31	22.37	23.73	7	2
2	2021	3.49	33.56	32.63	7	3
3	2021	12.6	29.44	26.04	7	4
4	2021	18.65	28.37	17.18	6	5
5	2021	17.59	21.39	9.63	5	6
6	2021	23.92	12.1	3.28	3	6
7	2021	23.11	2.5	0	0	4
8	2021	15.68	0.52	0.13	0	2
9	2021	7.21	0	5.96	0	0
10	2021	-2.91	3.68	7.66	1	0
11	2021	-2.5	15.4	10.04	2	0
0	2022	-4.13	14.24	9.05	3	0
1	2022	2.67	30.96	22.73	4	1
2	2022	2.66	30.54	35.24	5	2
3	2022	17.33	34.34	28.98	5	3
4	2022	12.5	24.15	25.1	5	4
5	2022	24.69	20.59	18.75	4	5
6	2022	22.73	14.86	13.67	3	5
7	2022	22.14	1.13	9.86	2	5
8	2022	18	3.66	7.35	1	3
9	2022	8.75	0	10.17	1	1
10	2022	4.05	6.38	20.44	2	1
11	2022	-0.68	14.44	25.11	3	1
0	2023	4.12	14.74	38.28	4	1
1	2023	6.47	27.39	50.89	5	2
2	2023	8.95	32.82	54.21	5	3
3	2023	7.35	32.5	62.15	5	4
4	2023	19.01	27.34	55.82	4	5
5	2023	19.29	22.91	50.76	3	6
6	2023	20.92	16.14	46.95	1	4
7	2023	20.38	8.78	45.68	0	2
8	2023	17.53	4.18	45.72	0	0
9	2023	10	0	48.47	1	0
10	2023	6.88	0.15	53.44	2	0
11	2023	-4.26	12.38	52.24	3	0
0	2024	1.52	21.29	63.45	4	1
1	2024	4.01	24.02	78.51	5	2
2	2024	12.51	31.4	74.49	5	3
3	2024	8.47	32.26	79.3	5	4
4	2024	14.64	26.48	73.65	4	5
5	2024	23.1	23.7	68.57	3	6

6	2024	23.43	14.49	64.76	1	4
7	2024	17.94	1.2	63.51	0	2
8	2024	14.89	5.45	63.83	0	0
9	2024	8.04	4.61	70.67	1	0
10	2024	5.16	0.63	77.12	2	0
11	2024	2.19	7.61	85.14	3	0



Commentary

Since the grain already has several factors influencing its growth, I wanted to add something that affects the deer population. Through several runs, I can see that the temperature and precipitation levels are relatively stable, which means the grain will always have an opportunity to grow back if its height reaches 0. The grain height does reach 0 only once before taking off after the 48-month mark.

In the beginning, I gave the deer population a bit of a head-start so they wouldn't die off too soon. This resulted in the two smaller grain spikes between months 24 and 48 before the deer population declined and fell into a cycle with the predator population. It was a little difficult to balance out both deer and predator populations just right so that one would not totally dominate the other (or the grain) and cause it to die off.

I used a similar method as was directed to calculate the graindeer population growth to calculate predator population growth. Since predators tend to be larger (and thus have to be more efficient with their energy expenditure), multiple predators will fall if the available food isn't in

abundance. This is shown in the graph as the predator population is unable to maintain any lead on the deer population, and the predator numbers trend toward the deer numbers.

In general, the graph shows that the predator population is keeping the graindeer population under control, which is allowing the grain to remain plentiful. It reaches 0 for only one month, unlike the example graph (or a run without predators). The specs seemed to only suggest modifying certain parts of the code, so I was unsure if it would be acceptable to change the graindeer calculations as outlined in the specs. Since the deer/predator populations are dealt with in small integers, I would probably change the deer population to be able to reproduce at a faster rate than the predators (i.e. more than plus one) to see if that keeps the grain in balance as well. The current graph shows a cycle with the deer declining as the grain starts to, and predators that gain an edge right after the peak of the deer populations. The predator population then begins to wane with the deer. It seems this pattern would continue under the conditions I have set up, despite there being ample food to accommodate a large deer population. Thus, we know the predators are affecting the system.