Intro to Parallel Programming

Project n°3 – Functional Decomposition

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What "own-choice" quantity did I choose and how does it fit to the simulation ?

Given the current state of the world, I chose to add an infectious disease to the simulation. It would be measured in infectiousness percentage. Every time the temperature would be below 50°F and the precipitation level would be over 11 cm, the infectious disease would strike with an increment of 25% infectiousness. This means that 25% percent of the graindeers would die. Since the population of graindeers does usually not go over 6 individuals, we subtract to the total population of graindeers the rounded number resulting from the calculation:

<center>Number of Graindeer * Infectiousness</center>

If the weather gets better, meaning that the temperature would be over 50°F or that the precipitation level would go under 11 cm, then the infectiousness of the disease would decrease by 2.5% until it eventually disappears.

This "quantity" affects the number of graindeers that survive when the grain level is usually high. It also indirectly affect the grain level because there are less graindeers eating the grain.

Table with the results of the simulation:

Year	Month Nb	Temperature in C°	Precipitation in cm	Nb GrainDeer	Height of Grain in cm	Infectious Level in %
2020	0	-0,72	9,75	1	0	0
2020	1	11,41	9,67	0	7,06	0
2020	2	15,60	13,33	1	11,79	0
2020	3	17,62	14,79	2	9,61	0
2020	4	25,32	10,57	3	4,59	0
2020	5	23,52	8,78	2	0	0
2020	6	23,43	4,78	1	0	0
2020	7	23,89	1,86	0	0	0
2020	8	21,60	0,6	0	0	0
2020	9	9,99	3,06	1	0	0
2020	10	11,68	3,06	0	2,65	0
2020	11	8,40	4,46	1	4,63	0
2021	12	9,96	10,34	2	12,22	0

2021	13	6,19	13,15	3	15,65	0
2021	14	17,44	14,23	4	26,78	25
2021	15	23,01	14,24	4	16,7	22,5
2021	16	23,91	13,13	4	6,54	20
2021	17	21,39	6,86	2	0	17,5
2021	18	30,66	5,48	1	0	15
2021	19	24,51	1,3	0	0	12,5
2021	20	22,91	1,48	0	0	10
2021	21	14,11	1,67	1	0	7,5
2021	22	9,14	4,69	0	0	5
2021	23	6,17	4,51	0	8,43	2,5
2022	24	7,58	9,54	1	23,8	0
2022	25	12,87	12,84	2	37,94	0
2022	26	15,60	13,03	3	34,87	0
2022	27	18,20	13,5	4	17,5	0
2022	28	22,81	13,03	5	17,5	0
2022	29	25,00	7,45	6	4,8	0
2022	30	31,60	5,36	5	0	0
2022	31	20,65	1,05	4	0	0
2022	32	16,53	1,58	3	0	0
2022	33	11,86	3,08	2	0	0
2022	34	5,86	2,76	1	0	0
2022	35	3,75	5,49	0	10,14	0
2023	36	-0,61	9,25	1	28,52	0
2023	37	9,76	11,8	2	35,89	0
2023	38	13,51	12,66	3	39,66	25
2023	39	19,57	12,63	3	33,52	22,5
2023	40	25,56	10,37	2	25,91	20
2023	41	27,48	10,27	3	18,29	17,5
2023	42	25,64	6,93	3	10,67	15
2023	43	23,75	4,2	4	3,054	12,5
2023	44	18,29	0	3	0	10
2023	45	10,58	2,38	2	0	7,5
2023	46	13,12	2,39	1	0	5
2023	47	6,97	4,22	0	0	2,5
2024	48	7,21	8,23	0	13,31	0
2024	49	6,53	11,27	1	30,59	0
2024	50	16,99	13	2	47,58	25
2024	51	15,51	12,96	2	42,63	22,5

2024	52	20,44	12,37	3	37,95	20
2024	53	29,10	9,42	3	30,33	17,5
2024	54	29,11	3,87	3	22,71	15
2024	55	26,29	3,32	4	15,09	12,5
2024	56	21,05	1,05	5	4,93	10
2024	57	11,46	1,31	4	0	7,5
2024	58	7,09	3,84	3	0	5
2024	59	0,60	7,3	2	4,85	2,5
2025	60	0,08	8,82	1	12,93	0
2025	61	4,67	11,37	2	22,59	0
2025	62	11,36	13,63	3	39,9	25
2025	63	15,72	13,83	3	36,53	22,5
2025	64	24,14	12,05	3	29,23	20
2025	65	30,95	10,18	3	21,61	17,5
2025	66	30,22	3,85	3	13,99	15
2025	67	28,89	1,28	4	0	12,5
2025	68	16,28	1,28	3	0	10
2025	69	14,51	1,02	2	0	7,5
2025	70	5,96	3,61	1	0	5
2025	71	8,80	3,83	0	11,57	2,5

Graph showing Temperature, Precipitation, Number of Graindeer, Height of the Grain and Infectiousness as a function of the month number
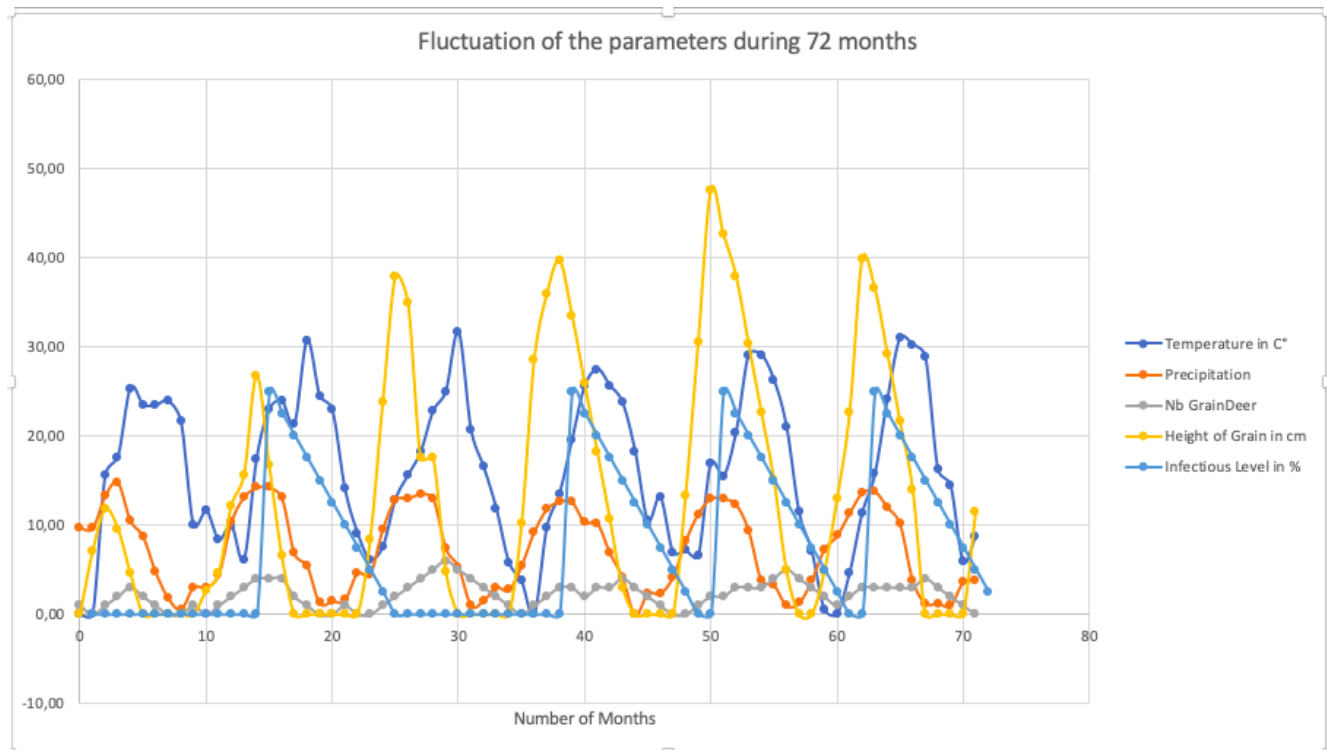
Commentary about the pattern observed:

The first thing we can notice in this graph is that the precipitation level (in cm) and the temperature (displayed in degrees Celsius) seem constant throughout the years. The temperature fluctuates between 30°C in summer and 0°C in winter when the precipitation level settles down around 13 cm at the end of each winter and the start of spring before coming back to values around 3 cm in summer and fall.

What we can also notice, is that the number of graindeers stays stable when there is a lot of food available. This is due to the fact that, when the grain grows a lot, the conditions for the infectious disease to strike also become satisfactory. This prohibits the population of graindeers to develop, eventually causing the population of graindeers to decrease very quickly when the amount of grain available decreases. Therefore, each year the population of graindeers disappears before reappearing when the grain level rises the year after. Clearly, the addition of an infectious disease creates a non-sustainable environment for the graindeers.

One last observation would be that even though the temperature and precipitation level are relatively stable, the height (in cm) of the grain seems to increases significantly when the infectious disease strikes the population of graindeers.