Tetris Simulation Results

Sameer Pai

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1 Results

Problem 1.1. Simulate Tetris whereby pieces appear at random, according to random orientations and random starting points. Don't worry about deleting rows when they become full, just track the process by which the blocks accumulate. Do this for a width N with periodic boundary conditions (so the left and right match up). If blocks appear at rate N (meaning N per second) then at what speed does the interface rise? Now focus on the behavior above a fixed location of the interface (i.e., the top block above that location). How does its standard deviation grow over time?

I simulated a Tetris matrix of width 10 (the standard width) and infinite height, according to the conditions in the problem. I measured (over 10^5 trials) the minimum, maximum, and average height, as well as the standard deviation of the height of the first column. My code is in the file `Tetris.cpp`. Here are the results:

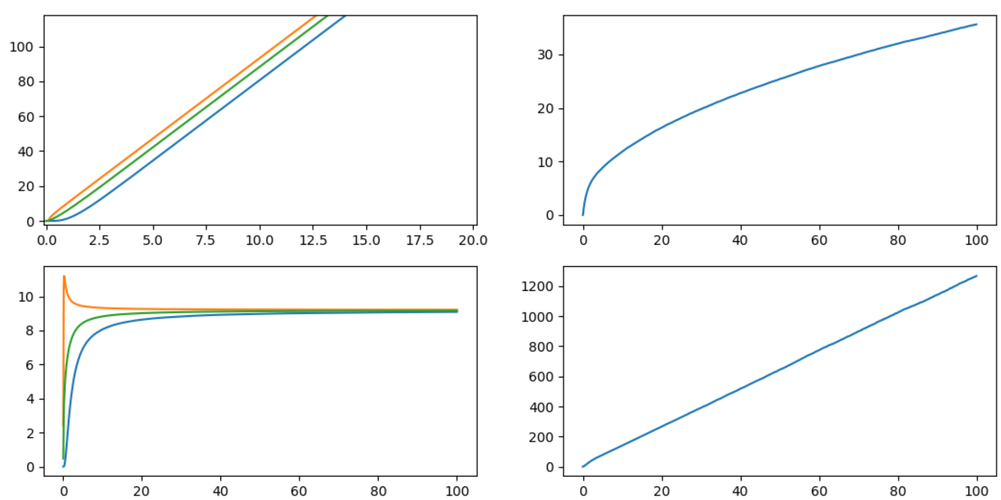

Figure 1: Assorted Graphs

The x-axis of all of the above graphs is time.

In the top left is a (very zoomed in) graph of the minimum (blue), maximum (orange), and average (green) height of the grid.

Graphed in the bottom left are the three aforementioned statistics, each divided by the elapsed time. We see that each of the max, min, and average height are proportional to t, with the constant of proportionality being approximately 9.2.

In the top right is a graph of the standard deviation of the height of the first column. In the bottom right is a graph of the variance (i.e. the square of the standard deviation). We see that the standard deviation is proportional to $\sqrt{t}$, with the constant of proportionality being approximately 3.56.

In conclusion, the height of the Tetris interface increases at a rate of 9.2 cells per second, while the standard deviation over any specific column is about $3.56\sqrt{t}$. Changing the width of the grid would change the constants of proportionality, but not the fact that the height and variance are both linear in time. For example, for $N = 20$, the height increases at a rate of 9.8, while the standard deviation is about $3.13\sqrt{t}$.