Rensselaer Polytechnic Institute

School of Science

CSCI 4320

Parallel Computing and Programming

Massively Parallel Game of Life with MPI, Pthreads and Parallel I/O

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1 Parallel I/O

A 32768x32678 cell universe was run for 256 ticks using the following configurations, while both, the execution time for the universe simulation, and the Parallel I/O execution time was recorded. As the number of ranks increase, the execution time increases – however, as the ranks decreases and threads increase, there is also an execution time increase.

Nodes	Ranks Per Node	Threads	Execution Time [s]	Parallel I/O Time [s]
4	64	1	1194.674451	N/A
	16	4	1153.360064	N/A
	4	16	1151.234792	N/A
	2	32	1173.932753	N/A
	1	64	1198.823657	N/A
16	64	1	724.949370	N/A
	16	4	718.252021	N/A
	4	16	713.982376	N/A
	2	32	715.234983	N/A
	1	64	726.739284	N/A
64	64	1	723.742976	N/A
	16	4	718.248766	N/A
	4	16	716.295873	N/A
	2	32	719.384712	N/A
	1	64	724.837234	N/A
128	64	1	723.976975	33.758028
	16	4	718.198368	1.712863
	4	16	717.816823	10.315968
	2	32	719.937283	32.978729
	1	64	723.836194	35.459833

Table 1: Execution times

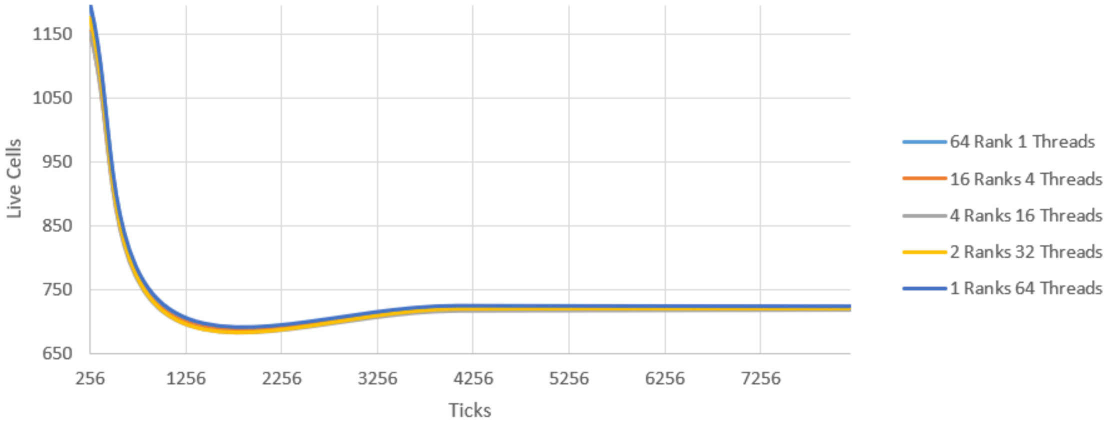

Figure 1: Execution time

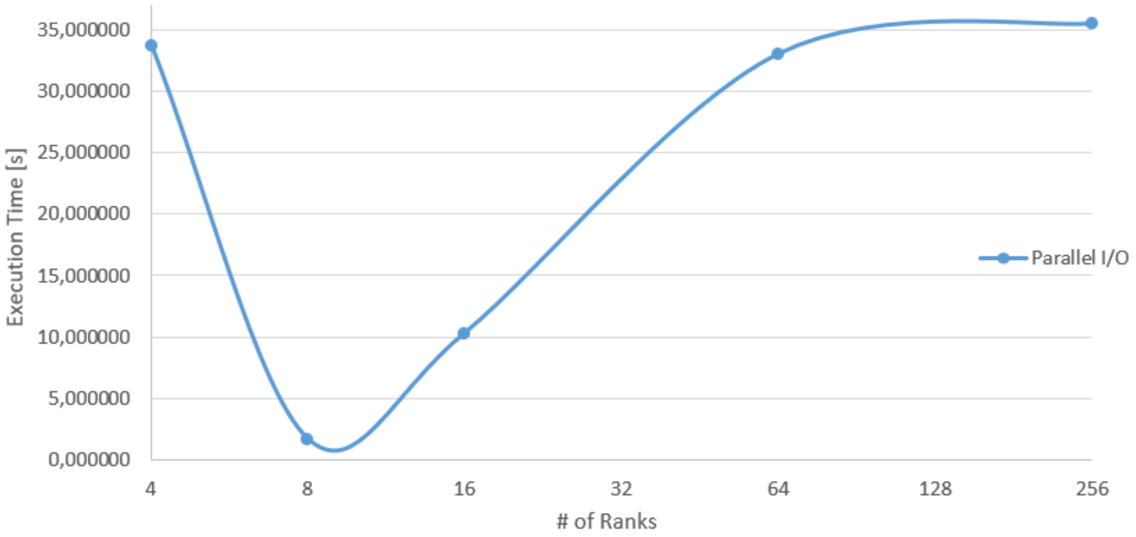

Figure 2: Parallel I/O

2 Heatmap

The heatmap of final universe was generated by reduction of the 32768x32768 cell universe, by summing all the live cells within the 32x32 sliding window, and writing the sum into the new, 1024x1024 heatmap matrix. The following figures 3, 4, 5, shows the heatmap after 128 ticks, for program running on 128 compute nodes, with thresholds 0%, 50%, and 75%, respectively. The darker the colour in the heatmap, the less cells are alive in a given 32x32 square.

The heatmaps were constructed using the numpy and the matplotlib component of pyplot. This python script takes in a .ibin file, which reads in binary and reconstructs it to decimal form. The points are then stored in a list and then reshaped. The heatmap uses nearest interpolation to construct the points.

When the threshold increases, the less of the standard rules of the Game of Life are adhered, resulting in increased randomized noise, as reflected in the graphs. As a consequence, less of the standard Conway patterns emerge.

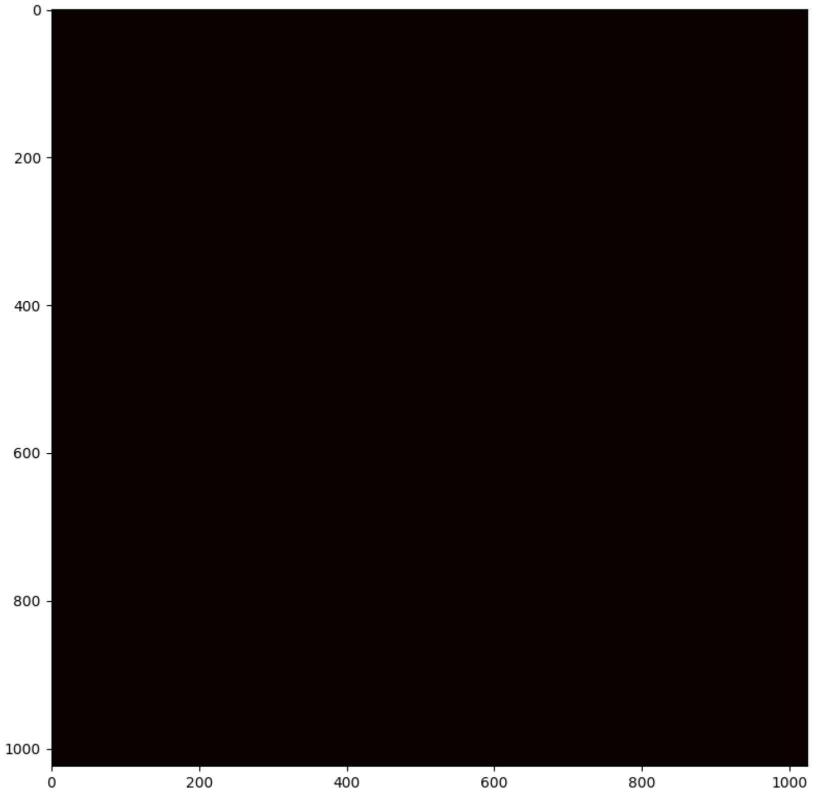

Figure 3: Heatmap - 0% threshold

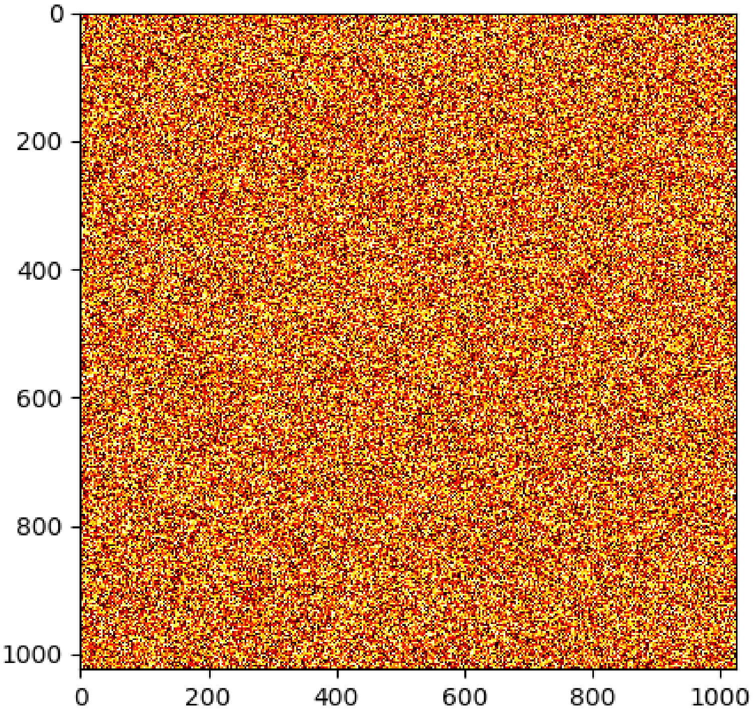

Figure 4: Heatmap - 50% threshold

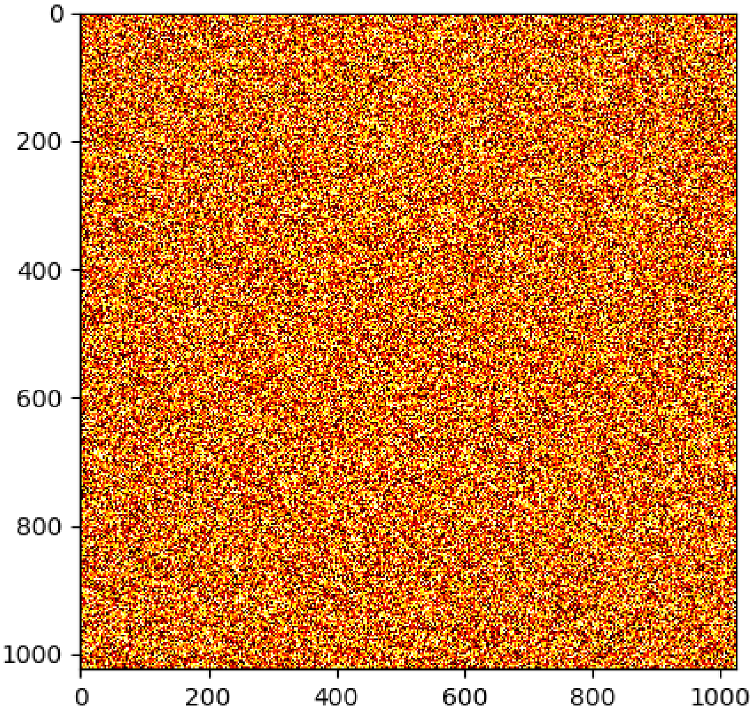

Figure 5: Heatmap - 75% threshold

3 Alive Cells

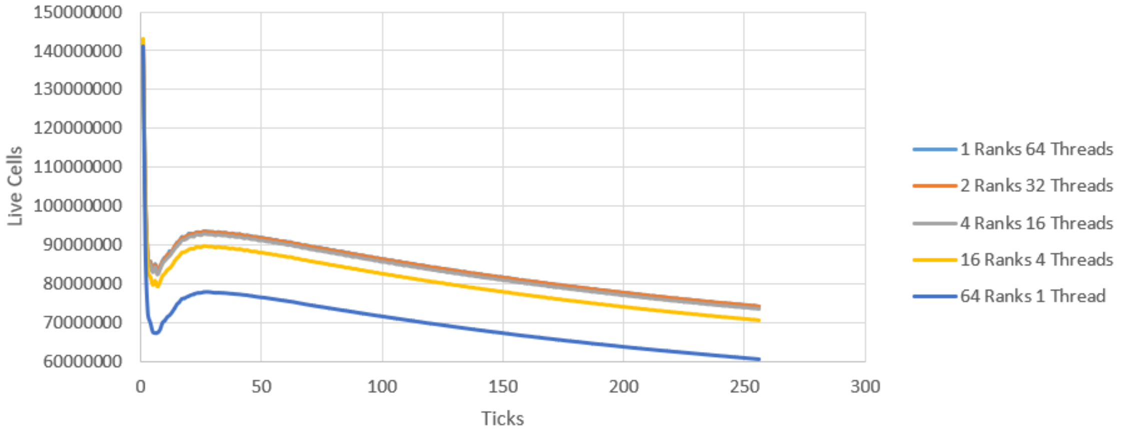

Figure 6: Alive cells vs. Ticks

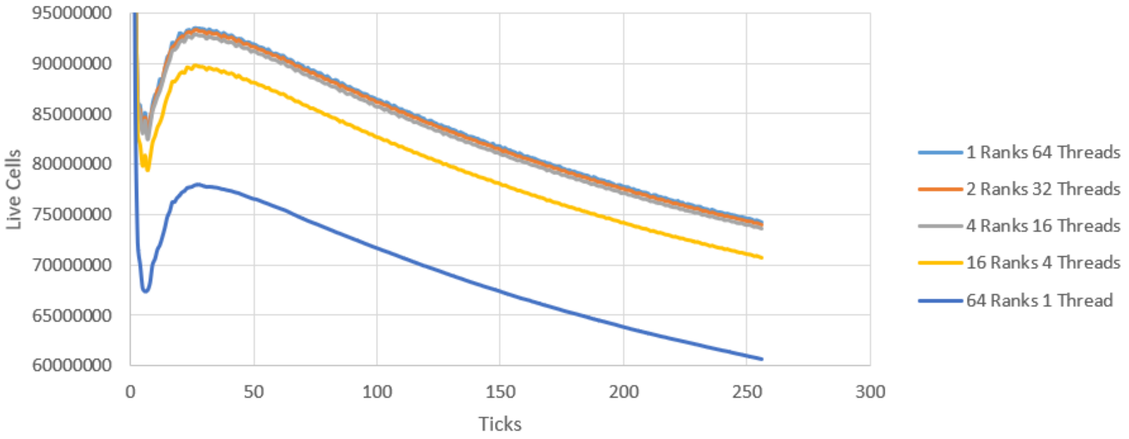

Figure 7: Alive cells vs. Ticks - Zoom