Complexity Report

For this project, we simulated the functionality of a Turing Machine and its tapes to create the cellular automata. The javascript code itself simulates the instruction tape, and we used two additional writing tapes—a 2D tape that had all the cell data, and a small 3-indexed tape that kept track of the 3 cells utilized to compute the next generation.

To understand the complexity, it is only necessary to understand how the machine is iterating through its 2D tape. There are a small constant number of calls needed per iteration:

-        3 read calls on the 2D tape

-        3 write calls on the 3-indexed tape

-        3 read calls on the resulting 3-indexed tape

-        6-10 calls to move the head

Since these instructions are repeated for each new cell being computed, the total instructions comes to about $O(18N)$. Additionally, after each row, the head needs to be scooted all the way back to the beginning of the next row, which nets another N calls to move the head for a total of $O(19N)$.

Because 19 is a constant, it can be dropped from the complexity analysis to reveal the asymptotic growth of the Turing Machine. This leaves us with a complexity of $O(N)$.