Project 1 – Final

January 30, 2025

Introduction

For the final report, I was unable to get adequate time with compute resources. Wait times were 1 day or more. Values in table are what I was able to get with careful executing and figuring out how to navigate scheduling. Some times are for initial runs, while others are for non exclusive nodes.

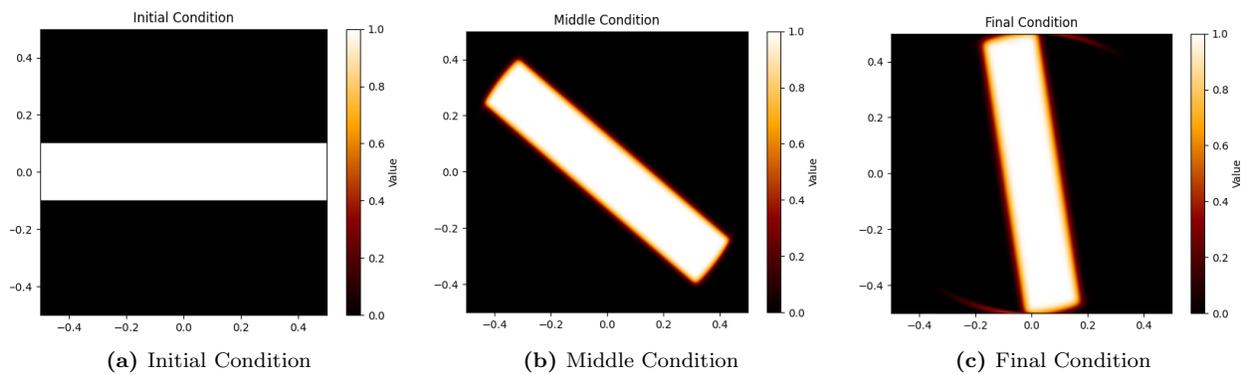Fastest runtime for benchmark problem: 45.464 with One MPI Rank Per Node 1 Node

Verification

(a) Initial Condition   **(b)** Middle Condition   **(c)** Final Condition

Figure 1: Lax method verification: Single Core

(a) Initial Condition   **(b)** Middle Condition   **(c)** Final Condition
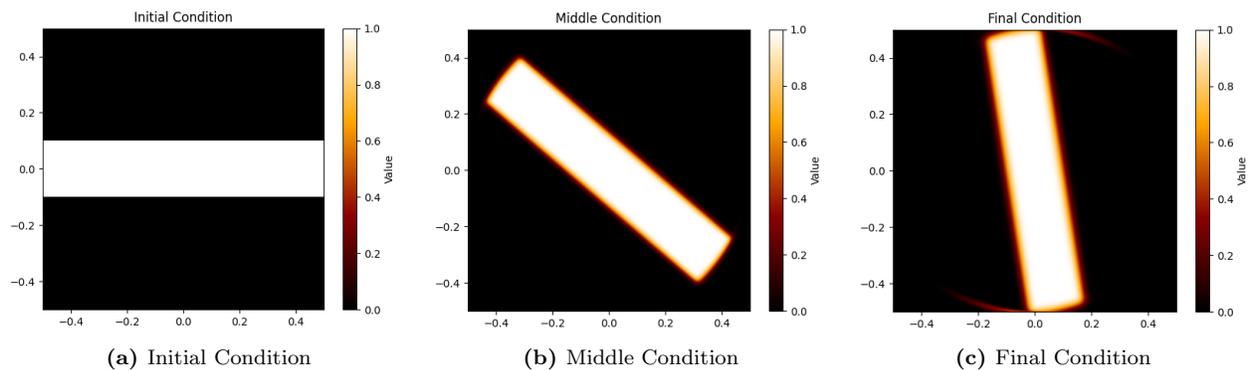
Figure 2: Lax method verification: Single Core

Performance

(a) Initial Condition   **(b)** Middle Condition   **(c)** Final Condition
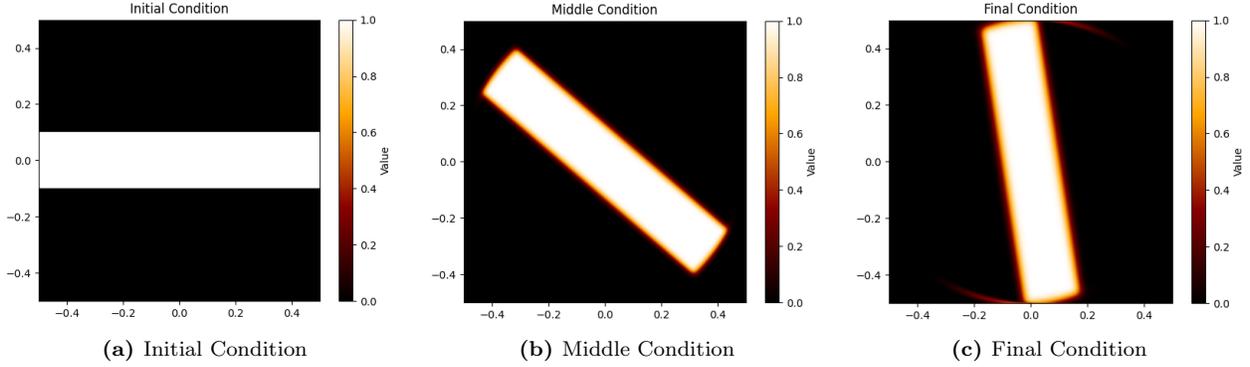
Figure 3: Distributed Memory Parallel Lax 1 core per node, 4 nodes

(a) Initial Condition   **(b)** Middle Condition   **(c)** Final Condition
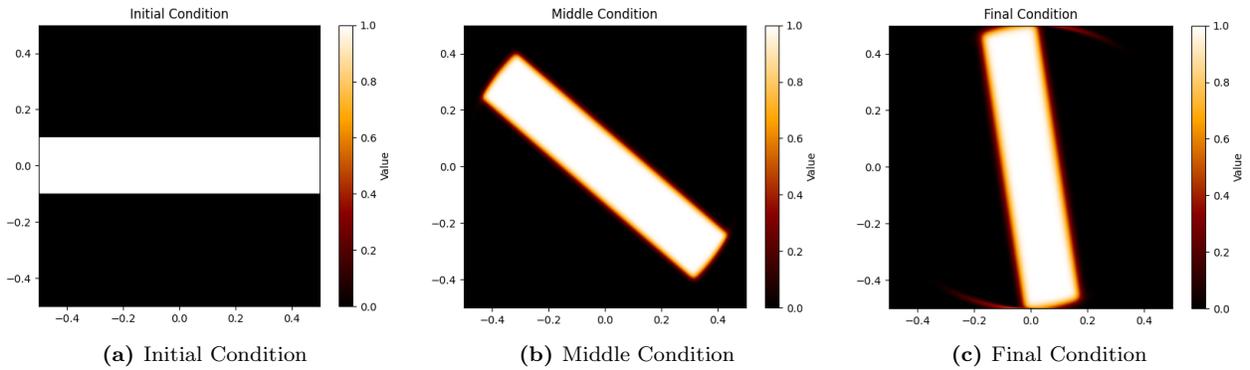
Figure 4: Distributed Memory Parallel Lax, $N = 4000$, 16 cores

Programming Model	Nodes	Cores Per Node	Execution Time (sec)
MPI-Only	1	1	1531.72
MPI-Only	2x1	1	403.181
MPI-Only	2x2	1	2507.71
MPI-Only	3x3	1	-
MPI-Only	4x4	1	-
OpenMP-Only	1	1	335.867
OpenMP-Only	1	2	180.50
OpenMP-Only	1	4	92.4454
OpenMP-Only	1	9	51.8647
OpenMP-Only	1	16	45.4826
Hybrid: One MPI rank per node	1	16	45.464
Hybrid: One MPI rank per node	2x1	16	51.3962
Hybrid: One MPI rank per node	2x2	16	517.064
Hybrid: One MPI rank per node	3x3	16	49.7175
Hybrid: One MPI rank per node	4x4	16	1896.46

Table 1: Parameter values for all of the performance tests. Use all problem values shown in Table **??**. Additionally, to facilitate performance comparisons, use $dt = 1.25 \times 10^{-4}$.