



Parallelization of Conway's Game of Life Using CUDA

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Conway's Game of Life

It is a cellular automaton

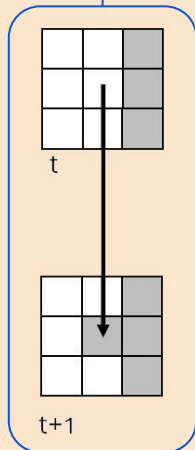
Devised by John Horton Conway in 1970

It is a zero-player game

Rules of the Game

Birth

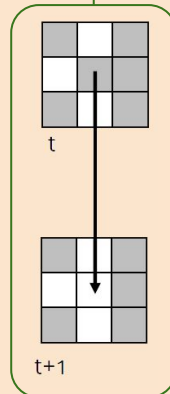
If exactly 3 of its eight neighbors are alive



Death

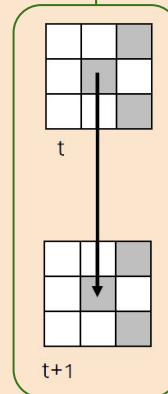
Overcrowding

If 4 or more of its neighbors are alive



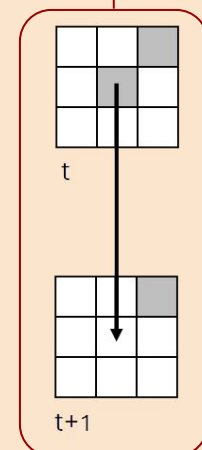
Exposure

If one or none of the neighbours are alive



Survival

If and only if 2 or 3 of its neighbors are alive



Parallelizing the Game

Goals

Leverage parallelism to efficiently compute the game evolution

Measure the efficiency of the program

CUDA and OpenMP
with 2 GPUs

Strategies

OpenMP

MPI

CUDA

MPI and OpenMP

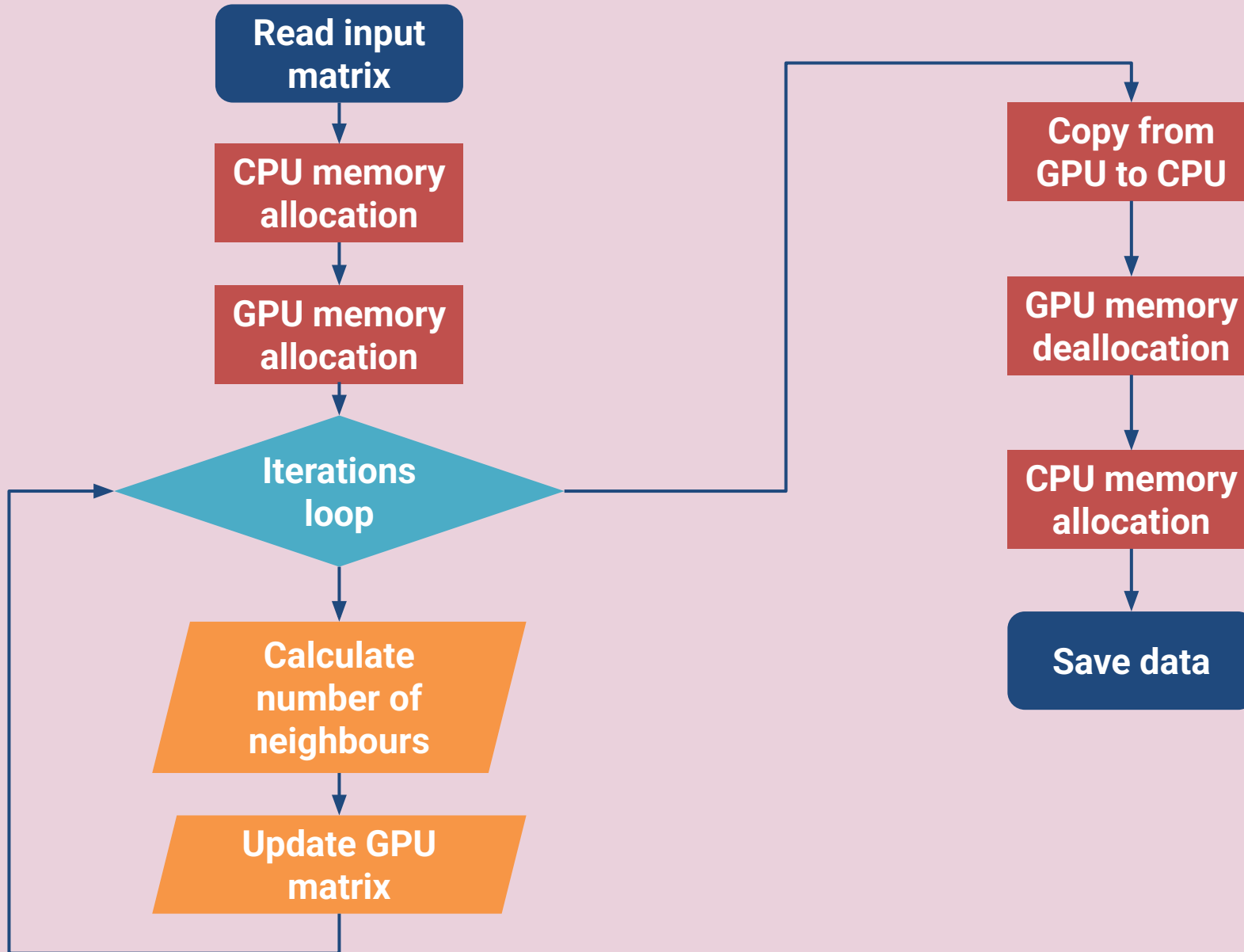
Why

Thousands of parallel
processors

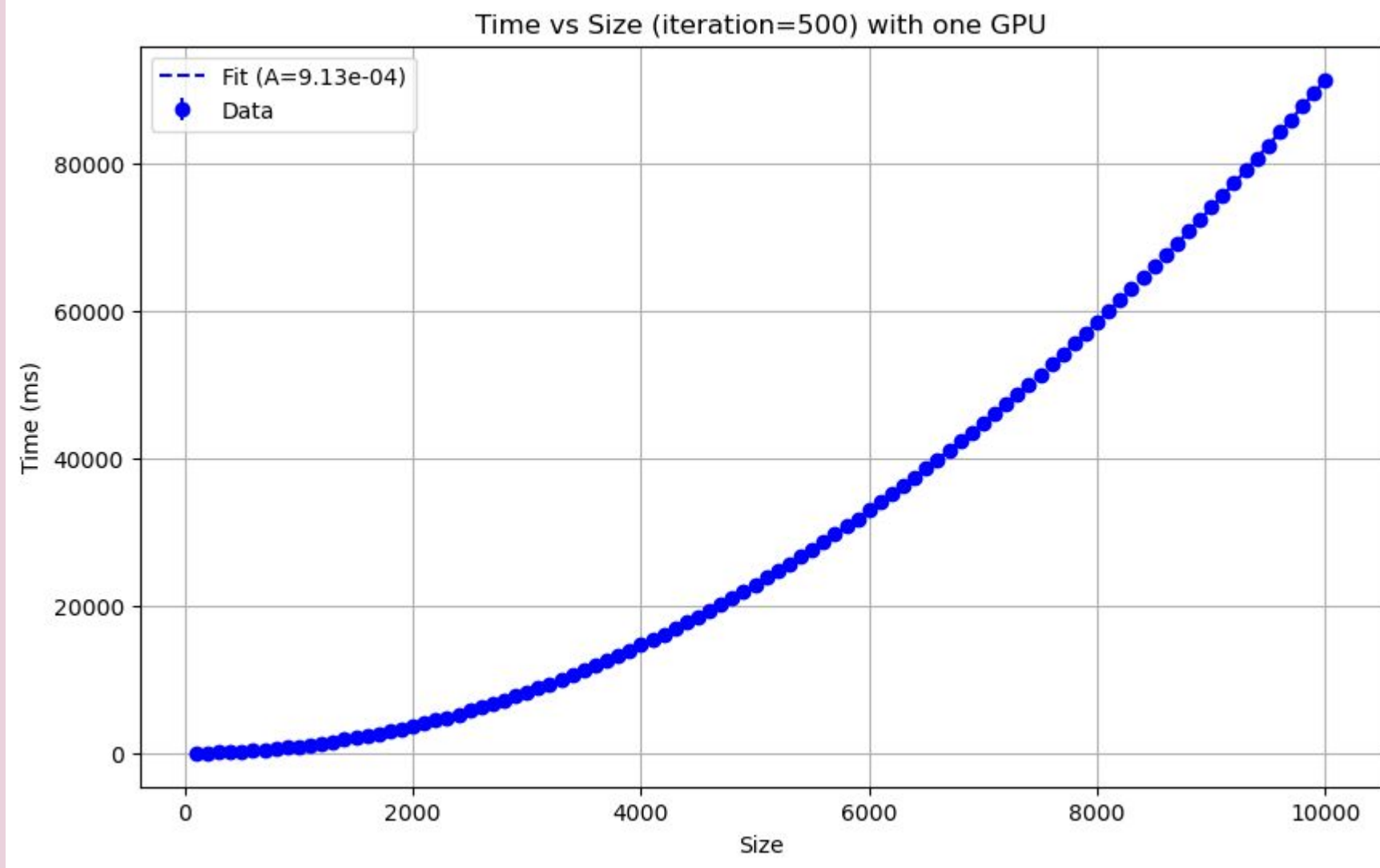
Optimized for
multiple but small
operation

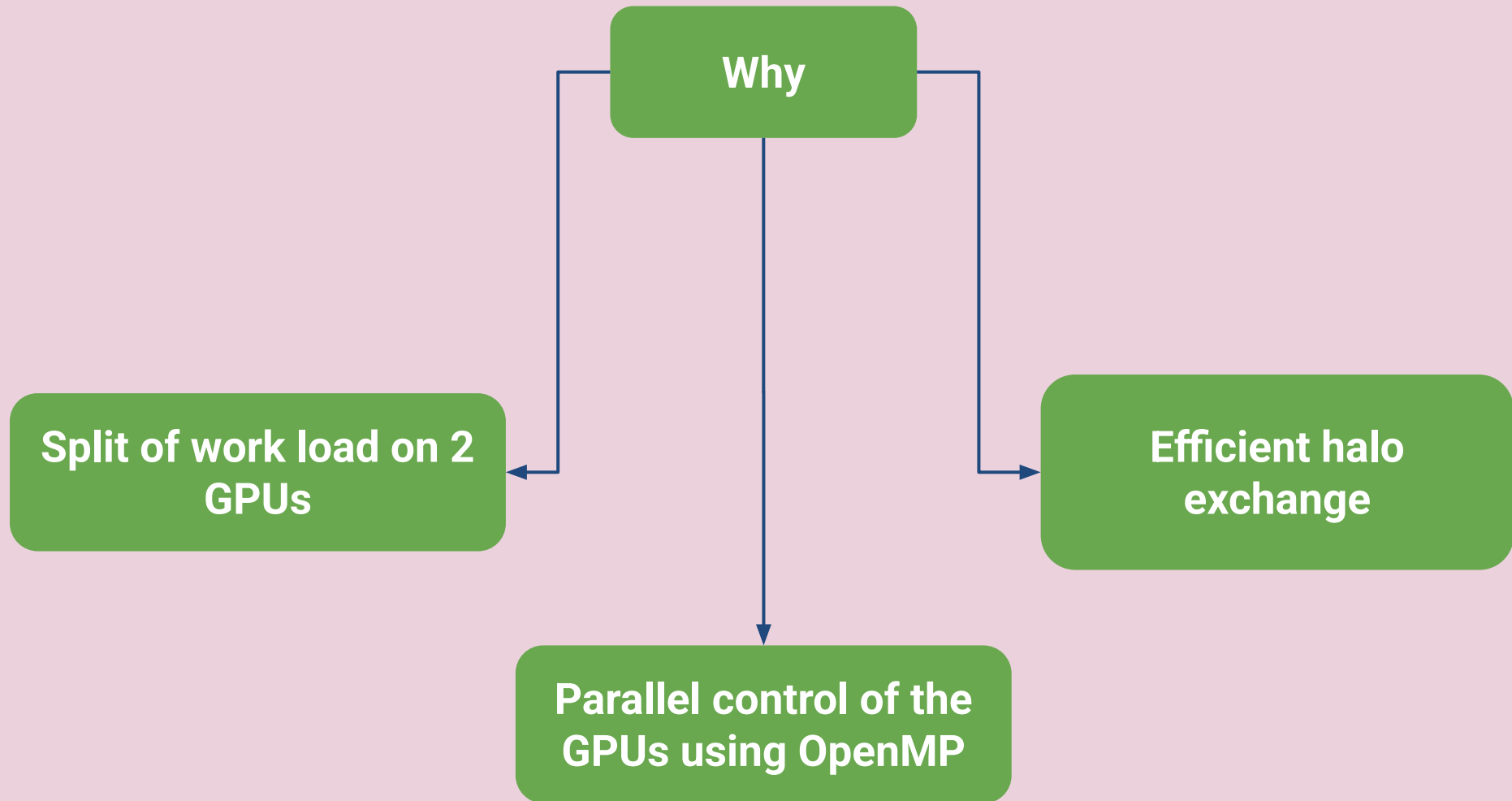
SIMD paradigm

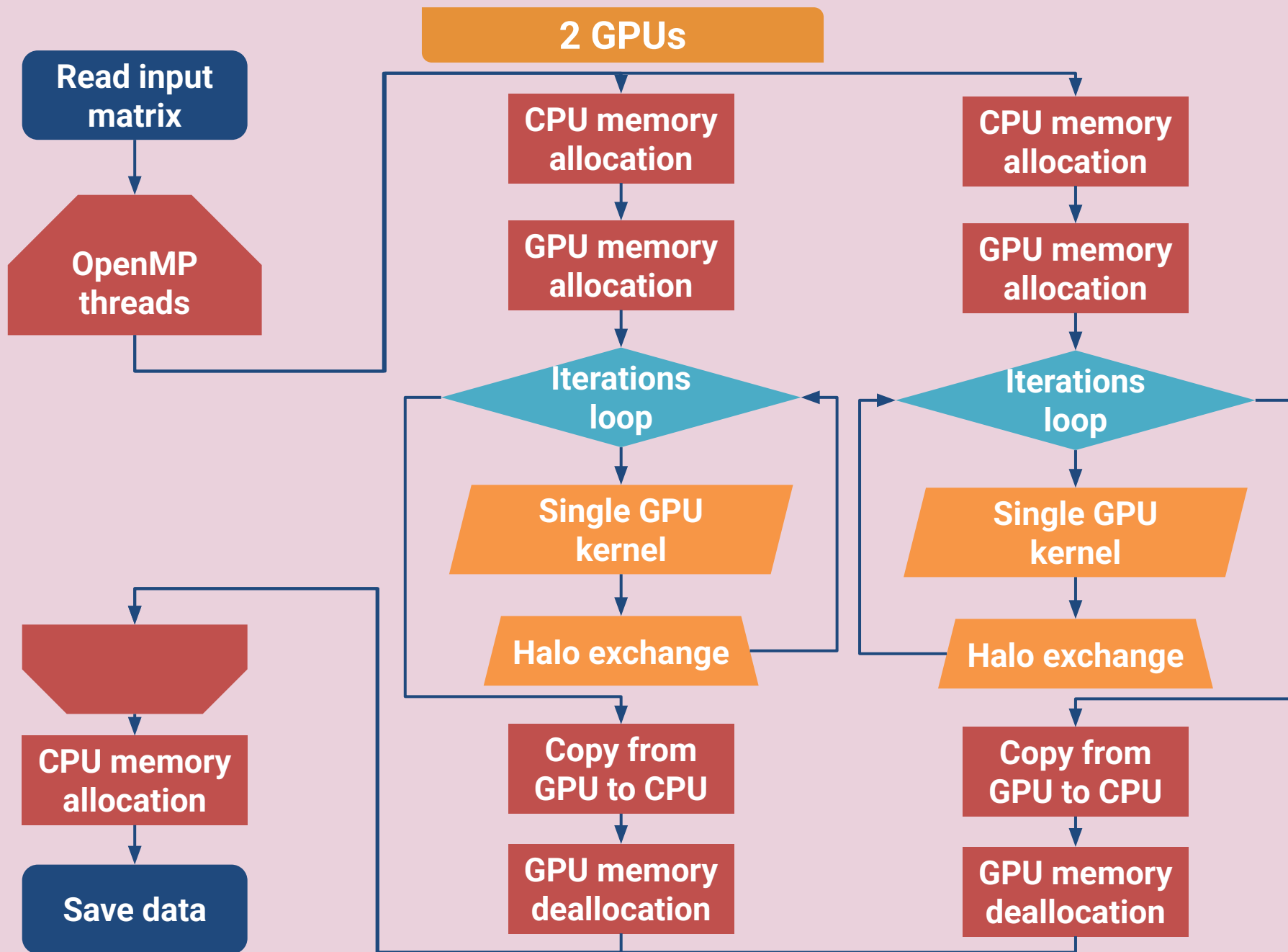
CUDA



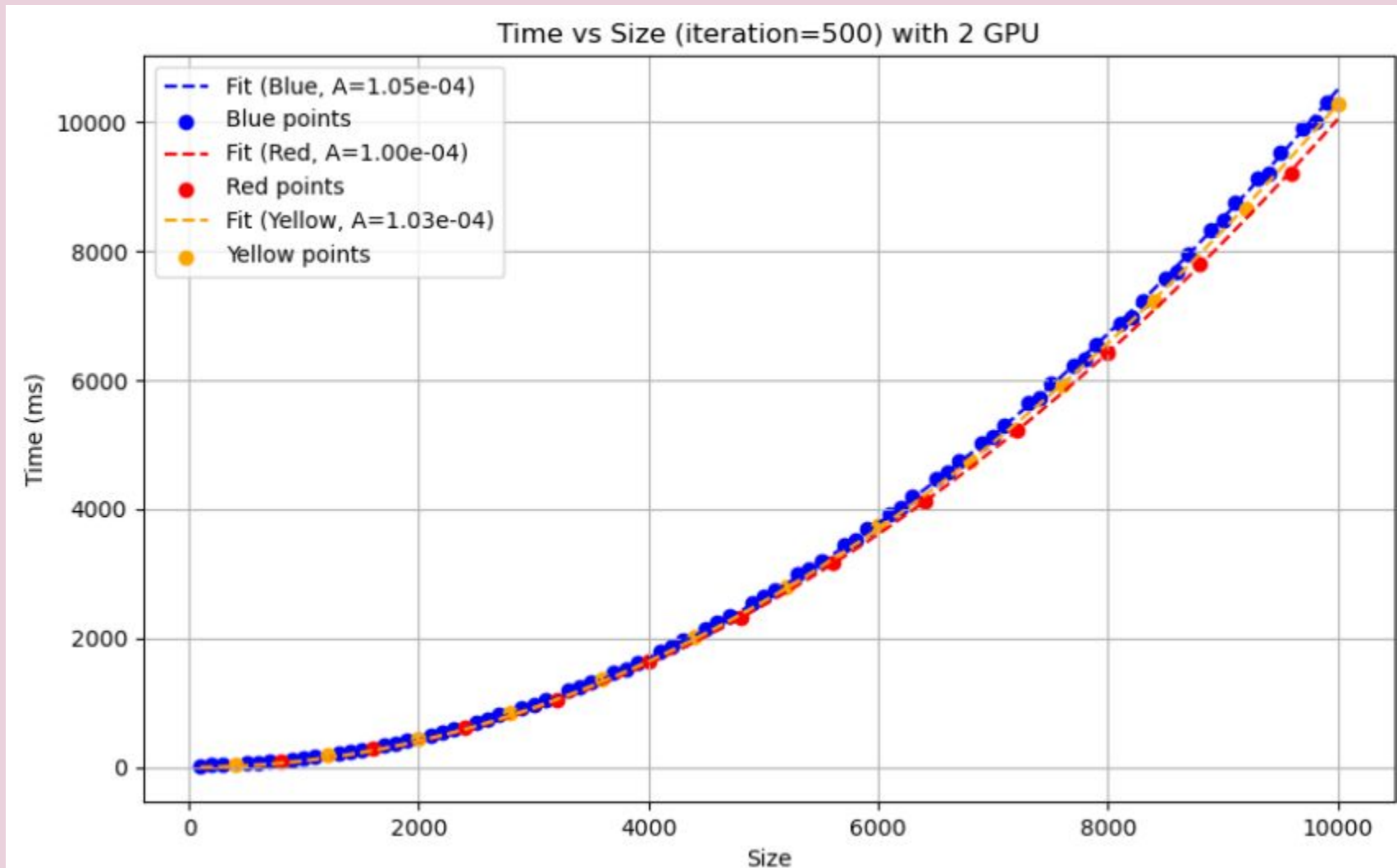
CUDA performance







2 GPUs performance



OpenMP

Why

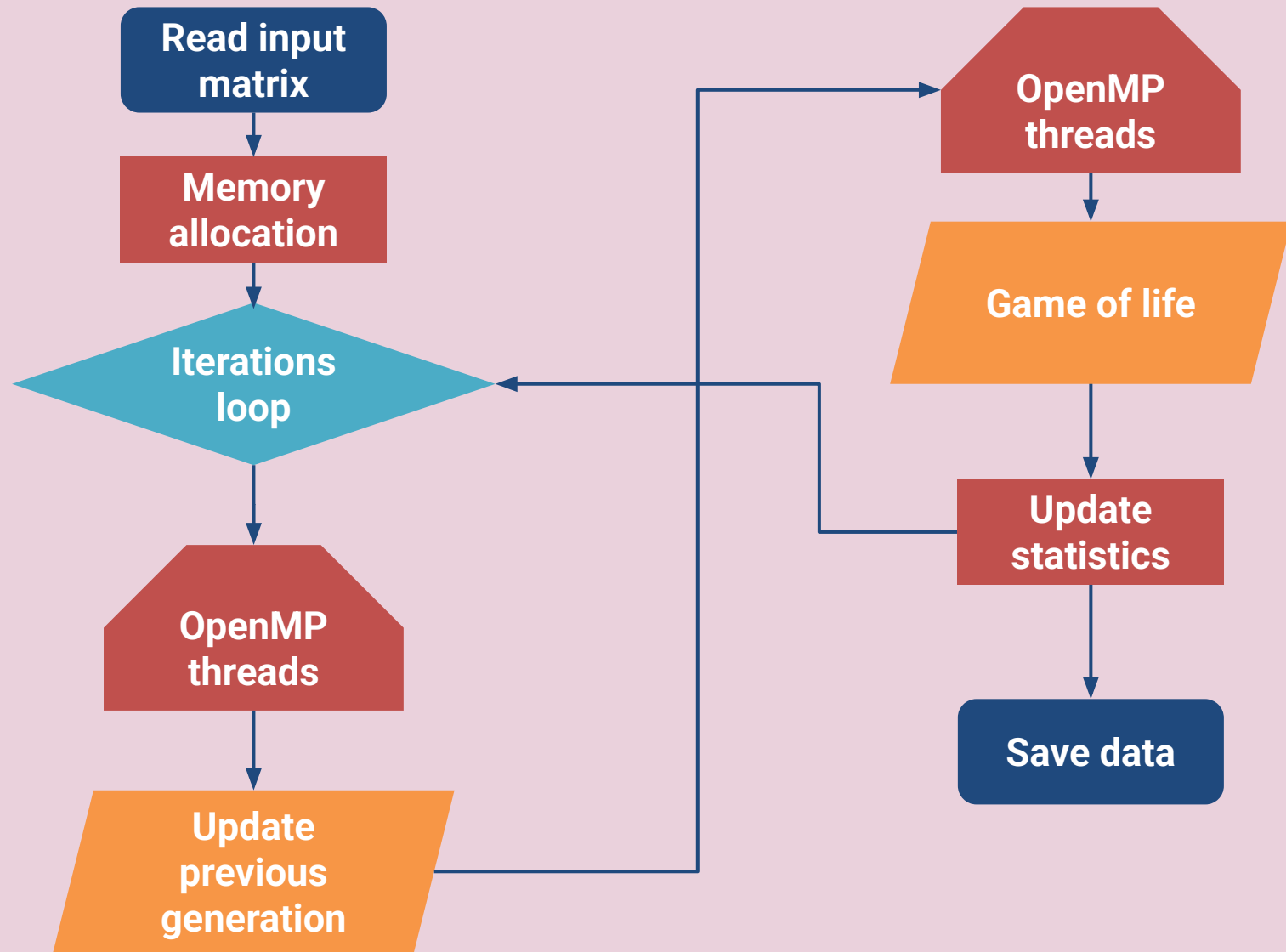
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graph TD; Why[Why] --> Parallelization[Parallelization within a single node]; Why --> Automatic[Automatic creation and management of threads]; Why --> Hardware[No need for specific hardware];
```

Parallelization within a single node

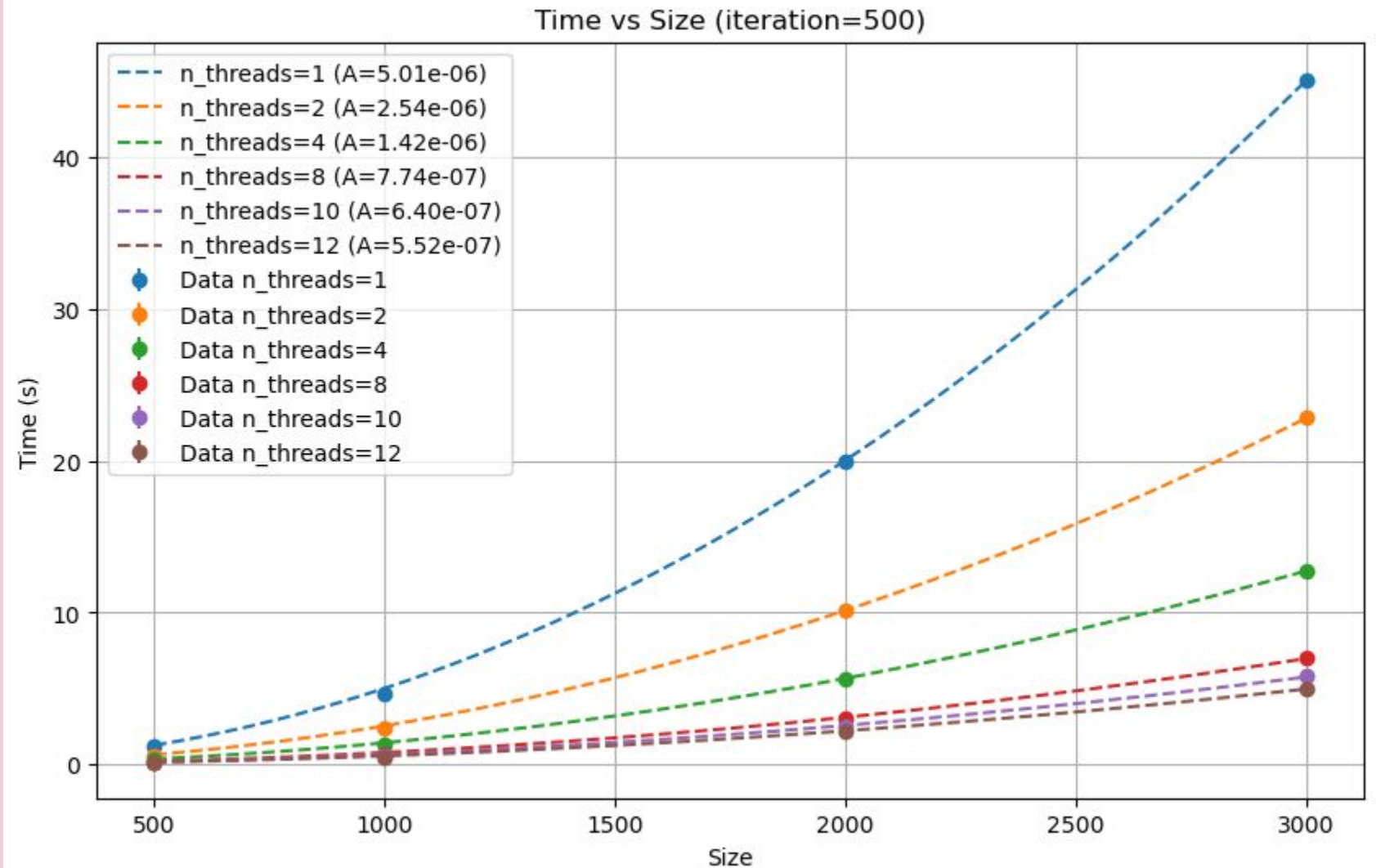
Automatic creation and management of threads

No need for specific hardware

OpenMP



OpenMP performance



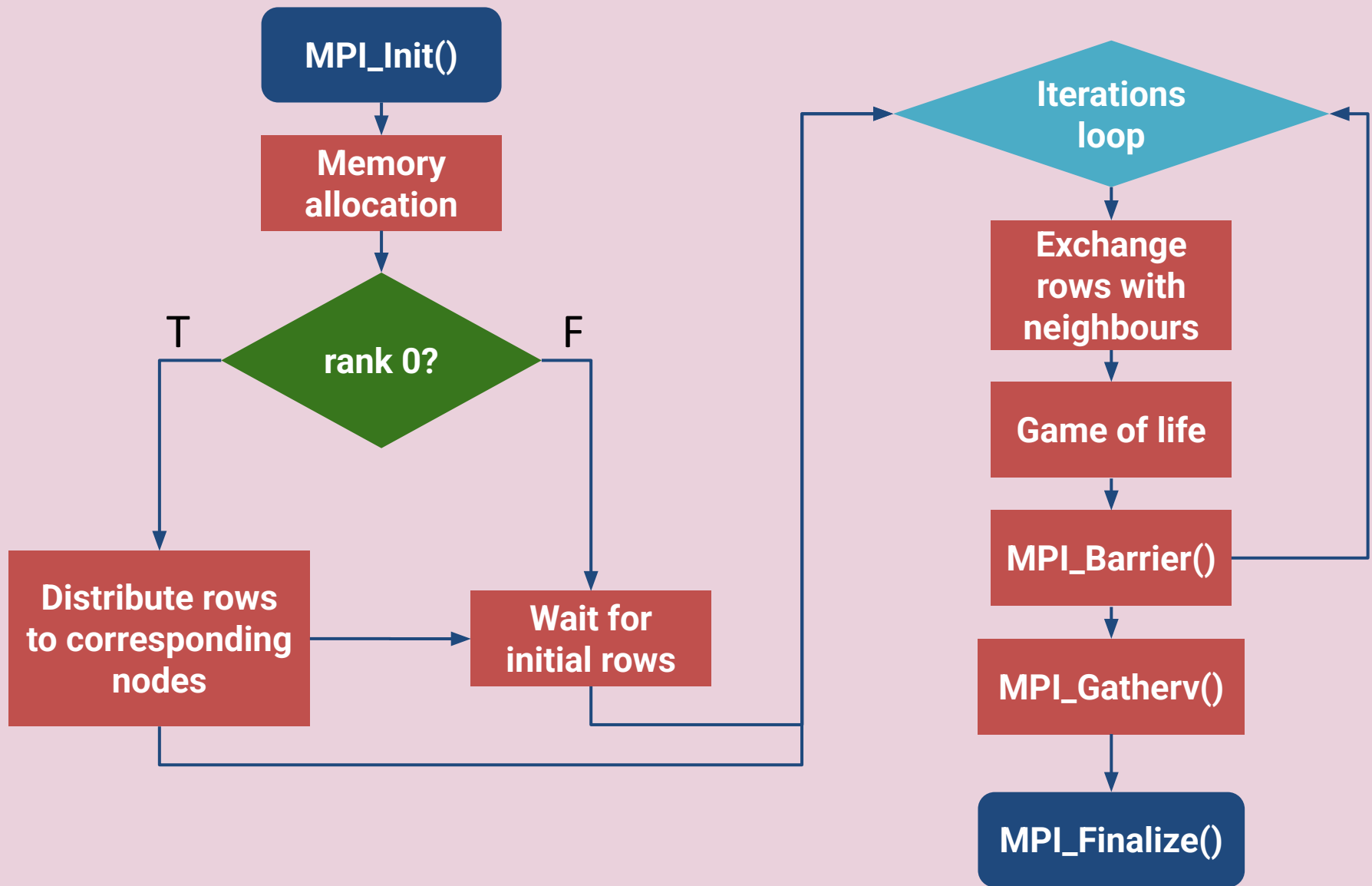
MPI

Why

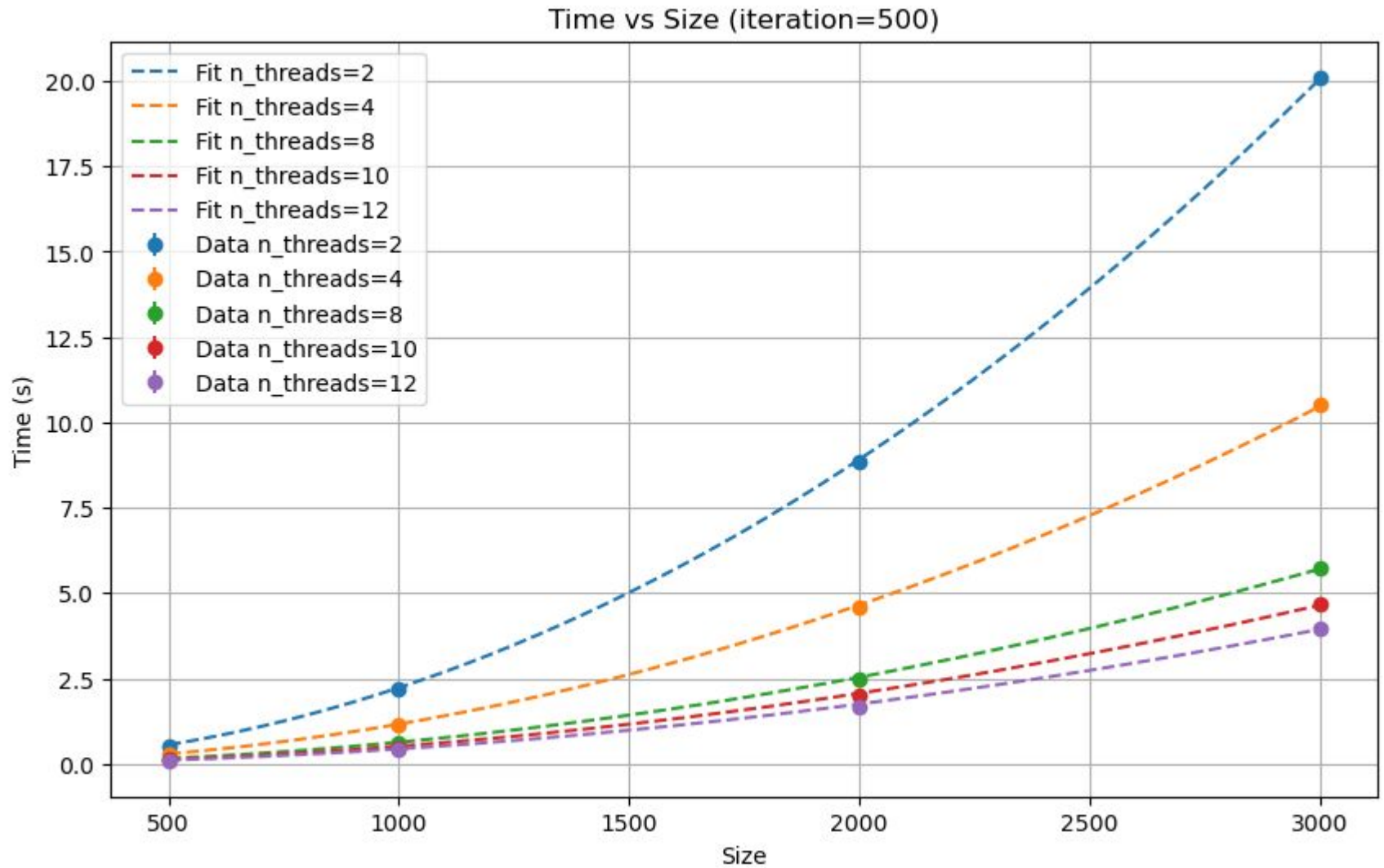
Message Parsing
Interface between
multiple nodes

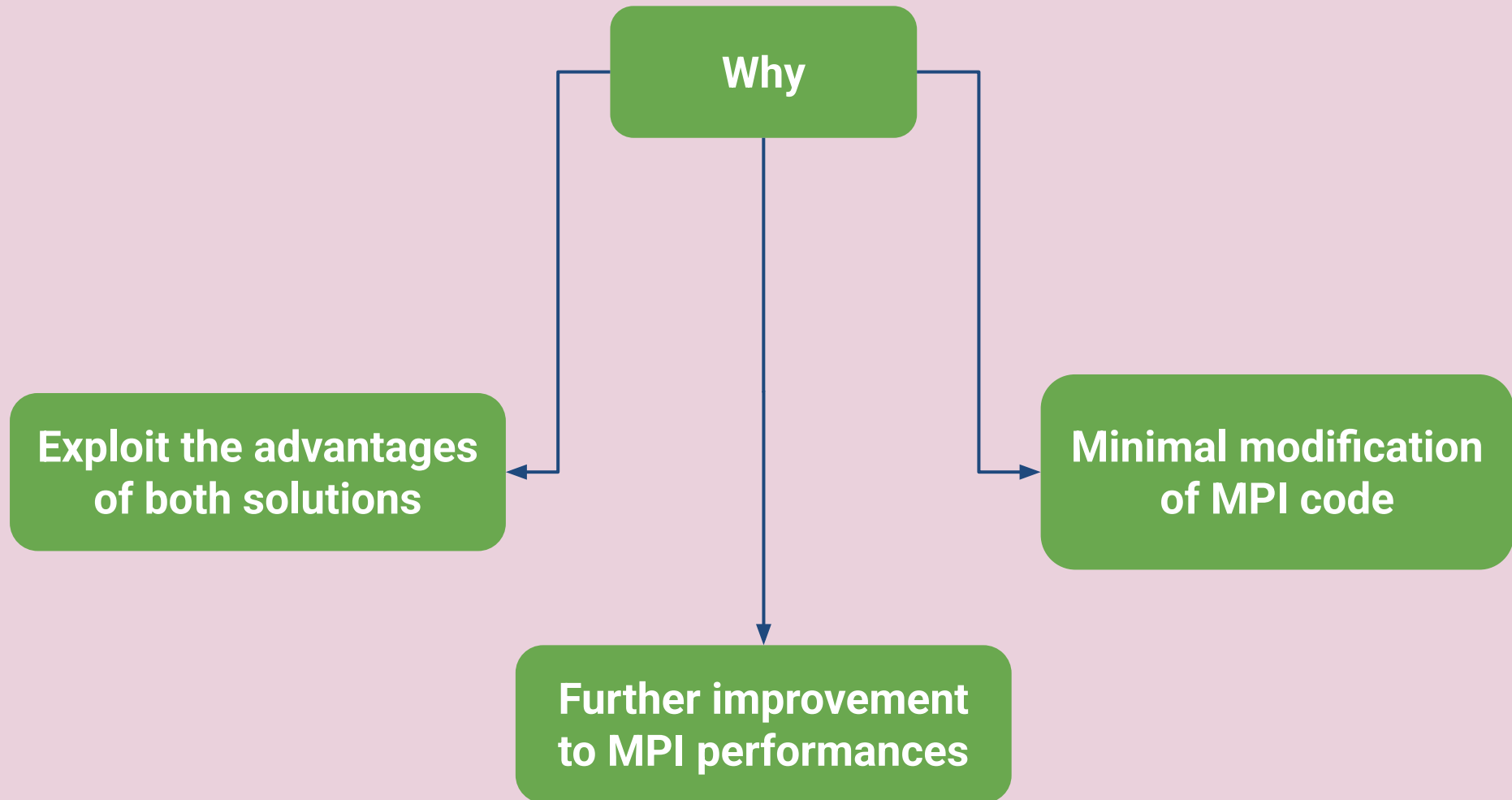
No need for specific
hardware

Minimal
communication
overhead

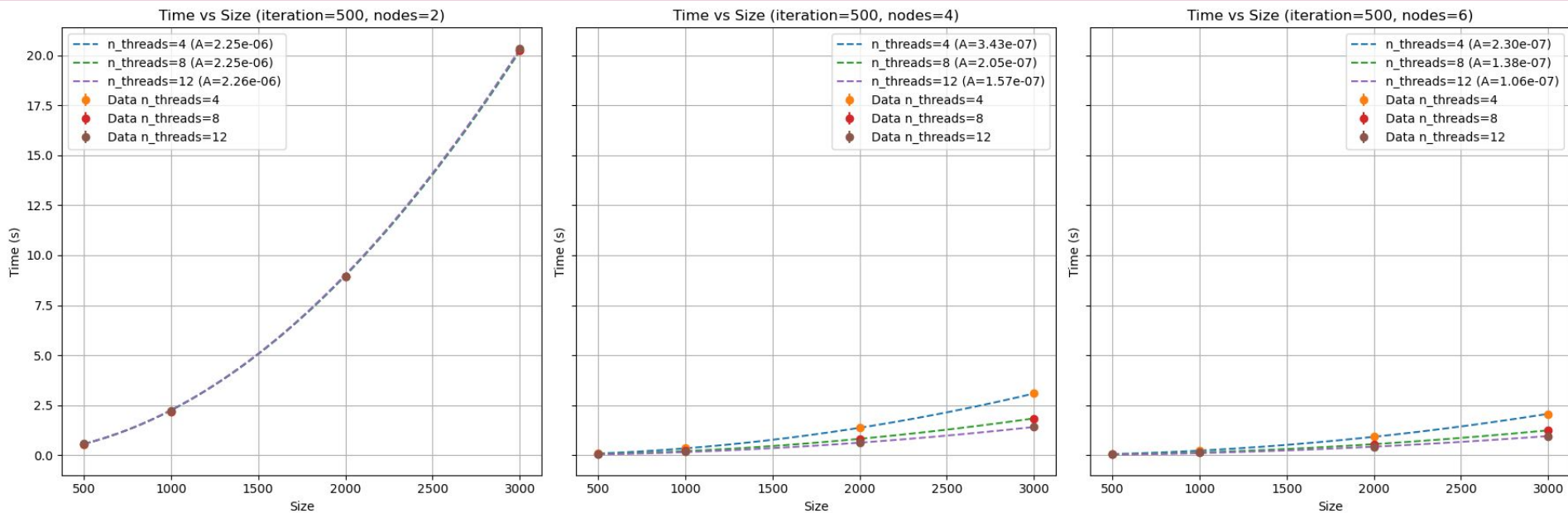


MPI performance



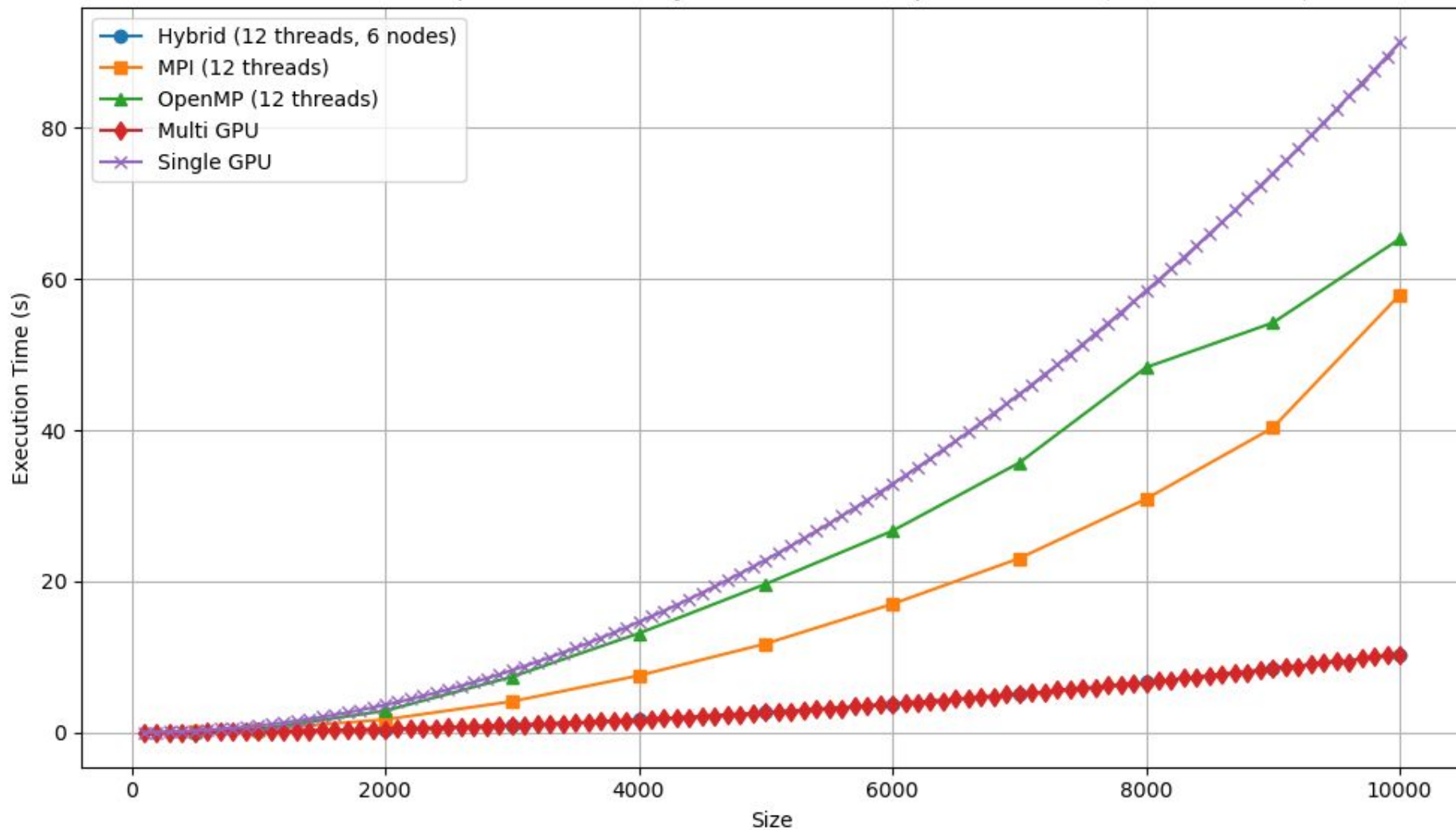


MPI + OMP performance



Overall comparison

Performance Comparison of Conway's Game of Life Implementations (iteration = 500)



Key Achievements

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graph TD; A[Key Achievements] --> B[Successfully mapped Conway's Game of Life to different parallelization strategies]; A --> C[Achieved significant performance improvements through parallelization]; B --> D[Efficient implementation on various architectures]; C --> E[Comparison of performance shows that 2 GPUs and MPI+OMP implementations scales better with increased grid size];
```

**Successfully mapped
Conway's Game of Life
to different
parallelization strategies**

**Efficient
implementation on
various architectures**

**Achieved significant
performance improvements
through parallelization**

**Comparison of performance
shows that 2 GPUs and MPI+OMP
implementations scales better
with increased grid size**

Thank you!