

# Genetic Algorithm Parallelization with CUDA





# Advantages of Parallelization for Genetic Algorithms

- Increased computational efficiency
- Scalability
- Exploration of solution space
- Flexibility and adaptability
- Convergence speedup
- Handling complex problems
- Real-time and interactive applications
- Resource utilization

Parallelization leverages multiple cores or GPUs simultaneously, enabling faster execution and handling of larger populations and more generations, while also maximizing resource utilization and system efficiency. Consider exploring further parallelization techniques for enhanced performance and scalability in optimization and problem-solving tasks.



# Initialization

1

CUDA Setup

Uses CUDA for GPU parallelization.

2

Parallel Initialization

initializePopulation kernel initializes chromosomes in parallel.

# Parallel Fitness Evaluation and Iteration

## Fitness Evaluation

getFitnessValue computes  
chromosome fitness in parallel.  
parallel.

## Parallel Iteration

startIteration kernel generates  
offspring through  
crossover/mutation.

## Control Flow

Threads check indices for  
offspring generation.

# Execution and Performance

1

## Kernel Invocation

`geneticAlgorithm` repeatedly invokes `startIteration` kernel.

2

## Data Movement

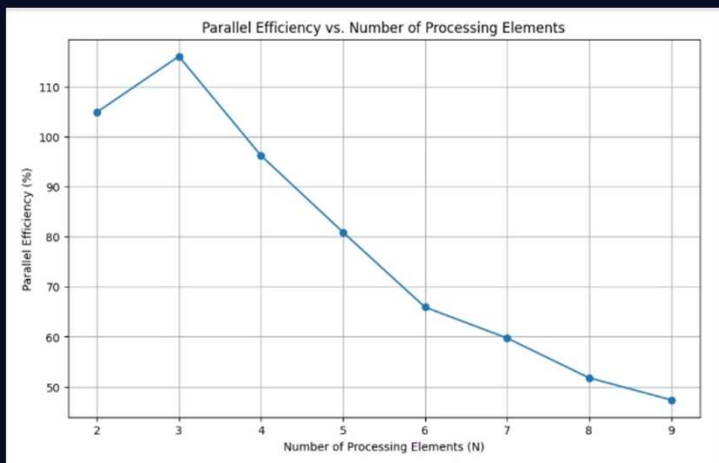
transfers data between CPU/GPU.

3

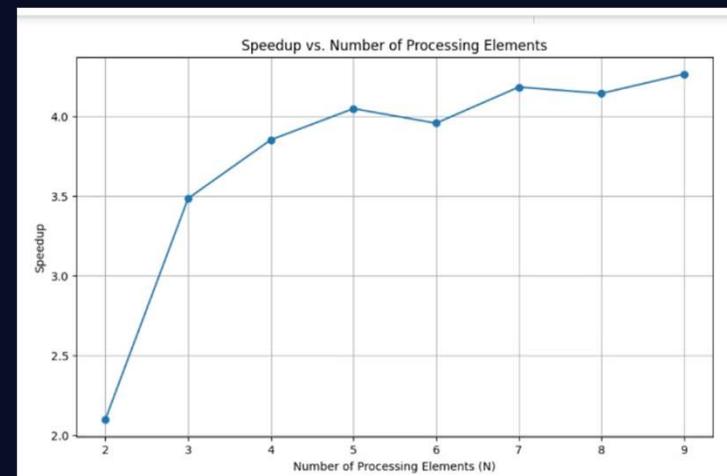
## Execution Time

`clock()` measures parallel execution time.





the total speedup achieved by parallelizing the genetic algorithm is 45.44 times.



The total parallel efficiency is about 22.922%.

# RESULTS

- Significant Speedup: The execution time on the GPU is much faster than on the CPU
- Parallel Efficiency: Higher values of N (threads per block) result in better utilization of the GPU's processing capabilities
- Optimal Configuration: There is an optimal N that maximizes parallel efficiency
- Scalability: The algorithm scales well with increasing N
- Overall Performance: GPU-based implementation consistently outperforms CPU-based implementation

In summary, parallelization accelerates the genetic algorithm, leading to faster convergence and improved resource utilization.