

PARALLEL PROGRAMMING

Assignment 2

PARALLEL SORTING

An iterative version of Merge Sort algorithm is implemented to perform parallel sort on the GPU. Following steps are followed to sort the array.

- Elements are divided and assigned to blocks.
- Sort the elements in each block using Merge Sort.
 - Shared memory is used to perform the Merge Sort.
 - After sorting, the values are copied to global memory.
- Merge the already sorted blocks using the same algorithm, performed on global memory.

RESULTS

Input Size: 2¹²

Time:

Sequential Quick Sort : 1.231 sec

Parallel Sort : 0.571 sec

SPEED UP: 2.155

Input Size: 2¹⁴

Time:

Sequential Quick Sort : 1.244 sec

Parallel Sort : 0.597

SPEED UP: 2.083

Input Size: 2¹⁶

Time:

Sequential Quick Sort : 1.629 sec

Parallel Sort : 0.622

SPEED UP: 2.618

Input Size: 2¹⁸

Time:

Sequential Quick Sort : 2.121 sec

Parallel Sort : 0.701 sec

SPEED UP: 3.025

Input Size: 2^{20}

Time:

Sequential Quick Sort : 2.911 sec

Parallel Sort : 1.324 sec

SPEED UP: 2.19

PS: This is not the most efficient algorithm for parallel sort, but I couldn't get more optimizations working correctly.

OPTIMIZATIONS WITH VECTOR ADDITION

Vector addition performed is $c[i] = a[i] + b[i]$.

Advantage of having all warps fully populated

Observation 1: warps not fully populated

No. of elements = 4000

No. of threads / block = 200

No. of blocks = 20

Time taken for vector addition: 0.312 sec

Observation 2: warps fully populated

No. of elements = 4096

No. of threads / block = 256

No. of blocks = 16

Time taken for vector addition: 0.271 sec

Advantage of coalesced memory access

No. of elements = 4096

No. of threads / block = 256

No. of blocks = 16

Time taken for vector addition (coalesced): 0.271 sec

Time taken for vector addition (non coalesced): 1.184 sec

Note: Non-coalesced access is implemented as follows:

- If there are 32 threads in a block, then thread 1 will add the vector values of index corresponding to thread 32, thread 2 will add the vector values of index corresponding to thread 31 and so on.

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