

CUDA - Parallel Radix Partition (Project 3)

- Radix Partition Implementation in Project 3

The goal in project 3 is to accept 2 arguments, viz. total number of keys and number of partitions to perform parallel radix partition. Here I have implemented the following 3 kernel functions : 1) Kernel for computing histogram 2) Kernel for computing the starting index of every radix partition (Using prefix sum) 3) Kernel for reordering the keys as per the radix partition. Each of the kernel functions have been described below :

1. Histogram

The histogram kernel implemented in this project runs **128** threads on the entire key array in parallel. Every thread accesses individual key element and computes the hash value using the bit field extract function which is a function embeds PTX code of CUDA to extract bit field from any key value k . We use shared memory to implement output privatization and atomic operations to avoid race conditions.

2. Prefix Scan

We need an exclusive prefix sum of the histogram to derive the starting position for reorder of all the elements for radix partition. This part in the project is implemented using a balanced tree approach. Prefix sum on input histogram is calculated using : 1) up sweep (tree is traversed from leaves to root computing the sum of internal nodes) and 2) down sweep (tree is again traversed from root to leaves to compute the scan using the partial sum computed during up sweep).

3. Reorder

The prefix sum gives us the offset index for every radix partition. Using this offset information we can calculate the position of every key in the radix partition. In this project we have run **128** threads on an array of keys and determined their hash values using bfe function. After calculating their hash positions we check for their offset information using the prefix scan output and increment the offset after accessing any offset index for a key.

Output :

1) Keys : 1000 Partition : 32

2) Keys : 100000 Partition : 16

3) Keys : 40 Partition : 8

```
[plohar@c4cuda02 cuda]$ ./proj3 40 8
Histogram Array : 5 5 5 5 5 5 5

Prefix Scan Array : 0 5 10 15 20 25 30 35

Radix Partition Result : 8 32 24 0 16 17 25 33 9 1 26 2 34 18 10 11 19 35 27 3 36 28 20 4 12 37 21 13 5 29 30 6 22 38 14 39 15 23 31 7

***** Total Running Time of Kernel: 0.08755 ms *****
[plohar@c4cuda02 cuda]$
```

Pallavi Lohar - U36047678