GPU Assignment - 2

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Assign consecutive word(4 bytes) from the input file to each thread in the grid. Check for the pattern with offset 0, 1 & 2 on the same thread. 4 bytes word are assigned row wise in the grid [Threads in First row get 4 bytes in sequence].

Naive approach to do pattern matching on GPU would be to directly read 4 bytes from global memory. Which is very costly since we are trying to match word with various offsets, so we also required next 4 bytes. This means that each thread is doing two read operations from global memory.

Since each thread is reading extra 4 bytes, which are also read by next thread in the sequence. So i solved this problem using shared memory.

I created a 1D shared memory in which each thread do at least 1 read operation from global memory and last thread in block does 2 read operations.

```
const dim3 block_size(32, 1);
const dim3 num_blocks(ceil(len/2), 1);
__shared__ unsigned int sm_text[TOTAL+1]; // TOTAL = 32
```

Total is equal to BlockDim.x, last thread does two read operation.

Since the keywords used for pattern matching are used again and again by all threads, I created a 1D Shared Memory Array to store those elements.

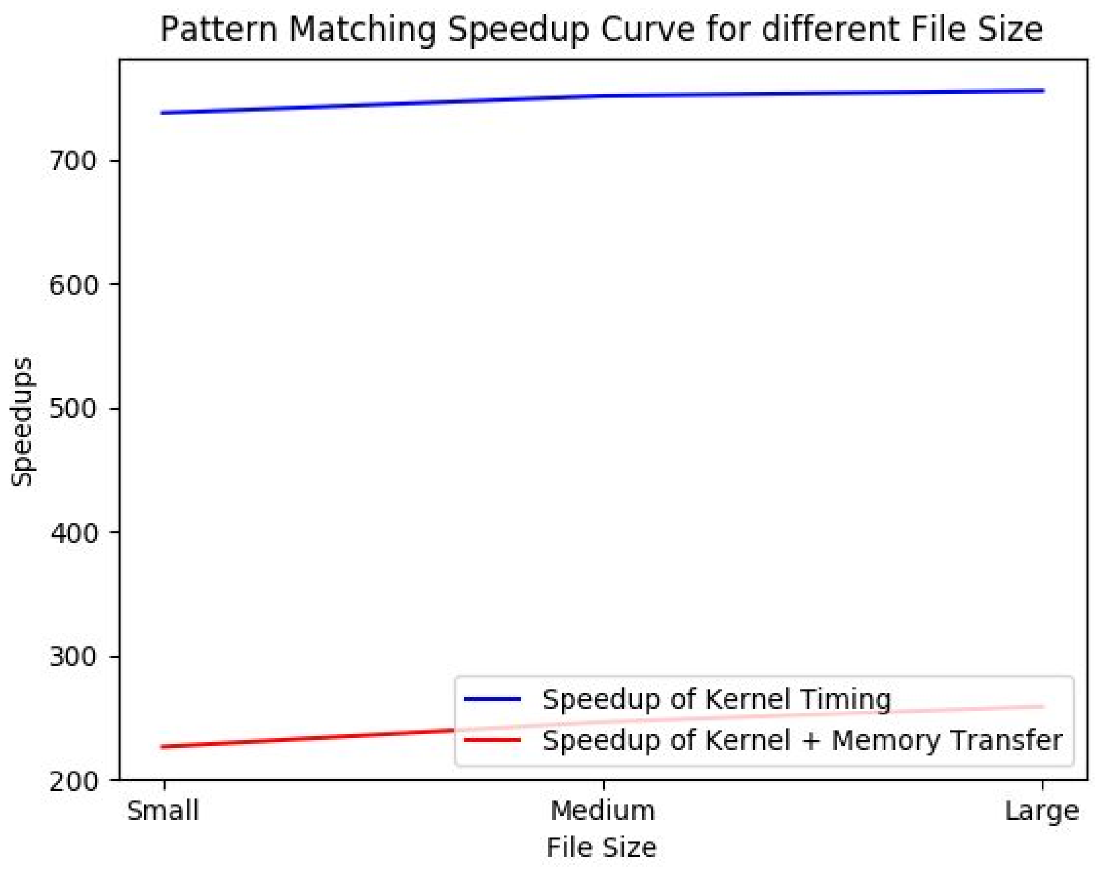
```
__shared__ unsigned int sm_words[MAX_WORDS];
```

To increase the frequency of each word match, I'm doing atomic add to increment frequency for each keyword in global memory. Initially i was trying to do frequency increment in shared memory then in the end of each thread, transferring data from shared memory to global memory.

Note:-

Its mentioned on many of the blogs that atomicAdd is slower for shared memory as compared to global memory. I also noticed that no of atomic add for a word doesn't affect total time taken by the kernel.

Timings\File Size	**Small**	**Medium**	**Large**
CPU Time	0.452815s	1.14571s	2.27357s
GPU Kernel Time	0.613728ms	1.52448ms	3.00848ms
GPU Kernel + Memory Transfer	1.99693ms	4.64781ms	8.76992ms
Speedup	737.811	751.542	755.719
Speedup with memory Transfer	226.756	246.506	259.246


Pattern Matching Speedup Curve for different File Size
Speedups
Small
Medium
Large
File Size
Speedup of Kernel Timing
Speedup of Kernel + Memory Transfer