# CSCD 439/539 GPU Computing HW4
## Modify Reduction

No Late Submissions are accepted. **Rules:** Your code must CUDA C Language. If your program shows a compilation or run-time error, you get a zero for this assignment.

**Submission:** Wrap up all your **source files** into a single zip file. Name your zip file as *FirstInitialYourLastName*Hw4.zip. For example, if your legal name is Will Smith, you should name your zip file as wsmithHw4.zip. A simple makefile has been provided in the zip file.

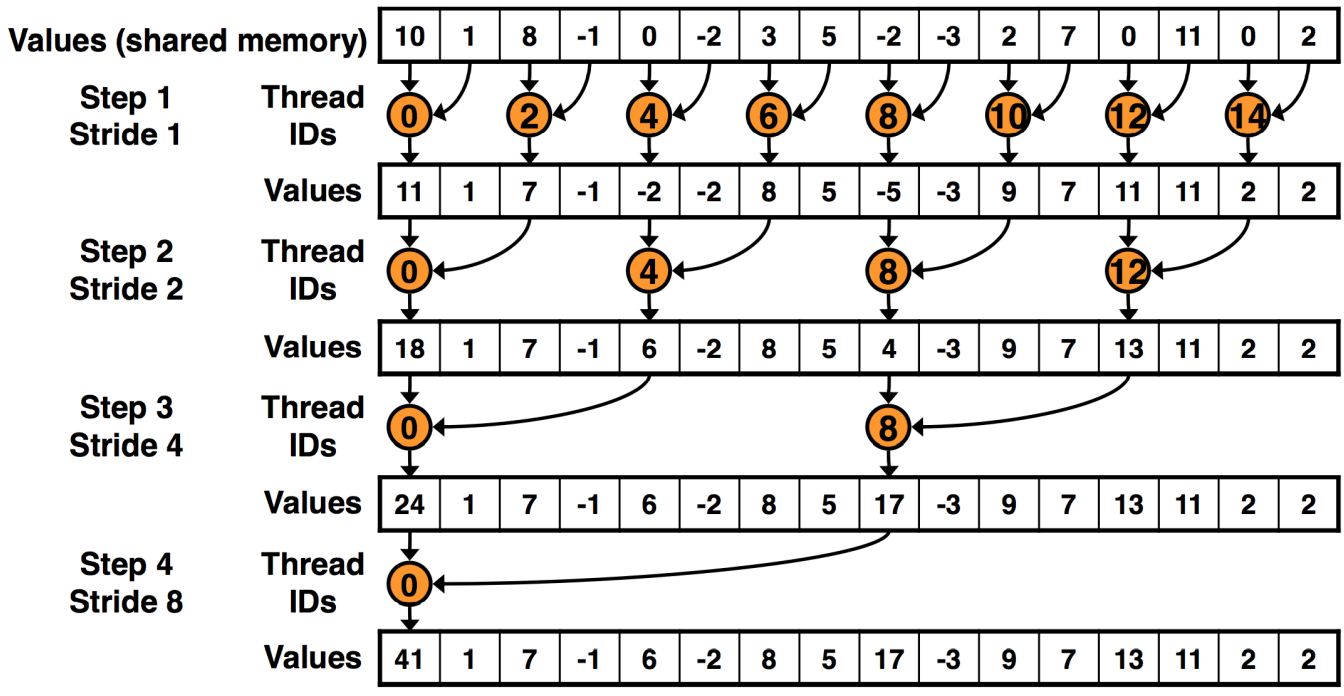
**For archive purpose, please also submit your single zip file on EWU Canvas by following CSCD439-01 Course → Assignments → Hw4 → Submit Assignment to upload your single zip file.**

**Problem Description:**

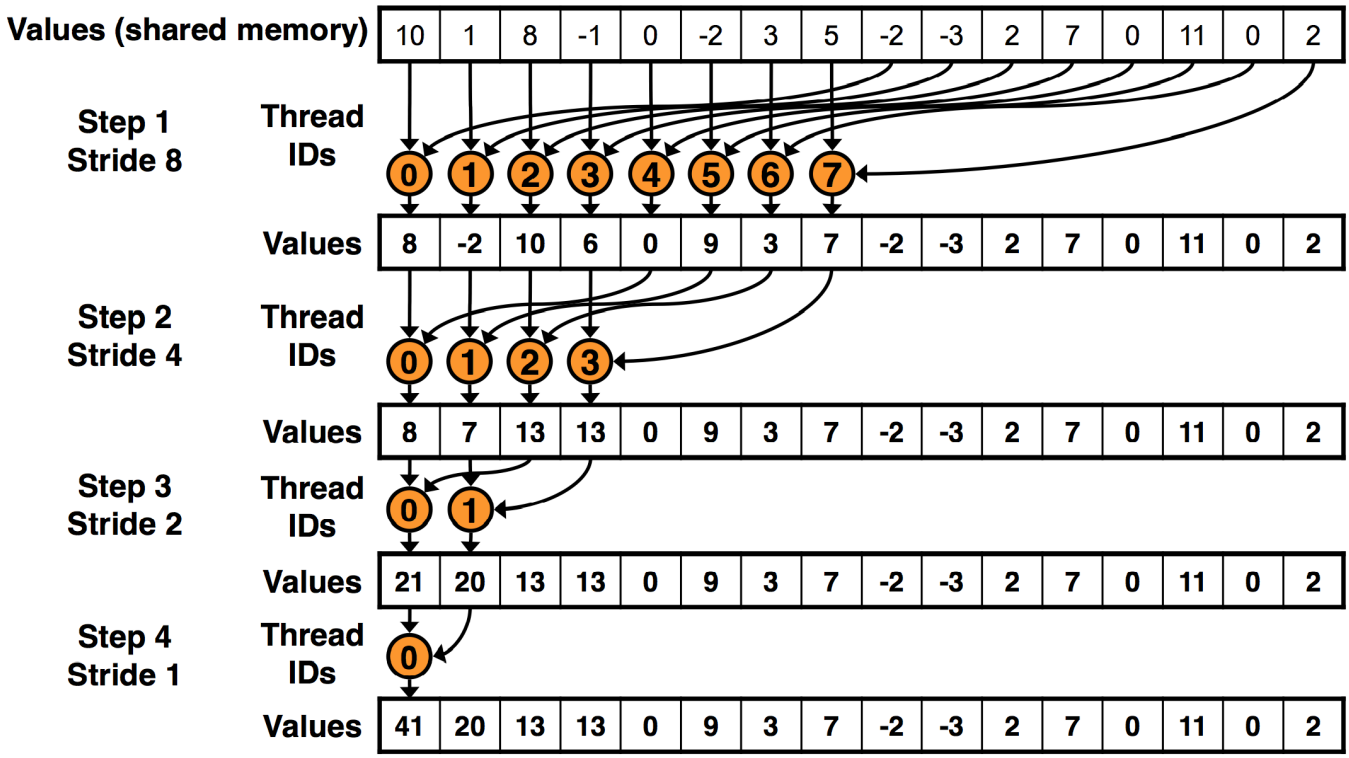
Based on the lecture about reduction algorithm on CUDA device, you are required to implement the following features and answer the questions.

1, Download the demo code d10_reduce.zip on canvas under Files→DemoCode. Read and understand the provide CUDA C program. We have already gone through this code in class.

2, The provided kernel in the demo code, __global__ void reduce2(float *in, float *out, int n), is not optimized. The following diagram illustrates reduce2() kernel.




3, You have to write another kernel reduce3(), that also performs reduction on CUDA device. Kernel reduce3() accepts the same set of parameters list as reduce2() kernel has, with each parameter maintaining the same meaning. But reduce3() kernel uses the following threads-data mapping and data access patterns.




In this design, the size of thread block (in shape of 1 * N) could be half of that in kernel reduce2(), while they are able to perform the same task. The major difference between reduce2() and reduce3() kernel lies in the way regarding which pair of data elements are processed by a thread.

3, Change the main() function to invoke the kernel **reduce3()** you implemented, and measure the kernel execution time. Then you have to compare the kernel reduce3() with the reduce2() by filling out the following table. **If the number of blocks you created exceeds the maximum allowed limits, please use 2D grid to create more threads. We discussed this idea in class**. In these cases, you have to modify main().

| Input size | 1048576 | 16777216 | 67108864 | 134217728 |
|---|---|---|---|---|
| Block Dimensions | 1 X 1024 | 1 X 1024 | 1 X 1024 | 1 X 1024 |
| T1:time cost for reduce2 (ms) | | | | |
| T2:time cost for reduce3 (ms) | | | | |
| Speedup = T1 / T2 | | | | |

4, Do you identify any advantage of reduce3() over reduce2() kernel? Or vice versus? And why ? ( hint: in terms of performance, such as bank conflicts or condition divergence )

5, What are disadvantage(s) of reduce2()? And any disadvantages for reduce3()? And Why? ( hint: in terms of performance, such as bank conflicts or condition divergence )