

Assignment 4

Q1

```
Iterative sum result: 0
Direct formula sum result: 0
Expected sum: 524800
```

Q2 a.

```
Unsorted Array:
2666 9110 6044 3902 2631 6012 4546 8810 1587 1976 8189 1797 607 1239 7079 3835 5077 8543 3495 1325
4274 5872 6728 7114 5626 9614 4707 692 1253 8606 8217 3920 7717 613 4174 6700 2978 8720 5511 917
7048 52 2714 7656 7643 9793 7843 2720 4689 7690 397 5315 9914 7125 2429 5540 6739 3489 6232 4345
2095 802 4617 6164 1415 8791 2865 4393 3863 4728 5310 911 4780 4376 4919 2423 522 9114 5143 5211
6804 1892 6878 6718 9018 5659 8611 2109 9148 1195 2806 7596 1997 7423 3760 9765 6214 2977 510 6429

Sorted Array using Pipelined Merge Sort:
52 397 510 522 607 613 692 802 911 917 1195 1239 1253 1325 1415 1587 1797 1892 1976 1997
2095 2109 2423 2429 2631 2666 2714 2720 2806 2865 2977 2978 3489 3495 3760 3835 3863 3902 3920 4174
4274 4345 4376 4393 4546 4617 4689 4707 4728 4780 4919 5077 5143 5211 5310 5315 5511 5540 5626 5659
5872 6012 6044 6164 6214 6232 6429 6700 6718 6728 6739 6804 6878 7048 7079 7114 7125 7423 7596 7643
7656 7690 7717 7843 8189 8217 8543 8606 8611 8720 8791 8810 9018 9110 9114 9148 9614 9765 9793 9914

Pipelined Merge Sort Time: 0.007719 seconds

Sorted Array using CUDA Merge Sort:
2666 9110 6044 3902 2631 6012 4546 8810 1587 1976 8189 1797 607 1239 7079 3835 5077 8543 3495 1325
4274 5872 6728 7114 5626 9614 4707 692 1253 8606 8217 3920 7717 613 4174 6700 2978 8720 5511 917
7048 52 2714 7656 7643 9793 7843 2720 4689 7690 397 5315 9914 7125 2429 5540 6739 3489 6232 4345
2095 802 4617 6164 1415 8791 2865 4393 3863 4728 5310 911 4780 4376 4919 2423 522 9114 5143 5211
6804 1892 6878 6718 9018 5659 8611 2109 9148 1195 2806 7596 1997 7423 3760 9765 6214 2977 510 6429

CUDA Merge Sort Time: 0.514357 seconds
```

Q2 b.

```
Unsorted Array:
9151 1886 5447 9098 389 1745 9130 6275 2632 6510 7577 2777 5044 6636 6277 8382 6485 2687 6629 5756
3385 6655 4399 5777 3712 6654 2647 8083 2397 1672 2320 7901 9911 4119 6999 300 5865 2481 2927 4849
8992 504 3978 4036 3493 256 8770 9978 2943 1751 2087 2680 8407 6486 8458 8471 9493 7457 2906 1890
5481 5227 9791 5392 9346 3143 2044 5211 5624 4971 60 968 1828 4039 5004 5321 647 126 1651 3590
1878 90 2622 6637 6577 7432 5108 2422 4889 4366 4312 6723 9593 456 8467 8940 3599 6864 503 5575

Sorted Array using Pipelined Merge Sort:
60 90 126 256 300 389 456 503 504 647 968 1651 1672 1745 1751 1828 1878 1886 1890 2044
2087 2320 2397 2422 2481 2622 2632 2647 2680 2687 2777 2906 2927 2943 3143 3385 3493 3590 3599 3712
3978 4036 4039 4119 4312 4366 4399 4849 4889 4971 5004 5044 5108 5211 5227 5321 5392 5447 5481 5575
5624 5756 5777 5865 6275 6277 6485 6486 6510 6577 6629 6636 6637 6654 6655 6723 6864 6999 7432 7457
7577 7901 8083 8382 8407 8458 8467 8471 8770 8940 8992 9098 9130 9151 9346 9493 9593 9791 9911 9978

Pipelined Merge Sort Time: 0.001275 seconds

Sorted Array using CUDA Merge Sort:
9151 1886 5447 9098 389 1745 9130 6275 2632 6510 7577 2777 5044 6636 6277 8382 6485 2687 6629 5756
3385 6655 4399 5777 3712 6654 2647 8083 2397 1672 2320 7901 9911 4119 6999 300 5865 2481 2927 4849
8992 504 3978 4036 3493 256 8770 9978 2943 1751 2087 2680 8407 6486 8458 8471 9493 7457 2906 1890
5481 5227 9791 5392 9346 3143 2044 5211 5624 4971 60 968 1828 4039 5004 5321 647 126 1651 3590
1878 90 2622 6637 6577 7432 5108 2422 4889 4366 4312 6723 9593 456 8467 8940 3599 6864 503 5575

CUDA Merge Sort Time: 0.211816 seconds
```

Q2 c.



Assignment-5

```
!nvcc -arch=sm_75 -o assignment5 assignment5.cu  
!./assignment5
```

```
⇒ CUDA kernel launch with 4 blocks of 256 threads  
Kernel execution time: 0.0449 ms  
0.84 + 0.39 = 1.23  
0.78 + 0.80 = 1.58  
0.91 + 0.20 = 1.11  
0.34 + 0.77 = 1.10  
0.28 + 0.55 = 0.83
```

Device Properties:

```
Device name: Tesla T4  
Memory Clock Rate (kHz): 5001000  
Memory Bus Width (bits): 256  
Theoretical Bandwidth: 320.06 GB/s
```

Bandwidth Measurements:

```
Data Read: 0.01 MB  
Data Written: 0.00 MB  
Total Data: 0.01 MB  
Measured Bandwidth: 0.27 GB/s  
Bandwidth Utilization: 0.08%
```