CS 4370 - Parallel Programming

Bella Brickler, Jahcorian Ivery, Renee Paxson

Professor Meilin Liu

18 October 2024

Project 2: Tiled Matrix Multiplication - Project Report

Report

For this lab, we were able to get our code fully functional and working. We executed the code using the command, nvcc Project2.cu && ./a.out. The program does both cpu multiplication and gpu tiled matrix multiplication correctly. For runtimes for the configurations and the performance differentials are listed in the table below.

Runtime Table

Time	128 * 128	1024 * 1024	4096 * 4096
CPU Comp Time (s)	0.011143	5.552852	1196.504552
GPU Comp Time (ms)	0.075584 (Tile width of 8) / 0.06752 (Tile width of 16)	6.23139 (Tile width of 8) / 5.28634 (Tile width of 16)	388.023 (Tile width of 8) / 286.391 (Tile width of 16) / 203.53 (Tile width of 32)
Speedup	-85% / -84%	-10% / 5%	208% / 318%

Execution Results

8*8 matrix with a tile width of 4:

```
Array size: 64
Thread block size: 4
Number of thread blocks: 4
Clocks per second: 1000000
Number of clock ticks: 4
CPU execution time in seconds: 0.000004
Matrix A:
4682 3173
           -845 5006 -42 4582 5217
-75 -248 3026 5043 4182 287
                              3886
5481 3355 4347 4778 1735
                              763 3855
                                          680
47 928 1793 5082 1550 -698 -882 782
4253
     -640 3437
                 5030
                      2875
                             4984 3291
                                         937
           2466
                 4694
                        1355
                             -644 4043
3706
      318
            3753
                              -716 1845
3196
      5500
                 3027
                        1615
                                         3757
2421
     1682
            5516
                 1329
                        3295
                              331
                                   3773 -3
Matrix B:
160 157
          155
               233
                     205
                         60
                              193
     250
          10
              19 162 32 117
         76
206
    88
                      6
                         86
    171
         32
              58
                  40
                           118
                                25
233
     109
          170
                   110
                                  190
188
     63
         203
               172
                         105
     225
          235
                         33 84
                                  239
180
               11
                    105
158
          241
                70
                                244
CPU Output:
3.76397e+06
            4.46158e+06
                        3.97437e+06 2.56486e+06 2.57991e+06 1.58361e+06 2.35164e+06 3.16148e+06
2.39647e+06 2.27586e+06 1.88132e+06
                                    350839 1.7019e+06 1.24745e+06 1.24225e+06 2.20488e+06
3.904e+06 4.12036e+06 2.88602e+06 1.87133e+06 3.52422e+06 1.33108e+06 2.77374e+06
                                                           574385
949742 1.32722e+06 418455 266586 799454 586542 821707
3.842e+06 3.19931e+06 3.57469e+06 2.264e+06 2.90922e+06 1.82161e+06 2.0989e+06 3.25295e+06
3.06403e+06 3.55146e+06 3.16104e+06 1.44337e+06 2.20456e+06 1.21562e+06 1.8956e+06 2.89626e+06
3.52803e+06 3.91691e+06 2.40069e+06 1.21332e+06 2.91952e+06 1.15666e+06 2.13257e+06 2.33207e+06
3.37874e+06 2.74168e+06 2.36709e+06 818708 2.85336e+06 1.15424e+06 1.69886e+06 2.59662e+06
GPU Execution Time in seconds: 0.027648
GPU Output:
3.76397e+06
            4.46158e+06
                        3.97437e+06
                                    2.56486e+06 2.57991e+06 1.58361e+06 2.35164e+06
                                                                                      3.16148e+06
2.39647e+06 2.27586e+06 1.88132e+06
                                    350839 1.7019e+06 1.24745e+06 1.24225e+06 2.20488e+06
3.904e+06 4.12036e+06 2.88602e+06 1.87133e+06 3.52422e+06
                                                           1.33108e+06 2.77374e+06 2.52181e+06
949742 1.32722e+06 418455 266586 799454 586542 821707
                                                            574385
3.842e+06 3.19931e+06 3.57469e+06 2.264e+06 2.90922e+06 1.82161e+06 2.0989e+06 3.25295e+06
3.06403e+06 3.55146e+06 3.16104e+06 1.44337e+06 2.20456e+06 1.21562e+06 1.8956e+06 2.89626e+06
3.52803e+06 3.91691e+06 2.40069e+06 1.21332e+06 2.91952e+06
                                                            1.15666e+06
                                                                         2.13257e+06
                                                                                     2.33207e+06
                                    818708 2.85336e+06 1.15424e+06 1.69886e+06 2.59662e+06
3.37874e+06
           2.74168e+06 2.36709e+06
TEST PASSED
```

128*128 matrix with a tile width of 8:

```
Array size: 16384

Thread block size: 8

Number of the trivaci blocks: 1256

Clacks per second: 180808

Number of the trivaci blocks: 1256

Clacks per second: 180808

Number of the trivaci blocks: 1253

Clacks per second: 180808

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Clacks per second: 180808

Number of the trivaci blocks: 1253

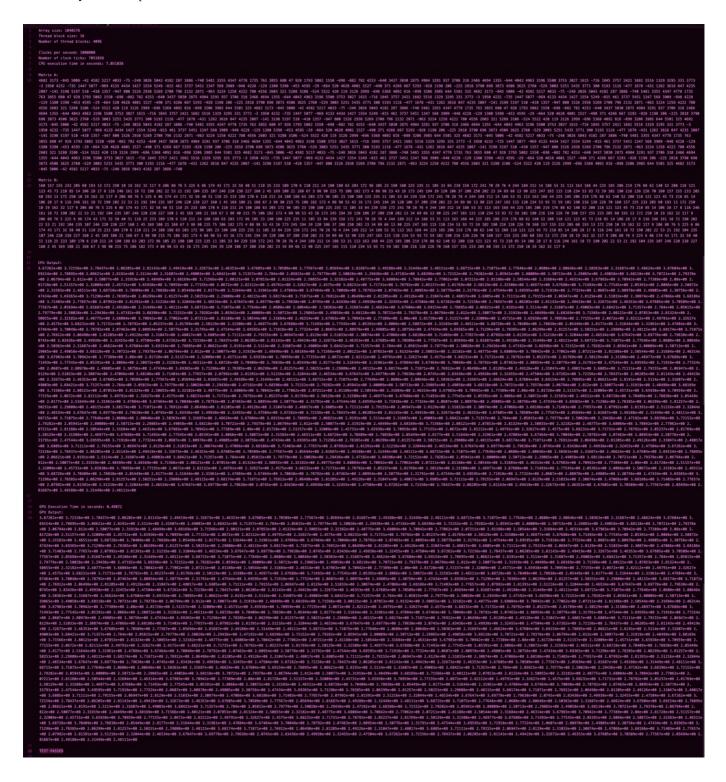
Clacks per second: 180808

Number of the trivaci blocks: 1253

Number of the trivacion: 1253

Number of the trivaci
```

1024*1024 matrix with a tile width of 16:



4096*4096 matrix with a tile width of 32 (had to zoom out a lot to capture a screenshot, but TEST PASSED can still be seen at the bottom of the image, and a textfile version of this output can be found in the output-files folder):

N 600 Aug 1677216
Proof blot side: 2
Newton of North Shothas 1884
Choix ser second: 199909
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563 330 563 3994 3-44 4233 -339 3319 507 543 3995 3-44 4233 -439 335 573 3-40 335 57
333, 2999 -499 3348 4892 555 -898 3288 4992 555 -898 3288 4992 555 -898 3288 4992 555 -898 3288 4992 555 -898 3288 3783 3997 565 -776 201 365 3375 3997 567 377 227 327 327 327 327 327 327 327 32
275 540 997 349 4311 443 302 1554 539 815 64 3777 561 339 430 32 1554 539 81 540 1707 561 1307 597 599 440 302 379 580 430 1707 561 1307 597 599 440 302 379 580 590 590 590 590 590 590 590 590 590 59
125 027 796 055 300 125 300 105 500 125 300 105 500 105 500 500 500 500 500 500 5
155 260 500 515 135 135 135 135 135 135 135 135 135
-947 898 1555 2931 5349 2788 788 2512 2931 5349 2788 788 2512 2971 -945 3224 2578 892 2778 885 2788 278 2788 2512 2971 -945 3224 278 892 278 2788 2512 4813 251 482 278 2888 -298 4513 3355 488 47 278 2795 788 2512 4813 251 482 287 287 288 278 288 278 288 278 288 278 288 28
1355 -444 440 4951 3196 5989 3753 3827 3155 -716 3865 3379 3207 3155 -716 3865 3379 3487 3497 3498 3327 3355 -716 3865 3379 3495 3379 3495 3379 3495 3379 3495 3379 3495 3379 3495 3379 3495 3379 3495 3379 3495 3379 3495 3379 3495 3379 3495 3379 3495 3379 3495 3379 3495 3479 3479 3479 3479 3479 3479 3479 3479
-01 130 303 407 420 3097 3-01 1309 5197 519 -409 1357 519 -409 1357 519 -409 1357 519 -500 1309 5309 5309 5309 5309 5309 5309 5309 5
4251 - 5448 - 3467 - 5497 - 34275 - 5498 - 3257 - 5498 - 32
2764 - 527 3089 5351 5475 3277 3089 5351 5475 3277 3089 5351 5475 3277 3089 5351 5475 3277 3089 5362 327 3482 327 3485 3277 4801 - 57 - 5485 3008 5482 327 4802 327 4803 327 4
1715 783 385 589 47 928 1793 580 3358 -469 -982 3358 -469 -982 3358 -469 -982 3358 -469 347 528 3358 -469 347 528 3358 -469 347 527 -469 331 453 546 349 -415 463 377 548 349 -488 347 548 349 -488 348 347 548 349 -488 348 348 348 348 348 348 348 348 348
647 5293 -928 1398 246 -225 2838 3708 -525 2508 3708
-75 -248 3935 5941 4332 287 3988 -748 5483 3355 6347 4778 1725 763 3955 6347 4778 1725 763 3955 6347 4778 1725 763 3955 6348 4779 1725 763 3955 763
5398 -453 -559 -29 -464 528 4029 4883 3527 -469 278 4029 4883 3527 -469 277, 4364 567 529 -292 2878 3264 522 2878 -559 288 322 2878 -559 2788 786 202 2878 -759 288 328 288 328 288 328 288 328 288 328 288 328 288 328 288 328 288 328 288 328 32
2985 644 5595 325 4662 3273 -845 5895 -325 4662 3273 -845 5896 -32 5595 327 4603 -75 -246 3005 5891 3275 -446 5005 3295 5891 327 403 -75 -246 3005 5891 327 403 -75 -246 3005 5891 327 403 -75 -246 3005 5891 327 327 403 327 328 469 327 327 403 327 328 469 327 328 469 327 328 469 327 328 469 327 328 469 327 328 469 327 328 469 328 328 328 328 328 328 328 328 328 328
5249 -815 461 3737 5451 1347 546 3999 -846 4226 -129 1386 5398 -653 6576 -225 2818 3796 699 3873 4586 3425 -8125 2818 3796 699 3873 4586 3425 2818 3796 3425 281
-534 5572 478 139 139 139 139 139 139 139 2999 -696 5368 4892 815 -898 5482 537 489 139 139 5462 5375 -648 5481 335 4484 6493 815 -898 375 382 537 483 375 7481 7478 7718 7718 783 5485 -898 5481 3355 484 4843 693 3186 5486 4892 815 -898 375 382 537 483 375 7481 7482 5375 488 375 382 537 483 375 7481 7482 5375 488 375 382 5375 488 375 488 375 382 5375 488 375 387
3771 -1 3998 4332 -735 3447 5977 -949 4333 4433 377 5451 3399 -949 4333 4433 3427 3554 5299 -815 461 3777 5451 3399 -949 4333 4433 3427 3554 5299 -815 461 3777 5451 3399 -949 374 3599 374 4333 4399 -949 374 529 379 374 3478 539 379 374 3478 539 379 374 3478 5478 3499 -940 374 548 3427 3554 529 4878 3478 3478 3478 3478 3478 3478 3478
2132 2873 -963 3224 1258 4222 788 4556 2883 327 5482 278 4556 2883 327 5482 327 4855 5482 327 4853 -748 5482 327 4853 -748 5482 327 4853 -748 5482 327 4853 -758 5482 327 4853 -758 5482 327 4853 -758 5482 327 4853 -758 5482 327 4853 -758 5482 327 4853 -758 5482 327 4853 -758 5482 327 4853 -758 5482 327 4853 -758 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 327 3482 328 5482 3
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5197 518 -419 1357 -947 680 5156 2918 5169 2768 796 2132 2917 -963 3256 2918 5169 2708 796 2132 2917 -963 3255 400 312 5218 3316 -524 5122 297 4053 -795 -240 3255 400 3297 4078 1715 743 3055 600 47 928 1703 500 2550 -600 -802 702 4253 -640 307 5930 2075 4004 3291 937
3706 328 2464 4494 1355 -444 4404 4963 3316 5500 3793 2467 1505 -726 1865 3797 2463 1862 5705 1377 2463 1862 5705 1377 2463 1877 5663 1377 2463 1877 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 1377 5705 137
1116 -477 3578 -481 1262 3616 647 4235 2867 -143 3109 5197 510 -418 2357 -947 680 1526 2938 7 -143 3109 5197 510 -418 2357 -947 680 1526 2938 7 -143 3109 5197 510 -418 2357 -947 680 1526 2938 5497 4778 1793 793 3855 680 47 828 7793 5802 1550
-698 -812 702 4253 -648 3477 5878 2975 7678 4253 7578 5878 2975 7678 4384 2975 5878 4257 -735 5878 4259 -815 577 -858 4239 -858 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -858 577 -858 4239 -815 577 -858 4239 -858 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815 577 -858 4239 -815
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-409 371 4266 67 5299 -938 1288 286 -5229 -938 1288 286 -525 2888 3706 688 3673 4586 3675 2708 -520 3883 5276 438 5286 4375 2708 -520 3885 5278 3878 5388 4892 816 -638 3208 5387 5388 4892 816 -638 3208 5387 5388 4892 816 -638 3208 5387 5388 4892 816 -638 3208 5387 5388 5388 5388 5388 5388 5388 538
4592 5217 483) -75 -748 1826 5850 5182 287 3886 -740 5841 2375 5860 5182 287 3886 -740 5841 2375 5860 47 928 1793 5862 479 28 1793 5862 479 28 1793 5862 479 28 1793 5862 479 28 1793 5862 479 4894 2291 977 3796 318 2869 -7408
4128 -129 1300 5390 -453 4595 -29 -464 520 4635 4895 -29 -464 520 4635 4802 1357 -400 371 4366 667 5293 -428 1397 540 655 271 300 5321 1398 549 745 5495 -29 -464 520 4802 1357 540 -410 1357 -407 000 1252 299 520 2700 746 5212 277 -463 272 740 4556 5771 300 5321 1398 549 749 540 520 740 740 740 740 740 740 740 740 740 74
815 -090 2395 5464 5581 325 4662 3137 -005 5462 3137 -005 5806 -02 4512 5217 4033 -75 -243 5022 5217 4033 -75 -243 5022 5217 4033 -75 -243 5022 5218 5034 5212 5218 5034 5212 5218 5034 5212 5218 5218 5218 5218 5218 5218 5218
4434 1227 1554 1240 -115 1561 1240 -115 1561 1240 1365 1461 1377 5461 1370 546 1309 -488 1228 -120 1380 5309 -413 1385 -29 -464 128 1287 -480 132 128 129 120 128 129 140 128 129 129 140 128 129 129 129 129 129 129 129 129 129 129
323 5288 5386 -524 525 22 428 139 3126 -924 525 22 428 139 3126 -989 5286 4902 816 -989 5286 4902 816 -989 5286 4902 816 -989 5386 5886 47 828 139 5484 5291 97 3786 528 486 498 328 588 588 588 588 588 588 588 588 588 5
1329 3215 331 3773 -3 1984 4212 -735 1447 5077 -00 4133 4634 1427 1554 5200 -815 461 3777 506 13000 -904 4228 -728 2007 -141 3207 5207 510 -418 1327 507 1300 4331 4334 507 1300 5251 5415 3771 300 5130 5270 500 -525 3000 5251 5415 3771 300 5270 510 -418 1327 500 510 510 510 510 510 510 510 510 510

