**Question 2: Thread Performance**

The Table and Graph are as below:

Table 1: Number of threads and Time to Execute.

|  |  |
| --- | --- |
| Number of Threads | Time (s) |
| 1 (Original) | 8.730 |
| 1 | 8.712 |
| 2 | 4.445 |
| 3 | 3.083 |
| 4 | 2.23 |
| 6 | 1.503 |
| 8 | 1.156 |
| 12 | 1.319 |
| 16 | 1.393 |
| 24 | 1.295 |
| 32 | 1.321 |

Figure 1: Bar Graph of the Speed Up by Threads.

1. N-times speedup:
   1. Based off the results above, we do see an N-times speed up, until we hit 8 threads, after which we no longer see any speedup. Instead, it continues to take roughly the same amount of time as with 8 threads.
2. Why no more speedup?
   1. Based off discussion in class, the most likely reason for a lack of speed up after 8 threads is because the system this program is being run on (the CPSC servers) only lets us use 8 cores/cpus (or the system itself only has 8 cores/cpus). After 8 threads, it is being forced to simulate multithreading, which doesn’t actually provide any speedup, since we still only have 8 cores running at full throttle.

For raw data, see the Appendix.

**Appendix:**

Question 2:

The raw timing results are as follows: (note: I had my debug printing off. This has since been turned off, with no significant differences).

john.ngo@csx:~/457/A2/subset-sum-master$ time ./subsetOrig 3 < test3.txt

Sorry, I don't know how to use multiple threads yet.

Using 1 thread(s) on 27 numbers.

134217728

Subsets found: 557424

real 0m8.730s

user 0m8.661s

sys 0m0.003s

john.ngo@csx:~/457/A2/subset-sum-master$

john.ngo@csx:~/457/A2/subset-sum-master$ time ./subset 1 < test3.txt

Using 1 thread(s) on 27 numbers.

Number Zeros Counted by Thread: 557424

Subsets found: 557424

real 0m8.712s

user 0m8.662s

sys 0m0.002s

john.ngo@csx:~/457/A2/subset-sum-master$ time ./subset 2 < test3.txt

Using 2 thread(s) on 27 numbers.

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 557424

Subsets found: 557424

real 0m4.445s

user 0m8.797s

sys 0m0.005s

john.ngo@csx:~/457/A2/subset-sum-master$ time ./subset 3 < test3.txt

Using 3 thread(s) on 27 numbers.

Number Zeros Counted by Thread: 465587

Number Zeros Counted by Thread: 91837

Number Zeros Counted by Thread: 0

Subsets found: 557424

real 0m3.083s

user 0m8.817s

sys 0m0.002s

john.ngo@csx:~/457/A2/subset-sum-master$ time ./subset 4 < test3.txt

Using 4 thread(s) on 27 numbers.

Number Zeros Counted by Thread: 338337

Number Zeros Counted by Thread: 219087

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Subsets found: 557424

real 0m2.230s

user 0m8.757s

sys 0m0.004s

john.ngo@csx:~/457/A2/subset-sum-master$ time ./subset 6 < test3.txt

Using 6 thread(s) on 27 numbers.

Number Zeros Counted by Thread: 262244

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 203343

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 91837

Number Zeros Counted by Thread: 0

Subsets found: 557424

real 0m1.503s

user 0m8.810s

sys 0m0.004s

john.ngo@csx:~/457/A2/subset-sum-master$ time ./subset 8 < test3.txt

Using 8 thread(s) on 27 numbers.

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 187615

Number Zeros Counted by Thread: 147915

Number Zeros Counted by Thread: 150722

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 71172

Number Zeros Counted by Thread: 0

Subsets found: 557424

real 0m1.156s

user 0m8.835s

sys 0m0.007s

john.ngo@csx:~/457/A2/subset-sum-master$ time ./subset 12 < test3.txt

Using 12 thread(s) on 27 numbers.

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 132102

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 76093

Number Zeros Counted by Thread: 127250

Number Zeros Counted by Thread: 21733

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 130142

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 70104

Subsets found: 557424

real 0m1.319s

user 0m9.567s

sys 0m0.008s

john.ngo@csx:~/457/A2/subset-sum-master$ time ./subset 16 < test3.txt

Using 16 thread(s) on 27 numbers.

Number Zeros Counted by Thread: 94774

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 93846

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 55074

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 17891

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 53281

Number Zeros Counted by Thread: 92841

Number Zeros Counted by Thread: 92841

Number Zeros Counted by Thread: 56876

Number Zeros Counted by Thread: 0

Subsets found: 557424

real 0m1.393s

user 0m9.479s

sys 0m0.006s

john.ngo@csx:~/457/A2/subset-sum-master$ time ./subset 24 < test3.txt

Using 24 thread(s) on 27 numbers.

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 54604

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 20665

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 74629

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 52785

Number Zeros Counted by Thread: 3526

Number Zeros Counted by Thread: 75538

Number Zeros Counted by Thread: 21808

Number Zeros Counted by Thread: 57473

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 74465

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 18207

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 54285

Number Zeros Counted by Thread: 49439

Subsets found: 557424

real 0m1.295s

user 0m9.662s

sys 0m0.010s

john.ngo@csx:~/457/A2/subset-sum-master$ time ./subset 32 < test3.txt

Using 32 thread(s) on 27 numbers.

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 14770

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 39674

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 16370

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 3121

Number Zeros Counted by Thread: 40624

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 53167

Number Zeros Counted by Thread: 38704

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 17202

Number Zeros Counted by Thread: 53222

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 37724

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 39674

Number Zeros Counted by Thread: 53167

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 0

Number Zeros Counted by Thread: 39674

Number Zeros Counted by Thread: 41552

Number Zeros Counted by Thread: 15557

Number Zeros Counted by Thread: 53222

Number Zeros Counted by Thread: 0

Subsets found: 557424

real 0m1.321s

user 0m10.048s

sys 0m0.010s

john.ngo@csx:~/457/A2/subset-sum-master$

Documentation Screenshots:







