Assignment 3

G3 - Emily Bolles, Tanner Kirsch, Robert Krency

1 Data Collection

This experiment was run using a collection of threads to calculate the numbers in the range $[1723453000, 1723454200]$. As this gives us 1201 numbers to check for primality, we instead eliminate the first number in the range 1723453000 as it's an even number and not prime. This gives us 1200 numbers to check for primality, allowing us to split our range into sub-ranges of even size. Each run of the procedure utilized a different number of threads, from the set $\{1, 2, 3, 4, 8\}$.

1.1 Aggregated Results

# of Threads	Time Taken	% Relative
1	46.1 s	100.0 %
2	26.7 s	57.93 %
3	19.7 s	42.66 %
4	15.1 s	32.79 %
8	11.4 s	24.79 %

The aggregated results above are the averages taken from 30 runs of each thread count. Times are measured in milliseconds. In all cases, we can see that the Time Taken is approximately equivalent to the Longest Thread Time. This is due to the nature of thread joining, such that the *Main* thread has to wait for all of its children threads to finish. Each thread was assigned a number range of equal size to check for prime numbers. Threads run faster when their range contains less primes. For a complete listing of test data, see Section 4: Full Results.

As expected, higher thread counts have a faster execution time. The % Relative listed in the table above is the ratio of that thread count's execution speed to that of using 1 Thread.

2 List of Primes

The result of this program was the finding of the following 60 prime numbers.

1723453001 1723453003 1723453009 1723453021 1723453033 1723453037
1723453057 1723453063 1723453079 1723453087 1723453111 1723453133
1723453169 1723453211 1723453241 1723453253 1723453301 1723453309
1723453351 1723453363 1723453379 1723453393 1723453397 1723453399
1723453427 1723453429 1723453439 1723453453 1723453471 1723453477
1723453519 1723453531 1723453541 1723453579 1723453619 1723453681
1723453741 1723453757 1723453793 1723453817 1723453877 1723453891
1723453903 1723453943 1723453987 1723453993 1723454011 1723454017
1723454023 1723454041 1723454063 1723454077 1723454087 1723454093
1723454107 1723454111 1723454113 1723454141 1723454177 1723454179

3 System Specs

The developed program was executed on a system with the following specs:

CPU	AMD Ryzen 5 5600X, 6 Cores
Motherboard	Gigabyte X570 Aorus Ultra
Memory	32GB DDR4 RAM 4800 MHz
GPU	AMD Radeon RX 6700XT

4 Full Results

4.1 Results: 1 Thread

	Total	T1
Test 1	46.2 s	46.2 s
Test 2	46.5 s	46.5 s
Test 3	46.1 s	46.1 s
Test 4	46.8 s	46.8 s
Test 5	47.1 s	47.1 s
Test 6	47.2 s	47.2 s
Test 7	46.9 s	46.9 s
Test 8	46.5 s	46.5 s
Test 9	46.8 s	46.8 s
Test 10	46.8 s	46.8 s
Test 11	46.7 s	46.7 s
Test 12	46.9 s	46.9 s
Test 13	45.9 s	45.9 s
Test 14	45.8 s	45.8 s
Test 15	45.8 s	45.8 s
Test 16	45.7 s	45.7 s
Test 17	45.7 s	45.7 s
Test 18	45.7 s	45.7 s
Test 19	45.7 s	45.7 s
Test 20	45.8 s	45.8 s
Test 21	46.3 s	46.3 s
Test 22	45.8 s	45.8 s
Test 23	45.9 s	45.9 s
Test 24	45.7 s	45.7 s
Test 25	45.9 s	45.9 s
Test 26	45.8 s	45.8 s
Test 27	45.2 s	45.2 s
Test 28	45.4 s	45.4 s
Test 29	45.2 s	45.2 s
Test 30	45.7 s	45.7 s

4.2 Results: 2 Threads

	Total	T1	T2
Test 1	27.0 s	27.0 s	21.1 s
Test 2	26.6 s	26.6 s	20.4 s
Test 3	27.0 s	27.0 s	20.6 s
Test 4	27.0 s	27.0 s	20.7 s
Test 5	27.0 s	27.0 s	20.7 s
Test 6	27.3 s	27.3 s	21.0 s
Test 7	27.1 s	27.1 s	20.9 s
Test 8	27.1 s	27.1 s	20.9 s
Test 9	27.1 s	27.1 s	20.9 s
Test 10	27.1 s	27.1 s	20.8 s
Test 11	26.9 s	26.9 s	20.8 s
Test 12	26.6 s	26.6 s	20.3 s
Test 13	26.2 s	26.2 s	20.2 s
Test 14	26.2 s	26.2 s	20.3 s
Test 15	26.1 s	26.1 s	20.0 s
Test 16	26.8 s	26.8 s	20.5 s
Test 17	26.1 s	26.1 s	20.0 s
Test 18	26.0 s	26.0 s	20.3 s
Test 19	26.1 s	26.1 s	20.2 s
Test 20	26.2 s	26.2 s	20.2 s
Test 21	31.9 s	31.9 s	25.5 s
Test 22	26.2 s	26.2 s	20.3 s
Test 23	26.4 s	26.4 s	20.2 s
Test 24	26.2 s	26.2 s	20.1 s
Test 25	26.1 s	26.1 s	20.0 s
Test 26	26.3 s	26.3 s	20.3 s
Test 27	26.2 s	26.2 s	20.1 s
Test 28	26.3 s	26.3 s	19.9 s
Test 29	26.1 s	26.1 s	20.3 s
Test 30	26.3 s	26.3 s	20.3 s

4.3 Results: 3 Threads

	Total	T1	T2	T3
Test 1	20.2 s	20.2 s	13.4 s	17.7 s
Test 2	19.9 s	19.9 s	12.6 s	17.8 s
Test 3	20.3 s	20.3 s	13.0 s	17.8 s
Test 4	20.1 s	20.1 s	12.7 s	17.6 s
Test 5	19.9 s	19.9 s	12.7 s	17.4 s
Test 6	20.0 s	20.0 s	12.7 s	17.6 s
Test 7	20.1 s	20.1 s	12.8 s	17.4 s
Test 8	20.1 s	20.1 s	12.7 s	17.5 s
Test 9	20.0 s	20.0 s	12.9 s	17.4 s
Test 10	20.0 s	20.0 s	12.8 s	17.6 s
Test 11	19.9 s	19.9 s	12.9 s	17.5 s
Test 12	19.0 s	19.0 s	12.1 s	16.8 s
Test 13	19.2 s	19.2 s	12.0 s	16.6 s
Test 14	19.5 s	19.5 s	12.7 s	16.9 s
Test 15	19.4 s	19.4 s	12.3 s	16.8 s
Test 16	19.6 s	19.6 s	12.8 s	17.2 s
Test 17	19.3 s	19.3 s	12.3 s	16.7 s
Test 18	19.5 s	19.5 s	12.6 s	16.9 s
Test 19	19.2 s	19.2 s	12.1 s	16.5 s
Test 20	19.1 s	19.1 s	12.4 s	16.8 s
Test 21	20.5 s	20.5 s	13.7 s	18.0 s
Test 22	19.7 s	19.7 s	12.6 s	17.6 s
Test 23	19.4 s	19.4 s	12.2 s	16.6 s
Test 24	19.5 s	19.5 s	12.5 s	17.0 s
Test 25	19.4 s	19.4 s	12.5 s	16.8 s
Test 26	19.5 s	19.5 s	12.9 s	17.2 s
Test 27	19.0 s	19.0 s	12.1 s	16.7 s
Test 28	19.7 s	19.7 s	12.6 s	17.5 s
Test 29	19.4 s	19.4 s	12.1 s	17.1 s
Test 30	19.8 s	19.8 s	13.1 s	17.0 s

4.4 Results: 4 Threads

	Total	T1	T2	T3	T4
Test 1	16.0 s	14.1 s	15.8 s	7.4 s	16.0 s
Test 2	15.8 s	14.0 s	15.6 s	7.3 s	15.8 s
Test 3	16.0 s	14.0 s	15.7 s	7.2 s	16.0 s
Test 4	15.4 s	13.6 s	15.4 s	7.0 s	15.4 s
Test 5	15.6 s	13.9 s	15.4 s	7.1 s	15.6 s
Test 6	15.5 s	13.8 s	15.5 s	7.2 s	15.5 s
Test 7	15.6 s	13.8 s	15.5 s	7.1 s	15.6 s
Test 8	15.7 s	13.9 s	15.7 s	7.1 s	15.7 s
Test 9	15.6 s	13.7 s	15.4 s	7.1 s	15.6 s
Test 10	15.6 s	14.0 s	15.5 s	7.2 s	15.6 s
Test 11	15.6 s	13.8 s	15.3 s	7.1 s	15.6 s
Test 12	14.8 s	13.1 s	14.7 s	6.6 s	14.8 s
Test 13	14.8 s	13.3 s	14.8 s	6.8 s	14.8 s
Test 14	14.8 s	13.1 s	14.8 s	6.7 s	14.7 s
Test 15	14.8 s	13.4 s	14.6 s	7.1 s	14.8 s
Test 16	14.6 s	13.2 s	14.6 s	7.0 s	14.5 s
Test 17	14.6 s	12.9 s	14.6 s	6.6 s	14.5 s
Test 18	15.0 s	13.2 s	14.9 s	7.1 s	15.0 s
Test 19	15.0 s	13.4 s	15.0 s	7.0 s	15.0 s
Test 20	14.6 s	13.1 s	14.6 s	6.9 s	14.4 s
Test 21	14.5 s	13.0 s	14.3 s	6.5 s	14.5 s
Test 22	15.1 s	13.5 s	14.8 s	6.7 s	15.1 s
Test 23	14.9 s	13.2 s	14.8 s	6.6 s	14.9 s
Test 24	14.6 s	12.9 s	14.6 s	6.5 s	14.5 s
Test 25	14.9 s	13.2 s	14.7 s	7.0 s	14.9 s
Test 26	14.8 s	13.1 s	14.5 s	6.9 s	14.8 s
Test 27	14.9 s	13.4 s	14.6 s	6.5 s	14.9 s
Test 28	14.8 s	13.1 s	14.7 s	6.8 s	14.8 s
Test 29	14.8 s	13.3 s	14.6 s	6.5 s	14.8 s
Test 30	14.9 s	13.4 s	14.8 s	6.9 s	14.9 s

4.5 Results: 8 Threads

	Total	T1	T2	T3	T4	T5	T6	T7	T8
Test 1	11.7 s	11.7 s	4.8 s	10.9 s	7.6 s	3.7 s	5.8 s	8.3 s	10.0 s
Test 2	11.8 s	11.8 s	4.5 s	11.0 s	7.6 s	3.5 s	5.8 s	8.5 s	10.3 s
Test 3	11.6 s	11.6 s	4.5 s	11.1 s	7.3 s	3.4 s	5.6 s	8.5 s	10.1 s
Test 4	11.6 s	11.6 s	4.5 s	10.9 s	7.4 s	3.4 s	5.9 s	8.4 s	10.1 s
Test 5	11.6 s	11.6 s	4.6 s	10.9 s	7.5 s	3.4 s	5.8 s	8.5 s	10.1 s
Test 6	11.8 s	11.8 s	4.6 s	10.9 s	7.7 s	3.6 s	6.0 s	8.5 s	10.2 s
Test 7	11.8 s	11.8 s	4.8 s	10.9 s	7.6 s	3.5 s	5.7 s	8.5 s	10.1 s
Test 8	11.6 s	11.6 s	4.7 s	10.9 s	7.6 s	3.5 s	5.8 s	8.7 s	10.2 s
Test 9	11.6 s	11.6 s	4.7 s	10.8 s	7.4 s	3.5 s	5.7 s	8.4 s	10.1 s
Test 10	11.7 s	11.7 s	4.6 s	11.0 s	7.7 s	3.7 s	5.7 s	8.7 s	10.3 s
Test 11	11.9 s	11.9 s	4.7 s	11.0 s	7.4 s	3.4 s	6.2 s	8.2 s	10.2 s
Test 12	11.2 s	11.2 s	4.4 s	10.5 s	7.2 s	3.7 s	5.9 s	8.2 s	9.8 s
Test 13	11.4 s	11.4 s	4.6 s	10.6 s	7.2 s	3.6 s	5.9 s	8.3 s	9.8 s
Test 14	11.1 s	11.1 s	4.5 s	10.6 s	7.3 s	3.6 s	6.0 s	8.3 s	9.8 s
Test 15	11.2 s	11.2 s	4.7 s	10.3 s	7.3 s	3.4 s	5.7 s	8.2 s	9.8 s
Test 16	11.5 s	11.5 s	4.6 s	11.0 s	7.3 s	3.9 s	5.8 s	8.2 s	10.2 s
Test 17	11.2 s	11.2 s	4.7 s	10.5 s	7.3 s	3.5 s	5.8 s	8.2 s	9.8 s
Test 18	11.2 s	11.2 s	4.5 s	10.7 s	7.5 s	3.6 s	6.0 s	8.1 s	9.8 s
Test 19	11.6 s	11.6 s	4.6 s	10.7 s	7.6 s	3.5 s	5.7 s	8.6 s	9.9 s
Test 20	11.3 s	11.3 s	4.8 s	10.6 s	7.5 s	3.8 s	5.7 s	8.2 s	9.8 s
Test 21	11.1 s	11.1 s	4.5 s	10.3 s	7.4 s	3.4 s	5.8 s	8.3 s	9.8 s
Test 22	11.2 s	11.2 s	4.6 s	10.6 s	7.4 s	3.5 s	5.7 s	8.1 s	9.7 s
Test 23	11.2 s	11.2 s	4.6 s	10.6 s	7.5 s	3.6 s	5.9 s	8.4 s	9.7 s
Test 24	11.6 s	11.6 s	4.6 s	10.4 s	7.3 s	3.7 s	5.8 s	8.3 s	9.8 s
Test 25	11.3 s	11.3 s	4.7 s	10.7 s	7.5 s	3.6 s	5.9 s	8.6 s	9.8 s
Test 26	11.3 s	11.3 s	4.8 s	10.5 s	7.2 s	3.6 s	5.9 s	8.4 s	9.6 s
Test 27	11.2 s	11.2 s	4.9 s	10.7 s	7.5 s	3.7 s	5.8 s	8.3 s	9.7 s
Test 28	11.1 s	11.1 s	4.5 s	10.4 s	7.5 s	3.6 s	6.0 s	8.4 s	9.8 s
Test 29	11.4 s	11.4 s	4.6 s	10.9 s	7.5 s	3.6 s	6.0 s	8.1 s	9.9 s
Test 30	11.1 s	11.1 s	4.5 s	10.6 s	7.4 s	3.5 s	5.7 s	8.2 s	9.8 s