Rohit Raj

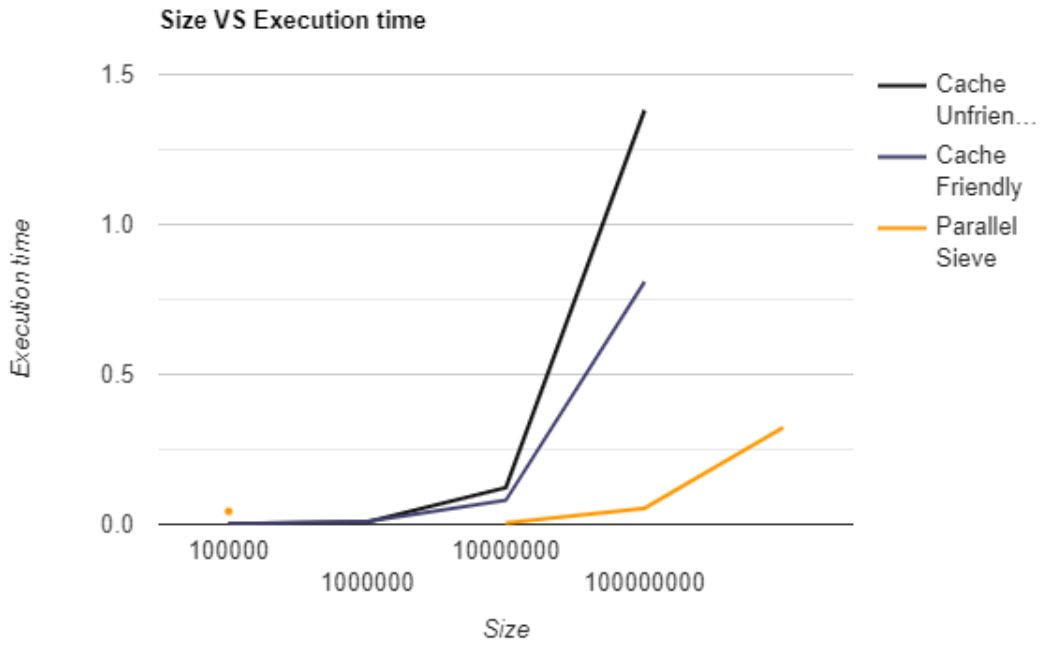
1RV17CS125

BATCH C2

Program 3

Output:

```
rohit@Rohit: /mnt/c/Users/rohit/Desktop
rohit@Rohit:/mnt/c/Users/rohit/Desktop$ g++ program3.cpp -fopenmp
rohit@Rohit:/mnt/c/Users/rohit/Desktop$ ./a.out
Size            Cache Unfriendly        Cache Friendly          Parallel Sieve
100000          9592    0.000822        9592    0.000833        9592    0.043400
1000000         78498   0.007768        78498   0.008669        78498   0.004766
10000000        664579  0.121830        664579  0.080145        664579  0.053607
100000000       5761455 1.380913        5761455 0.808402        5761455 0.322364
rohit@Rohit:/mnt/c/Users/rohit/Desktop$
```



Code:

```
#include<math.h>
#include<string.h>
#include<omp.h>
#include<iostream>
using namespace std;
double t=0.0;
inline long Strike(bool composite[], long i, long stride, long limit) {
	for (; i <= limit; i += stride)
		composite[i] = true;
	return i;
}

long min(long a, long b){
	return a > b ? b : a;
}

long CacheUnfriendlySieve(long n)
{
	long count = 0;
	long m = (long)sqrt((double)n);
	bool* composite = new bool[n + 1];
	memset(composite, 0, n);
	t = omp_get_wtime();
	for (long i = 2; i <= m; ++i)
		if (!composite[i]) {
			++count;
			// Strike walks array of size n here.
			Strike(composite, 2 * i, i, n);
```

```
                }
        for (long i = m + 1; i <= n; ++i)
                if (!composite[i]) {
                        ++count;
                }
        t = omp_get_wtime() - t;
        delete[] composite;
        return count;
}
long CacheFriendlySieve(long n)
{
        long count = 0;
        long m = (long)sqrt((double)n);
        bool* composite = new bool[n + 1];
        memset(composite, 0, n);
        long* factor = new long[m];
        long* striker = new long[m];
        long n_factor = 0;
        t = omp_get_wtime();
        for (long i = 2; i <= m; ++i)
                if (!composite[i])
                {
                        ++count;
                        striker[n_factor] = Strike(composite, 2 * i, i, m);
                        factor[n_factor++] = i;
                }
        // Chops sieve into windows of size ~ sqrt(n)
        for (long window = m + 1; window <= n; window += m)
        {
                long limit = min(window + m - 1, n);
                for (long k = 0; k < n_factor; ++k)
```

```
                        // Strike walks window of size sqrt(n) here.
                        striker[k] = Strike(composite, striker[k], factor[k], limit);
                for (long i = window; i <= limit; ++i)
                        if (!composite[i])
                                ++count;
        }
        t = omp_get_wtime() - t;
        delete[] striker;
        delete[] factor;
        delete[] composite;
        return count;
}

long ParallelSieve(long n){
        long count = 0;
        long m = (long)sqrt((double)n);
        long n_factor = 0;
        long* factor = new long[m];

        t = omp_get_wtime();

#pragma omp parallel
        {
                bool* composite = new bool[m + 1];
                long* striker = new long[m];
#pragma omp single
                {
                        memset(composite, 0, m);
                        for (long i = 2; i <= m; ++i)
                                if (!composite[i])
                                {
```

```
                                        ++count;
                                        Strike(composite, 2 * i, i, m);
                                        factor[n_factor++] = i;
                                }
                        }
                        long base = -1;

#pragma omp for reduction (+:count)
                        for (long window = m + 1; window <= n; window += m)
                        {
                                memset(composite, 0, m);
                                if (base != window)
                                {
                                        // Must compute striker from scratch.
                                        base = window;
                                        for (long k = 0; k < n_factor; ++k)
                                                striker[k] = (base + factor[k] - 1) / factor[k] * factor[k] - base;

                                }       long limit = min(window + m - 1, n) - base;

                                for (long k = 0; k < n_factor; ++k)
                                        striker[k] = Strike(composite, striker[k], factor[k], limit) - m;

                                for (long i = 0; i <= limit; ++i)
                                        if (!composite[i])
                                                ++count;
                                base += m;
                        }
                        delete[] striker;
                        delete[] composite;
                }
```

```
	t = omp_get_wtime() - t;


	delete[] factor;
	return count;
}


int main(){
	long size = 10000,count;
	printf("Size\t\tCache Unfriendly\tCache Friendly\t\tParallel Sieve\n");
	for(int i=1; i<=4; i++ ){
		size = size*10;
		printf("%ld\t",size);
		if(i<3)
			printf("\t");
		count = CacheUnfriendlySieve(size);
		printf("%ld\t%f\t",count,t);
		count = CacheFriendlySieve(size);
		printf("%ld\t%f\t",count,t);
		count = ParallelSieve(size);
		printf("%ld\t%f\n",count,t);
	}
	return 0;
}
```