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\* This program is an implementation of the global sum

\* problem, where an array of size 50000000 is split

\* among several threads and each thread computes a

\* partial sum. It is an example of parallel processing to

\* showcase the time difference between a serial program vs parallel

\* NOTE: the array is of size 50000000 (50 million as 500 million would not work

\* on the test system

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#include <iostream>

#include <cstdlib>

#include <stdint.h>

#include <pthread.h>

#include <time.h>

#include <stdio.h>

using namespace std;

#define MAX 50000000 // Could not go higher

#define BILLION 1000000000L //used for nanosecond

pthread\_mutex\_t c\_lock = PTHREAD\_MUTEX\_INITIALIZER;

pthread\_mutex\_t sum\_lock = PTHREAD\_MUTEX\_INITIALIZER;

int thread\_count;

int my\_array[MAX];

float global\_sum;

void\* compute(void\* rank);

int main(int argc, char\* argv[]){

long thread\_id;

uint64\_t diff;

struct timespec start, end; //for time

for(int i = 0; i < MAX; i++){

my\_array[i] = i+1;

}

thread\_count = atoi(argv[1]);

pthread\_t myThreads[thread\_count];

clock\_gettime(CLOCK\_MONOTONIC, &start); //start time

for(thread\_id = 0; thread\_id < thread\_count; thread\_id++){

pthread\_create(&myThreads[thread\_id], NULL, compute, (void\*)thread\_id);

}

//Wait for threads

for(thread\_id = 0; thread\_id < thread\_count; thread\_id++)

pthread\_join(myThreads[thread\_id], NULL);

clock\_gettime(CLOCK\_MONOTONIC, &end); //end time

diff = BILLION \* (end.tv\_sec - start.tv\_sec) + end.tv\_nsec - start.tv\_nsec;

printf("elapsed time = %llu nanoseconds\n", (long long unsigned int) diff);

cout << "Final sum: " << global\_sum << endl;

return 0;

}

void\* compute(void\* rank){

int my\_id = long(rank); // typecast (void\*) to long

int partition\_size, start\_index, end\_index; // init partial\_sum only to 0

float partial\_sum = 0;

partition\_size = MAX/thread\_count; // how many values each thread will compute

start\_index = my\_id \* partition\_size; // start index uses thread's id

end\_index = start\_index + partition\_size - 1; // minus one to make up for index starting at 0

// computation of partial sum

for(int i = start\_index; i <= end\_index; i++){

partial\_sum += my\_array[i];

}

// lock for global sum computation

pthread\_mutex\_lock(&sum\_lock);

global\_sum += partial\_sum;

pthread\_mutex\_unlock(&sum\_lock);

// lock for cout

pthread\_mutex\_lock(&c\_lock);

cout << "Hello from thread\_" << my\_id << " Start: " << start\_index << " End: " << end\_index << endl;

cout << "My sum: " << partial\_sum << endl;

pthread\_mutex\_unlock(&c\_lock);

}

**OUTPUT**

edwinp7@DESKTOP-0DVV906:/mnt/c/Users/edwin/Desktop/New folder/CSCI176/global\_sum$ g++ source.cpp -pthread

edwinp7@DESKTOP-0DVV906:/mnt/c/Users/edwin/Desktop/New folder/CSCI176/global\_sum$ ./a.out 1

Hello from thread\_0 Start: 0 End: 49999999

My sum: 1.1259e+15

elapsed time = 323719000 nanoseconds

Final sum: 1.1259e+15

edwinp7@DESKTOP-0DVV906:/mnt/c/Users/edwin/Desktop/New folder/CSCI176/global\_sum$ ./a.out 2

Hello from thread\_1 Start: 25000000 End: 49999999

My sum: 1.04606e+15

Hello from thread\_0 Start: 0 End: 24999999

My sum: 2.87657e+14

elapsed time = 200973000 nanoseconds

Final sum: 1.33372e+15

edwinp7@DESKTOP-0DVV906:/mnt/c/Users/edwin/Desktop/New folder/CSCI176/global\_sum$ ./a.out 4

Hello from thread\_0 Start: 0 End: 12499999

My sum: 7.55461e+13

Hello from thread\_1 Start: 12500000 End: 24999999

My sum: 2.04456e+14

Hello from thread\_2 Start: 25000000 End: 37499999

My sum: 3.85075e+14

Hello from thread\_3 Start: 37500000 End: 49999999

My sum: 4.78139e+14

elapsed time = 138734000 nanoseconds

Final sum: 1.14322e+15

edwinp7@DESKTOP-0DVV906:/mnt/c/Users/edwin/Desktop/New folder/CSCI176/global\_sum$ ./a.out 8

Hello from thread\_1 Start: 6250000 End: 12499999

My sum: 6.07374e+13

Hello from thread\_0 Start: 0 End: 6249999

My sum: 1.95436e+13

Hello from thread\_4 Start: 25000000 End: 31249999

My sum: 1.7536e+14

Hello from thread\_3 Start: 18750000 End: 24999999

My sum: 1.40639e+14

Hello from thread\_2 Start: 12500000 End: 18749999

My sum: 9.7664e+13

Hello from thread\_7 Start: 43750000 End: 49999999

My sum: 2.93422e+14

Hello from thread\_6 Start: 37500000 End: 43749999

My sum: 2.61898e+14

Hello from thread\_5 Start: 31250000 End: 37499999

My sum: 2.07356e+14

elapsed time = 142215000 nanoseconds

Final sum: 1.25662e+15

edwinp7@DESKTOP-0DVV906:/mnt/c/Users/edwin/Desktop/New folder/CSCI176/global\_sum$