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CSE344 System Programming HW5 Report

1. Design

Used pthread mutex and pthread contidion variable for synchronization barrier. When each thread finish its first part, it waits the other threads with pthread_cond_wait function. When last thread finish the first part sends signal to all other threads which waits condition variable with pthread_cond_broadcast.

It was noticed that when the number of threads increased by 2 times by trying different matrices, the elapsed time decreased by nearly about 2 times.

2. Signal Handling

Defined sigint handler function with sigaction for the threads to exit. When takes SIGINT signal, changes the global sigint flag to 1. All threads returns, process free resources and exits.

3. Functions

void *threadFun(void *arg): This function for all threads. First Each thread calculates (2^n)/m columns of AxB matrix. The threads waits for each other and advance to the second part when all AxB calculated.

Then threads switch to the second task and calculate the 2D Discrete Fourier Transform of AxB, the same way as (2^n)/m columns calculated by each thread.

void errExit(char *s): This function prints given error via perror then exits.

void sigint_handler(int signum): Handler for SIGINT and SIGTERM for wholesaler.

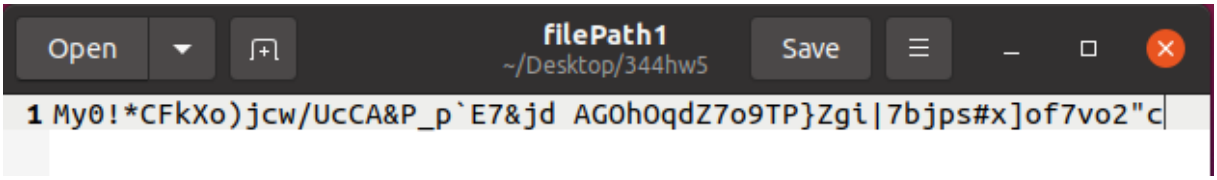
unsigned long get_time_microseconds(): This function returns current timestamp in microseconds.

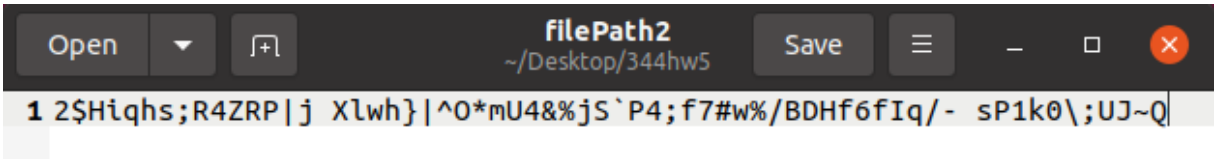
unsigned long get_time_seconds(): This function returns current timestamp in seconds.

int main(int argc, char *argv[]): Checks the correctness of the arguments.
Open files and reads matrices. Inıtializes mutex and condition variable. Sets sigint handler.
Creates threads waits them to finish calculations then collects the outputs of each thread and writes them to the output file. Finally free the resources and exits.

4. Sample Screenshots

Input Files for matrix1 and matrix 2





Output

```
ubuntu@ubuntu:~/Desktop/344hw5$ ./hw5 -i filePath1 -j filePath2 -o output -n 3 -m 4
[1653266745788892]Two matrices of size 8x8 have been read. The number of threads is 4
[1653266745789057]Thread 2 has reached the rendezvous point in 0.000002 seconds
[1653266745789062]Thread 1 has reached the rendezvous point in 0.000001 seconds
[1653266745789085]Thread 3 has reached the rendezvous point in 0.000001 seconds
[1653266745789086]Thread 0 has reached the rendezvous point in 0.000002 seconds
[1653266745789114]Thread 0 is advancing to the second part
[1653266745789167]Thread 2 is advancing to the second part
[1653266745789186]Thread 0 has has finished the second part in 0.000072 seconds
[1653266745789217]Thread 1 is advancing to the second part
[1653266745789231]Thread 2 has has finished the second part in 0.000064 seconds
[1653266745789275]Thread 1 has has finished the second part in 0.000058 seconds
[1653266745789345]Thread 3 is advancing to the second part
[1653266745789422]Thread 3 has has finished the second part in 0.000077 seconds
[1653266745789944]The process has written the output file. The total time spent is 0.001052 seconds
ubuntu@ubuntu:~/Desktop/344hw5$
```

Open | output ~/Desktop/344hw5 | Save

```
1 3370868.000000 + i(0.000000),-78534.848684 + i(150395.399065),-82335.000000 +
  i(-87335.000000),3838.848684 + i(11765.399065),65570.000000 + i(0.000000),-
  3838.848684 + i(-11765.399064),-82335.000000 + i(87335.000001),-78534.848685 +
  i(-150395.399064),
2 -68798.003579 + i(160794.309966),-18437.110265 + i(14699.341728),13531.149489 +
  i(-3920.755416),19871.979964 + i(-1340.713445),11039.032457 + i(9713.360092),-
  7930.849032 + i(-4566.311065),-8806.035565 + i(-12831.331224),-23774.553619 +
  i(5979.183215),
3 -55712.000000 + i(-148280.000000),-1143.559562 + i(7031.562582),-15275.000000 +
  i(19067.000000),14563.920792 + i(-1546.966484),16704.000000 +
  i(9770.000000),-3758.440438 + i(-5915.562582),2827.000000 +
  i(-4285.000000),-20741.920792 + i(2286.966484),
4 -135579.996421 + i(46580.309966),-1913.979964 + i(-16332.713444),-679.964435 +
  i(-12825.331224),6081.110265 + i(1865.341728),-4489.032457 + i(3611.360092),-
  14164.553619 + i(9519.183215),3710.850511 + i(11133.244584),17413.150968 +
  i(-10400.311065),
5 28240.000000 + i(0.000000),-16335.966966 + i(3452.900826),6851.000000 +
  i(-21849.000000),22759.966966 + i(2954.900826),2306.000000 + i(0.000000),-
  22759.966966 + i(-2954.900826),6851.000000 + i(21849.000000),-16335.966966 +
  i(-3452.900826),
6 -135579.996421 + i(-46580.309966),17413.150968 + i(10400.311065),3710.850511 +
  i(-11133.244584),14164.553619 + i(-9519.183215),-4489.032457 + i(-3611.360092),-
  6081.110265 + i(-1865.341728),-679.964435 + i(12825.331224),-1913.979964 +
  i(16332.713444),
7 -55712.000000 + i(148280.000001),-20741.920792 + i(-2286.966484),2827.000000 +
  i(4285.000000),-3758.440438 + i(5915.562582),16704.000000 + i(-9770.000000),-
  14563.920792 + i(1546.966484),-15275.000000 + i(-19067.000000),-1143.559562 +
  i(-7031.562582),
8 -68798.003581 + i(-160794.309965),-23774.553619 + i(-5979.183215),-8806.035565 +
  i(12831.331224),7930.849032 + i(4566.311065),11039.032457 + i(-9713.360092),-
  19871.979964 + i(1340.713444),13531.149489 + i(3920.755416),-18437.110265 +
  i(-14699.341728),
```