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Homework 4

Overview:

The purpose of this program was to create a multithreaded ASCII character counter. We were provided with a ASCII text file called “large.txt” which we read into a 64MB buffer in global memory. Once the file is read into the buffer we partition the buffer based on how many threads we use in the program. The partitions need to be roughly equal in size, so the size of the partition is just the number of bytes in the buffer divided by the number of threads. Next, we create an array of threads whose size is the number of threads being used in the program. Each thread needed a thread index and a partition bound, which are passed to the thread using a struct in global memory. Using a for loop, we spawn the threads one by one. Inside the for loop, using pthread_create(), a thread is passed to the void *characterCounter function. In void *characterCounter, we’re just examining the partition each thread is responsible for counting the ASCII characters for one character at a time. There is a 2-D array, int threadCounts[][], in global memory that is responsible for storing the occurrences of each individual ASCII character that each thread counts. Once void *charCounter finishes, the occurrences of each ASCII character found in the partition that the thread being passed into void *charCounter was responsible for are updated in the 2-D array int threadCounts[][]. The last step in the program is adding up the grand total of occurrences of each ASCII character found by the threads. This is done with another for loop that loops through the 2-D array. A variable, int chTotal, stores the grand total for each ASCII character found in all the threads and is reset to 0 after each iteration. On success, the grand total is printed out along with either the hex code or the actual ASCII character depending on the the ASCII character was a printable or non-printable character.

Testing:

To test the program I created my own text file that was a lot smaller than the text file we were given. I typed in some characters and kept track of the occurrences of the characters in the text file. I passed my text file into the program using the command line and checked to see if the correct number of occurrences was recorded.

Statistics:

These were the statistics I recorded for my program using the “time” UNIX command and recording the execution time of each run using 1, 2, 4, and 8 threads. The testing platform I was using to run this program has 4 CPU cores. The speed up observed seemed to be linear.

Using 1 thread:

0m0.786s

0m0.763s

0m0.744s

0m0.755s

0m0.732s

AVERAGE: 0.756s

Using 2 threads:

0m0.776s

0m0.769s

0m0.733s

0m0.739s

0m0.774s

AVERAGE: 0.758s

Using 4 threads:

0m0.820s

0m0.735s

0m0.732s

0m0.746s

0m0.727s

AVERAGE: 0.752s

Using 8 threads:

0m0.728s

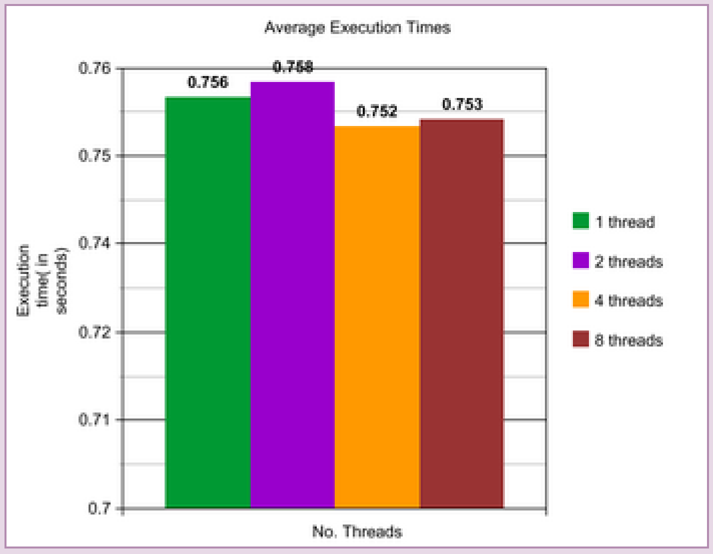
0m0.688s

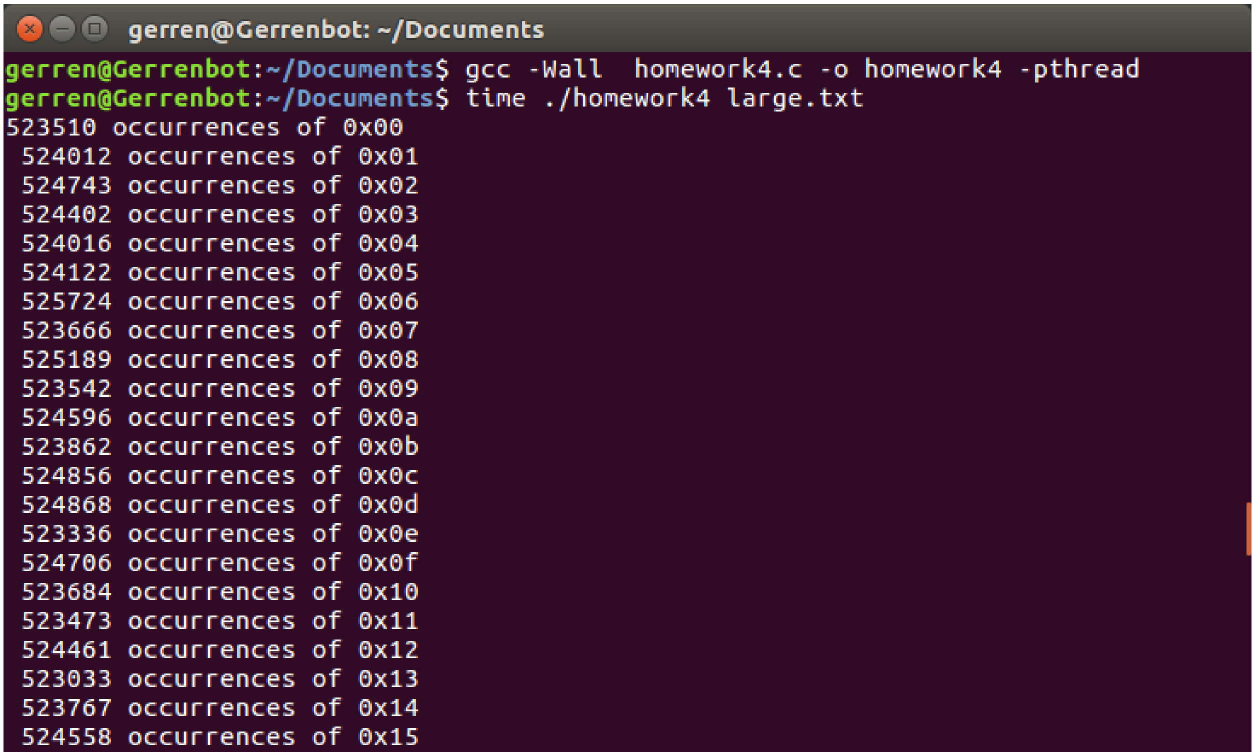
0m0.760s

0m0.829s

0m0.758s

AVERAGE: 0.753s





```
gerren@Gerrenbot:~/Documents$ gcc -Wall  homework4.c -o homework4 -pthread
gerren@Gerrenbot:~/Documents$ time ./homework4 large.txt
523510 occurrences of 0x00
 524012 occurrences of 0x01
 524743 occurrences of 0x02
 524402 occurrences of 0x03
 524016 occurrences of 0x04
 524122 occurrences of 0x05
 525724 occurrences of 0x06
 523666 occurrences of 0x07
 525189 occurrences of 0x08
 523542 occurrences of 0x09
 524596 occurrences of 0x0a
 523862 occurrences of 0x0b
 524856 occurrences of 0x0c
 524868 occurrences of 0x0d
 523336 occurrences of 0x0e
 524706 occurrences of 0x0f
 523684 occurrences of 0x10
 523473 occurrences of 0x11
 524461 occurrences of 0x12
 523033 occurrences of 0x13
 523767 occurrences of 0x14
 524558 occurrences of 0x15
```