

Homework #4

For this assignment we were instructed to implement a multi-threaded ASCII character count program. Basically the program will receive the name of an ASCII text file as a command-line argument and output the number of each kind of ASCII character in the file. I set up a 64KB buffer in global memory and read the contents of the file into the buffer or as much of it as will fit. Then I partition the buffer and spawn a number of threads to count the number of occurrences of each ASCII character in each partition. Each thread recorded these counts in a separate 128-element int array in global memory. When the worker threads finish writing their local counts, they exit. The main thread waits for all of them to complete. It then adds the partition counts for each ASCII character and prints each overall count. I have provided results below.

Win 32

-First I compiled my program and then executed it with a test.txt file. The test file has random input as well as website source code to see a difference in time when testing different number of threads. You can see the test file and output of program in the screenshot below.

The screenshot displays three windows from a Windows operating system:

- main.c [Win 32 ASCIICount]**: A code editor showing the source code of the program.


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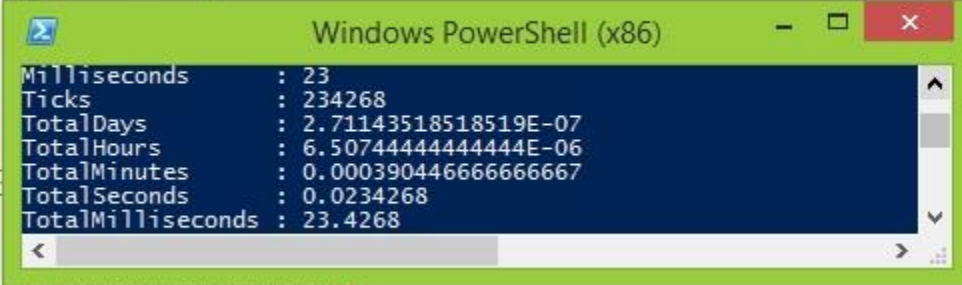
1  #include <stdio.h>
2  #include <Windows.h>
3  #include <time.h>
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5  #define NUM_THREADS 1
6  #define BUFFERLENGTH 65536
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```

Results of testing different number of threads on a 2 core platform

(I used Measure-Command in PowerShell to measure the time)

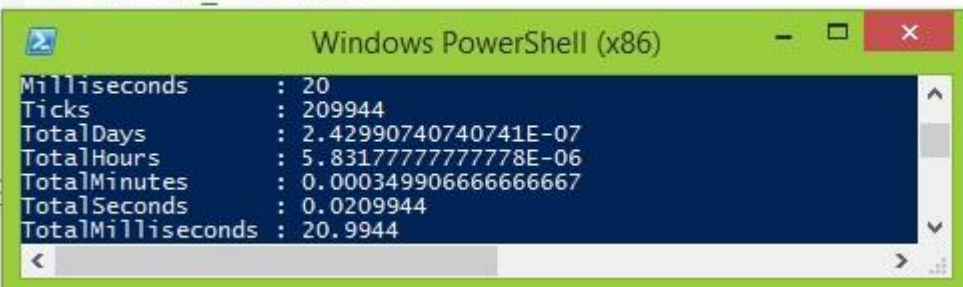
1 thread = 0.023 sec

```
9  #define NUM_THREADS 1
10
11
12  Milliseconds : 23
13  Ticks       : 234268
14  TotalDays   : 2.71143518518519E-07
15  TotalHours  : 6.50744444444444E-06
16  TotalMinutes: 0.000390446666666667
17  TotalSeconds: 0.0234268
18  TotalMilliseconds : 23.4268
```



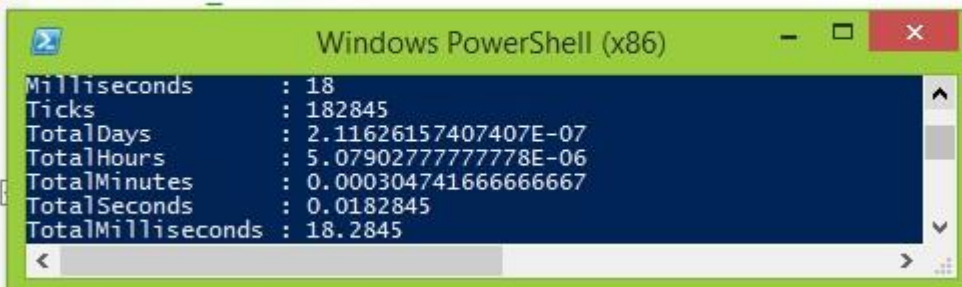
2 threads = 0.020 sec

```
8
9  #define NUM_THREADS 2
10
11
12  Milliseconds : 20
13  Ticks       : 209944
14  TotalDays   : 2.42990740740741E-07
15  TotalHours  : 5.83177777777778E-06
16  TotalMinutes: 0.000349906666666667
17  TotalSeconds: 0.0209944
18  TotalMilliseconds : 20.9944
```



4 threads = 0.018 sec

```
8
9  #define NUM_THREADS 4
10
11
12  Milliseconds : 18
13  Ticks       : 182845
14  TotalDays   : 2.11626157407407E-07
15  TotalHours  : 5.07902777777778E-06
16  TotalMinutes: 0.000304741666666667
17  TotalSeconds: 0.0182845
18  TotalMilliseconds : 18.2845
```



8 threads = 0.017 sec

```
9  #define NUM_THREADS 8
10
11
12  Windows PowerShell (x86)
13  Milliseconds : 17
14  Ticks : 174831
15  TotalDays : 2.02350694444444E-07
16  TotalHours : 4.85641666666667E-06
17  TotalMinutes : 0.000291385
18  TotalSeconds : 0.0174831
19  TotalMilliseconds : 17.4831
```

Posix

-First I compiled my program and then executed it with a test.txt file. The test file is the same one I use for the win 32 version and has random input as well as website source code to see a difference in time when testing different number of threads. You can see the test file and output of program in the screenshot below.

The screenshot shows a terminal window with two panes. The left pane displays C code for a multi-threaded program. The right pane shows the output of the program, which counts the occurrences of various hexadecimal characters in a test file.

```
main.c x test.txt x
//Eric Gonzalez
//CSC 415 - HW #4

#include <stdio.h>
#include <pthread.h>
#include <time.h>
#include <unistd.h>
#include <sys/stat.h>
#include <fcntl.h>

#define NUM_THREADS 4
#define BUFFERLENGTH 65536

int ascii_characters[NUM_THREADS][128];
char buffer[BUFFERLENGTH];

typedef struct {
    int partition_bounds;
    int thread_number;
} thread_information;

void *runner(void *t_info) {
    int i, threadLocation;
    char current_char;

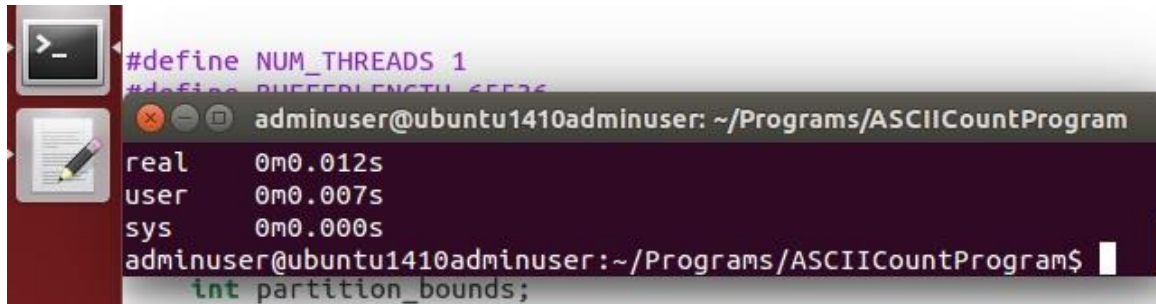
    thread_information threadinfo = *
    threadLocation = threadinfo.thread_number;
    current_char = buffer[threadLocation];
```

```
adminuser@ubuntu1410adminuser: ~/Programs/ASCIICountProgram
main.c:(.text+0x213): undefined reference to `pthread_join'
collect2: error: ld returned 1 exit status
adminuser@ubuntu1410adminuser:~/Programs/ASCIICountProgram$ gcc -pthread -o count main.c
adminuser@ubuntu1410adminuser:~/Programs/ASCIICountProgram$ ./count test.txt
0 occurrences of 0
0 occurrences of 0x1
0 occurrences of 0x2
0 occurrences of 0x3
0 occurrences of 0x4
0 occurrences of 0x5
0 occurrences of 0x6
0 occurrences of 0x7
0 occurrences of 0x8
2 occurrences of 0x9
15 occurrences of 0xa
0 occurrences of 0xb
0 occurrences of 0xc
15 occurrences of 0xd
0 occurrences of 0xe
0 occurrences of 0xf
0 occurrences of 0x10
1 occurrences of 0x11
2 occurrences of 0x12
0 occurrences of 0x13
```

Results of testing different number of threads on a 2 core platform

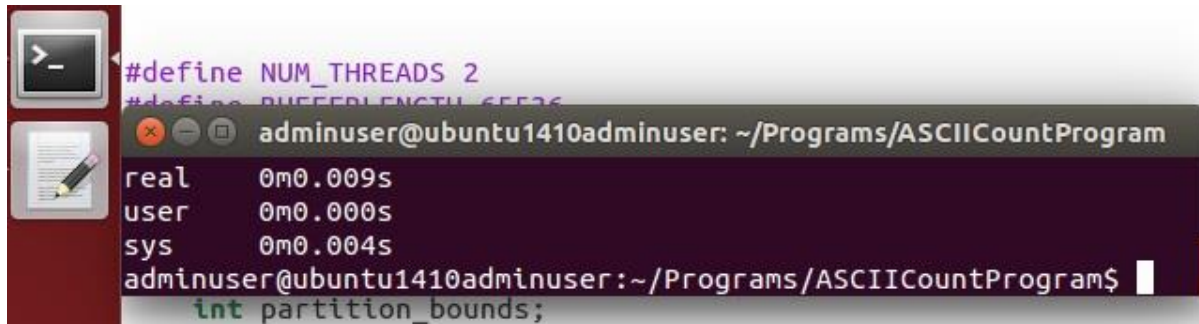
(I used the Time command to measure the time)

1 thread = 0.012 sec

A terminal window showing the execution of a program with 1 thread. The window title is 'adminuser@ubuntu1410adminuser: ~/Programs/ASCIICountProgram'. The output shows 'real 0m0.012s', 'user 0m0.007s', and 'sys 0m0.000s'. The prompt is 'adminuser@ubuntu1410adminuser:~/Programs/ASCIICountProgram\$'.

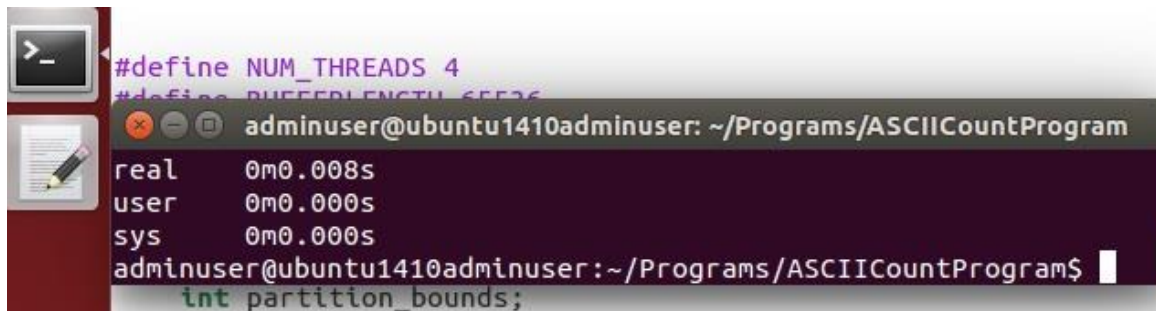
```
#define NUM_THREADS 1
#define BUFFERLENGTH 65536
adminuser@ubuntu1410adminuser: ~/Programs/ASCIICountProgram
real    0m0.012s
user    0m0.007s
sys     0m0.000s
adminuser@ubuntu1410adminuser:~/Programs/ASCIICountProgram$
```

2 threads = 0.009sec

A terminal window showing the execution of a program with 2 threads. The window title is 'adminuser@ubuntu1410adminuser: ~/Programs/ASCIICountProgram'. The output shows 'real 0m0.009s', 'user 0m0.000s', and 'sys 0m0.004s'. The prompt is 'adminuser@ubuntu1410adminuser:~/Programs/ASCIICountProgram\$'.

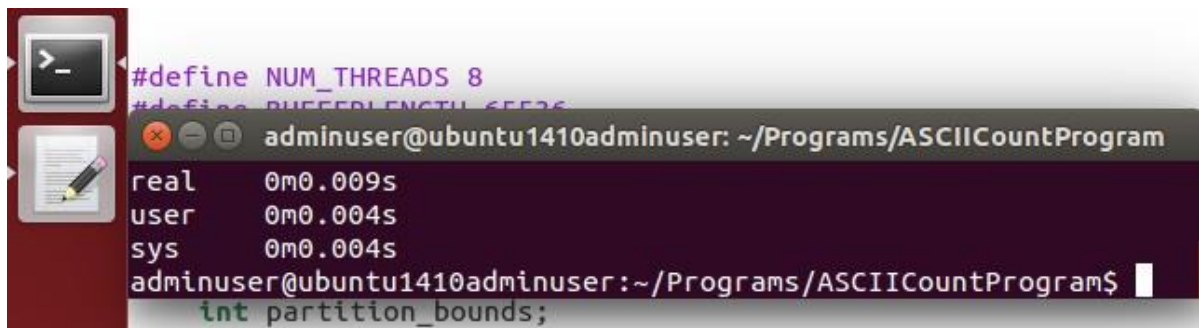
```
#define NUM_THREADS 2
#define BUFFERLENGTH 65536
adminuser@ubuntu1410adminuser: ~/Programs/ASCIICountProgram
real    0m0.009s
user    0m0.000s
sys     0m0.004s
adminuser@ubuntu1410adminuser:~/Programs/ASCIICountProgram$
```

4 threads = 0.008 sec

A terminal window showing the execution of a program with 4 threads. The window title is 'adminuser@ubuntu1410adminuser: ~/Programs/ASCIICountProgram'. The output shows 'real 0m0.008s', 'user 0m0.000s', and 'sys 0m0.000s'. The prompt is 'adminuser@ubuntu1410adminuser:~/Programs/ASCIICountProgram\$'.

```
#define NUM_THREADS 4
#define BUFFERLENGTH 65536
adminuser@ubuntu1410adminuser: ~/Programs/ASCIICountProgram
real    0m0.008s
user    0m0.000s
sys     0m0.000s
adminuser@ubuntu1410adminuser:~/Programs/ASCIICountProgram$
```

8 threads = .009 sec

A terminal window showing the execution of a program with 8 threads. The window title is 'adminuser@ubuntu1410adminuser: ~/Programs/ASCIICountProgram'. The output shows 'real 0m0.009s', 'user 0m0.004s', and 'sys 0m0.004s'. The prompt is 'adminuser@ubuntu1410adminuser:~/Programs/ASCIICountProgram\$'.

```
#define NUM_THREADS 8
#define BUFFERLENGTH 65536
adminuser@ubuntu1410adminuser: ~/Programs/ASCIICountProgram
real    0m0.009s
user    0m0.004s
sys     0m0.004s
adminuser@ubuntu1410adminuser:~/Programs/ASCIICountProgram$
```


As you can see the execution times get a bit shorter when more threads are used. In some cases you can't even tell the difference. The speedup is there when more threads are used but it's really not that noticeable unless using an extremely large file to scan. To some degree you could say it's linearly improving.