

Assignment 4 – Processing CSV Data with Threads

Description:

This assignment is to write a C program that reads a csv file, parsing the data that is separated by commas and handling conditions where there are commas or newlines enclosed by quotation marks. Then I made a data structure (a linked list) to store each police call type which held int arrays for storing the time brackets in which the police were dispatched and arrived onscene. Using that data I printed the information alphabetically by call type with the times showing the total times the calls were made including three subfields, may it be the neighborhood or police district. After I used threading to decrease the time it takes to tally up that information onto my linked list.

Approach:

for part 1: my approach was to implement the 4 functions defined in the readme. I need to open the csv and read it with fgets. I started to do strtok but realized that it might be harder because I would have to deal with the commas enclosed in quotation marks. So I decided to do character by character using a buffer. I wanted to read the characters in my buffer and when it encountered a quotation mark it would skip through the buffer until it found another quotation mark in which case it removed the quotation marks and put the string inside my string vector header. And everytime it read a comma it would copy the previous chars as a string into the string vector header. I used the same parsing for csvnext() while also handling new lines by using fgets again if the amount of ("')s were not even signifying that the quotation marks were not closed and putting it into a temporary buffer then adding the tempbuffer into the regular buffer before parsing. I also kept track of the number of columns in the header so I know how many columns each line in the cvs should have and the number of lines in csvnext because csvclose should return the line count if successful.

for part 2: My approach was to use a linked list for my data structure because i had experience with it in csc 317, it will contain the necessary information that we are tracking for each call type, like the total dispatch/onscene time then one of each for the subfields. Each one will be an array from 0-3. 0, is less than 2 minutes, 1 is from 3 to 5 , 2 is from 6 to 10 and 3 being over 10 minutes. Then i had to figure out how to subtract the times from the day time format in the csv, I used strtok to separate the numbers and assigned them to ints for month, day, year, hours,minute . then multiplied each int by the amount of seconds in the month, day , year etc, and subtracted it to get the total seconds. Using the seconds I could use conditions to tally up the different time brackets. Then I print out all the information for each calltype which is contained in its own linked list node. I reused the bubble sort that I wrote in csc 317 to sort the linked list.

for part 3: for threading i would move the whole linked list tallying code into a function that the threads would run while adding locks so that they wouldn't be able to access the same data at the same time. I'll use a for loop so that I can make the number of threads i specified in the run options.

Issues and Resolutions:

My first issue was ... double quotes

I resolved it by... replacing them in the buffer with @'s which is then replaced while parsing into the row array. i replace one of the " with @ and copying over the other one in the buffer, thus removing the second one.

Next issue... dealing with the newlines imbedded by quotes

I resolved it by... counting the numbers of " and if it is even i use a while loop to keep running fgets and appending the temp buffer from fgets with the previous one until "'s had a even count meaning the each quote had a ending

Next issue... running the full size csv, it caused my program to be killed since it was using too much memory

I resolved it by... I tried to store the last row vector globally and the freeing it the next time csvnext was called which worked with a single thread but i wasn't able to get it to work with multiple threads because they would just end up waiting and going the same speed as one thread since csvnext couldn't access the prevrow array until one was finished. So i looked at the implementation in the csvtest and used that to free each line after the tallying was done.

Analysis:

VMware Fusion File Edit View Virtual Machine Window Help

Activities Terminal student@student:~/Documents/csc415-assignment-4-csvthreads-Novedit\$

| | SIGNAL 200 / RAT | 21 | 17 | 3 | 0 | 1 | 13 | 7 | 0 | 1 | 6 | 1 | |
|----------------------|------------------|-------|------|------|-------|-------|-------|------|-------|-------|-----|----|--|
| SILENT ALARM | 1188 | 136 | 529 | 154 | 369 | 233 | 547 | 73 | 335 | 18 | 90 | 1 | |
| SILENT HOLDUP ALARM | 1134 | 602 | 513 | 13 | 6 | 270 | 851 | 4 | 9 | 28 | 28 | 1 | |
| SIT/LIE ENFORCEMENT | 7705 | 1704 | 248 | 364 | 5389 | 3894 | 701 | 175 | 2935 | 44 | 6 | 1 | |
| STABBING | 740 | 422 | 236 | 44 | 38 | 351 | 323 | 19 | 47 | 37 | 17 | 1 | |
| STABBING DV | 26 | 10 | 11 | 3 | 2 | 9 | 14 | 2 | 1 | 0 | 0 | 0 | |
| STALKING | 399 | 45 | 54 | 61 | 239 | 104 | 58 | 34 | 203 | 4 | 1 | 1 | |
| STALKING DV | 62 | 5 | 13 | 9 | 35 | 12 | 13 | 8 | 29 | 0 | 0 | 0 | |
| STOLEN PROPERTY | 475 | 36 | 29 | 54 | 356 | 186 | 29 | 41 | 219 | 0 | 1 | 1 | |
| STOLEN VEHICLE | 5212 | 844 | 658 | 414 | 3296 | 1491 | 827 | 255 | 2639 | 131 | 91 | 6 | |
| STRONGARM ROBBERY | 2032 | 625 | 786 | 215 | 406 | 546 | 1011 | 104 | 371 | 41 | 61 | 2 | |
| SUICIDE ATT CRIT | 45 | 12 | 22 | 7 | 4 | 5 | 30 | 4 | 6 | 0 | 0 | 0 | |
| SUICIDE ATTEMPT | 7816 | 2083 | 4064 | 1213 | 456 | 911 | 5388 | 757 | 760 | 0 | 0 | 0 | |
| SURVEILLANCE | 320 | 314 | 4 | 2 | 0 | 318 | 2 | 0 | 0 | 0 | 0 | 0 | |
| SUSPICIOUS MAILING | 47 | 4 | 11 | 11 | 21 | 7 | 13 | 8 | 19 | 0 | 0 | 0 | |
| SUSPICIOUS PERSON | 49255 | 22372 | 2434 | 3203 | 21246 | 33707 | 2083 | 1359 | 12106 | 10931 | 123 | 12 | |
| SUSPICIOUS VEHICLE | 22388 | 12988 | 844 | 1106 | 7450 | 16102 | 793 | 577 | 4916 | 2654 | 130 | 18 | |
| THREATS / HARASSMENT | 9227 | 580 | 1475 | 1258 | 5914 | 2291 | 1511 | 690 | 4735 | 52 | 108 | 9 | |
| THREATS DV | 521 | 29 | 77 | 66 | 349 | 124 | 83 | 37 | 277 | 0 | 0 | 0 | |
| THREATS EA | 4 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | |
| TOW TRUCK | 7655 | 235 | 1032 | 1229 | 5159 | 312 | 1173 | 1148 | 5022 | 18 | 36 | 4 | |
| TRAF VIOLATION CITE | 50162 | 4022 | 4006 | 4141 | 37993 | 7496 | 5917 | 3734 | 33015 | 357 | 147 | 16 | |
| TRAF VIOLATION TOW | 20436 | 1393 | 2739 | 2862 | 13442 | 1039 | 3986 | 2575 | 12836 | 75 | 149 | 18 | |
| TRAFFIC HAZARD | 5158 | 1341 | 995 | 804 | 2018 | 2080 | 1005 | 444 | 1629 | 186 | 78 | 5 | |
| TRAFFIC STOP | 66151 | 66150 | 0 | 1 | 0 | 66148 | 2 | 1 | 0 | 4237 | 0 | 0 | |
| TRESPASSER | 28087 | 1721 | 2646 | 2878 | 20842 | 10630 | 2556 | 1356 | 13545 | 58 | 117 | 11 | |
| TRO SERVICE | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | |
| TRUANCY | 12 | 1 | 2 | 2 | 7 | 2 | 2 | 2 | 6 | 0 | 0 | 0 | |
| Traffic Pursuit | 9 | 9 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 2 | 0 | 0 | |
| URGENT NOTIFICATION | 3055 | 295 | 716 | 674 | 1370 | 349 | 902 | 469 | 1335 | 37 | 114 | 8 | |
| VANDALISM | 9231 | 1864 | 2596 | 963 | 3808 | 2289 | 3281 | 533 | 3128 | 139 | 208 | 8 | |
| VANDALISM DV | 248 | 61 | 87 | 20 | 80 | 39 | 132 | 12 | 65 | 0 | 0 | 0 | |
| VEH ACCIDENT | 3303 | 1714 | 472 | 333 | 784 | 1920 | 539 | 185 | 659 | 190 | 37 | 3 | |
| VEHICLE ALARM | 805 | 17 | 51 | 62 | 675 | 341 | 47 | 35 | 382 | 1 | 6 | 1 | |
| WANTED VEHICLE / SUB | 7536 | 3739 | 567 | 571 | 2659 | 4439 | 604 | 349 | 2144 | 1037 | 101 | 9 | |
| WELL BEING CHECK | 35126 | 5041 | 9066 | 6854 | 14165 | 7660 | 10362 | 4105 | 12999 | 313 | 621 | 48 | |
| WELL BEING CHECK CA | 31 | 2 | 6 | 10 | 13 | 7 | 7 | 4 | 13 | 0 | 0 | 0 | |
| WELL BEING CHECK DV | 56 | 5 | 12 | 16 | 23 | 7 | 16 | 10 | 23 | 0 | 0 | 0 | |
| WELL BEING CHECK EA | 21 | 3 | 2 | 2 | 14 | 4 | 4 | 1 | 12 | 0 | 0 | 0 | |
| Warrants | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | |
| YCC / JAIL BREAK | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | |
| YOUTH INTERACT | 295 | 295 | 0 | 0 | 0 | 295 | 0 | 0 | 0 | 68 | 0 | 0 | |

This is RUNOPTIONS=Law1M.csv 1 police district BAYVIEW MISSION TENDERLOIN

So with one thread it took 10.28 seconds

The screenshot shows a VMware Fusion interface with a terminal window open. The terminal window title is "student@student: ~/Documents/csc415-assignment-4-csv". The terminal content displays a large table of data with many columns and rows, representing a CSV file. The table includes various police-related incidents such as SIGNAL 200 / RAT, SILENT ALARM, SILENT HOLDUP ALARM, SIT/LIE ENFORCEMENT, STABBING, STABBING DV, STALKING, STALKING DV, STOLEN PROPERTY, STOLEN VEHICLE, STRONGARM ROBBERY, SUICIDE ATT CRIT, SUICIDE ATTEMPT, SURVEILLANCE, SUSPICIOUS MAILING, SUSPICIOUS PERSON, SUSPICIOUS VEHICLE, THREATS / HARASSMENT, THREATS DV, THREATS EA, TOW TRUCK, TRAF VIOLATION CITE, TRAF VIOLATION TOW, TRAFFIC HAZARD, TRAFFIC STOP, TRESPASSER, TRO SERVICE, TRUANCY, Traffic Pursuit, URGENT NOTIFICATION, VANDALISM, VANDALISM DV, VEH ACCIDENT, VEHICLE ALARM, WANTED VEHICLE / SUB, WELL BEING CHECK, WELL BEING CHECK CA, WELL BEING CHECK DV, WELL BEING CHECK EA, Warrants, YGC / JAIL BREAK, and YOUTH INTERACT. The terminal also shows the command "Total Time was 6.556061136 seconds".

| | 21 | 17 | 3 | 8 | 1 | 13 | 7 | 8 | 1 | 6 | 1 | 0 | 0 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
|----------------------|-------|-------|------|------|-------|-------|-------|------|-------|------|-----|-----|------|------|-----|-----|------|------|------|-----|---|---|
| SIGNAL 200 / RAT | 1188 | 136 | 529 | 154 | 369 | 233 | 547 | 73 | 335 | 18 | 98 | 17 | 49 | 32 | 88 | 9 | 45 | 10 | 37 | 13 | 0 | |
| SILENT ALARM | 1134 | 602 | 513 | 13 | 6 | 270 | 851 | 4 | 9 | 28 | 28 | 0 | 0 | 19 | 37 | 0 | 0 | 91 | 63 | 1 | 0 | |
| SILENT HOLDUP ALARM | 7705 | 1784 | 248 | 364 | 5389 | 3894 | 701 | 175 | 2935 | 44 | 6 | 5 | 75 | 65 | 16 | 1 | 48 | 361 | 41 | 44 | 0 | |
| SIT/LIE ENFORCEMENT | 740 | 422 | 236 | 44 | 38 | 351 | 323 | 19 | 47 | 37 | 17 | 3 | 2 | 23 | 32 | 0 | 4 | 80 | 40 | 9 | 0 | |
| STABBING | 26 | 10 | 11 | 3 | 2 | 9 | 14 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| STABBING DV | 399 | 45 | 54 | 61 | 239 | 184 | 58 | 34 | 203 | 4 | 1 | 5 | 18 | 6 | 2 | 5 | 15 | 7 | 11 | 4 | 0 | |
| STALKING | 62 | 5 | 13 | 9 | 35 | 12 | 13 | 8 | 29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| STALKING DV | 475 | 36 | 29 | 54 | 356 | 186 | 29 | 41 | 219 | 0 | 1 | 5 | 21 | 9 | 1 | 5 | 12 | 8 | 4 | 12 | 0 | |
| STOLEN PROPERTY | 5212 | 844 | 658 | 414 | 3296 | 1491 | 827 | 255 | 2639 | 131 | 91 | 68 | 534 | 217 | 114 | 44 | 449 | 137 | 94 | 47 | 0 | |
| STOLEN VEHICLE | 2032 | 625 | 786 | 215 | 406 | 546 | 1011 | 104 | 371 | 41 | 61 | 21 | 33 | 35 | 75 | 12 | 34 | 97 | 130 | 38 | 0 | |
| STRONGARM ROBBERY | 45 | 12 | 22 | 7 | 4 | 5 | 30 | 4 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| SUICIDE ATT CRIT | 7816 | 2083 | 4064 | 1213 | 456 | 911 | 5388 | 757 | 760 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| SUICIDE ATTEMPT | 320 | 314 | 4 | 2 | 0 | 318 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| SURVEILLANCE | 47 | 4 | 11 | 11 | 21 | 7 | 13 | 8 | 19 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | |
| SUSPICIOUS MAILING | 49255 | 23272 | 2434 | 3203 | 21245 | 33706 | 2083 | 1359 | 12105 | 1031 | 123 | 126 | 795 | 1350 | 107 | 80 | 538 | 3680 | 351 | 450 | 0 | |
| SUSPICIOUS PERSON | 22386 | 12987 | 844 | 1106 | 7449 | 16101 | 793 | 577 | 4916 | 2654 | 130 | 180 | 1356 | 3169 | 122 | 98 | 931 | 2191 | 67 | 87 | 0 | |
| SUSPICIOUS VEHICLE | 9226 | 588 | 1475 | 1258 | 5914 | 2291 | 1511 | 690 | 4735 | 52 | 108 | 97 | 432 | 141 | 126 | 57 | 365 | 110 | 221 | 183 | 0 | |
| THREATS / HARASSMENT | 521 | 29 | 77 | 66 | 349 | 124 | 83 | 37 | 277 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| THREATS DV | 4 | 0 | 1 | 0 | 3 | 0 | 1 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| THREATS EA | 7655 | 235 | 1032 | 1229 | 5159 | 312 | 1173 | 1148 | 5022 | 18 | 36 | 44 | 293 | 23 | 43 | 42 | 283 | 30 | 108 | 142 | 0 | |
| TRAF VIOLATION CITE | 50160 | 4022 | 4006 | 4141 | 37992 | 7496 | 5917 | 3734 | 33014 | 357 | 147 | 164 | 3005 | 782 | 226 | 148 | 2517 | 410 | 411 | 502 | 0 | |
| TRAF VIOLATION TOW | 20435 | 1393 | 2739 | 2862 | 13442 | 1039 | 3986 | 2575 | 12835 | 75 | 149 | 188 | 1122 | 83 | 203 | 176 | 1872 | 194 | 386 | 414 | 0 | |
| TRAFFIC HAZARD | 5158 | 1341 | 995 | 804 | 2018 | 2080 | 1005 | 444 | 1629 | 186 | 78 | 58 | 236 | 254 | 82 | 36 | 186 | 131 | 87 | 90 | 0 | |
| TRAFFIC STOP | 66145 | 66146 | 0 | 1 | 0 | 66144 | 2 | 1 | 0 | 4237 | 0 | 0 | 0 | 4237 | 0 | 0 | 0 | 7566 | 0 | 0 | 0 | |
| TRESPASSER | 28087 | 1721 | 2646 | 2878 | 20842 | 10630 | 2556 | 1356 | 13545 | 58 | 117 | 112 | 657 | 260 | 112 | 67 | 505 | 345 | 328 | 340 | 0 | |
| TRO SERVICE | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| TRUANCY | 12 | 1 | 2 | 2 | 7 | 2 | 2 | 2 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Traffic Pursuit | 9 | 9 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 0 | |
| URGENT NOTIFICATION | 3055 | 295 | 716 | 674 | 1370 | 349 | 902 | 469 | 1335 | 37 | 114 | 99 | 224 | 49 | 140 | 62 | 223 | 30 | 69 | 62 | 0 | |
| VANDALISM | 9231 | 1864 | 2596 | 963 | 3808 | 2289 | 3281 | 533 | 3128 | 139 | 208 | 82 | 346 | 174 | 254 | 54 | 293 | 318 | 405 | 146 | 0 | |
| VANDALISM DV | 248 | 61 | 87 | 28 | 80 | 39 | 132 | 12 | 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| VEH ACCIDENT | 3303 | 1714 | 472 | 333 | 784 | 1920 | 539 | 185 | 659 | 199 | 37 | 34 | 100 | 205 | 52 | 19 | 85 | 202 | 51 | 40 | 0 | |
| VEHICLE ALARM | 805 | 17 | 51 | 62 | 675 | 341 | 47 | 35 | 382 | 1 | 6 | 2 | 40 | 17 | 6 | 2 | 24 | 2 | 2 | 7 | 0 | |
| WANTED VEHICLE / SUB | 7536 | 3739 | 567 | 571 | 2659 | 4439 | 604 | 349 | 2144 | 1037 | 101 | 91 | 508 | 1170 | 103 | 56 | 408 | 425 | 53 | 53 | 0 | |
| WELL BEING CHECK | 35125 | 5041 | 9866 | 6854 | 14165 | 7660 | 10362 | 4105 | 12999 | 313 | 621 | 482 | 950 | 391 | 736 | 303 | 936 | 694 | 1114 | 796 | 0 | |
| WELL BEING CHECK CA | 31 | 2 | 6 | 10 | 13 | 7 | 7 | 4 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| WELL BEING CHECK DV | 56 | 5 | 12 | 15 | 23 | 7 | 16 | 10 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| WELL BEING CHECK EA | 21 | 3 | 2 | 2 | 14 | 4 | 4 | 1 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Warrants | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| YGC / JAIL BREAK | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | |
| YOUTH INTERACT | 295 | 295 | 0 | 0 | 0 | 0 | 295 | 0 | 0 | 0 | 68 | 0 | 0 | 0 | 68 | 0 | 0 | 0 | 8 | 0 | 0 | |

Total Time was 6.556061136 seconds

RUNOPTIONS=Law1M.csv 2 police_district BAYVIEW MISSION TENDERLOIN

with two threads it took 6.55 seconds which is 36.29% faster than with one thread, all of the outputs are the same.

RUNOPTIONS=Law1M.csv 4 police district BAYVIEW MISSION TENDERLOIN

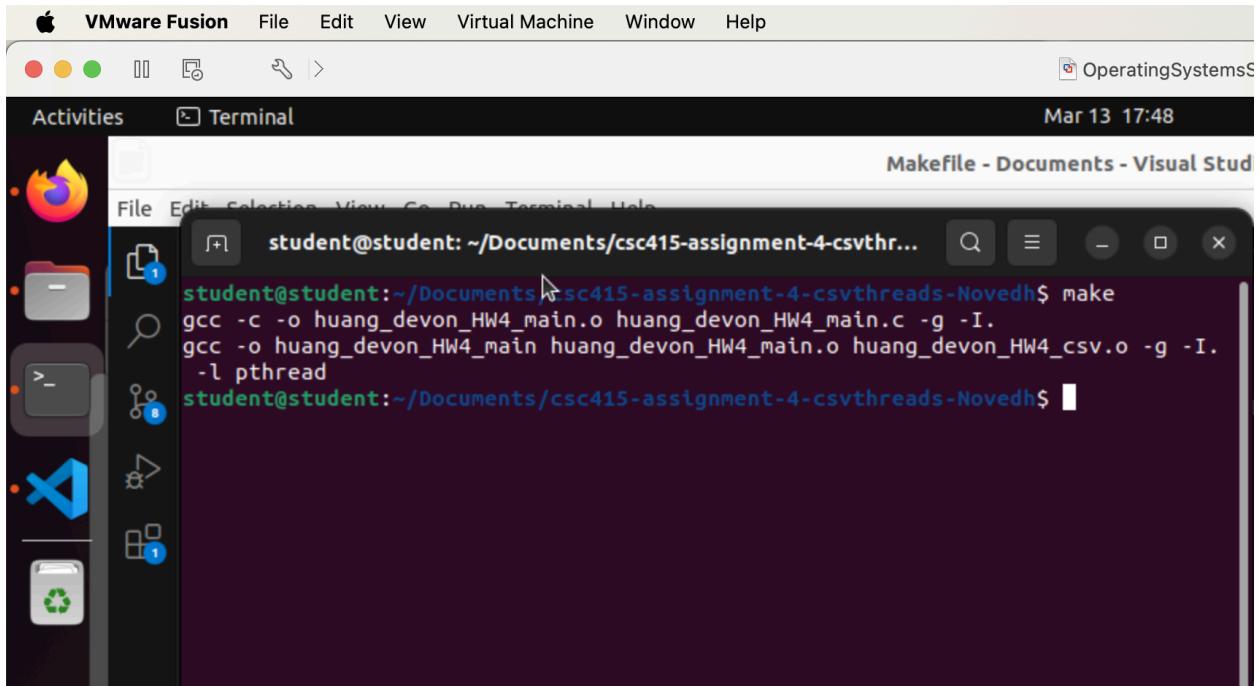
This is when I saw a decrease in speed. I'm not sure why but the time was not much faster after using 4 threads. All of the outputs are the same.

| | | Activities | | Terminal | | Mar 1 | |
|----------------------|---|------------|--|----------|--|-------|--|
| | + [1] | | | | | | |
| SIGNAL 200 / RAT | 21 17 3 0 1 13 7 0 1 6 1 0 0 6 1 0 0 4 | | | | | | |
| SILENT ALARM | 1188 136 529 154 369 233 547 73 335 18 90 17 49 32 88 9 4 | | | | | | |
| SILENT HOLDUP ALARM | 1134 602 513 13 6 270 851 4 9 28 28 0 0 19 37 0 0 | | | | | | |
| SIT/LIE ENFORCEMENT | 7705 1704 248 364 5389 3894 701 175 2935 44 6 5 75 65 16 1 4 | | | | | | |
| STABBING | 749 422 236 44 38 351 323 19 47 37 17 3 2 23 32 0 0 | | | | | | |
| STABBING DV | 26 10 11 3 2 9 14 2 1 0 0 0 0 0 0 0 0 0 | | | | | | |
| STALKING | 399 45 54 61 239 104 58 34 203 4 1 5 18 6 2 5 1 | | | | | | |
| STALKING DV | 62 5 13 9 35 12 13 8 29 0 0 0 0 0 0 0 0 0 | | | | | | |
| STOLEN PROPERTY | 475 36 29 54 356 186 29 41 219 0 1 5 21 9 1 5 1 | | | | | | |
| STOLEN VEHICLE | 5212 844 658 414 3296 1491 827 255 2639 131 91 68 534 217 114 44 44 | | | | | | |
| STRONGARM ROBBERY | 2032 625 786 215 406 546 1011 104 371 41 61 21 33 35 75 12 3 | | | | | | |
| SUICIDE ATT CRIT | 45 12 22 7 4 5 30 4 6 0 0 0 0 0 0 0 0 0 | | | | | | |
| SUICIDE ATTEMPT | 7816 2083 4064 1213 456 911 5388 757 760 0 0 0 0 0 0 0 0 | | | | | | |
| SURVEILLANCE | 320 314 4 2 0 318 2 0 0 0 0 0 0 0 0 0 0 0 | | | | | | |
| SUSPICIOUS MAILING | 47 4 11 11 21 7 13 8 19 0 0 0 5 0 0 0 0 0 | | | | | | |
| SUSPICIOUS PERSON | 49255 22372 2434 3203 21246 33707 2083 1359 12106 1031 123 126 795 1350 107 80 53 | | | | | | |
| SUSPICIOUS VEHICLE | 22388 12988 844 1186 7450 16102 793 577 4916 2654 130 189 1356 3169 122 98 93 | | | | | | |
| THREATS / HARASSMENT | 9227 580 1475 1258 5914 2291 1511 690 4735 52 108 97 432 141 126 57 36 | | | | | | |
| THREATS DV | 521 29 77 66 349 124 83 37 277 0 0 0 0 0 0 0 0 0 | | | | | | |
| THREATS EA | 4 0 1 0 3 0 1 0 3 0 0 0 0 0 0 0 0 0 | | | | | | |
| TOW TRUCK | 7655 235 1032 1229 5159 312 1173 1148 5022 18 36 44 293 23 43 42 28 | | | | | | |
| TRAF VIOLATION CITE | 50160 4022 4066 4141 37992 7495 5917 3734 33014 357 147 164 3005 782 226 148 251 | | | | | | |
| TRAF VIOLATION TOW | 20436 1393 2739 2862 13442 1039 3986 2575 12836 75 149 188 1122 83 203 176 107 | | | | | | |
| TRAFFIC HAZARD | 5158 1341 995 804 2018 2080 1005 444 1629 186 78 58 236 254 82 36 18 | | | | | | |
| TRAFFIC STOP | 66149 66149 0 1 0 66148 2 1 0 4237 0 0 0 0 4237 0 0 0 | | | | | | |
| TRESPASSER | 28087 1721 2646 2878 20842 10630 2556 1356 13545 58 117 112 657 260 112 67 50 | | | | | | |
| TRO SERVICE | 1 1 0 0 0 0 1 0 0 0 1 0 0 0 1 0 0 0 | | | | | | |
| TRUANCY | 12 1 2 2 7 2 2 2 6 0 0 0 0 0 0 0 0 0 | | | | | | |
| Traffic Pursuit | 9 9 0 0 0 0 9 0 0 0 2 0 0 0 2 0 0 0 | | | | | | |
| URGENT NOTIFICATION | 3055 295 716 674 1370 349 992 469 1335 37 114 99 224 49 140 62 22 | | | | | | |
| VANDALISM | 9231 1864 2596 963 3808 2289 3281 533 3128 139 208 82 346 174 254 54 29 | | | | | | |
| VANDALISM DV | 248 61 87 20 80 39 132 12 65 0 0 0 0 0 0 0 0 0 | | | | | | |
| VEH ACCIDENT | 3303 1714 472 333 784 1920 539 185 659 198 37 34 106 205 52 19 8 | | | | | | |
| VEHICLE ALARM | 805 17 51 62 675 341 47 35 382 1 6 2 40 17 6 2 2 | | | | | | |
| WANTED VEHICLE / SUB | 7536 3739 567 571 2659 4439 604 349 2144 1037 101 91 508 1170 103 56 40 | | | | | | |
| WELL BEING CHECK | 35126 5041 9066 6854 14165 7660 10362 4105 12999 313 621 482 958 391 736 303 93 | | | | | | |
| WELL BEING CHECK CA | 31 2 6 10 13 7 7 4 13 0 0 0 0 0 0 0 0 0 | | | | | | |
| WELL BEING CHECK DV | 56 5 12 16 23 7 16 10 23 0 0 0 0 0 0 0 0 0 | | | | | | |
| WELL BEING CHECK EA | 21 3 2 2 14 4 4 1 12 0 0 0 0 0 0 0 0 0 | | | | | | |
| Warrants | 1 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 | | | | | | |
| YGC / JAIL BREAK | 2 1 1 0 0 0 1 1 0 0 1 0 0 0 1 0 0 0 | | | | | | |
| YOUTH INTERACT | 295 295 0 0 0 0 295 0 0 0 68 0 0 0 68 0 0 0 | | | | | | |

RUNOPTIONS=Law1M.csv 8 police district BAYVIEW MISSION TENDERLOIN

with 8 threads the time actually increased compared to 2 and 4 threads but is still faster than with a single thread. All of the outputs are the same.

Screen shot of compilation:

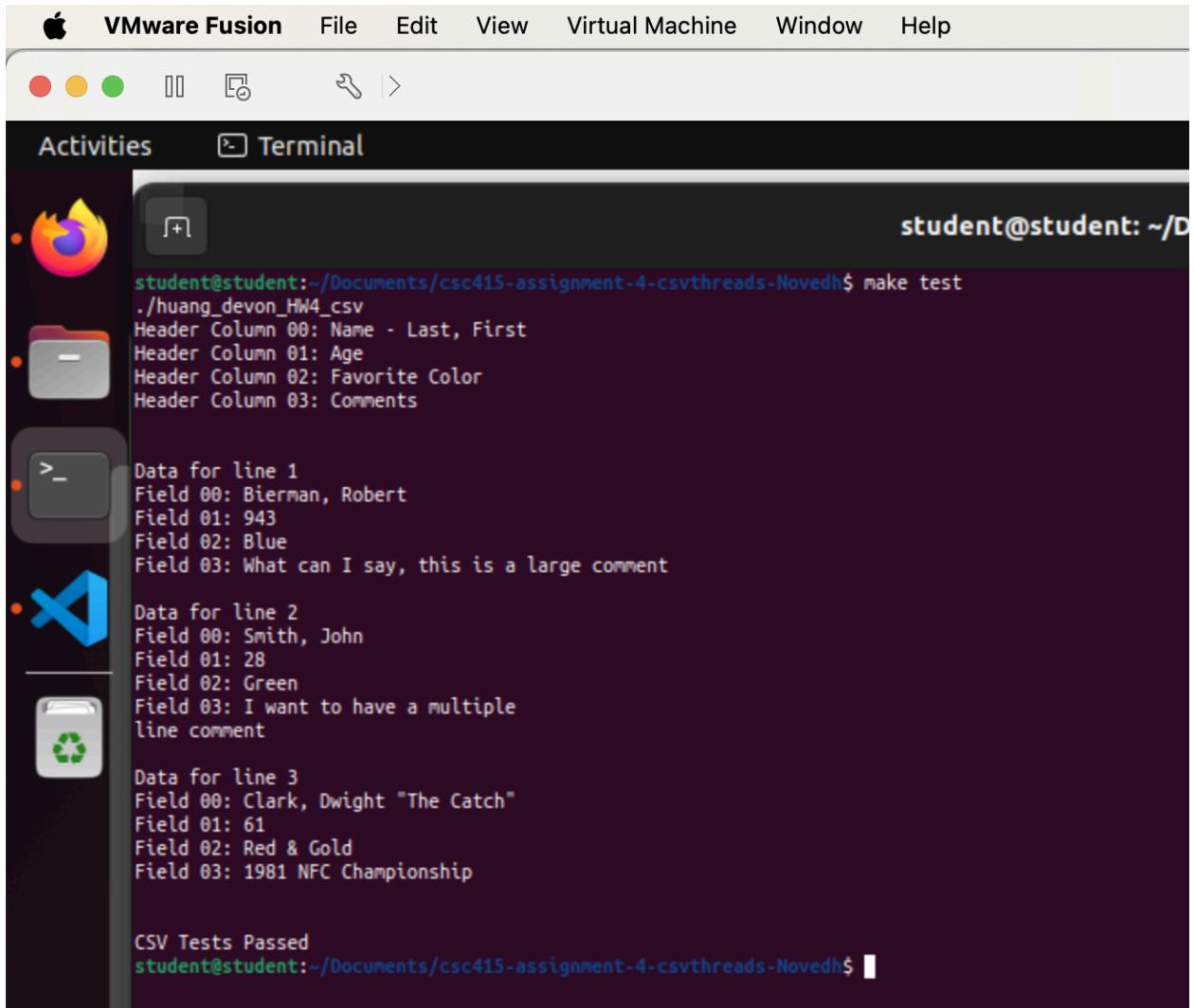


A screenshot of a VMware Fusion terminal window. The window title is "student@student: ~/Documents/csc415-assignment-4-csvthr...". The terminal shows the following command being run:

```
student@student:~/Documents/csc415-assignment-4-csvthreads-Novedh$ make
gcc -c -o huang_devon_HW4_main.o huang_devon_HW4_main.c -g -I.
gcc -o huang_devon_HW4_main huang_devon_HW4_main.o huang_devon_HW4_csv.o -g -I.
-l pthread
student@student:~/Documents/csc415-assignment-4-csvthreads-Novedh$
```

The terminal is part of a larger desktop environment with a dock containing icons for a browser, file manager, terminal, and code editor.

Screen shot(s) of the execution of the program:



The screenshot shows a VMware Fusion window running on a Mac OS X host. The window title is "VMware Fusion". Inside, a terminal window is open with the following command and output:

```
student@student:~/Documents/csc415-assignment-4-csvthreads-Novedh$ make test
./huang_devon_HW4_csv
Header Column 00: Name - Last, First
Header Column 01: Age
Header Column 02: Favorite Color
Header Column 03: Comments

Data for line 1
Field 00: Bierman, Robert
Field 01: 943
Field 02: Blue
Field 03: What can I say, this is a large comment

Data for line 2
Field 00: Smith, John
Field 01: 28
Field 02: Green
Field 03: I want to have a multiple
line comment

Data for line 3
Field 00: Clark, Dwight "The Catch"
Field 01: 61
Field 02: Red & Gold
Field 03: 1981 NFC Championship

CSV Tests Passed
student@student:~/Documents/csc415-assignment-4-csvthreads-Novedh$
```

this is the full output for
RUNOPTIONS=Law_Full.csv 2 police_district BAYVIEW MISSION TENDERLOIN

