Operating Systems

PROJECT IV

REPORT

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Implementation of Module and Tests

In our implementation of module, rather than directly jumping into programming phase we first viewed the sources that our instructor gave. Sources were including simple implementations for kernel modules which we could use as skeleton code. Hence, we used hello module to start implementing our module. First question we searched in online was obtaining the given parameter when initializing our module. However, later, we found out that it was already explained in the sources too. Modules using one entry function and one exit function. In our code, project_module_init does all the job that stated in our assignment. Simple summary of what our module does in step-by-step style is given below.

It gets an PID number at the very first installing onto kernel. After it gets PID as input, it uses its *current* task_struct and iter through until it finds the match. For this purpose, we used *for_each_process* definition that we defined at the beginning of our module_base.c, it uses *next_task* definition, again, defined at the beginning of the file. Once it finds the match with the input PID, it checks whether it has parent or not. If it does have a parent, it first prints the parent's name and PID. Then we are printing our process tree, first parent's name and PID then parent's childs in same style. Since our process is also its parent's child, once we come our process, we are printing our process' childs too. And then we continue with printing other childs of our process' parents. Then, we move to find how much VM does our process allocates. For this purpose, we use mm_struct and vm_area_struct. We get our process' mm_struct. It contains a property called mmap which is a vm_area_struct. vm_area_struct is actually a linked list contains a vm_area_struct objects in it. It also contains vm_start which is the start byte of vm block and it also has vm_end which is the end byte. As you can already guess, vm_end – vm_start gives us the total allocation for each block. Hence, we move in this linked list to find total allocation. While we are moving in liked list, we are printing where each VM start and where each VM ends. And we are also adding the byte count to the totalSize property which we print at the end of the linked list in order to inform our user about the process' VM allocation. Then, as our assignment also ask from us, we start printing the opened files of process. For this purpose, we used files_struct and fdtable structs. files_struct contains a fdtable struct in it. In fdtable struct we have an array of file descriptors called fd[]. Fdtable also contains max_fds integer which indicates the maximum file that can process open. We used that while we are printing our process' opened files. To print specific information, we move in this array. For each fd, we get it's inode information, its name from f_path's dentry object and its flags from f_flags. Struct inode contains more information about our files. i.e block size in bits. In total, for each file, we are printing its File handler, its name, its flags, its inode version number, its size, its block size in bits and its inode number.

We tested our module with using proc folder. To pick a logical folder, we first typed ps -e to command panel to see names of every process that is currently up and running. For every type of process, we made tests. In our modules' early stages, we were crashing the kernel with the OS process' because some of them are not using VM or have any fd. About proc folder, to be more specific, we used mostly stat file in /proc/[pid]/stat. First element in stat is process ID. Second one is its command name. Fourth element is its parent's process ID. Element at 23 is its virtual memory size. We used this for checking our file's Virtual memory size. But for further inspection, we checked /proc/[pid]/maps file which contains address values for each mapped virtual memory. In proc folder we also have comm file which shows the command name of our process.

Sample Output

```
                Input process' parent name is chrome with pid 7725
5359.657434] |+>  chrome pid:7725
5359.657436]       |-->   chrome pid:7957
5359.657438]       |-->   chrome pid:8378
5359.657439]       |-->   chrome pid:8484
5359.657440] VM_START: 195702816768, VM_END: 195702820864
5359.657441] VM_START: 195702820864, VM_END: 195702943744
5359.657442] VM_START: 195702943744, VM_END: 195704127488
5359.657443] VM_START: 1891985915904, VM_END: 1891985920000
5359.657444] VM_START: 1891985920000, VM_END: 1891986042880
5359.657445] VM_START: 1891986042880, VM_END: 1891986706432
5359.657447] VM_START: 1891986706432, VM_END: 1891986829312
5359.657447] VM_START: 1891986829312, VM_END: 1891986837504
5359.657448] VM_START: 1891986837504, VM_END: 1891986960384
5359.657449] VM_START: 1891986960384, VM_END: 1891986968576
5359.657450] VM_START: 1891986968576, VM_END: 1891987091456
5359.657451] VM_START: 1891987091456, VM_END: 1891987099648
5359.657452] VM_START: 1891987099648, VM_END: 1891987222528
5359.657453] VM_START: 1891987222528, VM_END: 1891987226624
5359.657454] VM_START: 2330746785792, VM_END: 2330746789888
5359.657455] VM_START: 2330746789888, VM_END: 2330746916864
5359.657456] VM_START: 2330746916864, VM_END: 2330746920960
5359.657457] VM_START: 2330746920960, VM_END: 2330747047936
5359.657458] VM_START: 2330747047936, VM_END: 2330747052032
5359.657459] VM_START: 2330747052032, VM_END: 2330747273216
5359.657460] VM_START: 2330747273216, VM_END: 2330747277312
5359.657461] VM_START: 2330747277312, VM_END: 2330748518400
5359.657461] VM_START: 3628074663936, VM_END: 3628074668032
5359.657462] VM_START: 3628074668032, VM_END: 3628074790912
5359.657463] VM_START: 3628074790912, VM_END: 3628075061248
5359.657464] VM_START: 3628075061248, VM_END: 3628075184128
5359.657465] VM_START: 3628075184128, VM_END: 3628075192320
5359.657466] VM_START: 3628075192320, VM_END: 3628075315200
5359.657467] VM_START: 3628075315200, VM_END: 3628075323392
5359.657468] VM_START: 3628075323392, VM_END: 3628075446272
5359.657469] VM_START: 3628075446272, VM_END: 3628075454464
5359.657470] VM_START: 3628075454464, VM_END: 3628075577344
5359.657471] VM_START: 3628075577344, VM_END: 3628075585536
5359.657472] VM_START: 3628075585536, VM_END: 3628075708416
5359.657473] VM_START: 3628075708416, VM_END: 3628075716608
5359.657474] VM_START: 3628075716608, VM_END: 3628075839488
5359.657475] VM_START: 3628075839488, VM_END: 3628075847680
5359.657476] VM_START: 3628075847680, VM_END: 3628075970560
5359.657477] VM_START: 3628075970560, VM_END: 3628075974656
5359.657478] VM_START: 5811641778176, VM_END: 5811642302464
5359.657479] VM_START: 6204162048000, VM_END: 6204162052096
5359.657480] VM_START: 6204162052096, VM_END: 6204162056192
5359.657480] VM_START: 6204162056192, VM_END: 6204162064384
5359.657481] VM_START: 6204162064384, VM_END: 6204164128768
5359.657482] VM_START: 6204164128768, VM_END: 6204164149248
5359.657483] VM_START: 6204164149248, VM_END: 6204164153344
5359.657484] VM_START: 6204164153344, VM_END: 6204164161536
5359.657485] VM_START: 6204164161536, VM_END: 6204166225920
5359.657486] VM_START: 6204166225920, VM_END: 6204166246400
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[5359.658142] VM_START: 140726986186752, VM_END: 140726986194944
[5359.658143] Total VM size is ... bytes
[5359.658145] Max opened fds are 64
[5359.658147] File Descriptor 0, File name: null; Flags:32768, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 6
[5359.658149] File Descriptor 1, File name: ; Flags:32769, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 26007
[5359.658150] File Descriptor 2, File name: ; Flags:32769, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 26009
[5359.658151] File Descriptor 3, File name: UNIX; Flags:2050, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 40344
[5359.658153] File Descriptor 4, File name: UNIX; Flags:2, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 26013
[5359.658155] File Descriptor 5, File name: urandom; Flags:32768, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 11
[5359.658156] File Descriptor 6, File name: icudtl.dat; Flags:32768, Version number: 1, Size of file: 10130464, Block size in bits: 12, Inode Number: 571958
[5359.658158] File Descriptor 7, File name: snapshot_blob.bin; Flags:32768, Version number: 1, Size of file: 993500, Block size in bits: 12, Inode Number: 571946
[5359.658160] File Descriptor 8, File name: natives_blob.bin; Flags:32768, Version number: 1, Size of file: 342741, Block size in bits: 12, Inode Number: 571944
[5359.658162] File Descriptor 9, File name: chrome_100_percent.pak; Flags:32768, Version number: 1, Size of file: 512709, Block size in bits: 12, Inode Number: 571938
[5359.658164] File Descriptor 10, File name: chrome_200_percent.pak; Flags:32768, Version number: 1, Size of file: 790162, Block size in bits: 12, Inode Number: 571967
[5359.658165] File Descriptor 11, File name: en-US.pak; Flags:32768, Version number: 1, Size of file: 272373, Block size in bits: 12, Inode Number: 571881
[5359.658167] File Descriptor 12, File name: resources.pak; Flags:32768, Version number: 1, Size of file: 17379802, Block size in bits: 12, Inode Number: 571880
[5359.658168] File Descriptor 13, File name: [eventpoll]; Flags:2, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 6978
[5359.658170] File Descriptor 14, File name: UNIX; Flags:2050, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 40345
[5359.658171] File Descriptor 15, File name: urandom; Flags:32768, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 11
[5359.658173] File Descriptor 16, File name: urandom; Flags:32768, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 11
[5359.658174] File Descriptor 17, File name: urandom; Flags:32768, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 11
[5359.658176] File Descriptor 18, File name: UNIX; Flags:2050, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 40346
[5359.658177] File Descriptor 19, File name: UNIX; Flags:2, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 40292
[5359.658179] File Descriptor 20, File name: UNIX; Flags:2, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 26442
[5359.658180] File Descriptor 21, File name: natives_blob.bin; Flags:32768, Version number: 1, Size of file: 342741, Block size in bits: 12, Inode Number: 571944
[5359.658182] File Descriptor 22, File name: snapshot_blob.bin; Flags:32768, Version number: 1, Size of file: 993500, Block size in bits: 12, Inode Number: 571946
[5359.658184] File Descriptor 23, File name: ; Flags:2048, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 40347
[5359.658185] File Descriptor 24, File name: ; Flags:2049, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 40347
[5359.658187] File Descriptor 25, File name: Ruleset Data; Flags:32768, Version number: 1, Size of file: 3788232, Block size in bits: 12, Inode Number: 829299
[5359.658189] File Descriptor 26, File name: en-US-7-1.bdic; Flags:32768, Version number: 1, Size of file: 446149, Block size in bits: 12, Inode Number: 805642
[5359.658191] File Descriptor 27, File name: .com.google.Chrome.qOhDGQ; Flags:33794, Version number: 0, Size of file: 4198400, Block size in bits: 12, Inode Number: 41
[5359.658193] File Descriptor 28, File name: .com.google.Chrome.eB00wX; Flags:32768, Version number: 0, Size of file: 131060, Block size in bits: 12, Inode Number: 19
[5359.658194] File Descriptor 30, File name: LiberationSans-Regular.ttf; Flags:32768, Version number: 1, Size of file: 139764, Block size in bits: 12, Inode Number: 528055
[5359.658196] File Descriptor 31, File name: LiberationSans-Regular.ttf; Flags:32768, Version number: 1, Size of file: 139764, Block size in bits: 12, Inode Number: 528055
[5359.658198] File Descriptor 32, File name: .com.google.Chrome.940WhH; Flags:33794, Version number: 0, Size of file: 4112, Block size in bits: 12, Inode Number: 76
[5359.658199] File Descriptor 34, File name: UNIX; Flags:2, Version number: 0, Size of file: 0, Block size in bits: 12, Inode Number: 40628
[5359.658201] File Descriptor 36, File name: Symbola_hint.ttf; Flags:32768, Version number: 1, Size of file: 3025192, Block size in bits: 12, Inode Number: 528008
[5359.658203] File Descriptor 37, File name: LiberationMono-Regular.ttf; Flags:32768, Version number: 1, Size of file: 108492, Block size in bits: 12, Inode Number: 528051
[5359.658204] File Descriptor 38, File name: LiberationSans-Bold.ttf; Flags:32768, Version number: 1, Size of file: 137372, Block size in bits: 12, Inode Number: 528052
[5359.658206] File Descriptor 39, File name: LiberationSans-Bold.ttf; Flags:32768, Version number: 1, Size of file: 137372, Block size in bits: 12, Inode Number: 528052
[5359.658207] File Descriptor 40, File name: DejaVuSansMono.ttf; Flags:32768, Version number: 1, Size of file: 340240, Block size in bits: 12, Inode Number: 528014
[5359.658209] File Descriptor 41, File name: LiberationMono-Regular.ttf; Flags:32768, Version number: 1, Size of file: 108492, Block size in bits: 12, Inode Number: 528051
[5359.658211] File Descriptor 42, File name: LiberationSerif-Regular.ttf; Flags:32768, Version number: 1, Size of file: 152408, Block size in bits: 12, Inode Number: 528063
[5359.658212] File Descriptor 43, File name: LiberationSans-Italic.ttf; Flags:32768, Version number: 1, Size of file: 164264, Block size in bits: 12, Inode Number: 528054
[5359.658214] File Descriptor 44, File name: LiberationSans-Italic.ttf; Flags:32768, Version number: 1, Size of file: 164264, Block size in bits: 12, Inode Number: 528054
[5359.658215] File Descriptor 45, File name: LiberationSerif-Regular.ttf; Flags:32768, Version number: 1, Size of file: 152408, Block size in bits: 12, Inode Number: 528063
[5359.658217] File Descriptor 47, File name: DejaVuSansMono.ttf; Flags:32768, Version number: 1, Size of file: 340240, Block size in bits: 12, Inode Number: 528014
[5359.658219] File Descriptor 48, File name: Ubuntu-R.ttf; Flags:32768, Version number: 1, Size of file: 353824, Block size in bits: 12, Inode Number: 528146
[5359.658220] File Descriptor 49, File name: Ubuntu-R.ttf; Flags:32768, Version number: 1, Size of file: 353824, Block size in bits: 12, Inode Number: 528146
[5359.658222] File Descriptor 50, File name: FreeMono.ttf; Flags:32768, Version number: 1, Size of file: 592632, Block size in bits: 12, Inode Number: 528018
[5359.658223] File Descriptor 51, File name: FreeMono.ttf; Flags:32768, Version number: 1, Size of file: 592632, Block size in bits: 12, Inode Number: 528018
[5359.658225] File Descriptor 52, File name: DejaVuSans.ttf; Flags:32768, Version number: 1, Size of file: 756072, Block size in bits: 12, Inode Number: 528012
[5359.658226] File Descriptor 53, File name: DejaVuSans.ttf; Flags:32768, Version number: 1, Size of file: 756072, Block size in bits: 12, Inode Number: 528012
root@dell-VirtualBox:/home/dell/Desktop/Project4#
```

Sample RAW Output

```
[ 3812.413860] ************ BEGINNING OF MODULE ************
[ 3812.413882] Input process' name is chrome
               Input process' parent name is chrome with pid 7725
[ 3812.413883] |+>  chrome pid:7725
[ 3812.413885]       |-->  chrome pid:7845
[ 3812.413887]       |-->  chrome pid:7957
[ 3812.413888]       |-->  chrome pid:7974
[ 3812.413889] VM_START: 358166298624, VM_END: 358166822912
[ 3812.413890] VM_START: 521057337344, VM_END: 521057861632
[ 3812.413891] VM_START: 1010592907264, VM_END: 1010592911360
[ 3812.413892] VM_START: 1010592911360, VM_END: 1010593034240
[ 3812.413893] VM_START: 1010593034240, VM_END: 1010593435648
[ 3812.413893] VM_START: 1010593435648, VM_END: 1010593558528
[ 3812.413894] VM_START: 1010593558528, VM_END: 1010593566720
[ 3812.413895] VM_START: 1010593566720, VM_END: 1010593689600
[ 3812.413896] VM_START: 1010593689600, VM_END: 1010593697792
[ 3812.413896] VM_START: 1010593697792, VM_END: 1010593820672
[ 3812.413897] VM_START: 1010593820672, VM_END: 1010593828864
[ 3812.413898] VM_START: 1010593828864, VM_END: 1010593951744
[ 3812.413899] VM_START: 1010593951744, VM_END: 1010593959936
[ 3812.413900] VM_START: 1010593959936, VM_END: 1010594082816
[ 3812.413900] VM_START: 1010594082816, VM_END: 1010594091008
[ 3812.413901] VM_START: 1010594091008, VM_END: 1010594213888
[ 3812.413902] VM_START: 1010594213888, VM_END: 1010594217984
[ 3812.413903] VM_START: 1797139202048, VM_END: 1797139726336
[ 3812.413904] VM_START: 1800124497920, VM_END: 1800125022208
[ 3812.413904] VM_START: 2330746785792, VM_END: 2330746789888
[ 3812.413905] VM_START: 2330746789888, VM_END: 2330746916864
[ 3812.413906] VM_START: 2330746916864, VM_END: 2330746920960
[ 3812.413907] VM_START: 2330746920960, VM_END: 2330747047936
[ 3812.413908] VM_START: 2330747047936, VM_END: 2330747052032
[ 3812.413908] VM_START: 2330747052032, VM_END: 2330747273216
[ 3812.413909] VM_START: 2330747273216, VM_END: 2330747277312
[ 3812.413910] VM_START: 2330747277312, VM_END: 2330748518400
[ 3812.413911] VM_START: 3090670944256, VM_END: 3090671468544
[ 3812.413912] VM_START: 3801386319872, VM_END: 3801386844160
[ 3812.413913] VM_START: 3954210504704, VM_END: 3954211028992
[ 3812.413914] VM_START: 4009269657600, VM_END: 4009270181888
[ 3812.413914] VM_START: 4156535865344, VM_END: 4156536389632
[ 3812.413915] VM_START: 4233742516224, VM_END: 4233743040512
[ 3812.413916] VM_START: 4235378819072, VM_END: 4235379343360
[ 3812.413917] VM_START: 4666257047552, VM_END: 4666257571840
[ 3812.413918] VM_START: 4963346415616, VM_END: 4963346939904
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```
[ 3812.413919] VM_START: 5065744580608, VM_END: 5065744584704
[ 3812.413919] VM_START: 5065744584704, VM_END: 5065744707584
[ 3812.413920] VM_START: 5065744707584, VM_END: 5065745764352
[ 3812.413921] VM_START: 5065745764352, VM_END: 5065745887232
[ 3812.413922] VM_START: 5065745887232, VM_END: 5065745891328
[ 3812.413923] VM_START: 5120209715200, VM_END: 5120210239488
[ 3812.413924] VM_START: 5267453902848, VM_END: 5267454427136
[ 3812.413925] VM_START: 6163402850304, VM_END: 6163403374592
[ 3812.413925] VM_START: 6191385149440, VM_END: 6191385673728
[ 3812.413926] VM_START: 6214401392640, VM_END: 6214401916928
[ 3812.413927] VM_START: 6810346455040, VM_END: 6810346979328
[ 3812.413928] VM_START: 6997399142400, VM_END: 6997399306240
[ 3812.413928] VM_START: 6997399306240, VM_END: 6997399318528
[ 3812.413929] VM_START: 6997399318528, VM_END: 6997399322624
[ 3812.413930] VM_START: 6997399322624, VM_END: 6997399326720
[ 3812.413931] VM_START: 6997399326720, VM_END: 6997399830528
[ 3812.413931] VM_START: 6997399830528, VM_END: 6997399842816
[ 3812.413932] VM_START: 6997399842816, VM_END: 6997399846912
[ 3812.413933] VM_START: 6997399846912, VM_END: 6997399851008
[ 3812.413934] VM_START: 6997399851008, VM_END: 6997400354816
[ 3812.413934] VM_START: 6997400354816, VM_END: 6997400367104
[ 3812.413935] VM_START: 6997400367104, VM_END: 6997400371200
[ 3812.413936] VM_START: 6997400371200, VM_END: 6997400375296
[ 3812.413937] VM_START: 6997400375296, VM_END: 6997400879104
[ 3812.413938] VM_START: 6997400879104, VM_END: 6997400891392
[ 3812.413939] VM_START: 6997400891392, VM_END: 6997400895488
[ 3812.413940] VM_START: 6997400895488, VM_END: 6997401399296
[ 3812.413941] VM_START: 6997401399296, VM_END: 6997401403392
[ 3812.413941] VM_START: 6997401403392, VM_END: 6997401415680
[ 3812.413942] VM_START: 6997401415680, VM_END: 6997401419776
[ 3812.413944] VM_START: 6997401419776, VM_END: 6997401608192
[ 3812.413944] VM_START: 6997401608192, VM_END: 6997401927680
[ 3812.413945] VM_START: 6997401927680, VM_END: 6997401939968
[ 3812.413946] VM_START: 6997401939968, VM_END: 6997401944064
[ 3812.413947] VM_START: 6997401944064, VM_END: 6997402447872
[ 3812.413948] VM_START: 6997402447872, VM_END: 6997402451968
[ 3812.413949] VM_START: 6997402451968, VM_END: 6997402464256
[ 3812.413949] VM_START: 6997402464256, VM_END: 6997402468352
[ 3812.413950] VM_START: 6997402468352, VM_END: 6997402972160
[ 3812.413952] VM_START: 6997402972160, VM_END: 6997402976256
[ 3812.413952] VM_START: 6997402976256, VM_END: 6997402988544
[ 3812.413954] VM_START: 6997402988544, VM_END: 6997402992640
[ 3812.413955] VM_START: 6997402992640, VM_END: 6997403496448
[ 3812.413956] VM_START: 6997403496448, VM_END: 6997403500544
[ 3812.413957] VM_START: 6997403500544, VM_END: 6997403512832
[ 3812.413957] VM_START: 6997403512832, VM_END: 6997403516928
[ 3812.413958] VM_START: 6997403516928, VM_END: 6997404020736
[ 3812.413959] VM_START: 6997404020736, VM_END: 6997404024832
[ 3812.413960] VM_START: 6997404024832, VM_END: 6997404037120
[ 3812.413961] VM_START: 6997404037120, VM_END: 6997404041216
[ 3812.413962] VM_START: 6997404041216, VM_END: 6997404545024
[ 3812.413962] VM_START: 6997404545024, VM_END: 6997404549120
[ 3812.413963] VM_START: 6997404549120, VM_END: 6997404561408
[ 3812.413964] VM_START: 6997404561408, VM_END: 6997404565504
[ 3812.413965] VM_START: 6997404565504, VM_END: 6997405069312
[ 3812.413965] VM_START: 6997405069312, VM_END: 6997405073408
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[ 3812.414860] VM_START: 139871928365056, VM_END: 139871928373248
[ 3812.414860] VM_START: 139871928373248, VM_END: 139871928377344
[ 3812.414861] VM_START: 139871928377344, VM_END: 139871928426496
[ 3812.414862] VM_START: 139871928426496, VM_END: 139871930519552
[ 3812.414862] VM_START: 139871930519552, VM_END: 139871930523648
[ 3812.414863] VM_START: 139871930523648, VM_END: 139871930527744
[ 3812.414864] VM_START: 139871930527744, VM_END: 139871930556416
[ 3812.414865] VM_START: 139871930556416, VM_END: 139871932649472
[ 3812.414866] VM_START: 139871932649472, VM_END: 139871932653568
[ 3812.414866] VM_START: 139871932653568, VM_END: 139871932657664
[ 3812.414867] VM_START: 139871932657664, VM_END: 139871932669952
[ 3812.414868] VM_START: 139871932669952, VM_END: 139871934763008
[ 3812.414869] VM_START: 139871934763008, VM_END: 139871934767104
[ 3812.414869] VM_START: 139871934767104, VM_END: 139871934771200
[ 3812.414870] VM_START: 139871934771200, VM_END: 139871934869504
[ 3812.414871] VM_START: 139871934869504, VM_END: 139871936962560
[ 3812.414872] VM_START: 139871936962560, VM_END: 139871936966656
[ 3812.414873] VM_START: 139871936966656, VM_END: 139871936970752
[ 3812.414873] VM_START: 139871936970752, VM_END: 139871936987136
[ 3812.414874] VM_START: 139871936987136, VM_END: 139871937142784
[ 3812.414875] VM_START: 139871937142784, VM_END: 139871937417216
[ 3812.414876] VM_START: 139871937417216, VM_END: 139871938412544
[ 3812.414876] VM_START: 139871938412544, VM_END: 139871938490368
[ 3812.414877] VM_START: 139871938490368, VM_END: 139871939014656
[ 3812.414878] VM_START: 139871939014656, VM_END: 139871939026944
[ 3812.414878] VM_START: 139871939026944, VM_END: 139871939031040
[ 3812.414879] VM_START: 139871939031040, VM_END: 139871939117056
[ 3812.414880] VM_START: 139871939121152, VM_END: 139871939190784
[ 3812.414881] VM_START: 139871939190784, VM_END: 139871939194880
[ 3812.414882] VM_START: 139871939194880, VM_END: 139871939198976
[ 3812.414882] VM_START: 139871939198976, VM_END: 139871939227648
[ 3812.414883] VM_START: 139871939227648, VM_END: 139871939235840
[ 3812.414884] VM_START: 139871939235840, VM_END: 139871939239936
[ 3812.414885] VM_START: 139871939239936, VM_END: 139871939244032
[ 3812.414885] VM_START: 139871939244032, VM_END: 139871939248128
[ 3812.414886] VM_START: 140726986018816, VM_END: 140726986158080
[ 3812.414887] VM_START: 140726986178560, VM_END: 140726986186752
[ 3812.414888] VM_START: 140726986186752, VM_END: 140726986194944
[ 3812.414889] Total VM size, 965423104 byte
[ 3812.414892] File Descriptor 0, File name: null; Flags:32768, Version number: 0, Size of
file: 0, Block size in bits: 12, Inode Number: 6
[ 3812.414894] File Descriptor 1, File name: ; Flags:32769, Version number: 0, Size of file:
0, Block size in bits: 12, Inode Number: 26007
[ 3812.414895] File Descriptor 2, File name: ; Flags:32769, Version number: 0, Size of file:
0, Block size in bits: 12, Inode Number: 26009
[ 3812.414896] File Descriptor 3, File name: [eventpoll]; Flags:2, Version number: 0, Size of
file: 0, Block size in bits: 12, Inode Number: 6978
```

[3812.414898] File Descriptor 4, File name: UNIX; Flags:2, Version number: 0, Size of file:
0, Block size in bits: 12, Inode Number: 26013
[3812.414899] File Descriptor 5, File name: urandom; Flags:32768, Version number: 0, Size of
file: 0, Block size in bits: 12, Inode Number: 11
[3812.414901] File Descriptor 6, File name: icudtl.dat; Flags:32768, Version number: 1, Size
of file: 10130464, Block size in bits: 12, Inode Number: 571958
[3812.414902] File Descriptor 7, File name: snapshot_blob.bin; Flags:32768, Version number:
1, Size of file: 993500, Block size in bits: 12, Inode Number: 571946
[3812.414904] File Descriptor 8, File name: natives_blob.bin; Flags:32768, Version number: 1,
Size of file: 342741, Block size in bits: 12, Inode Number: 571944
[3812.414905] File Descriptor 9, File name: chrome_100_percent.pak; Flags:32768, Version
number: 1, Size of file: 512709, Block size in bits: 12, Inode Number: 571938
[3812.414907] File Descriptor 10, File name: chrome_200_percent.pak; Flags:32768, Version
number: 1, Size of file: 790162, Block size in bits: 12, Inode Number: 571967
[3812.414908] File Descriptor 11, File name: en-US.pak; Flags:32768, Version number: 1, Size
of file: 272373, Block size in bits: 12, Inode Number: 571881
[3812.414910] File Descriptor 12, File name: resources.pak; Flags:32768, Version number: 1,
Size of file: 17379802, Block size in bits: 12, Inode Number: 571939
[3812.414911] File Descriptor 13, File name: UNIX; Flags:2050, Version number: 0, Size of
file: 0, Block size in bits: 12, Inode Number: 27196
[3812.414912] File Descriptor 14, File name: UNIX; Flags:2050, Version number: 0, Size of
file: 0, Block size in bits: 12, Inode Number: 27197
[3812.414914] File Descriptor 15, File name: urandom; Flags:32768, Version number: 0, Size of
file: 0, Block size in bits: 12, Inode Number: 11
[3812.414915] File Descriptor 16, File name: urandom; Flags:32768, Version number: 0, Size of
file: 0, Block size in bits: 12, Inode Number: 11
[3812.414916] File Descriptor 17, File name: urandom; Flags:32768, Version number: 0, Size of
file: 0, Block size in bits: 12, Inode Number: 11
[3812.414917] File Descriptor 18, File name: ; Flags:2048, Version number: 0, Size of file:
0, Block size in bits: 12, Inode Number: 27198
[3812.414919] File Descriptor 19, File name: UNIX; Flags:2, Version number: 0, Size of file:
0, Block size in bits: 12, Inode Number: 27185
[3812.414920] File Descriptor 20, File name: UNIX; Flags:2, Version number: 0, Size of file:
0, Block size in bits: 12, Inode Number: 26442
[3812.414922] File Descriptor 21, File name: natives_blob.bin; Flags:32768, Version number:
1, Size of file: 342741, Block size in bits: 12, Inode Number: 571944
[3812.414923] File Descriptor 22, File name: snapshot_blob.bin; Flags:32768, Version number:
1, Size of file: 993500, Block size in bits: 12, Inode Number: 571946
[3812.414924] File Descriptor 23, File name: ; Flags:2049, Version number: 0, Size of file:
0, Block size in bits: 12, Inode Number: 27198
[3812.414926] File Descriptor 24, File name: UNIX; Flags:2050, Version number: 0, Size of
file: 0, Block size in bits: 12, Inode Number: 27200
[3884.472537] ************ END OF MODULE ************

Module Code

```
#include <linux/init.h>
#include <linux/module.h>
#include <linux/sched.h>
#include <linux/module.h>
#include <linux/kernel.h>
#include <asm/uaccess.h>
#include <linux/fs.h>
#include <linux/file.h>
#include <linux/cdev.h>
#include <linux/proc_fs.h>
#include <linux/pid.h>
#include <linux/rcupdate.h>
#include <linux/fdtable.h>
#include <linux/fs_struct.h>
#include <linux/dcache.h>
#include <linux/slab.h>


#define next_task(p) \
list_entry_rcu((p)->tasks.next, struct task_struct, tasks)
```

```c
#define for_each_process(p) \
for (p = &init_task ; (p = next_task(p)) != &init_task ; )

        MODULE_LICENSE("GPL");
MODULE_AUTHOR("Serhan GURSOY & Ege YOSUNKAYA");
MODULE_DESCRIPTION("CS342 PROJECT 4 KERNEL MODULE. IT DOES REALLY TRICKY
JOBS. REALLY. SO, WATCH OUT FOR ITS OUTPUTS.");

short isDebug = 0;
int input_pid = -1;
module_param(input_pid, int, S_IRUSR | S_IWUSR | S_IRGRP | S_IROTH);

static int project_module_init(void)
{
        printk(KERN_INFO "************ BEGINNING OF MODULE
************\n");

        if (isDebug) {
                printk(KERN_WARNING "Input PID is %i\n", input_pid);
                printk("%s: The calling process is \"%s\" (pid
%i)\n",__FUNCTION__, current->comm, current->pid);
        }

        struct task_struct *temp = current;
        short checkerByte = 0;

        for_each_process(temp) {
                if (temp != NULL) {
                        if (temp->pid == input_pid) {
                                char *parentName = "NO PARENT - OS FUNCTION";
                                int  parentPid = "0";

                                // If we have task's parent, proceed from
here.
                                if (temp->parent != NULL) {
                                        parentName = temp->parent->comm;
                                        parentPid = temp->parent->pid;


                                        printk(KERN_WARNING "Input process'
name is %s\nInput process' parent name is %s with pid %i\n", temp->comm,
parentName, parentPid);

                                        printk(KERN_WARNING "|+>  %s
pid:%i\n", parentName, parentPid);

                                                struct list_head *p; //Pointer
                                                struct task_struct child_task;
                                                if (&(temp->parent->children) !=
NULL) {
                                                        list_for_each(p, &(temp-
>parent->children)){
                                                                child_task =
*list_entry(p, struct task_struct, sibling);
                                                                if (child_task.pid !=
input_pid)
                                                                        printk("
|-->  %s pid:%d\n",child_task.comm, child_task.pid);
                                                                else{
                                                                        printk("
|-->  %s pid:%d\n",child_task.comm, child_task.pid);
```

```c
                                    struct list_head *p2;
//Pointer
child task2;
                                    struct task_struct
                                    list_for_each(p2, &(temp-
>children)){
                                        child_task2 =
*list_entry(p2, struct task_struct, sibling);
                                        if (child_task2.pid !=
input_pid)
                                            printk("
|-->  %s pid:%d\n",child_task2.comm, child_task2.pid);
                                        }
                                    }
                                }
                            }

                    checkerByte = 1;

                    struct mm_struct *m = NULL;
                    struct vm_area_struct *v = NULL;
                    long totalSize = 0;

                    if(temp->mm != NULL)
                        m = temp->mm;

                    if (m != NULL) {

                        if (m->mmap != NULL)
                            v = m->mmap;

                        while(v != NULL) {
                            printk(KERN_WARNING "VM_START: %ld,
VM_END: %ld\n", v->vm_start, v->vm_end);
                            totalSize += v->vm_end - v->vm_start;
                            v = v->vm_next;
                        }

                        printk(KERN_ERR "Total VM size, %ld byte\n",
totalSize);
                    } else {
                        printk(KERN_ERR "Total VM size, 0 byte. It's
probably an OS process\n");
                    }

                    struct files_struct *files_task;
                    struct fdtable *table_file;

                    if (temp->files != NULL) {
                        files_task = temp->files;
                        table_file = files_fdtable(files_task);
                        int count = 0;
                        if (table_file != NULL) {
                            if (table_file->fd != NULL) {
                                int max_fd = table_file-
>max_fds;
                                // printk("Max opened fds are
%lu\n", max_fd);

                                short checkFiles = 0;
                                while(count < max_fd) {
```

```c
                                                        if (table_file-
>fd[count] != NULL) {
                                                            if
(table_file->fd[count]->f_inode != NULL) {
                                                                struct
inode *tmpNode = table_file->fd[count]->f_inode;

            printk(KERN_EMERG "File Descriptor %i, File name: %s; Flags:%ld,
Version number: %ld, Size of file: %lld, Block size in bits: %hu, Inode
Number: %ld\n",

            count, table_file->fd[count]->f_path.dentry->d_name.name,
table_file->fd[count]->f_flags, tmpNode->i_version, tmpNode->i_size,
tmpNode->i_blkbits, tmpNode->i_ino);

                                                                if
(!checkFiles) checkFiles = 1;
                                                            }
                                                        }
                                                        count++;
                                                    }

                                            if (!checkFiles)
                                                printk(KERN_ERR "This
process doesn't contain any opened files.\n");

                                        } else {
                                            printk(KERN_ERR "This process
doesn't contain any opened files.\n");
                                        }
                                    } else {
                                        printk(KERN_ERR "This process doesn't
contain any opened files.\n");
                                    }
                                } else {
                                    printk(KERN_ERR "This process doesn't contain
any opened files.\n");
                                }
                    }
                }
            }
}

if (checkerByte==0)
        printk(KERN_ERR "Couldn't find process with pid %i, are you sure
it's exists?\n", input_pid);

return 0;
}

static void project_module_exit(void)
{
        printk(KERN_INFO "************ END OF MODULE ************\n");
}


module_init(project_module_init);
module_exit(project_module_exit);
```