

**For each member in your team, provide 1 paragraph detailing what parts of the lab that member implemented / researched. (You may skip this question if you are doing the lab by yourself).**

Shweta – I have modified the file vmx.c to implement the logic to find the total number of exits, total number of cycles, total number of individual exits and total number of individual cycles as per the assignment requirement. I have helped to prepare this document.

Radhika – I have researched on the modifications to be made to the code and the logic to be used for the implementation of total number of exits, total number of cycles, total number of individual exits and total number of individual cycles as per the assignment requirements. I have written also this document.

**Describe in detail the steps you used to complete the assignment. Consider your reader to be someone skilled in software development but otherwise unfamiliar with the assignment. Good answers to this question will be recipes that someone can follow to reproduce your development steps.**

Open linux→arch→x86→kvm→vmx.c

Make changes to implement the requirement in the vmx.c to add counters into the KVM that track the following information:

Total number of exits (for each type of exit KVM enables)

Max number of CPU cycles for each exit type

Min number of CPU cycles for each exit type

Average number of CPU cycles for each exit type

Total amount of cycles spent processing all exits

Compile the kernel and its modules by checking number of processing units available

`nproc` [ to know the number of processing units, in our case it was 4]

`sudo make -j 4 && sudo make modules_install -j 4 && sudo make install -j 4`

Next reboot the system and start a virtual machine in order to trigger the exits.

Now, execute `dmesg` to see the output.

Note whether or not you used a larger count of exits between outputs (1000 or 2000 exits vs the suggested 500).

No, we used only 500 for the count of exits.

Include a sample of your print output from dmesg (take just one set of outputs).

```
721.517473 min time for exit reason 04 is 0
721.517474 total time for exit reason 04 is 0
721.517475 total no of times exit reason 04 happened is 0
721.517476
721.517477 total time : 2567500
721.517478
721.517479
721.517480
721.517481 with reason : 1 -- EXCFETCH_AMT
721.517482 average time for exit reason 0 is 10715
721.517483 max time for exit reason 0 is 25303
721.517484 min time for exit reason 0 is 457
721.517485 total time for exit reason 0 is 217309
721.517486 total no of times exit reason 0 happened is 11
721.517487 exit reason : 1 -- EXTERNAL_INTERRUPT
721.517488 average time for exit reason 1 is 333
721.517489 max time for exit reason 1 is 25001
721.517490 min time for exit reason 1 is 13
721.517491 total time for exit reason 1 is 4515267
721.517492 total no of times exit reason 1 happened is 13501
721.517493 exit reason : 1 -- TRIPLE_FAULT
721.517494 average time for exit reason 1 is 0
721.517495 max time for exit reason 2 is 0
721.517496 min time for exit reason 2 is 0
721.517497 total time for exit reason 2 is 0
721.517498 total no of times exit reason 2 happened is 0
721.517499 exit reason : 7 -- PENDING_INTERRUPT
721.517500 average time for exit reason 7 is 534
721.517501 max time for exit reason 7 is 21701
721.517502 min time for exit reason 7 is 34
721.517503 total time for exit reason 7 is 1547768
721.517504 total no of times exit reason 7 happened is 2932
721.517505 exit reason : 8 -- HRT_WINDOW
721.517506 average time for exit reason 8 is 0
721.517507 max time for exit reason 8 is 0
721.517508 min time for exit reason 8 is 0
721.517509 total time for exit reason 8 is 0
721.517510 total no of times exit reason 8 happened is 0
721.517511 exit reason : 9 -- TASK_SWITCH
721.517512 average time for exit reason 9 is 0
721.517513 max time for exit reason 9 is 0
721.517514 min time for exit reason 9 is 0
721.517515 total time for exit reason 9 is 0
721.517516 total no of times exit reason 9 happened is 0
721.517517 exit reason : 10 -- CPUID
721.517518 average time for exit reason 10 is 1077
721.517519 max time for exit reason 10 is 14740
721.517520 min time for exit reason 10 is 110
721.517521 total time for exit reason 10 is 342942
721.517522 total no of times exit reason 10 happened is 3214
```

What did you learn from the count of exits? Was the count what you expected? If not, why not?

The total count was higher than what we expected, and specifically MSR\_WRITE, IO\_INSTRUCTION, CPUID had a high no of exits count.

The reason for high count is that, the virtual machine is trying to execute these operations a lot of times, and each time it is exiting to the KVM.