

CMPE-283 Assignment - 2

Overview

In this assignment we will modify the CPUID emulation code in KVM, for the remaining 2 leaf nodes `0x4FFFFFE` and `0x4FFFFFFF`, by following some predefined rules set by SDM.

Contribution

Asish's Contribution

I modified the code in `vmx.c` to track the exit types by exit reason and also edit the `cpuid.c` to support the new LEAF node, also created a test c code to for the specific exit counts.

Dheeraj's Contribution

Investigated exit kinds that are not enabled in the KVM and not specified by the SDM. and modified `cpuid.c` to handle the exit kinds appropriately. Install the CPUid package and learn about its applications. Made a user application that prints the count for a given exit cause and added updates to the documentation.

Procedure

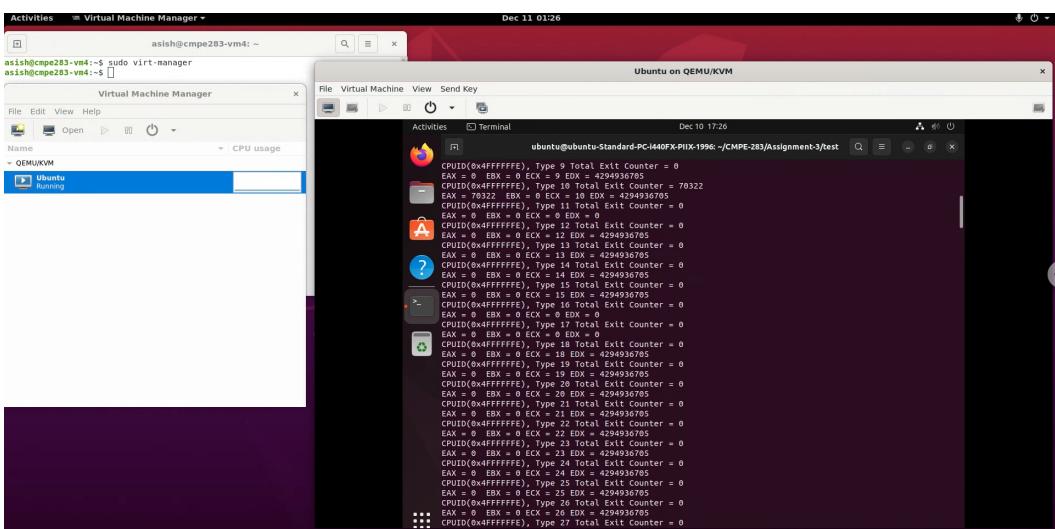
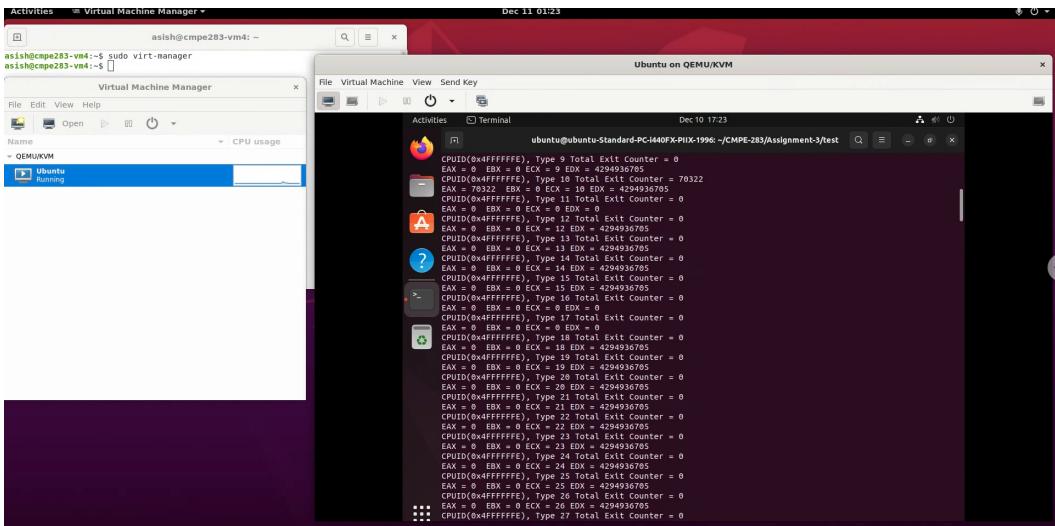
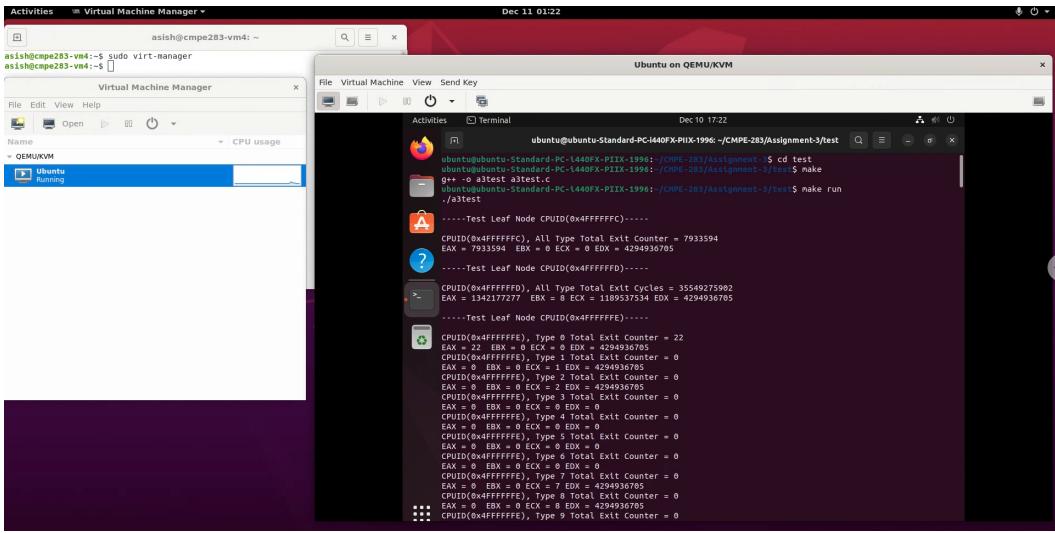
1. We use the same environment used for the assignment-2
2. Switch to the linux working directory and update the following files `vmx.c` and `cpuid.c` to update the following leaf node `0x4FFFFFE` and `0x4FFFFFFF`
3. After modifying the `vmx.c` and `cpuid.c` we now modify the header file with some constant values
4. Now we build our kernel again and remove and load the kvm intel module again.

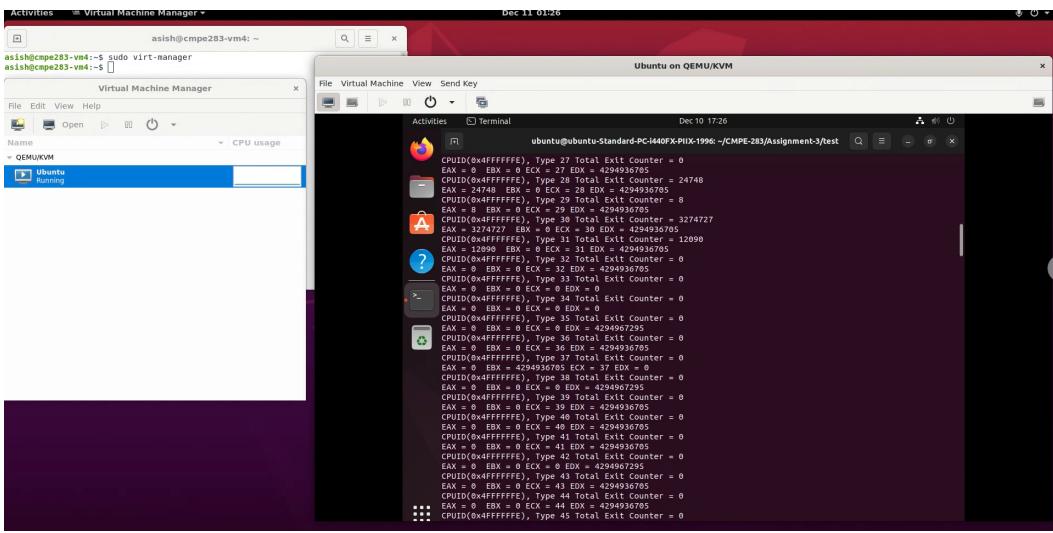
```
make -j 8 modules && make -j modules_install && make  
rmmod kvm_intel  
rmmod kvm  
insmod arch/x86/kvm/kvm.ko  
insmod arch/x86/kvm/kvm-intel.ko
```

5. Reboot the VM
6. Start your inner VM and write a small .c file to test the output result along with its makefile.
7. Run the test file

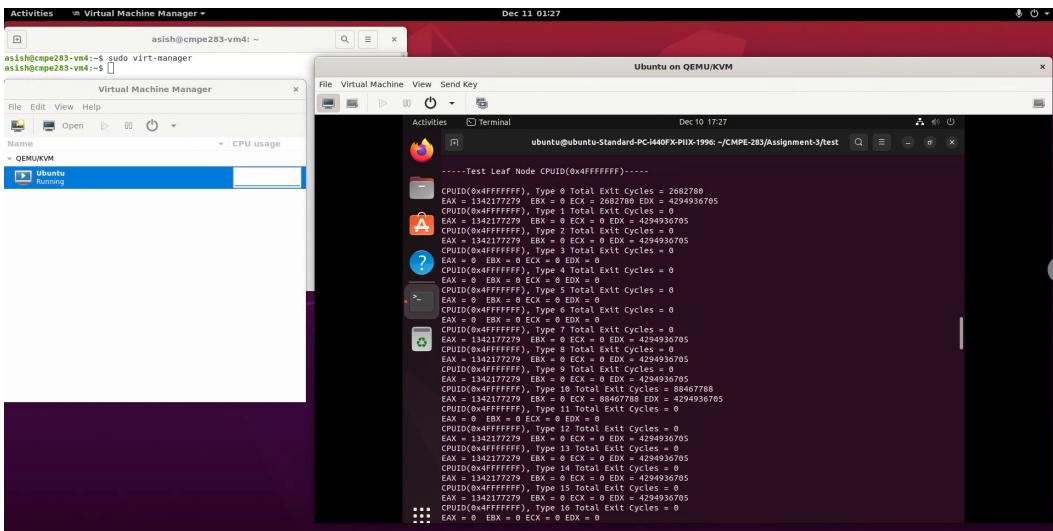
```
make  
make run
```

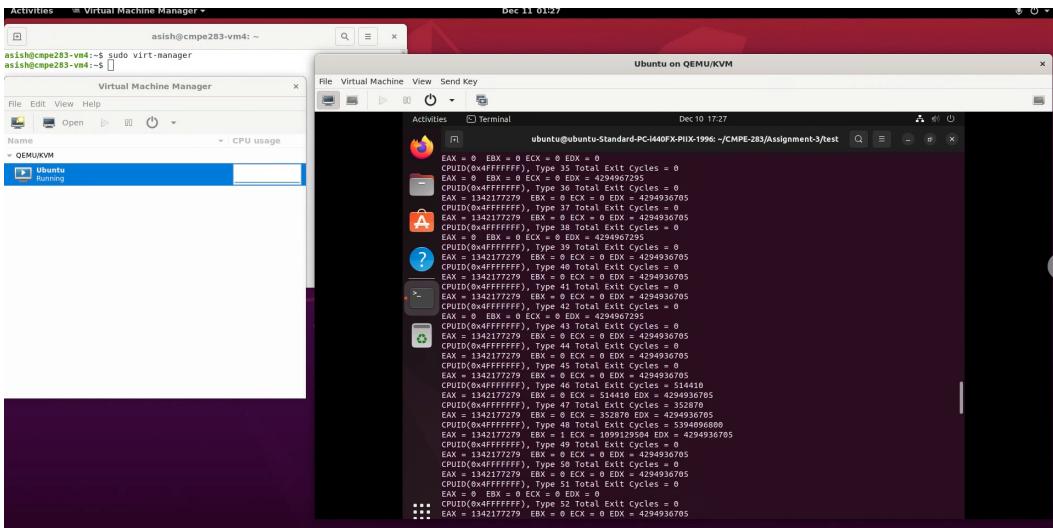
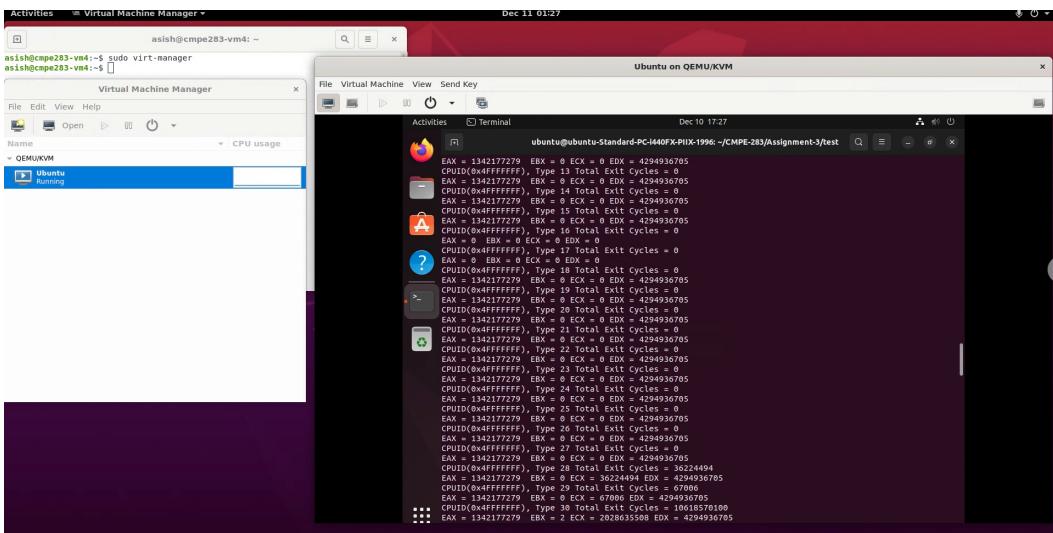
`0x4FFFFFE` - test output





0x4FFFFFFF - test output





8. Now in outer VM we run the following command `sudo dmesg`

`0x4FFFFFFE - output`

```
[ 135.054020] ### Type 15 Exit Count = 0
[ 135.054021] KVM CPUID(0x4FFFFFFE) -> ECX = 14
~ -- asish@cmpe283-vm4: ~ -- ssh asish@34.16.167.100 ~ -- zsh ~ -- zsh
[ 2012.905293] virbr0: topology change detected, propagating
[ 2225.876005] ### CPUID(0x4FFFFFC) ->
[ 2225.876009] ### Total Exits = 3519608
[ 2225.876009] ### CPUID(0x4FFFFFD) ->
[ 2225.876011] ### Total CPU Exit Cycle Time = 16052151832
[ 2225.876114] ### CPUID(0x4FFFFFFE) -> ECX = 0
[ 2225.876115] ### Type 0 Exit Count = 11
[ 2225.876133] ### CPUID(0x4FFFFFFE) -> ECX = 1
[ 2225.876134] ### Type 1 Exit Count = 0
[ 2225.876151] ### CPUID(0x4FFFFFFE) -> ECX = 2
[ 2225.876153] ### Type 2 Exit Count = 0
[ 2225.876186] ### CPUID(0x4FFFFFFE) -> ECX = 3
[ 2225.876187] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2225.876274] ### CPUID(0x4FFFFFFE) -> ECX = 4
[ 2225.876275] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2225.876296] ### CPUID(0x4FFFFFFE) -> ECX = 5
[ 2225.876297] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2225.876332] ### CPUID(0x4FFFFFFE) -> ECX = 6
[ 2225.876333] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2225.876368] ### CPUID(0x4FFFFFFE) -> ECX = 7
[ 2225.876369] ### Type 7 Exit Count = 0
[ 2225.876386] ### CPUID(0x4FFFFFFE) -> ECX = 8
[ 2225.876387] ### Type 8 Exit Count = 0
[ 2225.876405] ### CPUID(0x4FFFFFFE) -> ECX = 9
[ 2225.876406] ### Type 9 Exit Count = 0
[ 2225.876439] ### CPUID(0x4FFFFFFE) -> ECX = 10
[ 2225.876440] ### Type 10 Exit Count = 32876
[ 2225.876478] ### CPUID(0x4FFFFFFE) -> ECX = 11
[ 2225.876480] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2225.876501] ### CPUID(0x4FFFFFFE) -> ECX = 12
```

```
~ -- asish@cmpe283-vm4: ~ -- ssh asish@34.16.167.100 ~ -- zsh ~ -- zsh
[ 2225.876721] ### Type 18 Exit Count = 0
[ 2225.876757] ### CPUID(0x4FFFFFFE) -> ECX = 19
[ 2225.876758] ### Type 19 Exit Count = 0
[ 2225.876790] ### CPUID(0x4FFFFFFE) -> ECX = 20
[ 2225.876791] ### Type 20 Exit Count = 0
[ 2225.876824] ### CPUID(0x4FFFFFFE) -> ECX = 21
[ 2225.876825] ### Type 21 Exit Count = 0
[ 2225.876857] ### CPUID(0x4FFFFFFE) -> ECX = 22
[ 2225.876858] ### Type 22 Exit Count = 0
[ 2225.876890] ### CPUID(0x4FFFFFFE) -> ECX = 23
[ 2225.876892] ### Type 23 Exit Count = 0
[ 2225.876923] ### CPUID(0x4FFFFFFE) -> ECX = 24
[ 2225.876925] ### Type 24 Exit Count = 0
[ 2225.876957] ### CPUID(0x4FFFFFFE) -> ECX = 25
[ 2225.876958] ### Type 25 Exit Count = 0
[ 2225.876991] ### CPUID(0x4FFFFFFE) -> ECX = 26
[ 2225.876992] ### Type 26 Exit Count = 0
[ 2225.877024] ### CPUID(0x4FFFFFFE) -> ECX = 27
[ 2225.877026] ### Type 27 Exit Count = 0
[ 2225.877058] ### CPUID(0x4FFFFFFE) -> ECX = 28
[ 2225.877059] ### Type 28 Exit Count = 12407
[ 2225.877091] ### CPUID(0x4FFFFFFE) -> ECX = 29
[ 2225.877093] ### Type 29 Exit Count = 4
[ 2225.877125] ### CPUID(0x4FFFFFFE) -> ECX = 30
[ 2225.877127] ### Type 30 Exit Count = 1484388
[ 2225.877159] ### CPUID(0x4FFFFFFE) -> ECX = 31
[ 2225.877160] ### Type 31 Exit Count = 1931
[ 2225.877194] ### CPUID(0x4FFFFFFE) -> ECX = 32
[ 2225.877195] ### Type 32 Exit Count = 0
[ 2225.877227] ### CPUID(0x4FFFFFFE) -> ECX = 33
```

```
-- asish@cmpe283-vm4: ~ -- ssh asish@34.16.167.100 ~ -- zsh ~ -- zsh +  
[ 2225.877195] ### Type 32 Exit Count = 0  
[ 2225.877227] ### CPUID(0x4FFFFFFE) -> ECX = 33  
[ 2225.877229] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.877260] ### CPUID(0x4FFFFFFE) -> ECX = 34  
[ 2225.877262] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.877294] ### CPUID(0x4FFFFFFE) -> ECX = 35  
[ 2225.877295] ### Exit Number in ECX Not Defined in SDM  
[ 2225.877327] ### CPUID(0x4FFFFFFE) -> ECX = 36  
[ 2225.877328] ### Type 36 Exit Count = 0  
[ 2225.877362] ### CPUID(0x4FFFFFFE) -> ECX = 37  
[ 2225.877363] ### Type 37 Exit Count = 0  
[ 2225.877395] ### CPUID(0x4FFFFFFE) -> ECX = 38  
[ 2225.877396] ### Exit Number in ECX Not Defined in SDM  
[ 2225.877428] ### CPUID(0x4FFFFFFE) -> ECX = 39  
[ 2225.877429] ### Type 39 Exit Count = 0  
[ 2225.877461] ### CPUID(0x4FFFFFFE) -> ECX = 40  
[ 2225.877463] ### Type 40 Exit Count = 0  
[ 2225.877497] ### CPUID(0x4FFFFFFE) -> ECX = 41  
[ 2225.877499] ### Type 41 Exit Count = 0  
[ 2225.877531] ### CPUID(0x4FFFFFFE) -> ECX = 42  
[ 2225.877532] ### Exit Number in ECX Not Defined in SDM  
[ 2225.877564] ### CPUID(0x4FFFFFFE) -> ECX = 43  
[ 2225.877565] ### Type 43 Exit Count = 0  
[ 2225.877597] ### CPUID(0x4FFFFFFE) -> ECX = 44  
[ 2225.877599] ### Type 44 Exit Count = 0  
[ 2225.877631] ### CPUID(0x4FFFFFFE) -> ECX = 45  
[ 2225.877632] ### Type 45 Exit Count = 0  
[ 2225.877665] ### CPUID(0x4FFFFFFE) -> ECX = 46  
[ 2225.877666] ### Type 46 Exit Count = 10  
[ 2225.877699] ### CPUID(0x4FFFFFFE) -> ECX = 47
```

```
-- asish@cmpe283-vm4: ~ -- ssh asish@34.16.167.100 ~ -- zsh ~ -- zsh +  
[ 2225.878191] ### CPUID(0x4FFFFFFE) -> ECX = 60  
[ 2225.878193] ### Type 60 Exit Count = 0  
[ 2225.878225] ### CPUID(0x4FFFFFFE) -> ECX = 61  
[ 2225.878226] ### Type 61 Exit Count = 0  
[ 2225.878259] ### CPUID(0x4FFFFFFE) -> ECX = 62  
[ 2225.878260] ### Type 62 Exit Count = 0  
[ 2225.878292] ### CPUID(0x4FFFFFFE) -> ECX = 63  
[ 2225.878293] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.878325] ### CPUID(0x4FFFFFFE) -> ECX = 64  
[ 2225.878326] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.878361] ### CPUID(0x4FFFFFFE) -> ECX = 65  
[ 2225.878362] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.878423] ### CPUID(0x4FFFFFFE) -> ECX = 66  
[ 2225.878425] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.878460] ### CPUID(0x4FFFFFFE) -> ECX = 67  
[ 2225.878461] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.878517] ### CPUID(0x4FFFFFFE) -> ECX = 68  
[ 2225.878519] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.878533] ### CPUID(0x4FFFFFFE) -> ECX = 69  
[ 2225.878554] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.878586] ### CPUID(0x4FFFFFFE) -> ECX = 70  
[ 2225.878588] ### Exit Number in ECX Not Defined in SDM  
[ 2225.878620] ### CPUID(0x4FFFFFFE) -> ECX = 71  
[ 2225.878621] ### Exit Number in ECX Not Defined in SDM  
[ 2225.878653] ### CPUID(0x4FFFFFFE) -> ECX = 72  
[ 2225.878654] ### Exit Number in ECX Not Defined in SDM  
[ 2225.878686] ### CPUID(0x4FFFFFFE) -> ECX = 73  
[ 2225.878687] ### Exit Number in ECX Not Defined in SDM  
[ 2225.878719] ### CPUID(0x4FFFFFFE) -> ECX = 74  
[ 2225.878721] ### Exit Number in ECX Not Defined in SDM
```

0x4FFFFFFF - output

```
-- asish@cmpe283-vm4: -- ssh asish@34.16.167.100      ~ -- zsh
[ 2225.878777] ### Type 0 CPU Exit Cycle Time = 1323510
[ 2225.878796] ### CPUID(0x4FFFFFFF) -> ECX = 1
[ 2225.878797] ### Type 1 CPU Exit Cycle Time = 0
[ 2225.878830] ### CPUID(0x4FFFFFFF) -> ECX = 2
[ 2225.878831] ### Type 2 CPU Exit Cycle Time = 0
[ 2225.878863] ### CPUID(0x4FFFFFFF) -> ECX = 3
[ 2225.878865] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2225.878897] ### CPUID(0x4FFFFFFF) -> ECX = 4
[ 2225.878898] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2225.878930] ### CPUID(0x4FFFFFFF) -> ECX = 5
[ 2225.878931] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2225.878965] ### CPUID(0x4FFFFFFF) -> ECX = 6
[ 2225.878966] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2225.878998] ### CPUID(0x4FFFFFFF) -> ECX = 7
[ 2225.878999] ### Type 7 CPU Exit Cycle Time = 0
[ 2225.879031] ### CPUID(0x4FFFFFFF) -> ECX = 8
[ 2225.879033] ### Type 8 CPU Exit Cycle Time = 0
[ 2225.879065] ### CPUID(0x4FFFFFFF) -> ECX = 9
[ 2225.879066] ### Type 9 CPU Exit Cycle Time = 0
[ 2225.879099] ### CPUID(0x4FFFFFFF) -> ECX = 10
[ 2225.879100] ### Type 10 CPU Exit Cycle Time = 40951378
[ 2225.879133] ### CPUID(0x4FFFFFFF) -> ECX = 11
[ 2225.879134] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2225.879168] ### CPUID(0x4FFFFFFF) -> ECX = 12
[ 2225.879169] ### Type 12 CPU Exit Cycle Time = 0
[ 2225.879201] ### CPUID(0x4FFFFFFF) -> ECX = 13
[ 2225.879203] ### Type 13 CPU Exit Cycle Time = 0
[ 2225.879235] ### CPUID(0x4FFFFFFF) -> ECX = 14
[ 2225.879236] ### Type 14 CPU Exit Cycle Time = 0
[ 2225.879269] ### CPUID(0x4FFFFFFF) -> ECX = 15
```

```
-- asish@cmpe283-vm4: -- ssh asish@34.16.167.100      ~ -- zsh
[ 2225.879235] ### CPUID(0x4FFFFFFF) -> ECX = 14
[ 2225.879236] ### Type 14 CPU Exit Cycle Time = 0
[ 2225.879269] ### CPUID(0x4FFFFFFF) -> ECX = 15
[ 2225.879270] ### Type 15 CPU Exit Cycle Time = 0
[ 2225.879303] ### CPUID(0x4FFFFFFF) -> ECX = 16
[ 2225.879304] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2225.879343] ### CPUID(0x4FFFFFFF) -> ECX = 17
[ 2225.879345] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2225.879407] ### CPUID(0x4FFFFFFF) -> ECX = 18
[ 2225.879409] ### Type 18 CPU Exit Cycle Time = 0
[ 2225.879442] ### CPUID(0x4FFFFFFF) -> ECX = 19
[ 2225.879443] ### Type 19 CPU Exit Cycle Time = 0
[ 2225.879476] ### CPUID(0x4FFFFFFF) -> ECX = 20
[ 2225.879477] ### Type 20 CPU Exit Cycle Time = 0
[ 2225.879509] ### CPUID(0x4FFFFFFF) -> ECX = 21
[ 2225.879511] ### Type 21 CPU Exit Cycle Time = 0
[ 2225.879543] ### CPUID(0x4FFFFFFF) -> ECX = 22
[ 2225.879544] ### Type 22 CPU Exit Cycle Time = 0
[ 2225.879577] ### CPUID(0x4FFFFFFF) -> ECX = 23
[ 2225.879578] ### Type 23 CPU Exit Cycle Time = 0
[ 2225.879611] ### CPUID(0x4FFFFFFF) -> ECX = 24
[ 2225.879612] ### Type 24 CPU Exit Cycle Time = 0
[ 2225.879645] ### CPUID(0x4FFFFFFF) -> ECX = 25
[ 2225.879646] ### Type 25 CPU Exit Cycle Time = 0
[ 2225.879678] ### CPUID(0x4FFFFFFF) -> ECX = 26
[ 2225.879680] ### Type 26 CPU Exit Cycle Time = 0
[ 2225.879712] ### CPUID(0x4FFFFFFF) -> ECX = 27
[ 2225.879713] ### Type 27 CPU Exit Cycle Time = 0
[ 2225.879787] ### CPUID(0x4FFFFFFF) -> ECX = 28
[ 2225.879788] ### Type 28 CPU Exit Cycle Time = 18029388
```

```
~ -- asish@cmpe283-vm4: ~ ssh asish@34.16.167.100 ~ -- zsh ~ -- zsh +  
[ 2225.879912] ### Type 32 CPU Exit Cycle Time = 0  
[ 2225.879961] ### CPUID(0x4FFFFFFF) -> ECX = 33  
[ 2225.879962] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.879980] ### CPUID(0x4FFFFFFF) -> ECX = 34  
[ 2225.879981] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.880031] ### CPUID(0x4FFFFFFF) -> ECX = 35  
[ 2225.880032] ### Exit Number in ECX Not Defined in SDM  
[ 2225.880049] ### CPUID(0x4FFFFFFF) -> ECX = 36  
[ 2225.880051] ### Type 36 CPU Exit Cycle Time = 0  
[ 2225.880100] ### CPUID(0x4FFFFFFF) -> ECX = 37  
[ 2225.880101] ### Type 37 CPU Exit Cycle Time = 0  
[ 2225.880119] ### CPUID(0x4FFFFFFF) -> ECX = 38  
[ 2225.880120] ### Exit Number in ECX Not Defined in SDM  
[ 2225.880169] ### CPUID(0x4FFFFFFF) -> ECX = 39  
[ 2225.880170] ### Type 39 CPU Exit Cycle Time = 0  
[ 2225.880188] ### CPUID(0x4FFFFFFF) -> ECX = 40  
[ 2225.880189] ### Type 40 CPU Exit Cycle Time = 0  
[ 2225.880278] ### CPUID(0x4FFFFFFF) -> ECX = 41  
[ 2225.880280] ### Type 41 CPU Exit Cycle Time = 0  
[ 2225.880315] ### CPUID(0x4FFFFFFF) -> ECX = 42  
[ 2225.880316] ### Exit Number in ECX Not Defined in SDM  
[ 2225.880341] ### CPUID(0x4FFFFFFF) -> ECX = 43  
[ 2225.880335] ### Type 43 CPU Exit Cycle Time = 0  
[ 2225.880369] ### CPUID(0x4FFFFFFF) -> ECX = 44  
[ 2225.880370] ### Type 44 CPU Exit Cycle Time = 0  
[ 2225.880402] ### CPUID(0x4FFFFFFF) -> ECX = 45  
[ 2225.880403] ### Type 45 CPU Exit Cycle Time = 0  
[ 2225.880437] ### CPUID(0x4FFFFFFF) -> ECX = 46  
[ 2225.880438] ### Type 46 CPU Exit Cycle Time = 250854  
[ 2225.880472] ### CPUID(0x4FFFFFFF) -> ECX = 47
```

```
~ -- asish@cmpe283-vm4: ~ ssh asish@34.16.167.100 ~ -- zsh ~ -- zsh +  
[ 2225.880865] ### CPUID(0x4FFFFFFF) -> ECX = 57  
[ 2225.880867] ### Type 57 CPU Exit Cycle Time = 0  
[ 2225.880900] ### CPUID(0x4FFFFFFF) -> ECX = 58  
[ 2225.880901] ### Type 58 CPU Exit Cycle Time = 0  
[ 2225.880933] ### CPUID(0x4FFFFFFF) -> ECX = 59  
[ 2225.880935] ### Type 59 CPU Exit Cycle Time = 0  
[ 2225.880968] ### CPUID(0x4FFFFFFF) -> ECX = 60  
[ 2225.880969] ### Type 60 CPU Exit Cycle Time = 0  
[ 2225.881002] ### CPUID(0x4FFFFFFF) -> ECX = 61  
[ 2225.881003] ### Type 61 CPU Exit Cycle Time = 0  
[ 2225.881036] ### CPUID(0x4FFFFFFF) -> ECX = 62  
[ 2225.881038] ### Type 62 CPU Exit Cycle Time = 0  
[ 2225.881070] ### CPUID(0x4FFFFFFF) -> ECX = 63  
[ 2225.881071] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.881103] ### CPUID(0x4FFFFFFF) -> ECX = 64  
[ 2225.881105] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.881137] ### CPUID(0x4FFFFFFF) -> ECX = 65  
[ 2225.881138] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.881170] ### CPUID(0x4FFFFFFF) -> ECX = 66  
[ 2225.881172] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.881205] ### CPUID(0x4FFFFFFF) -> ECX = 67  
[ 2225.881206] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.881239] ### CPUID(0x4FFFFFFF) -> ECX = 68  
[ 2225.881240] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.881272] ### CPUID(0x4FFFFFFF) -> ECX = 69  
[ 2225.881273] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM  
[ 2225.881305] ### CPUID(0x4FFFFFFF) -> ECX = 70  
[ 2225.881306] ### Exit Number in ECX Not Defined in SDM  
[ 2225.881339] ### CPUID(0x4FFFFFFF) -> ECX = 71  
[ 2225.881340] ### Exit Number in ECX Not Defined in SDM
```

```

-- asish@cmpe283-vm4: ~ -- ssh asish@34.16.167.100
[ 2605.527816] ### CPUID(0x4FFFFFFF) -> ECX = 60
[ 2605.527817] ### Type 60 CPU Exit Cycle Time = 0
[ 2605.527841] ### CPUID(0x4FFFFFFF) -> ECX = 61
[ 2605.527843] ### Type 61 CPU Exit Cycle Time = 0
[ 2605.527865] ### CPUID(0x4FFFFFFF) -> ECX = 62
[ 2605.527867] ### Type 62 CPU Exit Cycle Time = 0
[ 2605.527889] ### CPUID(0x4FFFFFFF) -> ECX = 63
[ 2605.527891] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2605.527932] ### CPUID(0x4FFFFFFF) -> ECX = 64
[ 2605.527933] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2605.527955] ### CPUID(0x4FFFFFFF) -> ECX = 65
[ 2605.527957] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2605.527980] ### CPUID(0x4FFFFFFF) -> ECX = 66
[ 2605.527981] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2605.528004] ### CPUID(0x4FFFFFFF) -> ECX = 67
[ 2605.528005] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2605.528026] ### CPUID(0x4FFFFFFF) -> ECX = 68
[ 2605.528028] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2605.528051] ### CPUID(0x4FFFFFFF) -> ECX = 69
[ 2605.528052] ### Exit Number in ECX Defined in SDM But Not Enabled in KVM
[ 2605.528073] ### CPUID(0x4FFFFFFF) -> ECX = 70
[ 2605.528075] ### Exit Number in ECX Not Defined in SDM
[ 2605.528116] ### CPUID(0x4FFFFFFF) -> ECX = 71
[ 2605.528118] ### Exit Number in ECX Not Defined in SDM
[ 2605.528140] ### CPUID(0x4FFFFFFF) -> ECX = 72
[ 2605.528142] ### Exit Number in ECX Not Defined in SDM
[ 2605.528163] ### CPUID(0x4FFFFFFF) -> ECX = 73
[ 2605.528165] ### Exit Number in ECX Not Defined in SDM
[ 2605.528187] ### CPUID(0x4FFFFFFF) -> ECX = 74
asish@cmpe283-vm4:~$ 

```

Answers

Q1. Are there more exits performed during certain VM operations?

`EXIT_REASON_CPUID`, `EXIT_REASON_IO_INSTRUCTION` and other few perform more exits at certain period of time.

Q2. Approximately how many exits does a full VM boot entail?

Around 35549275902 cycle times with 7933594 exits

Q3. Of the exit types defined in the SDM, which are the most frequent? Least?

`EXIT_REASON_DR_ACCESS` – happens for the least
`EXIT_REASON_EPT_VIOLATION` – happens the highest no of times