

Submission Details:

Name: Smitha Venkatesh

Student ID: 011825177

Git Commit ID:

commit df8ba95c572a187ed2aa7403e97a7a7f58c01f00

2) Describe in detail the steps you used to complete the assignment.

Answer:

Steps:

Check if VMX is enabled

1)\$sudo apt-get update

2)\$sudo apt-get install cpu-checker

3)\$ kvm-ok

[/dev/kvm exists. KVM acceleration can be used]

Downloading Linux kernel code

1)\$git clone https://github.com/torvalds/linux.git

[This is cloning to local repository /linux]

2)Go to the local directory (/linux) cd linux

3)\$git log

commit df8ba95c572a187ed2aa7403e97a7a7f58c01f00

Merge: 42062b9 b12cbb2

Author: Linus Torvalds <torvalds@linux-foundation.org>

Date: Thu Nov 30 18:56:41 2017 -0500

4)\$sudo apt-get install libncurses5-dev

5)\$make menuconfig

6)\$sudo apt-get install libssl-dev

7)\$sudo make && sudo make modules && sudo make modules_install && sudo make install

8)\$uname -r

4.10.0-28-generic

9)Reboot

10)\$uname -r

4.15.0-rc1+

11) Edit the code in linux/arch/x86/kvm/vmx.c to perform the functionality of assignment

12) Install Virt Manager:

\$sudo apt install qemu-kvm

\$kvm-ok

\$sudo apt-get install virt-manager

13) Build the KVM module: [Steps to test and build the new module after any changes]

\$sudo make SUBDIRS=arch/x86/kvm/

14) \$lsmod | grep kvm

15) Remove the leaf modules first and later the dependent module.

\$sudo rmmod kvm_intel

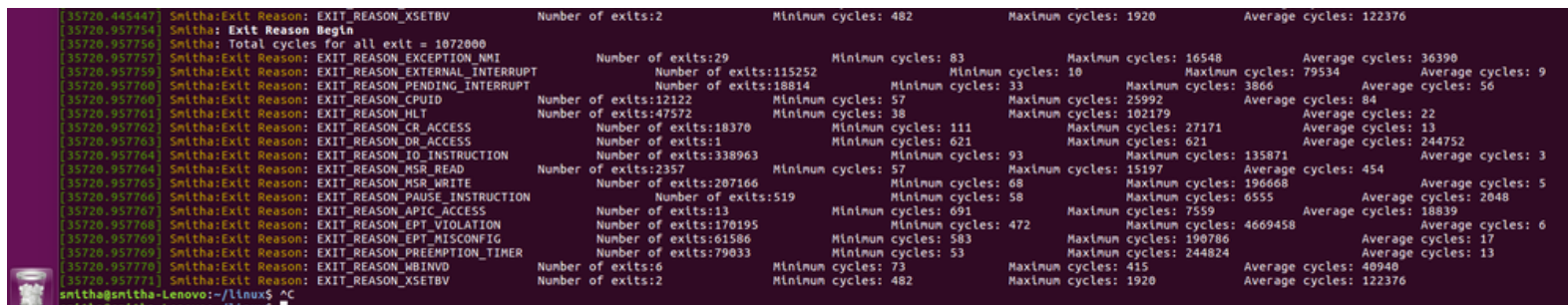
\$sudo rmmod kvm

16) Build the kernel modules:

\$sudo insmod arch/x86/kvm/kvm.ko

\$sudo insmod arch/x86/kvm/kvm-intel.ko

17) Start a Guest VM and run dmesg in Host VM to see the number of counts of each exits.



Exit Reason	Number of exits	Minimum cycles	Maximum cycles	Average cycles
EXIT_REASON_XSETBV	2	482	1920	122376
EXIT_REASON_EXCEPTION_NMI	29	83	16548	36390
EXIT_REASON_EXTERNAL_INTERRUPT	115252	10	79534	9
EXIT_REASON_PENDING_INTERRUPT	18814	33	3866	56
EXIT_REASON_CPUID	12122	57	25992	84
EXIT_REASON_HLT	47572	38	102179	22
EXIT_REASON_CR_ACCESS	18370	111	27171	13
EXIT_REASON_DR_ACCESS	11	621	621	244752
EXIT_REASON_IO_INSTRUCTION	338963	93	135871	3
EXIT_REASON_MSR_READ	2357	57	15197	454
EXIT_REASON_MSR_WRITE	207166	68	196668	5
EXIT_REASON_PAUSE_INSTRUCTION	519	58	6555	2848
EXIT_REASON_APRC_ACCESS	13	691	7559	18839
EXIT_REASON_EPT_VIOLATION	170195	472	4669458	6
EXIT_REASON_EPT_MISCONFIG	61586	583	190786	17
EXIT_REASON_PREEMPTION_TIMER	79033	53	244824	13
EXIT_REASON_MBINVD	6	73	415	48940
EXIT_REASON_XSETBV	2	482	1920	122376

18) Commit the changes to git

\$git config --global user.email "smithav17@gmail.com"

\$ git config --global user.name "Smitha Venkatesh"

\$ git commit -a

\$ git log

commit 1b191478a8818b3847e4b370241b8b8309420b92

Author: Smitha Venkatesh <smithav17@gmail.com>

Date: Sat Dec 2 17:56:49 2017 -0800

Edited arch/x86/kvm/vmx.c according to 283 assignment3 functionality

19) Get the diff file:

\$git diff HEAD~1 > cmpe283-3.diff

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

Answer:

I am displaying the statistics information for every 1000 total exits

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

Sample Output

```
[34411.661552] Smitha: Exit Reason Begin
[34411.661557] Smitha: Total cycles for all exit = 350000
[34411.661562] Smitha:Exit Reason: EXIT_REASON_EXCEPTION_NMI    Number of exits:12      Minimum cycles:
109      Maximum cycles: 16548  Average cycles: 27701

[34411.661565] Smitha:Exit Reason: EXIT_REASON_EXTERNAL_INTERRUPT    Number of exits:13262
Minimum cycles: 10      Maximum cycles: 24108  Average cycles: 26

[34411.661568] Smitha:Exit Reason: EXIT_REASON_PENDING_INTERRUPT    Number of exits:2555
Minimum cycles: 34      Maximum cycles: 2249  Average cycles: 136

[34411.661571] Smitha:Exit Reason: EXIT_REASON_CPUID    Number of exits:11115    Minimum cycles: 57
Maximum cycles: 25992  Average cycles: 31

[34411.661573] Smitha:Exit Reason: EXIT_REASON_HLT    Number of exits:5411    Minimum cycles: 38
Maximum cycles: 6038  Average cycles: 64

[34411.661576] Smitha:Exit Reason: EXIT_REASON_CR_ACCESS    Number of exits:18370    Minimum cycles:
111      Maximum cycles: 27171  Average cycles: 13

[34411.661579] Smitha:Exit Reason: EXIT_REASON_DR_ACCESS    Number of exits:1
Minimum cycles: 621    Maximum cycles: 621    Average cycles: 244752

[34411.661582] Smitha:Exit Reason: EXIT_REASON_IO_INSTRUCTION    Number of exits:246624  Minimum cycles:
93      Maximum cycles: 126678    Average cycles: 1

[34411.661584] Smitha:Exit Reason: EXIT_REASON_MSR_READ    Number of exits:226    Minimum cycles:
57      Maximum cycles: 5283  Average cycles: 1534

[34411.661586] Smitha:Exit Reason: EXIT_REASON_MSR_WRITE    Number of exits:13674    Minimum cycles:
68      Maximum cycles: 121362    Average cycles: 25

[34411.661589] Smitha:Exit Reason: EXIT_REASON_PAUSE_INSTRUCTION    Number of exits:54
Minimum cycles: 58      Maximum cycles: 1745  Average cycles: 6138

[34411.661592] Smitha:Exit Reason: EXIT_REASON_APIC_ACCESS    Number of exits:13    Minimum cycles:
691      Maximum cycles: 7559  Average cycles: 18839

[34411.661595] Smitha:Exit Reason: EXIT_REASON_EPT_VIOLATION    Number of exits:18523    Minimum cycles:
539      Maximum cycles: 1709028  Average cycles: 18

[34411.661597] Smitha:Exit Reason: EXIT_REASON_EPT_MISCONFIG    Number of exits:15630    Minimum cycles:
583      Maximum cycles: 134980    Average cycles: 22
```

```
[34411.661600] Smitha:Exit Reason: EXIT_REASON_PREEMPTION_TIMER      Number of exits:4522
Minimum cycles: 58      Maximum cycles: 38304  Average cycles: 77
```

[34411.661602] Smitha:Exit Reason: EXIT_REASON_WBINVD	Number of exits:6	Minimum cycles: 73
Maximum cycles: 415	Average cycles: 40940	

[34411.661605] Smitha:Exit Reason: EXIT_REASON_XSETBV	Number of exits:2	Minimum cycles: 482
Maximum cycles: 1920	Average cycles: 122376	

```
smitha@smitha-Lenovo: ~/linux$ cat /dev/kmsg
[35719.337765] Smitha:Exit Reason: EXIT_REASON_PREEMPTION_TIMER Number of exits:6 Minimum cycles: 53 Maximum cycles: 244824 Average cycles: 13
[35719.337765] Smitha:Exit Reason: EXIT_REASON_BINVD Number of exits:2 Minimum cycles: 73 Maximum cycles: 415 Average cycles: 40940
[35719.337767] Smitha:Exit Reason: EXIT_REASON_XSETBV Number of exits:2 Minimum cycles: 482 Maximum cycles: 1920 Average cycles: 122376
[35719.969308] Smitha: Total cycles for all exit = 1070000
[35719.969311] Smitha:Exit Reason: EXIT_REASON_EXCEPTION_NMI Number of exits:29 Minimum cycles: 83 Maximum cycles: 16548 Average cycles: 36390
[35719.969312] Smitha:Exit Reason: EXIT_REASON_EXTERNAL_INTERRUPT Number of exits:115028 Minimum cycles: 10 Maximum cycles: 79534 Average cycles: 9
[35719.969313] Smitha:Exit Reason: EXIT_REASON_PENDING_INTERRUPT Number of exits:18798 Minimum cycles: 33 Maximum cycles: 3866 Average cycles: 56
[35719.969314] Smitha:Exit Reason: EXIT_REASON_CPUID Number of exits:12122 Minimum cycles: 57 Maximum cycles: 25992 Average cycles: 84
[35719.969315] Smitha:Exit Reason: EXIT_REASON_HLT Number of exits:47388 Minimum cycles: 38 Maximum cycles: 102179 Average cycles: 22
[35719.969316] Smitha:Exit Reason: EXIT_REASON_CR_ACCESS Number of exits:18370 Minimum cycles: 111 Maximum cycles: 27171 Average cycles: 13
[35719.969316] Smitha:Exit Reason: EXIT_REASON_DR_ACCESS Number of exits:1 Minimum cycles: 621 Maximum cycles: 621 Average cycles: 244752
[35719.969317] Smitha:Exit Reason: EXIT_REASON_IO_INSTRUCTION Number of exits:338908 Minimum cycles: 93 Maximum cycles: 135871 Average cycles: 3
[35719.969318] Smitha:Exit Reason: EXIT_REASON_MSR_READ Number of exits:2357 Minimum cycles: 57 Maximum cycles: 15197 Average cycles: 454
[35719.969319] Smitha:Exit Reason: EXIT_REASON_MSR_WRITE Number of exits:206610 Minimum cycles: 68 Maximum cycles: 196668 Average cycles: 5
[35719.969319] Smitha:Exit Reason: EXIT_REASON_PAUSE_INSTRUCTION Number of exits:519 Minimum cycles: 58 Maximum cycles: 6555 Average cycles: 2048
[35719.969320] Smitha:Exit Reason: EXIT_REASON_APIC_ACCESS Number of exits:13 Minimum cycles: 691 Maximum cycles: 7559 Average cycles: 18839
[35719.969321] Smitha:Exit Reason: EXIT_REASON_EPT_VIOLATION Number of exits:169882 Minimum cycles: 472 Maximum cycles: 4669458 Average cycles: 6
[35719.969322] Smitha:Exit Reason: EXIT_REASON_EPT_MISCONFIG Number of exits:61170 Minimum cycles: 583 Maximum cycles: 190786 Average cycles: 17
[35719.969323] Smitha:Exit Reason: EXIT_REASON_PREEMPTION_TIMER Number of exits:78802 Minimum cycles: 53 Maximum cycles: 244824 Average cycles: 13
[35719.969324] Smitha:Exit Reason: EXIT_REASON_BINVD Number of exits:6 Minimum cycles: 73 Maximum cycles: 415 Average cycles: 40940
[35719.969324] Smitha:Exit Reason: EXIT_REASON_XSETBV Number of exits:2 Minimum cycles: 482 Maximum cycles: 1920 Average cycles: 122376
[35720.445431] Smitha: Exit Reason Begin
[35720.445433] Smitha: Total cycles for all exit = 1071000
[35720.445435] Smitha:Exit Reason: EXIT_REASON_EXCEPTION_NMI Number of exits:29 Minimum cycles: 83 Maximum cycles: 16548 Average cycles: 36390
[35720.445436] Smitha:Exit Reason: EXIT_REASON_EXTERNAL_INTERRUPT Number of exits:115159 Minimum cycles: 10 Maximum cycles: 79534 Average cycles: 9
[35720.445436] Smitha:Exit Reason: EXIT_REASON_PENDING_INTERRUPT Number of exits:18806 Minimum cycles: 33 Maximum cycles: 3866 Average cycles: 56
[35720.445437] Smitha:Exit Reason: EXIT_REASON_CPUID Number of exits:12122 Minimum cycles: 57 Maximum cycles: 25992 Average cycles: 84
[35720.445438] Smitha:Exit Reason: EXIT_REASON_HLT Number of exits:47468 Minimum cycles: 38 Maximum cycles: 102179 Average cycles: 22
[35720.445439] Smitha:Exit Reason: EXIT_REASON_CR_ACCESS Number of exits:18370 Minimum cycles: 111 Maximum cycles: 27171 Average cycles: 13
[35720.445440] Smitha:Exit Reason: EXIT_REASON_DR_ACCESS Number of exits:1 Minimum cycles: 621 Maximum cycles: 621 Average cycles: 244752
[35720.445440] Smitha:Exit Reason: EXIT_REASON_IO_INSTRUCTION Number of exits:338950 Minimum cycles: 93 Maximum cycles: 135871 Average cycles: 3
[35720.445441] Smitha:Exit Reason: EXIT_REASON_MSR_READ Number of exits:2354 Minimum cycles: 57 Maximum cycles: 15197 Average cycles: 454
[35720.445442] Smitha:Exit Reason: EXIT_REASON_MSR_WRITE Number of exits:206871 Minimum cycles: 68 Maximum cycles: 196668 Average cycles: 5
[35720.445443] Smitha:Exit Reason: EXIT_REASON_PAUSE_INSTRUCTION Number of exits:519 Minimum cycles: 58 Maximum cycles: 6555 Average cycles: 2048
[35720.445443] Smitha:Exit Reason: EXIT_REASON_APIC_ACCESS Number of exits:13 Minimum cycles: 691 Maximum cycles: 7559 Average cycles: 18839
[35720.445444] Smitha:Exit Reason: EXIT_REASON_EPT_VIOLATION Number of exits:170844 Minimum cycles: 472 Maximum cycles: 4669458 Average cycles: 6
[35720.445445] Smitha:Exit Reason: EXIT_REASON_EPT_MISCONFIG Number of exits:61370 Minimum cycles: 583 Maximum cycles: 190786 Average cycles: 17
[35720.445446] Smitha:Exit Reason: EXIT_REASON_PREEMPTION_TIMER Number of exits:78916 Minimum cycles: 53 Maximum cycles: 244824 Average cycles: 13
[35720.445446] Smitha:Exit Reason: EXIT_REASON_BINVD Number of exits:6 Minimum cycles: 73 Maximum cycles: 415 Average cycles: 40940
[35720.445447] Smitha:Exit Reason: EXIT_REASON_XSETBV Number of exits:2 Minimum cycles: 482 Maximum cycles: 1920 Average cycles: 122376
[35720.957754] Smitha: Exit Reason Begin
[35720.957756] Smitha: Total cycles for all exit = 1072000
[35720.957757] Smitha:Exit Reason: EXIT_REASON_EXCEPTION_NMI Number of exits:29 Minimum cycles: 83 Maximum cycles: 16548 Average cycles: 36390
[35720.957759] Smitha:Exit Reason: EXIT_REASON_EXTERNAL_INTERRUPT Number of exits:115252 Minimum cycles: 10 Maximum cycles: 79534 Average cycles: 9
[35720.957760] Smitha:Exit Reason: EXIT_REASON_PENDING_INTERRUPT Number of exits:18814 Minimum cycles: 33 Maximum cycles: 3866 Average cycles: 56
[35720.957760] Smitha:Exit Reason: EXIT_REASON_CPUID Number of exits:12122 Minimum cycles: 57 Maximum cycles: 25992 Average cycles: 84
[35720.957761] Smitha:Exit Reason: EXIT_REASON_HLT Number of exits:47572 Minimum cycles: 38 Maximum cycles: 102179 Average cycles: 22
[35720.957762] Smitha:Exit Reason: EXIT_REASON_CR_ACCESS Number of exits:18370 Minimum cycles: 111 Maximum cycles: 27171 Average cycles: 13
[35720.957763] Smitha:Exit Reason: EXIT_REASON_DR_ACCESS Number of exits:1 Minimum cycles: 621 Maximum cycles: 621 Average cycles: 244752
[35720.957764] Smitha:Exit Reason: EXIT_REASON_IO_INSTRUCTION Number of exits:338963 Minimum cycles: 93 Maximum cycles: 135871 Average cycles: 3
[35720.957764] Smitha:Exit Reason: EXIT_REASON_MSR_READ Number of exits:2357 Minimum cycles: 57 Maximum cycles: 15197 Average cycles: 454
[35720.957765] Smitha:Exit Reason: EXIT_REASON_MSR_WRITE Number of exits:207166 Minimum cycles: 68 Maximum cycles: 196668 Average cycles: 5
[35720.957766] Smitha:Exit Reason: EXIT_REASON_PAUSE_INSTRUCTION Number of exits:519 Minimum cycles: 58 Maximum cycles: 6555 Average cycles: 2048
[35720.957767] Smitha:Exit Reason: EXIT_REASON_APIC_ACCESS Number of exits:13 Minimum cycles: 691 Maximum cycles: 7559 Average cycles: 18839
[35720.957768] Smitha:Exit Reason: EXIT_REASON_EPT_VIOLATION Number of exits:170195 Minimum cycles: 472 Maximum cycles: 4669458 Average cycles: 6
[35720.957768] Smitha:Exit Reason: EXIT_REASON_EPT_MISCONFIG Number of exits:61586 Minimum cycles: 583 Maximum cycles: 190786 Average cycles: 17
[35720.957769] Smitha:Exit Reason: EXIT_REASON_PREEMPTION_TIMER Number of exits:79033 Minimum cycles: 53 Maximum cycles: 244824 Average cycles: 13
[35720.957770] Smitha:Exit Reason: EXIT_REASON_BINVD Number of exits:6 Minimum cycles: 73 Maximum cycles: 415 Average cycles: 40940
[35720.957771] Smitha:Exit Reason: EXIT_REASON_XSETBV Number of exits:2 Minimum cycles: 482 Maximum cycles: 1920 Average cycles: 122376
smitha@smitha-Lenovo: ~/linux$ cat /dev/kmsg
smitha@smitha-Lenovo: ~/linux$
```

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

Answer:

The total count of exits show how frequently there is a switch between guest VM and the Hyperwiser. Most of the VM exits happen due to IO_INSTRUCTION, EXTERNAL_INTERRUPT, MSR_WRITE, CPUID and these counts are expected to be higher in number.

The count of exits due to IO_INSTRUCTION, EXTERNAL_INTERRUPT, MSR_WRITE, CPUID are all more as all of these instructions have to be executed by the Hyperwiser. The guest VM cannot execute these because it may change all the contents of memory which it is not supposed to access. So whenever these instructions are encountered, VM exit occurs and the Hyperwiser handles it.