

COL732 ASSIGNMENT 3

VIRTUALISATION AND CLOUD COMPUTING

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1. Page table benchmarks

a. Experimental setup. Exact commands/programs that were run for the measurement.

Host : nc -w 3 192.168.241.2 1234 < page.out

Vm : nc -l -p 1234 > page.out

In Vm:

cd home

chmod +x page.out

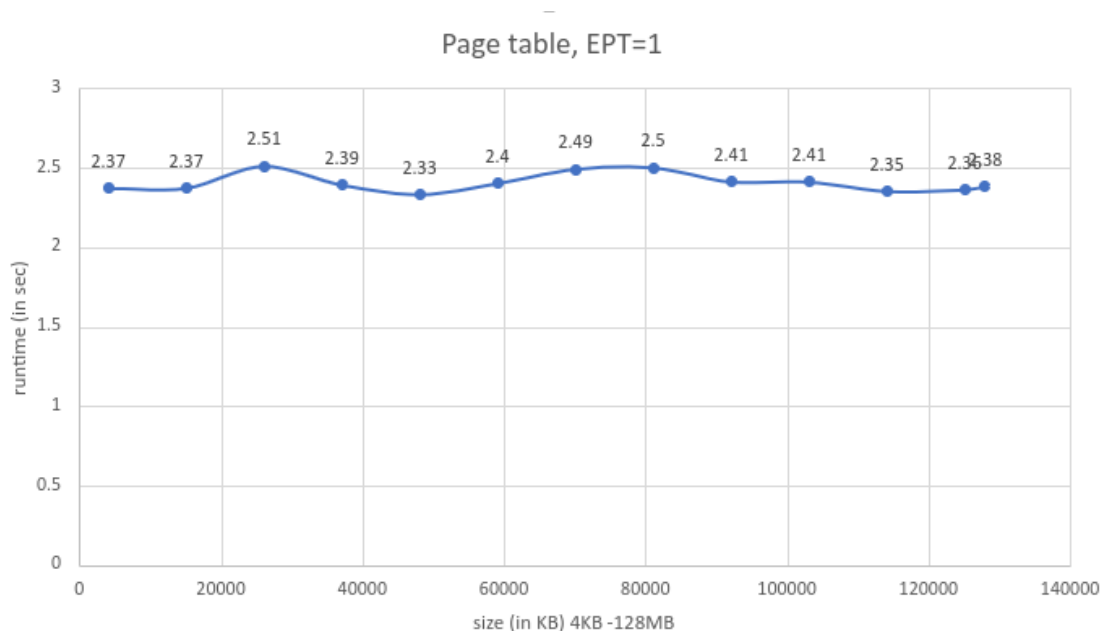
time ./page.out 4096 here i have given the size as argument in KB with 11MB gap in each one and took total of 13 readings to analyse the benchmark.

For **enable/disable** EPT I have used :

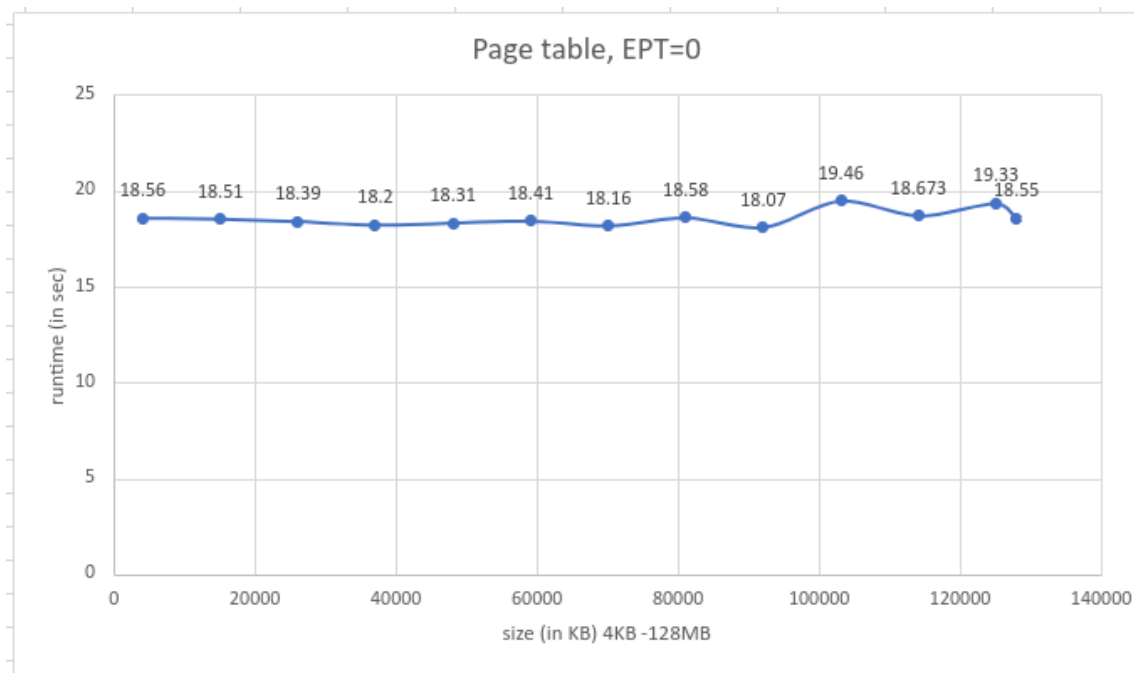
sudo modprobe -r kvm_intel

sudo modprobe kvm_intel ept=0/1

b. Relationship of runtime (with EPT=1) with the size of the resident memory



c. Relationship of runtime (with EPT=0) with the size of the resident memory



d. Justification of observations

Here we have to traverse the whole page table whether we find the cache or not, which takes the constant time for each traversal.

As this is the shadow page table technique, it requires more memory so the page table uses more time to fork the processes.

From the above graphs of pagetable we can say that it takes almost a constant amount of time for traversal because it needs constant time.

The TLB is a cache that holds (likely) recently used pages. It says that the pages referenced in the TLB are likely to be used again soon. This is the underlying idea for all caching. When these pages are needed again, it takes minimal time to find the address of the page in the TLB. The page table itself can be enormous, so walking it to find the address of the needed page can get very expensive.

Therefore $ept = 1$ is better than shadow pagetable ($ept = 0$) from the above graph 1, 2

2.TLB benchmark

a.Experimental setup. Exact commands/programs that were run for the measurement.

Host : nc -w 3 192.168.241.2 1234 < a.out

Vm : nc -l -p 1234 > a.out

In Vm:

cd home

chmod +x a.out

./a.out 4096 here i have given the size as argument in KB with 22MB gap in each one and took a total 12 readings to make a analysis .

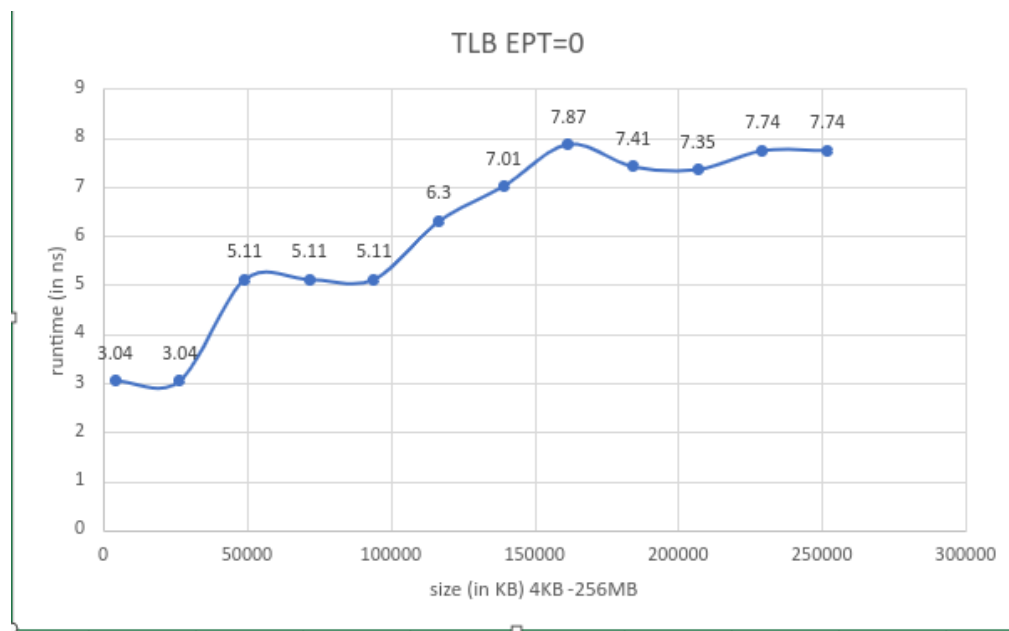
For **enable/disable** EPT I have used in host:

sudo modprobe -r kvm_intel

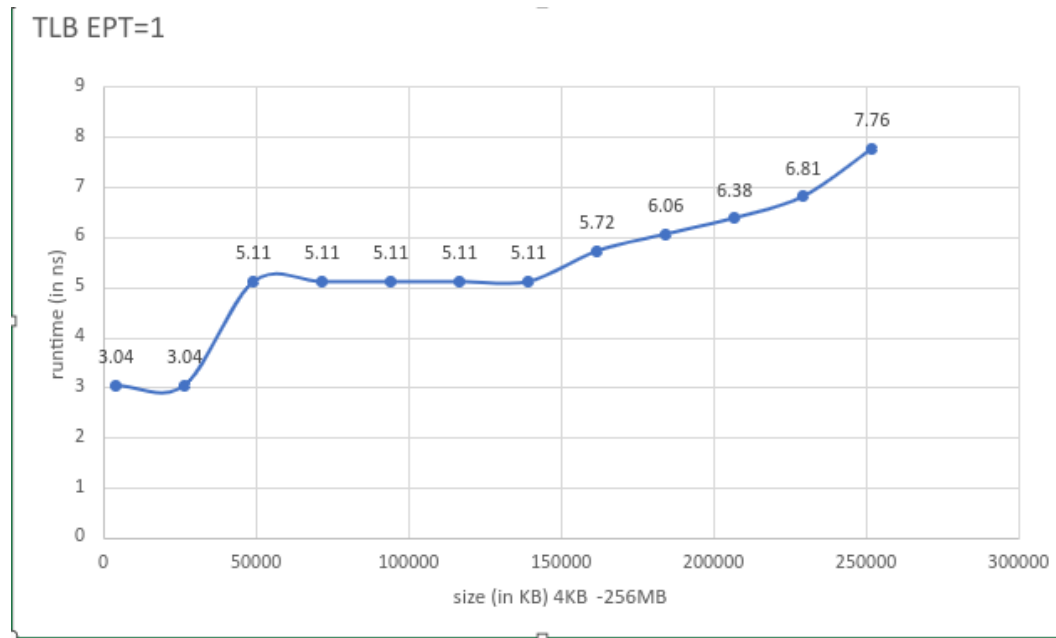
sudo modprobe kvm_intel ept=0

cat /sys/module/kvm_intel/parameters/ept used this for checking whether ept is Y or N

b.Relationship of runtime (with EPT=0) with the map size (4KB – 256M)



c. Relationship of runtime (with EPT=1) with the map size (4KB – 256M)



d. Justification of observations:

If we get hit

From Graph 1:

It is increasing drastically because we have two pagetables as we visit, we need to visit both pagetables so there are chances of higher cache miss rate.

In the case of tlb it is increasing drastically because if the translational lookaside buffer

doesn't get any cache hits and with high miss rates. It takes time to search in the already filled tlb.

which makes the time complexity higher comparatively.

In this case we can see from above graph that as we are using EPT = 0 which is shadow page table, it will be using single pagetable there are less chances of cache miss rate.

Screenshots :

```
laxman@laxman-Vostro-3578: ~/Downloads/VMM/vmm-reference
dr-xr-xr-x  12 0      0      0 Oct 15 16:00 sys
drwxrwxr-x  4 1000   1000   80 Jun  8 09:29 usr
/ # rm a.out
/ # ls
bin      etc      init     mnt      sbin     usr
dev      home     linuxrc  proc     sys
/ # cd home
/home # ls
/home # nc -l -p 1234 > a.out

/home #
/home # ls
a.out
/home # nc -l -p 1234 > page.out

/home #
/home # ls
a.out    page.out
/home # ./a.out
/bin/sh: ./a.out: Permission denied
/home # chmod +x a.out
/home # ./a.out
/bin/sh: ./a.out: Permission denied
/home # chmod +x a.out
/home # ./a.out
bad arguments size less than stride: test-tlb <size>
/home # ./a.out 4096
3.04ns (-11.8 cycles)
/home # ./a.out 26624
3.04ns (-11.9 cycles)
/home # ./a.out 49152
5.11ns (-19.9 cycles)
/home # ./a.out 71680
5.11ns (-19.9 cycles)[ 1317.160221] random: crng init done

/home # ./a.out 94208
5.11ns (-19.9 cycles)
/home # ./a.out 116736
5.11ns (-19.9 cycles)
/home # ./a.out 139264
5.11ns (-19.9 cycles)
/home # ./a.out 161792
5.72ns (-22.3 cycles)
/home # ./a.out 184320
6.06ns (-23.6 cycles)
/home # ./a.out 206848
6.38ns (-24.9 cycles)
/home # ./a.out 229376
6.81ns (-26.6 cycles)
/home # ./a.out 251904
7.76ns (-30.3 cycles)
/home #
```

```
laxman@laxman-Vostro-3578: ~/Downloads/VMM/vmm-reference
/ #
/ # ls
a.out    dev      home     linuxrc  proc     sys
bin      etc      init     mnt      sbin     usr
/ # rm a.out
/ # ls
bin      etc      init     mnt      sbin     usr
dev      home     linuxrc  proc     sys
/ # cd home
/home # l[ 64.435381] random: fast init done
s
/home # ls
/home # nc -l -p 1234 > a.out

/home # ls
a.out
/home # ./a.out 4096
/bin/sh: ./a.out: Permission denied
/home # chmod +x a.out
/home # ./a.out 4096
3.04ns (-11.9 cycles)
/home # ./a.out 26624
3.04ns (-11.9 cycles)
/home # ./a.out 49152
5.11ns (-19.9 cycles)
/home # ./a.out 71680
5.11ns (-19.9 cycles)
/home # ./a.out 94208
5.11ns (-19.9 cycles)
/home # ./a.out 116736
6.30ns (-24.6 cycles)
/home # ./a.out 139264
7.01ns (-27.3 cycles)
/home # ./a.out 161792
7.87ns (-30.7 cycles)
/home # ./a.out 184320
7.41ns (-28.9 cycles)
/home # ./a.out 206848
7.35ns (-28.6 cycles)
/home # l[ 574.534146] random: crng init done
/home # ./a.out 229376
7.74ns (-30.2 cycles)
/home # ./a.out 251904
7.74ns (-30.2 cycles)
/home #
```

```

laxman@laxman-Vostro-3578: ~/Downloads/VMM/vmm-reference
user      0m 12.55s
sys       0m 5.73s
/home # time ./page.out 37096
real      0m 18.20s
user      0m 12.70s
sys       0m 5.40s
/home # time ./page.out 48096
real      0m 18.31s
user      0m 12.60s
sys       0m 5.60s
/home # time ./page.out 59096
real      0m 18.41s
user      0m 12.57s
sys       0m 5.74s
/home # time ./page.out 70096
real      0m 18.10s
user      0m 12.64s
sys       0m 5.41s
/home # time ./page.out 70096[ 978.223150] random: crng init done

real      0m 18.61s
user      0m 12.75s
sys       0m 5.75s
/home #
/home #
/home #
/home #
/home # time ./page.out 81096
real      0m 18.58s
user      0m 12.72s
sys       0m 5.77s
/home # time ./page.out 92096
real      0m 18.07s
user      0m 12.62s
sys       0m 5.33s
/home # time ./page.out 103096
real      0m 19.46s
user      0m 13.08s
sys       0m 6.28s
/home # time ./page.out 114096
real      0m 18.67s
user      0m 12.95s
sys       0m 5.62s
/home # time ./page.out 125096
real      0m 19.33s
user      0m 12.98s
sys       0m 6.26s
/home # time ./page.out 128000
real      0m 18.55s
user      0m 12.78s

```

```

laxman@laxman-Vostro-3578: ~/Downloads/VMM/vmm-reference
/home #
/home # chmod +x page.out
/home # time ./page.out 4096
real      0m 2.37s
user      0m 1.56s
sys       0m 0.75s
/home # time ./page.out 15096
real      0m 2.37s
user      0m 1.56s
sys       0m 0.75s
/home # time ./page.out 26096
real      0m 2.51s
user      0m 1.63s
sys       0m 0.82s
/home # time ./page.out 37096
real      0m 2.39s
user      0m 1.58s
sys       0m 0.75s
/home # time ./page.out 48096
real      0m 2.33s
user      0m 1.53s
sys       0m 0.74s
/home # time ./page.out 59096
real      0m 2.40s
user      0m 1.58s
sys       0m 0.75s
/home # time ./page.out 70096
real      0m 2.49s
user      0m 1.62s
sys       0m 0.81s
/home # 81096
/bin/sh: 81096: not found
/home # time ./page.out 81096
real      0m 2.50s
user      0m 1.65s
sys       0m 0.79s
/home # time ./page.out 92096
real      0m 2.41s
user      0m 1.59s
sys       0m 0.76s
/home # time ./page.out 103096
real      0m 2.41s
user      0m 1.56s
sys       0m 0.79s
/home # time ./page.out 114096
real      0m 2.35s
user      0m 1.55s
sys       0m 0.74s
/home # time ./page.out 125096
real      0m 2.36s
user      0m 1.54s
sys       0m 0.76s
/home # time ./page.out 125096[ 344.296870] random: crng init done

real      0m 2.38s
user      0m 1.58s

```