King Saud University
Department of Computer Science
CSC227:Operating Systems
Tutorial No. 8

Exercise 1)
Consider a virtual address space of eight pages with 1024 bytes each, mapped onto a physical memory of 32 frames. How many bits are used in the virtual address ? How many bits are used in the physical address ?

Solution:
There are 13 bits in the virtual address.
There are 15 bits in the physical address.

Exercise 2)
Given memory partitions of 100K, 500K, 200K, 300K, and 600K (in order), how would each of the First-fit, Best-fit, and Worst-fit algorithms place processes of 212K, 417K, 112K, and 426K (in order)? Which algorithm makes the most efficient use of memory?

First-Fit:
212K is put in 500K partition.
417K is put in 600K partition.
112K is put in 288K partition (new partition 288K = 500K - 212K).
426K must wait.
Best-Fit:
212K is put in 300K partition.
417K is put in 500K partition.
112K is put in 200K partition.
426K is put in 600K partition.
Worst-Fit:
212K is put in 600K partition.
417K is put in 500K partition.
112K is put in 388K partition.
426K must wait.
In this example, Best-Fit turns out to be the best.

Exercise 3)
Consider a paging system with the page table stored in memory.
a) If a memory reference takes 200 nanoseconds, how long does a paged memory reference take?
b) If we add associative registers, and 75 percent of all page-table references are found in the associative registers, what is the effective memory reference time? (Assume that finding a page-table entry in the associative registers takes zero time, if the entry is there.)

Solution:
A paged memory reference would take 400 nanoseconds; 200 nanoseconds to access the page table and 200 nanoseconds to access the word in memory.

The effective memory access time is:
E.A.T. = 0.75 * (200 nanoseconds) + 0.25 * (400 nanoseconds) = 250 nanoseconds

Exercise 4)
Consider a segmentation system where virtual space can have up to 2^{14} segments of 2^{18} bytes

a) How many bits represent the address field?
b) What is the maximum size of SMT?
c) Assume a program P1 is loaded into memory with the following SMT:

Segment	Limit	Base
0	4000	1000
1	8000	2000

Translate the address (1,50) to an absolute address.

d) If the access time to the memory is 200 ns and associative memory access time is 4 ns, what is the effective access time if hit ratio is 80%,

Solution:

a) 32 bits
b) length is 2^{14} (number of segments) each filed is 32 bits (4 bytes), then size is $2^{14} * 2^2 = 2^{16}$ bytes.
c) <#segment, Offset> ➔ <1, 50> ➔ offset is less than limit ➔50 < 8000 (OK) ➔ <base, offset> ➔ <2000 , 50> ➔ 2000 + 50 = 2050.

   One access for table + one access to physical address □ 200 + 200 = 400ns

   (200 + 4) * 0.80 + (400 + 4) * 0.20 = 163.2 + 80.8= 244 ns