King Saud University
Department of Computer Science
CSC227:Operating Systems
Tutorial No. 6

Exercise 1)

Assume that we have the following jobs to be scheduled using FCFS algorithm with variable partition memory scheme:

Job	Size	CPU
1	50K	13
2	120K	3
3	70K	9
4	20K	3
5	105K	8
6	55K	13

Memory size is 256K. Jobs are initially loaded in memory as follows:

J1	50K
J2	120K
J3	70K
16K	

a) Show how the memory will look after scheduling job 6 (assume no memory compaction is allowed) using both FCFS and Best Fit strategies.

J1	50K
J2	120K
J3	70K
16K	

50K	
J2	120K
J3	70K
16K	

J4	20K
30K	
J2	120K
J3	70K
16K	

J4	20K
150K	
J3	70K
16K	

J4	20K
J5	105K
45K	
J3	70K
16K	

J4	20k
J5	105k
131k	

J4	20k
J5	105k
J6	55k
76k	

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 takes 500k remaining 288k
417k takes 600k remaining 183k
112k takes 288k remaining 176k *288k from step 1
426k waits as not enough memroy available.

Best Fit
212k takes 300k remaining 88k
417k takes 500k remaining 83k
112k takes 288k remaining 200k
426k takes 600k remaining 174k

Worst Fit
212k takes 600k remaining 388k
417k takes 500k remaining 83k
112k takes 388k remaining 276k
426k waits as not enough memroy available.

Exercise 3)
Given a logical address filed with the following format:

Page #	**Page Offset**
16-bits	8-bits

a) What is the size of a page?
b) What is the maximum number of pages?
c) What is the maximum size of page table (PT)? assume each page entry requires 4 bytes.
d) Consider that PT is stored in physical memory, the memory access time is 100ns and the access time to associateve memory is 10ns. If th hit ratio is 80%, what is the effective access time(EAT)?
e) Under what condition is an associtive memory effective?

a) 2^8 (for each page you have 2^8 offsets)
b) 2^{16} pages
c) $2^{16} \times 4 = 2^{16} \times 22 = 2^{18}$
d) EAT = (access time for associative memory for page# + access time for memory) × hit ratio + (access time for associative memory for page# + access time for memory for PT + access time for memory) × (1 - hit ratio)

$$(110 \times 0.80) + (10 + 100 + 100) \times (0.20) = 135$$

e) High hit ratio.

Exercise 4)
Consider a paged memory of 64 pages of 256 bytes each.
a) What is the size of the virtual space and the number of bits of a virtual address?
b) Assume that the free frame list is {29,4,18,5,22,15,7,2} and two programs P1(4 pages), P2(2 pages) are waiting to be loaded. Perform the memory allocation of P1 and P2 and show the their PMT's.
c) Assume that PMT is kept in memory and two register associative memory. The access time to the memory is 480ns and the access to associative memory is 50ns.
d) What is the effictive access time to the memory if the hit ratio in the associative memory is 50% ? 90%?

a)
Virtual space size = $64 \times 256 = 2^6 \times 2^8 = 2^{14}$ bytes
Virtual field is 14 bits long.

b) PMT of P1
V/I Index Frame# V/I

Index	Frame#	Status
0	29	v
1	4	v
2	18	v
3	5	v

PMT of P1

Index	Frame#	Status
0	22	v
1	15	v

c)
Memory access time = 480 ns.
Associative memory access time = 50 ns.
Effective access time =
(acacess time for associative memory + access time for memory) × hit ratio
+ (access time for associative memory + 2 × access time for memory) × miss ratio
d)
If hit ration 50%:
EAT = (50 + 480) × 0.50 + (50 + 2 × 480) × 0.50 = 265 + 505 = 770
If hit ration 90%:
EAT = (50 + 480) × 0.90 + (50 + 2 × 480) × 0.10 = 477 + 101 = 578

Exercise 5)
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.)
a) Two memory accesses are required to resolve the address implies 400ns
b) Using formula givne in ex 4,
EAT = 0 .75 × 200 + 0 .25 × 400 = 250 nanoseconds.

Exercise 6)
Consider the following segment table:

Segment	Base	Length	Last Addrress
0	219	600	819
1	2300	14	2314
2	90	100	190
3	1327	580	1907
4	1952	96	2048

What are the physical addresses for the following logical addresses?
a) 0,430
b) 1,10
c) 2,500
d) 3,400
e) 4,112
Answer:

a. 219 + 430 = 649
b. 2300 + 10 = 2310
c. 90 + 500 = 590 (illegal reference, trap to operating system)
d. 1327 + 400 = 1727
e. 1952 + 112 = 2064 (illegal reference, trap to operating system)

Exercise 7)

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:

Limit	Base
4000	1000
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%,