CS & IT

DPP

Operating System

Memory Management

Q1 Consider a fixed partition contiguous memory management technique, where there are 5 partitions of size 100MB, 250MB, 200MB, 500MB and 300MB. All Partitions are initially empty. The following process requests are made in the given order:

Process	Size
P1	150MB
P2	400MB
P3	270MB
P4	180MB
P5	80MB

The following 2 answers are calculated for First fit, Best fit and Worst Fit policies

1. Maximum degree of multiprogramming?
2. What is the total internal fragmentation size?

For which of the following partition allocation policy the above two calculations are not exactly same as other 2 policies?

(A) Best fit
(B) First fit
(C) Worst fit
(D) None of the above

Q2 Consider a paged memory system where the logical address is 25 bits and physical address is 33 bits. The page size is 4KB. The approximate size of page table size is _____k bytes (1k = 2^{10})?

Q3 Consider a paged memory system where the page number is 12 bits and physical address is 33 bits. The page size is 2KB. The approximate size of page table size is _____k bytes (1k = 2^{10})?

Q4 Consider a paged memory system which has 4k pages each with 8kbytes size. The system maintains page table of 12k bytes. Each page table entry contains frame number, 1 valid bit, 1 modified bit and 1 replacement bit. The number of frames in the main memory is _____*2^{20}?

Q5 A system has 43-bit logical addresses and 51-bit physical addresses. If the pages are 8 kB in size, the number of bits required for logical page number and physical frame number will be?

(A) 43 bits, 51 bits
(B) 30 bits, 51 bits
(C) 43 bits, 38 bits
(D) 30 bits, 38 bits

Q6 Consider a logical-address space of 8 pages, with page size 1024 bytes. The physical memory contains 32 frames. The page table size is _____ bits?

Q7 Consider a system using TLB for paging with TLB access time of 40ns. The hit ratio is to be used for TLB to reduce the effective memory access time from 400ns without using TLB to 280ns with using TLB, is ____ %?

Q8 A computer system implements a 42- bit virtual address, 512GB physical address space, page size of 2KB, and an 8KB look-aside buffer (TLB)

organized as direct mapped. Each page table entry contains a valid bit, a dirty bit and 2 protection bits along with the translation. The minimum length of the TLB tag in bits is _____?

Answer Key

Q1	(C)	Q5	(D)
Q2	21	Q6	40
Q3	11	Q7	80
Q4	2	Q8	20

Hints & Solutions

Q1 Text Solution:

For first fit the process allocation in blocks is as follows:

Process	Size	Block allocated	Internal Fragmentation
P1	150MB	250MB	100MB
P2	400MB	500MB	100MB
P3	270MB	300MB	30MB
P4	180MB	200MB	20MB
P5	80MB	100MB	20MB

Maximum degree of multiprogramming = 5 and Total internal fragmentation = 100 + 100 + 30 + 20 + 20 = 270MB

For best fit the process allocation in blocks is as follows:

Process	Size	Block allocated	Internal Fragmentation
P1	150MB	200MB	50MB
P2	400MB	500MB	100MB
P3	270MB	300MB	30MB
P4	180MB	200MB	20MB
P5	80MB	100MB	20MB

Maximum degree of multiprogramming = 5 and Total internal fragmentation = 50 + 100 + 30 + 20 + 20 = 270MB

For worst fit the process allocation in blocks is as follows:

Process	Size	Block allocated	Internal Fragmentation
P1	150MB	500MB	350MB
P2	400MB	Not allocated	
P3	270MB	300MB	30MB
P4	180MB	250MB	70MB
P5	80MB	200MB	120MB

Maximum degree of multiprogramming = 4 and Total internal fragmentation = 350 + 30 + 70 + 120 = 570MB

Here process P2 can not be allocated as any block of atleast 400MB is not available at all.

Hence worst fit does not have same Maximum degree of multiprogramming and Total internal fragmentation as other two policies.

Q2 Text Solution:

Number of pages in process = 2^{25} / 4K = 2^{13}

Number of frames in main memory = 2^{33}/4k = 2^{21}

Hence frame number = 21 bits

Page table size = number of pages in process * frame number

= 2^{13} * 21 bits

= 2^{10} * 21 bytes

= 21 k bytes

Q3 Text Solution:

Number of pages in process = 2^{12}

Number of frames in main memory = 2^{33}/2k = 2^{22}

Hence frame number = 22 bits

Page table size = number of pages in process * frame number

= 2^{12} * 22 bits

= 2^{10} * 11 bytes

= 11 k bytes

Q4 Text Solution:

Page table size = 12 k bytes = 12 k * 8 bits

12 k * 8 bits = 4k * (f + 1 + 1+ 1) bits

24 bits = f + 3 bits

f = 21 bits

Hence number of frames = 2^{21} = 2 * 2^{20}

Q5 Text Solution:

For page size of 8 kbytes, the number of bits for offset = log 8k = 13 bits

The 43 bits logical address is divided into 2 parts as follows:

P	d
30	13

Hence logical page number = 30 bits

The 51 bits physical address is divided into 2 parts as follows:

f	d
38	13

Hence physical frame number = 38

Q6 Text Solution:

Number of frames = 32, hence for frame numbers 5 bits are needed

Page table size = number of pages * frame number

= 8 * 5 bits

= 40 bits

Q7 Text Solution:

Without TLB effective memory access time = 2*Tmm = 400ns

Tmm = 200ns

With TLB effective memory access time = H * (Ttlb + Tmm) + (1-H)*(Ttlb + 2*Tmm)

280 = H *(40+200) + (1-H) * (40 + 400)

H = 0.8 = 80%

Q8 Text Solution:

Number of frames in physical memory = 512GB / 2KB = 258M = 2^{28}, hence frame number = 28 bits

Each page table entry size = frame number + extra bits

= 28 + 1 + 1 + 2

= 32 bits

= 4 bytes

Number of entries, TLB can store = 8KB/4B = 2K

For each entry in TLB, the entry number = log 2K = 11 bits

Page size = 2KB, hence offset = log 2K = 11 bits

The 42 bits logical address will be divided into 3 parts as follows:

Tag	TLB Entry number	d
	11	11

Tag size = 42 – (11+11) = 20 bits