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Homework -8

Operating System

Chapter-8(Main_Memory_Management)

1. Consider a logical address space of 64 pages of 1,024 words each, mapped onto a physical memory of 32 frames.

a. How many bits are there in the logical address?
b. How many bits are there in the physical address?

Solution:

Method1:

a) m =???
Size of logical address space = 2^m = # of pages × page size
2^m= 64 × 1024
$2^m = 2^6 \times 2^{10}$
2m =2^{16} »» **m=16 bit**

Method2:

m =???
# of pages = 2^{m-n}
n =???
Page size=2^n
1024=2^n
2^{10}=2^n »» n=10 bit
Again: # of pages = 2^{m-n}
64=2^{m-10}
2^6=2^{m-10}
6= m-10 »» **m=16 bit**
b)
Let **(x)** is number of bits in the physical address
x =???
Size of physical address space = 2_x
Size of physical address space = # of frames × frame size
(frame size = page size)
Size of physical address space = 32 × 1024

$2^x = 2^5 \times 2^{10}$
$2^x = 2^{15}$
»» number of required bits in the physical address=**x =15 bit**

2. Explain the difference between internal and external fragmentation.

Solution:

Internal Fragmentation

Memory block assigned to process is bigger. Some portion of memory is left unused, as it cannot be used by another process. The internal fragmentation can be reduced by effectively assigning the smallest partition but large enough for the process.

External Fragmentation

Total memory space is enough to satisfy a request or to reside a process in it, but it is not contiguous, so it cannot be used. External fragmentation can be reduced by compaction or shuffle memory contents to place all free memory together in one large block. To make compaction feasible, relocation should be dynamic.

Following are the important differences between Internal Fragmentation and External Fragmentation.

Sr. No.	Key	Internal Fragmentation	External Fragmentation
1	Definition	When there is a difference between required memory space vs allotted memory space, problem is termed as Internal Fragmentation.	When there are small and non-contiguous memory blocks which cannot be assigned to any process, the problem is termed as External Fragmentation.
2	Memory Block Size	Internal Fragmentation occurs when allotted memory blocks are of fixed size.	External Fragmentation occurs when allotted memory blocks are of varying size.
3	Occurrence	Internal Fragmentation occurs when a process needs more space than the size of allotted memory block or use less space.	External Fragmentation occurs when a process is removed from the main memory.

Sr. No.	Key	Internal Fragmentation	External Fragmentation
4	Solution	Best Fit Block Search is the solution for internal fragmentation.	Compaction is the solution for external fragmentation.
5	Process	Internal Fragmentation occurs when Paging is employed.	External Fragmentation occurs when Segmentation is employed.

3. Given six memory partitions of 300 KB, 600 KB, 350 KB, 200 KB, 750 KB, and 125 KB (in order), how would the first-fit, best-fit, and worst-fit algorithms place processes of size 115 KB, 500 KB, 358 KB, 200 KB, and 375 KB (in order)? Rank the algorithms in terms of how efficiently they use memory.

Solution:

First fit: Allocate the first hole that is big enough. Searching can start either at the beginning of the set of holes or at the location where the previous first-fit search ended. We can stop searching as soon as we find a free hole that is large enough.

Best fit: Allocate the smallest hole that is big enough. We must search the entire list, unless the list is ordered by size. This strategy produces the smallest leftover hole.

Worst fit: Allocate the largest hole. Again, we must search the entire list, unless it is sorted by size. This strategy produces the largest leftover hole, which may be more useful than the smaller leftover hole from a best-fit approach.

M1=300 KB M2=600 KB M3=350 KB M4=200 KB M5=750 KB M6=125 KB
P1=115 KB P2=500 KB P3=358 KB P4=200 KB P5=375 KB

First-fit:

P1 = 115 M1=**300** M2=600 M3=350 M4=200 M5=750 M6=125
P2 = 500 M1=185 M2=**600** M3=350 M4=200 M5=750 M6=125
P3 = 358 M1=185 M2=100 M3=350 M4=200 M5=**750** M6=125
P4 = 200 M1=185 M2=100 M3=**350** M4=200 M5=392 M6=125
P5 = 375 M1=185 M2=100 M3=150 M4=200 M5=**392** M6=125

Best-fit:

P1 = 115 M1=300 M2=600 M3=350 M4=200 M5=750 M6=**125**
P2 = 500 M1=300 M2=**600** M3=350 M4=200 M5=750 M6=10
P3 = 358 M1=300 M2=100 M3=350 M4=200 M5=**750** M6=10
P4 = 200 M1=300 M2=100 M3=350 M4=**200** M5=392 M6=10
P5 = 375 M1=300 M2=100 M3=350 M4=000 M5=**392** M6=10

Worst fit:

P1 = 115 KB is put in 750-KB partition, leaving 300 KB, 600 KB, 350 KB, 200KB, 635 KB, 125 KB

P2= 500 KB is put in 635-KB partition, leaving 300 KB, 600 KB, 350 KB,200 KB, 135 KB, 125 KB

P3 = 358 KB is put in 600-KB partition, leaving 300 KB, 242 KB, 350 KB,200 KB, 135 KB, 125 KB

P4 = 200 KB is put in 350-KB partition, leaving 300 KB, 242 KB, 150 KB,200 KB, 135 KB, 125 KB

P5 = 375 KB must wait.

4. Assuming a 1-KB page size, what are the page numbers and offsets for the following address references (provided as decimal numbers):
a. 3085
b. 42095
c. 215201
d. 2000001

Solution:

Page size $=2^n=1024$ B$=2^{10}$ B
\# of bits in offset part (n) =10
Solution steps :
1. Convert logical address: Decimal to Binary
2. Split binary address to 2 parts (page # , Offset), offset : n digits
3. Convert offset & page# : Binary to Decimal

Logical address (decimal)	Logical address (binary)	Page # (22 bits) (binary)	Offset (10 bits) (binary)	Page # decimal	Offset decimal
3085	00000000000000000 000110000001101	00000000000000000 00011	**0000001101**	3	13
42095	00000000000000001 010010001101111	00000000000000001 01001	**0001101111**	41	111
215201	00000000000000110 100100010100001	00000000000000110 10010	**0010100001**	210	161
650000	00000000000010011 110101100010000	00000000000010011 11010	**1100010000**	634	784
2000001	00000000000010000 000000000000001	00000000000010000 00000	**0000000001**	512	1

5. Consider the following segment table:

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

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

Solution:

Given	Logical Address	Physical Address
a. 0,430	0,430	219 + 430 = 649
b. 1,10	1,10	2300 + 10 = 2310
c. 2,500	2,500	Invalid
d. 3,400	3,400	1327 + 400 = 1727
e. 4,112	4,112	Invalid