

Operating System
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OS 2021 Problem Sheet #7

Problem 7.1: positioning algorithms

a) Best-fit

	17 KiB	8 KiB	10 KiB	21 KiB	12 KiB	13 KiB	Unallocated
11 KiB:					/////		
					12 KiB – 11 KiB 1 leftover		
9 KiB:			/////				
			10 KiB – 9 KiB 1 leftover				
7 KiB:		/////					
		8 KiB – 7 KiB 1 leftover					
16 KiB:	/////						
	17 KiB – 16 KiB 1 leftover						

$$\text{Fragmentation} = 1 \text{ KiB} + 1 \text{ KiB} + 1 \text{ KiB} + 21 \text{ KiB} + 1 \text{ KiB} + 13 \text{ KiB} = 38 \text{ KiB}$$

b) Worst-fit

	17 KiB	8 KiB	10 KiB	21 KiB	12 KiB	13 KiB	Unallocated
11 KiB:				/////			
				21 KiB – 11 KiB 10 leftover			
9 KiB:	/////						
	17 KiB – 9 KiB 8 leftover						
7 KiB:						/////	
						13 KiB – 7 KiB 6 leftover	
16 KiB:							/////
							16 KiB

$$\text{Fragmentation} = 17 \text{ KiB} + 8 \text{ KiB} + 10 \text{ KiB} + 10 \text{ KiB} + 12 \text{ KiB} + 6 \text{ KiB} = 63 \text{ KiB}$$

c) First-fit

	17 KiB	8 KiB	10 KiB	21 KiB	12 KiB	13 KiB	Unallocated
11 KiB:	/////						
	17 KiB – 11 KiB 6 leftover						
9 KiB:			/////				
			10 KiB – 9 KiB 1 leftover				
7 KiB:		/////					
		8 KiB – 7 KiB 1 leftover					
16 KiB:				/////			
				21 KiB – 16 KiB 5 leftover			

$$\text{Fragmentation} = 6 \text{ KiB} + 1 \text{ KiB} + 1 \text{ KiB} + 5 \text{ KiB} + 12 \text{ KiB} + 13 \text{ KiB} = 38 \text{ KiB}$$

d) Next-fit

	17 KiB	8 KiB	10 KiB	21 KiB	12 KiB	13 KiB	Unallocated
11 KiB:	/////						
	17 KiB - 11 KiB 6 leftover						
9 KiB:			/////				
			10 KiB - 9 KiB 1 leftover				
7 KiB:				/////			
				21 KiB - 7 KiB 14 leftover			
16 KiB:							/////
							16 KiB

$$\text{Fragmentation} = 6 \text{ KiB} + 8 \text{ KiB} + 1 \text{ KiB} + 14 \text{ KiB} + 12 \text{ KiB} + 13 \text{ KiB} = 54 \text{ KiB}$$

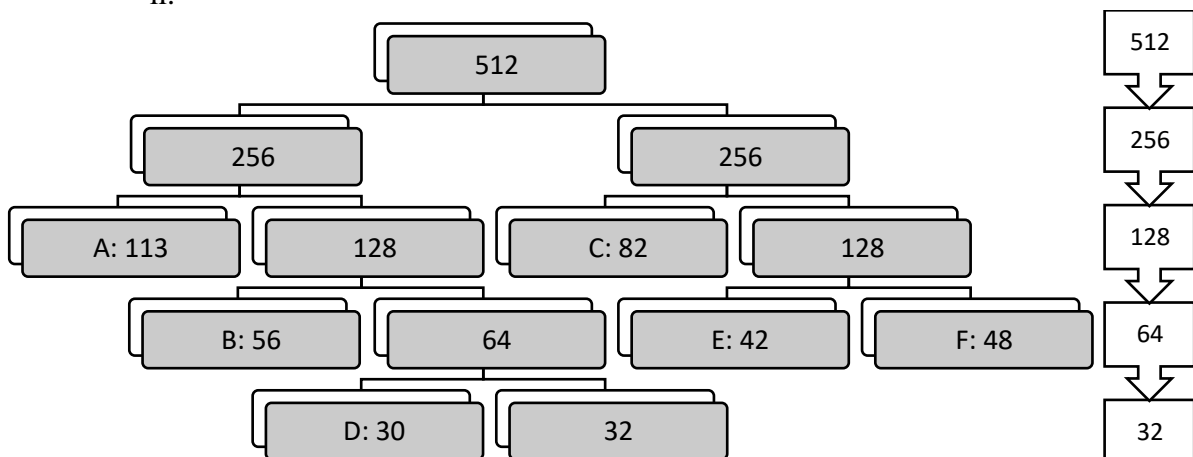
Problem 7.2: buddy system

a)

i. A: +113 KiB, B: +56 KiB, C: +82 KiB, D: +30 KiB, E: +42 KiB, F: +48 KiB

512 KiB						
A	128 KiB			256 KiB		
A	B	64 KiB		256 KiB		
A	B	64 KiB		C	128 KiB	
A	B	D	32 KiB	C	128 KiB	
A	B	D	32 KiB	C	E	64 KiB
A	B	D	32 KiB	C	E	F

ii.



b)

Fragmentations:

A: $128 - 113 = 15$ KiB

B: $64 - 56 = 8$ KiB

C: $128 - 82 = 46$ KiB

D: $32 - 30 = 2$ KiB

E: $64 - 42 = 22$ KiB

F: $64 - 48 = 16$ KiB

Overall internal fragmentation = $15 + 8 + 46 + 2 + 22 + 16 = 142$ KiB

The largest chunk of memory that can be **allocated** is 32 KiB.

c) G: 132 KiB

No, it will not be allocated even if C return its allocation. When C return its allocation, the next available largest chunk of memory to be allocated will be 128 KiB. Since G will not be able to fit in that, it will not be allocated space.

Problem 7.3: buddy system

a) First-In-First-Out (FIFO)

i. For two frames

Reference string	1	4	2	3	4	4	1	3	2	1
Frame 0	1	1	2	2	4	4	4	3	3	1
Frame 1		4	4	3	3	3	1	1	2	2
Faults	x	x	x	x	x		x	x	x	x

Hits = 1

Total page fault = 9

ii. For three frames

Reference string	1	4	2	3	4	4	1	3	2	1
Frame 0	1	1	1	3	3	3	3	3	3	3
Frame 1		4	4	4	4	4	1	1	1	1
Frame 2			2	2	2	2	2	2	2	2
Faults	x	x	x	x			x			

Hits = 5

Total page fault = 5

b) Belady's Optimal (BO)

i. For two frames

Reference string	1	4	2	3	4	4	1	3	2	1
Frame 0	1	1	2	3	3	3	3	3	2	2
Frame 1		4	4	4	4	4	1	1	1	1
Faults	x	x	x	x			x		x	

Hits = 4

Total page fault = 6

ii. For three frames

Reference string	1	4	2	3	4	4	1	3	2	1
Frame 0	1	1	1	1	1	1	1	1	1	1
Frame 1		4	4	4	4	4	4	4	4	4
Frame 2			2	3	3	3	3	3	2	2
Faults	x	x	x	x					x	

Hits = 5

Total page fault = 5

c) Least Recently Used (LRU)

i. For two frames

Reference string	1	4	2	3	4	4	1	3	2	1
Frame 0	1	1	2	2	4	4	4	4	2	3
Frame 1		4	4	3	3	3	1	3	3	1
Faults	x	x	x	x	x		x	x	x	x

Hits = 1

Total page fault = 9

ii. For three frames

Reference string	1	4	2	3	4	4	1	3	2	1
Frame 0	1	1	1	3	3	3	3	3	3	3
Frame 1		4	4	4	4	4	4	4	2	2
Frame 2			2	2	2	2	1	1	1	1
Faults	x	x	x	x			x		x	

Hits = 4

Total page fault = 6