

CIS 520 - Operating Systems I – Homework #3

Due: Monday, Oct. 28th, by 11:59 pm, upload via K-State OnLine

1. Consider the following page reference string: 1,2,3,4,2,3,5,3,6,5,5,4,2,4,5. How many page faults would result for the following replacement algorithms assuming two, three, four, five, or six frames? Remember that all frames are initially empty, so the first time a page is loaded will cause a fault.

Algorithm	2 Frames	3 Frames	4 Frames	5 Frames	6 Frames
LRU	12	8	8	6	6
FIFO	11	9	7	6	6
Optimal	10	7	6	6	6

2. You have devised a new page-replacement algorithm that you think may be optimal. In some contorted test cases, Belady's anomaly occurs. Is the new algorithm optimal? Explain your answer.

No, an optimal algorithm does not suffer from Belady's anomaly. If more memory frames are used then the number of page faults should decrease and if this does not happen in all cases then the algorithm is not optimal.

3. What is the copy-on-write feature, and under what circumstances is it beneficial to use this feature? What hardware support is required to implement this feature?

The copy-on-write feature allows the parent and child processes to initially share the same pages. Then if either process writes to the shared page, then a copy of the shared page is created. Very useful if multiple callers ask for resource page and only need to copy the pages the caller is trying to modify, which gives a performance boost. The hardware support needed is to check whether a page is write-protected.

4. Consider the page table for a system with 12-bit virtual and physical addresses, and 256-byte pages. The list of free page frames is D, E, 8, F (that is, D is at the head of the free list, E is second, 8 is third, and F is last).

Page	Page Frame
0	9
1	2
2	C
3	A
4	-
5	4
6	3
7	D
8	B
9	0
A	-
B	5
C	1
D	7
E	6

F	0
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Convert the following virtual addresses to their equivalent physical addresses in hexadecimal. All numbers are given in hexadecimal. (A dash for a page frame indicates the page is not in memory; i.e., the Valid/Invalid bit is set to Invalid).

- 8FF → BFF
- 111 → 211
- 700 → D00
- BFF → 5FF

Finally, show the resulting updates to the page table above after the preceding addresses are referenced causing some pages to be loaded.

(Page 7 goes from – to D)