

Homework #3 – 150 points

Due: **Thursday July 3rd by 11:59 pm.** NO LATE ASSIGNMENTS ACCEPTED

Answer each of the following questions completely. Make sure that your answers are neatly written and very readable. Points will be deducted if your assignment is not presented in a neat format.

NOTE: The last two pages of this document contain blank tables that you can use to answer the problems. I've also placed Excel spreadsheet templates on WebCourses for you if you prefer. The Excel spreadsheet is already set up to do the calculations required provided you use the symbols "Y" and "N" to indicate page faults. Hopefully, this will save you some time.

- 1) (90 pts – 15 pts each) For the reference string shown below, determine the number of page faults that occur for (a) FIFO replacement algorithm, (b) LRU replacement algorithm (c) Optimal replacement algorithm. Do parts (a)-(c) for allocations of (1) three page frame allocation and (2) four page frame allocation. In each case answer the question: Does this reference string suffer from Belady's anomaly for a three and four page allocation?

Reference string:

1, 0, 2, 2, 1, 7, 6, 7, 0, 1, 2, 0, 3, 0, 4, 5, 1, 5, 2, 4, 5, 6, 7, 6, 7, 2, 4, 2, 7, 3, 3, 2, 3

- 2) (30 pts – 15 points each) Using the reference string from problem 1, determine the number of page faults using an algorithm called LFU (Least Frequently Used), for both a three page and a four page allocation. The LFU algorithm will select the page that has been used with the least frequency whenever an existing page is being replaced by a new page in the allocation. In the event that two or more pages have the same frequency of use, the LFU algorithm reverts to FIFO in that the page that has been in the allocation the longest will be removed. Does this page replacement algorithm suffer from Belady's anomaly for this reference string using a three and four page allocation?

- 3) (30 pts - 15 pts each) Using the reference string from problem 1, determine the working set at each page reference for (a) $\Delta = 3$, and (b) $\Delta = 5$. Determine (1) the size of the working set at each page reference, (2) the average size of the working set (there are 33 entries in the reference string), and (3) the total number of page faults in each case.

Blank table for the three-frame allocation problems:

ref. string	1	0	2	2	1	7	6	7	0	1	2	0	3	0	4	5	1	5	2	4	5	6	7	6	7	2	4	2	7	3	3	2	3
frame 1																																	
frame 2																																	
frame 3																																	
page fault																																	
total page faults =	0																																

Blank table for the four-frame allocation problems:

ref. string	1	0	2	2	1	7	6	7	0	1	2	0	3	0	4	5	1	5	2	4	5	6	7	6	7	2	4	2	7	3	3	2	3
frame 1																																	
frame 2																																	
frame 3																																	
frame 4																																	
page fault																																	
total page faults =	0																																

Working Set Model: $\Delta =$			
Reference String			
	Working Set	Working Set Size	Page Fault
1			
0			
2			
2			
1			
7			
6			
7			
0			
1			
2			
0			
3			
0			
4			
5			
1			
5			
2			
4			
5			
6			
7			
6			
7			
2			
4			
2			
7			
3			
3			
2			
3			

average size = #DIV/0!

Page Faults = 0

