CS3600

Worksheet 10 - VM1 – Solutions Part 1

1. A process in a paged system accesses the following virtual addresses:
   10, 11, 104, 170, 73, 309, 185, 245, 246, 434, 458, 364

   Derive the corresponding reference string if the page size is 100 words and 200 words.

Page size	Reference string
100	0 0 1 1 0 3 1 2 2 4 4 3
200	0 0 0 0 0 1 0 1 1 2 2 1

2. At time i, the four-page frames contain the pages shown below.

Time t	...	i	...
Frame 0		0	
Frame 1		7	
Frame 2	➡	2	
Frame 3		5	

The ➡ points to the oldest resident page. Page size = 512 words. The system uses the FIFO page replacement algorithm. For each virtual address VA, write the corresponding page number p and whether that VA will cause a page fault at time i+1. Where will be the pointer after all replacements if any.

VA	Page	
2581	5	
4029	7	
1981	3	Fault at i+1
1189	2	

The pointer to oldest resident page will be at 5

3. Physical memory consists of 4-page frames, initially all empty. The following reference string is processed:
   0 1 4 0 2 3 0 1 0 2 3 4 2 3
   (a) Show which pages are resident under the optimal page replacement algorithm. Indicate when page faults happen.

Time t	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
RS		0	1	4	0	2	3	0	1	0	2	3	4	2	3
Frame 0	-	0	0	0	0	0	0	0	0	0	0	0	4	4	4
Frame 1	-	-	1	1	1	1	1	1	1	1	1	1	1	1	1
Frame 2	-	-	-	4	4	4	3	3	3	3	3	3	3	3	3
Frame 3	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2
Pg fault		*	*	*		*	*						*		

(b) Show which pages are resident under the FIFO page replacement algorithm. Indicate when page faults happen

Time t	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
RS		0	1	4	0	2	3	0	1	0	2	3	4	2	3
Frame 0	-	>0	>0	>0	>0	>0	3	3	3	3	3	3	>3	2	2
Frame 1	-	-	1	1	1	1	>1	0	0	0	0	0	0	>0	3
Frame 2	-	-	-	4	4	4	4	>4	1	1	1	1	1	1	>1
Frame 3	-	-	-	-	-	2	2	2	>2	>2	>2	>2	4	4	4
Pg fault		*	*	*		*	*	*	*				*	*	*

(c) Show which pages are resident under the LRU page replacement algorithm. Indicate when page faults happen.

Time t	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
RS		0	1	4	0	2	3	0	1	0	2	3	4	2	3
Frame 0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Frame 1	-	-	1	1	1	1	3	3	3	3	3	3	3	3	3
Frame 2	-	-	-	4	4	4	4	4	1	1	1	1	4	4	4
Frame 3	-	-	-	-	-	2	2	2	2	2	2	2	2	2	2
Pg fault		*	*	*		*	*		*				*		
Q end	-	0	1	4	0	2	3	0	1	0	2	3	4	2	3
	-	-	0	1	4	0	2	3	0	1	0	2	3	4	2
	-	-	-	0	1	4	0	2	3	3	1	0	2	3	4
Q head	-	-	-	-	-	1	4	4	2	2	3	1	0	0	0