

Worksheet 11- Solutions will be posted by 04/14 – 10 points for participation

1. A memory consists of 4-page frames, currently holding pages 0 - 3. A 6-bit aging register is associated with each frame. The table shows which pages were referenced during each of 8 consecutive periods d.

Period d	0	1	2	3	4	5	6	7
Pages referenced	3	1	0	0	0	2	2	1

Determine which page will be replaced if a page fault occurs at the end of last d period.

Hint: See section aging registers

2. 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

- Show which pages are resident under the second chance page replacement algorithm. Indicate when page faults occur.
- Assume that references to page 1 are write references (modifying page 1) and all others are read references. Show which pages are resident under the third chance page replacement algorithm. Indicate when page faults occur.

Hint: See sections and animation for second chance & third chance algorithms

3. A system uses demand paging to implement virtual memory.

- Access to physical memory is $m = 100$ ns. (Access to a page table is assumed to be negligible due to the use of caches and a TLB.)
- To process a page fault takes
 - $S = 5$ ms if a free page frame is available
 - $S = 15$ ms if no free frame is available and thus a resident page needs to be replaced
- On average, a free frame is available only 20% of the time.

Determine the maximum page fault rate, P , such that the average memory access time does not exceed 200 ns.

Hint: See section page fault overhead

4. Write your experience on self-learning, do you prefer self-learning (using class time for reading and ask questions if stuck) or flipped class model (to read sections before class and use class for solving exercises) ?