Operating Systems
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S08

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Exercise 2

Which page will NRU replace ? NRU will remove page 1 or 2.

Which page will FIFO replace ? FIFO will remove page 3, which was loaded at tick 110.

Which page will second chance replace ? LRU will remove page 1.

Which page will LRU replace ? Second chance will remove page 2.

Exercise 3

a)

All referenced bit are set to 0.

Table 1: Table entries at tick 9.

Page	Timestamp	V	R	M
0	6	1	0	1
1	9	1	1	0
2	9	1	1	1
3	7	1	0	0
4	4	0	0	0

Table 2: Table entries at tick 10.

Page	Timestamp	V	R	M
0	6	1	0	1
1	10	1	0	0
2	10	1	0	1
3	7	1	0	0
4	4	0	0	0

b)

Table 3: Table entries at tick 9.

Page	Timestamp	V	R	M
0	6	1	0	1
1	9	1	1	0
2	9	1	1	1
3	7	1	0	0
4	4	0	0	0

Table 4: Contents of the new table entries.

Page	Timestamp	V	R	M	Explanation
0	6	1	0	1	Not in the working set and not removed, go to the next page
1	9	1	0	0	Set R to 0 and go to the next page
2	9	1	0	1	Set R to 0 and go to the next page
3	7	0	0	0	Age > tau and clean –> replace it
4	4	0	0	0	Age > tau and dirty –> claim it

Exercise 4

a)

Address to read : $0x\underbrace{C}_{\text{4 bits}}\underbrace{0DED}_{\text{16 bits}}\underbrace{DAB}_{\text{12 bits}}$.

- Segment value : $0xC$
- Page value : $0x0DED$
- Offset value : $0xDAB$

b)

1. The segment value is used to find the segment descriptor.
2. Lookup for the page table entry $0x0DED$ and get its page number n.
3. Add $0xDAB$ to n shifted 12 bits to the left.
4. Access the memory.

c)

1. The segment value is used to find the segment descriptor.
2. If the segment is not in the memory, a segment fault is created.
3. If the page is not in the memory, a page fault is created.
4. The page is loaded in the memory.
5. Set the PTE's present bit to 1.

Exercise 5

a)

- m-bit is set when writing into the frame $\rightarrow$ non-modified frames don't have to be written back.
- r-bit is set when accessing the frame. The bit is periodicaly reset.

b)

Each page belongs to a category. There are $4 = 2^2$ categories in total : 00, 01, 10 and 11. The page with the lowest category is evicted at random (over all the page in the same category).

Exercise 6

The implementation of NRU, NFU and FIFO are available in appendices.