Operating Systems
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Homework 4

Problem 4.1

Solution:

a) Since the size of each frame is 1 KB and the total physical address space is 256 Kb there are 256 frames.

b) 10 bits are used to represent the 1024 byte offset and 6 bits are used to reference the 64 pages. It follows that a logical address contains 16 bits.

c) Similarly for the physical address space there are 10 bits to keep track of the 1024 byte frame size and another 8 bits to represent the 256 frames. Therefore, physical addresses have 18 bits.

d) 6 bits for the page numbers.

e) 10 bits are used for the offset.

Problem 4.2

Solution:

a)

reference string	1	2	3	4	1	1	4	2	1	2
frame 0	1*	1	3*	3	1*	1	1	1	1	1
frame 1		2*	2	4*	4	4	4	2*	2	2

6 page faults.

b)

reference string	1	2	3	4	1	1	4	2	1	2
frame 0	1*	1	1	4*	4	4	4	4	4	4
frame 1		2*	2	2	1*	1	1	1	1	1
frame 2			3*	3	3	3	3	2*	2	2

6 page faults.

c)

reference string	1	2	3	4	1	1	4	2	1	2
frame 0	1*	1	1	1	1	1	1	1	1	1
frame 1		2*	3*	4*	4	4	4	2*	2	2

5 page faults.

d)

reference string	1	2	3	4	1	1	4	2	1	2
frame 0	1*	1	1	1	1	1	1	1	1	1
frame 1		2*	2	2	2	2	2	2	2	2
frame 2			3*	4*	4	4	4	4	4	4

4 page faults.

e)

reference string	1	2	3	4	1	1	4	2	1	2
frame 0	1*	1	3*	3	1*	1	1	2*	2	2
frame 1		2*	2	4*	4	4	4	4	1*	1

7 page faults.

f)

reference string	1	2	3	4	1	1	4	2	1	2
frame 0	1*	1	1	4*	4	4	4	4	4	4
frame 1		2*	2	2	1*	1	1	1	1	1
frame 2			3*	3	3	3	3	2*	2	2

6 page faults.

Problem 4.3

Solution:

The working set page management system removes pages from context as soon as they are not in the current working set. This works similarly to LRU where the page that is the least recently used will be the next one to replace, except is a page is not used for a long period of time it is removed. In the best case, where the number of memory accesses N being tracked is optimal for frequency of page requests and the number of frames, the working set design will be as good as LRU. However, depending on N, working set is likely to perform worse than LRU. Given a situation where a page is not used for some period of time and is removed from the working set, it could still be the case that is is the next page to be requested. This causes a page fault using the working set design, where LRU would not have a page fault as all pages remain resident so long as there are free frames. Therefore, LRU would be preferable over working set. At any point in time, the pages resident in working set are the pages that have been used in the last N memory accesses whereas the pages resident in LRU are the pages that are the most recenlty used since the last page fault. An improvement would be to keep frames as long as there are free frames available. This ensures no pages are removed unnecessarily when there is space for more pages to be added.