

Assignment 4

Problem 4.1

- a) Frames in physical memory have the same size as pages in logical memory. Therefore, the physical memory has 256 frames, as each page is 1 Kb and the size of physical memory is 256 Kb.
- b) Since the logical address space needs to be able to reference a maximum of 64 (2^6) pages, as well as an offset of 1024 (2^{10}), the number of bits of an address in logical memory is: $6 + 10 = 16$ bits
- c) The physical memory, as shown before, has 256 (2^8) frames each with size 1024 (2^{10}) bytes. Therefore, in order to represent this we need $8 + 10 = 18$ bits.
- d) Given a maximum of 64 pages per process, 6 bits are needed for representing page numbers.
- e) The remaining 10 bits are then used for the offset.

Problem 4.2

* will indicate page faults.

a) FIFO:

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
Page faults	*	*	*	*	*			*		

There are 6 page faults.

b) FIFO:

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
Page faults	*	*	*	*	*			*		

There are 6 page faults

c) BO:

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
Page faults	*	*	*	*				*		

There are 5 page faults.

d) BO:

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
Page faults	*	*	*	*						

There are 4 page faults.

e) LRU:

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
Page faults	*	*	*	*	*			*	*	

There are 7 page faults.

f) LRU:

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
Page faults	*	*	*	*	*			*		

There are 6 page faults.

Problem 4.3

Depending on the constant N the working set design could have more or less page faults than LRU, i.e. if N is small then more page faults are likely to occur. LRU replaces the page that was used the least recently used if there are no free frames, whereas working set removes pages that have not been accessed in the last N memory accesses.

At any point in time after initial page faults, LRU has all frames filled with a page, whereas working set may have less pages than frames.

LRU is the preferable design, this is because, while all the frames are occupied, LRU keeps pages resident until a page that is not resident is needed. Therefore at any point in time, if the LRU page is also the next page to be accessed there is no page fault, whereas if the LRU page is out of the boundary N , it is removed and this would cause a page fault if it is the next page access.

In order to improve the memory access for working set, a counter on how many times a page has been accessed in the last N memory accesses. The page with the lowest count would be a candidate to replace upon a page fault. Therefore, pages would be replaced on a LFU basis.