CprE 308 Homework 3

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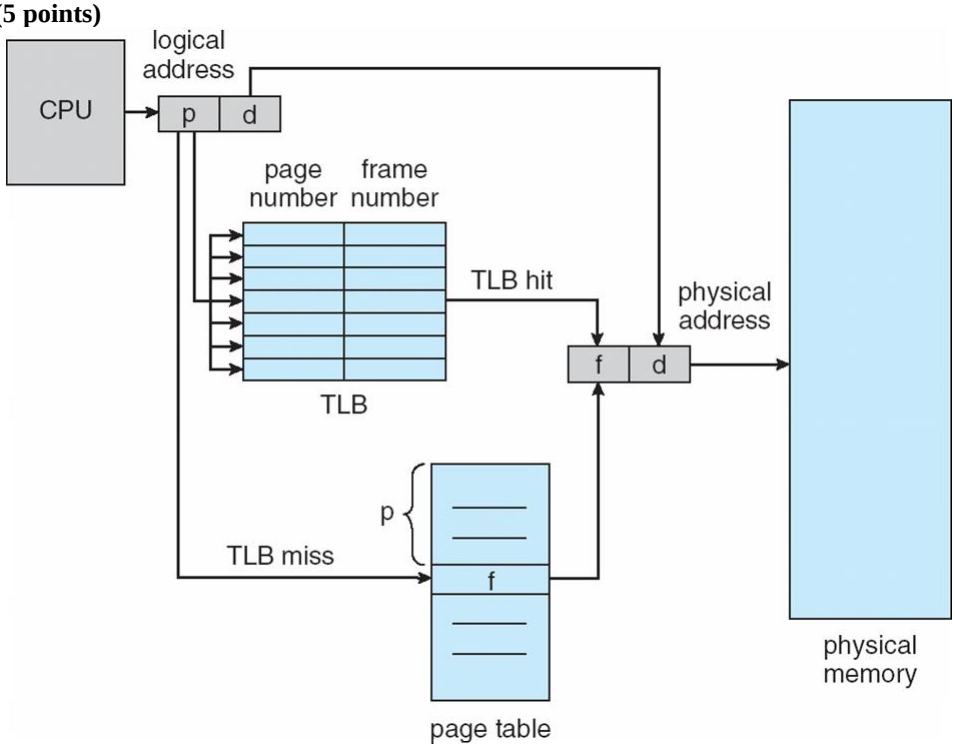
Problem 1. (5 points)

Applications can be roughly classified into two types based on I/O pattern: sequential and random. Which type of applications tend to have better I/O performance on hard disk drives? Why?

Sequential

Problem 2. (5 points)



The figure above shows the basic workflow of paging with TLB. Assume the TLB hit ratio is ***R***, which means the percentage of times that a page reference is found in the TLB. Also, assume the latency of memory access is ***L***. Calculate the Effective Access Time (EAT) using ***R*** and ***L***.

Answer:
On TLB hit, there is only one memory access needed, so the access time is about ***L;***
On TLB miss, there are two memory accesses, i.e., one to page table, another to physical memory, so the access time is about ***L*2***;
Since the TLB hit ratio is ***R***, the Effective Access Time (EAT) = ***R*L + (1-R)*L*2***

Problem 3. (10 points)

We can evaluate a page-replacement algorithm by running it on a particular string of memory references (reference string) and computing the number of page faults on that string. Each number in the reference string represents a page number. Assume there is a reference string as follows:

8,0,1,2,0,3,0,4,2,3,0,3,0,3,2,1,2,0,1,8

Assume the system only has three physical memory frames, and the content of the frames corresponding to the reference string above is as follows:

8	0	1	2	0	3	0	4	2	3	0	3	0	3	2	1	2	0	1	8
8	8	8	2	2	2	2	4	4	4	0	0	0	0	0	0	0	0	0	8
	0	0	0	0	3	3	3	2	2	2	2	2	2	2	1	1	1	1	1
		1	1	1	1	0	0	0	3	3	3	3	3	3	3	2	2	2	2

(1) Based on the memory content above, how many page faults are there for the given reference string?

Answer: 13

(2) Which page-replacement algorithm is used in the system?

Answer: FIFO

(3) Assume we extend the physical memory by adding one more frame, i.e., there are four frames in the main memory in total now. Assume the system uses Least Recently Used (LRU) page-replacement algorithm. Fill in the following table to show the content of the memory frames for the given reference string.

8	0	1	2	0	3	0	4	2	3	0	3	0	3	2	1	2	0	1	8
8	8	8	8	8	3	3	3	3	3	3	3	3	3	3	3	3	3	3	8
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	4	4	4	4	4	4	4	4	1	1	1	1	1
			2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2