CSCI 3753: Operating Systems
Homework Three

Please write your answers in the space provided.
Due date: Tuesday, April 22 in class. No extensions will be given, except at the instructor's discretion in documented cases of extreme hardship or emergencies.

Problem 1. [40 Points] A memory manager for a variable-sized region strategy has a free list of blocks of size 600, 400, 1000, 2200, 1600, and 1050 bytes. What block will be selected to honor a request for:

(a) 1603 bytes using a best-fit policy?
2200

(b) 949 bytes using a best-fit policy?
1000

(c) 1603 bytes using a worst-fit policy?
2200

(d) 349 bytes using a worst-fit policy?
2200

(e) 1603 bytes using a first-fit policy?
2200

(f) 1049 bytes using a first-fit policy?
2200

Problem 2. [30 Points] Given a memory of size 3 frames, and the following sequence of page references 3 2 4 3 4 2 2 3 4 5 6 7 7 6 5 4 5 6 7 2 1, and assuming that no page is initially loaded in the three frames, show the page faulting behavior using the following page replacement policies. How many page faults are generated by each page replacement algorithm?

(a) FIFO

3	3	3	5	5	5	4	4	4	7	7	7
	2	2	2	6	6	6	5	5	5	2	2
		4	4	4	7	7	7	6	6	6	1

Thats 12 faults.

(b) OPT

3	3	3	5	5	5	5	7	7
	2	2	2	6	6	6	6	2
		4	4	4	7	4	4	1

Thats 9 faults.

(c) LRU

3	3	3	3	6	6	6	6	6	1
	2	2	5	5	5	5	5	2	2
		4	4	4	7	4	7	7	7

Thats 10 faults.

Problem 3. [30 Points] Suppose on-demand paging is employed in addition to TLB caching. The time for a TLB access (hit or miss) is T = 1 ns, a memory read M = 10 ns, and a disk read D = 10 ms. Let p_TLB = the probability of a TLB hit, and p = the probability of a page fault given a TLB miss.

a. What is a general formula for the average memory access time expressed as a function of T, M, D, p, and p_TLB?

$$p\_TLB \cdot T + (1 - p\_TLB) \cdot p \cdot (T + M) + (1 - p\_TLB)(1 - p)(T + M + D)$$

b. Once parameter values are substituted, and assuming p = .001 and p_TLB = 90%, what is the average memory access time?

$$t = 0.999ms \approx 1ms$$