CS 4310 Operating Systems

Homework #2
(80 points) 8 questions

Due Date: 12/5

Question 1: (10 points) Consider a swapping system in which memory consists of the following hole sizes in memory order: **7KB, 4KB, 23KB, 9KB, 6KB, 18KB, 11KB, and 2KB.**
Which hole is taken for successive segment requests of

- **6KB**
- **15KB**
- **9KB**
- **10KB**
- **2KB**

for (a) first fit?
Now repeat the question for (b) best fit, (c) worst fit, and (d) next fit.

Question 2: (10 points) For each of the following decimal virtual addresses, compute the virtual page number and offset for a 2-KB page: **3002, 1097, 28127, 14550.**
Now repeat the question for a 4KB page. Show all steps.

Question 3: (10 points) A computer with a 64-bit address uses a two-level page table. Virtual addresses are split into a 14-bit top-level page table field, a 16-bit second-level page table field, and an offset. How large are the pages and how many pages are there in the address space?

Question 4: (10 points) If FIFO page replacement is used with five page frames and eight pages, how many page faults will occur with the reference string **236571345157245** if the five frames are initially empty?

Question 5: (10 points)
Repeat the question 4 for LRU. Show all steps.

Question 6: (10 points) The beginning of a free space bitmap looks like this after the disk partition is first formatted: 1000 0000 0000 0000 0000 0000 0000 0000 (the first block is used by the root directory). The system always searches for free blocks starting at the lowest numbered block, so after writing file A, which uses 8 blocks, the bitmap looks like this 1111 1111 1000 0000 0000 0000 0000 0000. Show the bitmap after each of the following actions:

(a) File B is written, using 12 blocks
(b) File C is written, using 9 blocks
(c) File A is deleted
(d) File B is deleted
(e) File D is written, using 10 blocks
(f) File E is written, using 3 blocks

Show all steps.

Question 7: (10 points) Take a careful look at the following figure. Use the Banker's Algorithm for a Single Resource for the following requests.

(a) If *B* asks for one more unit, does this lead to a safe state or an unsafe one? Show all steps.
(b) What if the request came from *A* instead of *B*? Show all steps.

	Has	Max
A	1	3
B	1	4
C	4	7
D	4	10
Free: 2		

Question 8: (10 points)

A system has four processes and five types of allocatable resources. The current allocation and maximum needs are as follows:

	Allocated	Maximum	Available
Process A	**2 1 0 2 2**	**4 2 2 3 3**	**3 2 x 2 3**
Process B	**3 1 1 0 2**	**3 3 6 1 2**	
Process C	**2 1 0 2 1**	**3 2 3 3 1**	
Process D	**1 1 0 1 0**	**1 2 3 2 1**	

What is the smallest value of x for which this is a safe state? Show all steps.