CSE 332 Midterm #2

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I. Question (16 points)

Consider the following snapshot of a system that allocates resources using the Banker's algorithm. Allocation shows the current allotments of resources to processes, and Max shows the potential maximum requirements for each process.

	Allocation		Max		Available	
	A	B	A	B	A	B
P0	1	2	1	3	1	1
P1	0	0	6	0		
P2	2	1	4	4		
P3	1	0	5	4		
P4	1	4	5	6		

a) Is the system in a safe state? If so, give a safe allocation sequence. If not, explain why not.
b) Suppose that P2 requests $(0, 1)$. Will the Banker's algorithm grant the request?

II. Question (12 points)

Assume the states of a system initially and after a few resource allocations are as shown in the following table. To be able to avoid deadlocks by using Dijkstra's Banker's algorithm, identify the question marked states as safe or unsafe, and also explain your reasoning. Assume there is only one type of resource, i.e. only tapes.

Requests	MaxP1	MaxP2	MaxP3	Alloc	Avail
1. Initial	10	4	9	0	12
2. P1 requests 5	5	4	9	5	7
3. P2 requests 2	5	4	9	7	5
4. P3 requests 2	5	2	7	9	3
5. P3 requests 1	5	2	6	10	2
6. P1 requests 1	4	2	6	11	1

III. Question (11 points)

Consider a demand-paging system with a paging disk that has an average access and transfer time of 20 milliseconds. Addresses are translated through a page table in main memory, with an access time of 1 microsecond per memory access. Thus, each memory reference through the page table takes two accesses. To improve this time, we have added an associative memory that reduces access time to one memory reference, if the page-table entry is in the associative memory. Assume that 80 percent of the accesses are in the associative memory, and that, of the remaining, 10 percent (or 2 percent of the total) cause page faults. What is the effective access time?

IV. Question (18 points)

Consider the following reference string:

`1,2,3,4,5,3,1,6,7,8,7,9,4,5,4,5,2,9`

Assuming that four page frames, which are initially empty, are used,

a) Show how many page faults occur for a FIFO replacement algorithm.
b) Show how many page faults occur for a LRU replacement algorithm.
c) Show how many page faults occur for the optimal replacement algorithm OPT.

V. Question (16 points)

Consider the two-dimensional array A:

```
var A:array[1...32] of array[1...32]of integer;
```

Where $A[1][1]$ is at location 2048, in a paged memory system with pages of size 128. A small process is in page 1 (locations 1 to 128) for manipulating the matrix; thus, every instruction fetch will be from page 1.

For three page frames, how many page faults are generated by the following array-initialization loops, using LRU replacement, and assuming page frame 1 has the process in it, and the other two are initially empty.

a)
```
for r : = 1 to 32 do
    for c : = 1 to 32 do
        A[r][c] : = 0;
```
b)
```
for c : = 1 to 32 do
    for r : = 1 to 32 do
        A[r][c] : = 0;
```

VI. Question (12 points)

Consider a demand-paged computer system where the degree of multi programming is currently fixed at six. The system was recently measured to determine utilization of CPU and the paging disk. The results are one of the following alternatives. For each case, what is happening? Can the degree of multiprogramming be increased to increase the CPU utilization? Is the paging helping? Explain.

a) CPU utilization 27 percent; disk utilization 5 percent
b) CPU utilization 18 percent; disk utilization 85 percent
c) CPU utilization 91 percent; disk utilization 4 percent

VII. Question (15 points)

Given memory partitions of 700K, 100K, 300K, 500K, 200K, 100K, and 100K (in order), how would each of the FirstFit, BestFit, and Worst Fit algorithms place the eight processes of respective sizes 310K, 290K, 112K, 97K, 97K, 97K, 97K, 410K (in order) into the partitions? Which algorithm makes the most efficient use of memory?