CS 385: HW5 – Due April 30, 2004

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1. **Monitors** Implement a resource allocator using monitors. Assume the total number of resources is MAX_RESOURCES and the resources are numbered 0 through (MAX_RESOURCES - 1). The two functions implemented by the monitor are

   int alloc() : returns the index of the resource allocated or -1 on failure.

   int free (int index) : index refers to the index of the resource being freed. Returns 0 if freed and -1 otherwise.

2. **Monitor and Semaphore** Implement a 4-level priority queue of processes using (a) semaphores and (b) monitor separately (that is there are two parts to the question – one implementation with just semaphores and the other as a monitor). The two functions to be implemented are:

   int enqueue(struct process *prcs, int priority) : Here priority denotes one of the 4 priority levels (0(HIGH) to 3(LOW)). If the process is successfully added to the queue denoted by priority, then return 0 else return -1.

   struct process * dequeue(void) : Dequeue the process with the highest priority. The process with the highest priority is the first one in the first queue, starting from the HIGH priority, that is not empty.

   Assume the system keeps track of a process using the following structure.

```
struct process {
        unsigned int pid;
        unsigned long programCounter;
};
```

3. **Virtual Memory** Consider a system with the following attributes:

   - Memory size = 512 MB
   - page size = 1 KB

- 32-bit address

For this system

(a) How many pages are there per process?

(b) How many page frames are there?

4. Consider a page table entry is 8-bytes long and the process size is 8 MB. How big is the single-level page table? How big is the two-level page table?

5. **Cache** How long does it take to access the memory in a page system if the time to acess the TLB is 20 ns, the time to access memory is 200 ns and the Miss rate is 4% ?

6. Using the data:

   - time to access memory 250 ns
   - time to access disk 60 ms
   - Miss ratio is 10^{-6}

   answer the following:

   (a) What is the average access time ?

   (b) If a hardware RAMDISK can do an access in 1μs, how much performance increase is there over the disk based system ?