Operating Systems, Spring 2012

Final

2:10pm $\sim$ 3:50pm, Tuesday, June 26, 2012

INSTRUCTIONS:

1. This is a *closed-book* exam.
2. Try to solve all of the problems.
3. Try to give short answers. (Hint: An answer need not always be longer than the question.)
4. No cheating.
5. Please hand in both the exam sheet and the answer sheet.

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1. (20%) What would be the output of the following C program? (*Note that the line numbers are for references only.*)

```
1  #include <stdio.h>
2  #include <unistd.h>
3  #include <sys/types.h>
4  #include <sys/wait.h>
5
6  int main()
7  {
8      int status;
9      int fd[2];
10     pipe(fd);
11     pid_t pid = fork();
12     if (pid > 0) {
13         close(fd[1]);
14         close(0);
15         dup(fd[0]);
16         close(fd[0]);
17         wait(&status);
18     }
19     else if (pid == 0) {
20         close(fd[0]);
21         close(1);
22         dup(fd[1]);
23         close(fd[1]);
24         execl("/bin/echo", "echo", "welcome", "to", "nsysu", (void*) 0);
25     }
26     else {
27         return 1;
28     }
29     return 0;
30 }
```

2. Given an i-node with *eight* direct blocks and *four* levels of indirect blocks and assuming that the sizes of a pointer and a block are, respectively, 8 bytes and 8 Kbytes, answer the following questions. *(Hint: you may assume all the meta-information for a file has been read into the main memory and forget about the case where some buffers may need to be written back to disk first.)*

   (a) (10%) What would be the size of the smallest file allowed in bytes?

   (b) (10%) What would be the size of the largest file allowed in bytes?

3. (10%) A small computer has 8 page frames, each containing a page. The page frames contain virtual pages A, C, G, H, B, L, N, and D in that order. Their respective load times were 18, 23, 5, 7, 32, 19, 3, and 8. Their reference bits are 1, 0, 1, 1, 0, 1, 1, and 0 and their modified bits are 1, 1, 1, 0, 0, 0, 1, and 1, respectively. Which page will the second chance page replacement algorithm replace?

4. (10%) A computer has six tape drives, with n processes competing for them. Each process may need two drives. For which values of n is the system deadlock free?

5. Disk requests come in to the driver for cylinders 10, 22, 20, 2, 40, 6, and 38, in that order. A seek takes 6 msec per cylinder moved. How much seek time is needed for

   (a) (10%) Closest cylinder next, and

   (b) (10%) Elevator algorithm (initially moving upward).

   In all cases, the arm is initially at cylinder 20.

6. Consider the following page reference string:

   1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6.

   How many page faults would occur for the following replacement algorithms, assuming three, four, or five frames? Remember all frames are initially empty, so your first unique pages will all cost one fault each.

   (a) (10%) LRU replacement

   (b) (10%) Optimal replacement