Operating System Concepts

Midterm Exam

Instructor: Farn Wang
Class hours: 9:10-12:00 Tuesday Course Nr. 901 49000
Room: BL 103 Fall 2014

Student name: Student ID:

1. In a multiprogramming and time-sharing environment, several users share the system simultaneously. This situation can result in various security problems.
   (a) Please explain the effect of one such problem. (3pts/3)

   (b) Please explain the mechanism of the problem in (a). (4pts/7)

   (c) Please explain how the problem in (a) can be remedied. (3pts/10)

2. Considering designing operating systems for mobile devices.

   (a) Please describe the challenges of designing a good user-interface. (5pts/15)

   (b) Please describe the challenges of designing a good application program interface. (5pts/20)

3. Describe a technique to obtain a statistical profile of the amount of time spent by a program executing different sections of its code. Explain the advantage and disadvantage of the technique. (10pts/30)

4. Please compare the differences in the technology of iOS and Android. Explain their respective strengths out of the technology differences. (10pts/40)

5. Explain the role of the *init* process on UNIX and Linux systems in regard to process termination. (10pts/50)

6. Please write down the algorithm of a girl-time server that listens to port 5575. When a client connects to this port, the server responds with the picture of a smiling girl and the current time. Please explain the system calls needed in each step of the algorithm. (10pts/60)

7. Using Amdahl's law to answer the following questions.

(a) Please calculate the speedup gain of an application that has an 80 percent parallel component for two processing cores (2pts/62)

(b) Please calculate the speedup gain of an application that has a 50 percent parallel component for 16 processing cores. (2pts/64)

8. Consider the following code segment:

```
if (fork()) {
    fork();
    thread_create(…);
}
thread_create(…);
```

(a) How many unique processes are created ? (4pts/68)

(b) How many unique threads are created ? (4pts/72)

9. Linux does not distinguish between processes and threads. Instead, Linux treats both in the same way, allowing a task to be more akin to a process or a thread depending on the set of flags passed to the clone() system call. Please explain the flags to clone() and their meaning. (8pts/80)

10. Consider the following set of processes, with the length of the CPU burst time given in milliseconds (ms):

Process	Burst Time	Priority
P1	3	2
P2	1	3
P3	9	4
P4	4	1

Here, a smaller priority number implies a higher priority. Assume that the four processes are to run on a single processor and the processes P1, P2, P3, and P4 are assumed to have arrived at time 0 ms, 1 ms, 2 ms, and 3 ms respectively.

(a) Draw four Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: FCFS, shortest remaining time first(SRTF), non-preemptive priority, and RR (quantum = 3). (4pts/84)

(b) What is the turnaround time of each process for the FCFS scheduling algorithms in part (a)? (4pts/88)

(c) What is the waiting time of each process for the SRTF scheduling algorithms? (4pts/92)

(d) Which of the algorithms results in the minimum average waiting time (over all processes)? (2pts/94)

11. Consider a non-preemptive priority scheduling algorithm based on dynamically changing priorities. Larger priority numbers imply higher priority. When a process is waiting for the CPU (in the ready queue, but not running), its priority changes at a rate α; when it is running, its priority changes at a rate β. All processes are given a priority of 0 when they first enter the ready queue. They keep their priority values at the last running state when re-entering the ready queue.

(a) Please explain the advantage and disadvantage of the algorithm that results from β> 0> α. (3pts/97)

(b) Please explain the advantage and disadvantage of the algorithm that results from α > 0 > β. (3pts/100)