Operating System Concepts, Midterm

November 19, 2012

1. (20%) Briefly explain and compare the following terminologies: (5 pt. each)
   (a) Multi-programming system vs. Time sharing system
   (b) Dynamic linking vs. Dynamic loading
   (c) API vs System call
   (d) Layered OS structure vs. Microkernel

2. (10%) a. (3%) Explain what is interrupt? b. (2%) Given a usage example for software and hardware interrupts? c. (5%) Please use a simple diagram to illustrate the key steps for handling an interrupt.

3. (8%) a. (5%) Explain how dual mode can protect computer system? b. (3%) Which of the following instructions should be privileged, and why?
   (A) read the clock (B) turn off interrupts (C) issue a trap instruction

4. (6%) A process can be in one of the following states: new, terminated, waiting, running, and ready. Please draw a diagram showing the life cycle of a process and the events triggering process transition from one state to another state.

5. (5%) Explain what is many-to-one multithreading model. What are the disadvantage and advantage of such model?

6. (7%) a. (4%) How many processes are created in the following program? (you need to plot the process tree to explain your answer) b. (3%) How does copy-on-write reduce the process creation time of fork()?

```
int main() {
    int pid = fork();
    if (pid==0) {
        fork();
    } else {
        int ret = fork();
        execlp("\bin\ls");
    }
    fork();
}
```

7. (10%) a. (5%) Explain how trashing occurs. b. (5%) Explain how to use working-set solution to solve the problem.

8. (9%) Given a reference string 1, 2, 1, 3, 1, 4, 1, 2, 3, 2. Please **step-by-step** show the references that cause pages faults with 3 memory frames using.
   (a) FIFO (b) Optimal (c) LRU replacement algorithm

9. (5%) a. (3%) What is memory mapped file (MMF)? b. (2%) What is the advantage and disadvantage of MMF

10. (20%) Consider a byte-addressable computer system with a 16-bit virtual address and total physical memory size 8KB. Let paging be implemented for the system with page size 128B. Please answer the following question:
    (a) (2%) If use one-level paging, how many entries should be in a page table?
    (b) (3%) If use inverted page table, how many entries should be in a page table?
    (c) (3%) Given a **three-level** paging, let the memory access time and TLB (translation lookaside buffer) access time be 500ns and 10ns, respectively. If the TLB hit ratio is 98%, what is the effective memory access time? (Only need to write down the equation)
    (d) (12%) Now consider to use the segment-paged scheme with each process can use at most 16 segments. Given the following segment table, page table and a 16 bits hexadecimal logical address “7482”, complete the address translation diagram below.
    (i)segment table offset; (ii) linear address (i.e. in binary form);
    (iii) page table offset; (iv) physical address(i.e. in binary form);