

Operating System Concepts

Final Exam

Instructor: Farn Wang

Class hours: 9:10-12:00 Tuesday

Room: BL 103

Course Nr. 901 49000

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Student name:

Student ID:

1. The first known correct software solution to the critical section problem for two processes was developed by Dekker. The two processes, P0 and P1, share the following variables:

```
boolean flag[2]; // initially false
int      turn;
```

An *incorrect* version of the structure of process P_i (i == 0 or 1) is shown below.

```
do {
    flag[i] = true;
    while (flag[i]) {
        if (turn == i) {
            flag[i] = false;
            while (turn == j) ;
            flag [i] = true;
        }
    }
    // critical section
    turn = j;
    flag[i] = false;
    // remainder section.
} while (true);
```

The other process is P_j (j == 1 or 0). Please write down an execution scenario that shows why the version fails. (20pts/20)

2. Consider the following snapshot of a system.

	<u>Allocation</u>				<u>Max</u>			
	A	B	C	D	A	B	C	D
P0	3	0	1	4	5	1	1	7
P1	2	2	0	0	3	2	1	1
P2	3	1	2	1	3	4	2	1
P3	0	5	1	0	4	6	1	2
P4	4	2	2	1	6	3	2	4

Using the banker's algorithm, determine whether or not each of the following states is unsafe. If the state is safe, illustrate the order in which the processes may complete. Otherwise, illustrate why the state is unsafe.

(a) Available = (0,3,0,1) (10pts/30)

(b) Available = (1,1,0,2) (10pts/40)

3. Frank wants to design an operating system, called FOS, with a 26-bit virtual address running on a mobile phone with 16-bit physical address. FOS also has a 4-KB page size. How many entries are there in each of the following.
- (a) A conventional, single-level page table. (4pts/44)
 - (b) An inner page table in 2-level paging with 16 entries in the outer page table. (4pts/48)
 - (c) An outer page table in 2-level paging with 32 entries in each inner page table. (4pts/52)
 - (d) A hashed page table with hash function ($\text{pageNumber} \% 64$). (4pts/56)
 - (e) An inverted page table. (4pts/60)

4. Consider the following page reference string:

7,2,3,7,2,5,1,4,6,5,7,1,0,5,4,0,2,3,0,5

Assuming demand paging with 4 frames, please show the frame contents of the pages after each page reference for the following page-replacement algorithms.

(a) LRU replacement (5pts/65)

(b) Clock replacement algorithm, assuming that everytime we start searching from the page next to the page that was last brought in. (5pts/70)

(c) Optimal replacement. (5pts/75)

(d) FIFO replacement. (5pts/80)

5. Please explain the following terms in allocating kernel memory.

(a) Buddy system ? (5pts/85)

(b) slab allocation ? (5pts/90)

6. Assume a virtual paging system uses a TLB that requires 5 nanoseconds to access the TLB, 95 nanoseconds to access main memory, and 20 milliseconds to swap in (or out) a page with the backing store. Assume no buffering in swapping out the pages. If the TLB hit rate is 99.9% and the page-fault rate is 0.0001%, what is the effective access time ? (5pts/95)

7. What is dynamic linking library (DLL) ? Please explain its principle and function. (5pts/100)