Operating Systems, 2nd Term Exam, Dec. 12, 2008; chapter 5 to chapter 8.4.2
A total of 110 points.

I. (5%)Write the full names of the following abbreviations for scheduling:
(1)FCFS , (2)SJF, (3)RR, (4)SMP, (5)SRTF.

II. (15%)Briefly explain the following terminology:
(1) load balance, (2) hyperthreading (on intel processors),
(3)busy waiting, (4)indefinite blocking, (5) mutex

III. (5%)Fill the blanks of the following program segments:
The structure of process Pi in Peterson's solution is:

```
Do {
    Flag[i] = TRUE;
    Turn = ____;
    While (Flag[____] && Turn == ____) ____
      Critical section;
    Flag[i] = ____;
      Remainder section
  } while (TRUE);
```

IV. (20%)Answer the follow questions briefly:
(1) What is external fragmentation? What is internal fragmentation?
(2) What are the operations of a semaphore? How are such operations implemented?
(3) What is the two phase locking protocol? Is the two-phase locking protocol free from deadlock? Why or why not?
(4) What timestamp protocol ensures conflict serializability? Is the timestamp protocol free from deadlock? Why or why not?

V. (35%)Show an example to the following questions:
(1) race (conditions), (2) atomic instruction , (3) (real-time) priority inversion ,
(4) There is a cycle in the resource allocation graph, but there is no deadlock;
(5) Inadequate (wrong) usage of semaphore operations that would cause a deadlock.
(6) A deadlock prevention approach.
(7) A logical address is transformed into a physical address by paging with TLB enabled.

VI(10%)Consider the following set of processes, with the length of the CPU burst given in milliseconds:

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process	Burst time	priority	Arrival time
P1	10	3	0
P2	1	1	1
P3	2	3	2
P4	1	4	3
P5	5	2	4

(i) Draw four Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: FCFS, SJF, nonpreemptive priority, and RR. (Note that priority is only used in priority scheduling).

(ii) What is the turnaround time of each process for each of the scheduling algorithm in part (i).

Ⅶ(10%)Consider the following snapshot of a system

	allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	0	0	1	2	0	0	1	2	1	5	2	0
P1	1	0	0	0	1	7	5	0				
P2	1	3	5	4	2	3	5	6				
P3	0	6	3	2	0	6	5	2				
P4	0	0	1	4	0	6	5	6				

(i) Is the system in a safe state?

(ii) If a request from process P1 arrives for (0, 4, 2, 0), can the request be granted immediately?

Ⅷ(10%)Suppose that a simple operating system uses contiguous memory allocation. A snapshot shows that its available (free) memory list has blocks of 3KB, 7KB and 5KB and its allocated memory list has 2KB, 8KB and 5KB, respectively. A new process arrives and it requires 4.5KB memory. (1)Which block of free memory will be allocated if the OS uses first fit, and worst fit, respectively? (2) Draw the available memory list and allocated memory list if best fit policy is used.

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