中 山 大 学 软 件 学 院 **2009** 级 软 件 工 程 专 业 （ 2010 学 年 春 季 学 期 ）

# 《SE-223 操作系统》期末考试试卷（A）

**(考 试 形 式 ： 闭 卷 考 试 时 间 ： 2 小 时)**

警 示

**《中山大学授予学士学位工作细则》第六条**

**考 试 作 弊 不 授 予 学 士 学 位**

方向：__________________ 姓名：__________ 学号：____________

## 一、**Explain following terms** （**15 pts**）

Cache coherency, PCB (Process Control Block), Medium-term scheduling, VFS (Virtual File System), DMA (Direct Memory Access)

## 二、**Short Answer**（**25 pts, select 5 from 6**）

1. List at least two advantages of User-Level Thread over Kernel-Level Thread.
2. What are the four necessary conditions of deadlock? Please briefly describe the meaning of each condition.
3. List and briefly describe three common schemes for defining the logical structure of a directory.
4. What is the difference between simple paging and virtual memory paging?
5. What are the three major methods of allocating disk space? Describe their advantages and disadvantages respectively.
6. List three basic process states and describe the meaning of each state.

## 三、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 two or three frames? All frames are initially empty.（**15 pts**）

（1）LRU replacement（**5 pts**）

（2）FIFO replacement（**5 pts**）

（3）Optimal replacement（**5 pts**）

## 四、Consider a simple paging system with the following parameters: $2^{32}$ bytes of physical memory; page size of $2^{10}$ bytes; $2^{16}$ pages of logical address space.（**10 pts**）

（1）How many bits are in a logical address?（**2 pts**）

（2）How many bytes in a frame?（**2 pts**）

（3）How many bits in the physical address specify the frame?（**2 pts**）

（4）How many entries in the page table?（**2 pts**）

（5）How many bits in each page table entry? Assume each page table entry contains a valid/invalid bit.（**2 pts**）

五、Five batch jobs, A through E, arrive at a computer center at essentially the same time. They have an estimated running time of 15, 9, 3, 6, and 12 minutes, respectively. Their priorities are 6, 3, 7, 9, and 4 respectively, with a lower value corresponding to a higher priority. For each of the following scheduling algorithms, determine the turnaround time for each process and the average turnaround for all jobs. Ignore process switching overhead. Explain how you arrived at your answers. In the last three cases, assume that only one job at a time runs until it finishes and that all jobs are completely processor bound.（**20 pts**）

（1）round robin with a time quantum of 1 minute;（**5 pts**）

（2）priority scheduling;（**5 pts**）

（3）FCFS (run in order A, B, C, D, and E);（**5 pts**）

（4）shortest job first.（**5 pts**）

六、Jurassic Park consists of a dinosaur museum and a park for safari riding. There are m passengers and n single-passenger cars. Passengers wander around the museum for a while, then line up to take a ride in a safari car. When a car is available, it loads the one passenger it can hold and rides around the park for a random amount of time. If the n cars are all out riding passengers around, then a passenger who wants to ride waits; if a car is ready to load but there are no waiting passengers, then the car waits. Use semaphores, wait() and signal() to synchronize the m passenger processes and the n car processes.（**15 pts**）

# 操作系统试卷 A 答案

## 一、**Explain following terms** （**15 pts**）

略

## 二、**Short Answer**（**25 pts**）

1. （1）Thread switching does not require kernel mode privileges because all of the thread management data structures are within the user address space of a single process. Therefore, the process does not switch to the kernel mode to do thread management. This saves the overhead of two mode switches (user to kernel; kernel back to user). （2）Scheduling can be application specific. One application may benefit most from a simple round-robin scheduling algorithm, while another might benefit from a priority-based scheduling algorithm. The scheduling algorithm can be tailored to the application without disturbing the underlying OS scheduler.（3）ULTs can run on any operating system. No changes are required to the underlying kernel to support ULTs. The threads library is a set of application-level utilities shared by all applications.
2. 略.
3. 略.
4. **Simple paging:** all the pages of a process must be in main memory for process to run, unless overlays are used. **Virtual memory paging:** not all pages of a process need be in main memory frames for the process to run.; pages may be read in as needed.
5. 略.
6. 略

## 三、**Answer**：（**15 pts**）

| Number of frames | LRU | FIFO | Optimal |
|---|---|---|---|
| 2 | 18 | 18 | 15 |
| 3 | 15 | 16 | 11 |

## 四、**Answer**：（**10 pts**）

（1）The number of bytes in the logical address space is ($2^{16}$ pages)*($2^{10}$ bytes/page) = $2^{26}$ bytes. Therefore, 26 bits are required for the logical address.

（2）A frame is the same size as a page, $2^{10}$ bytes.

（3）The number of frames in main memory is ($2^{32}$ bytes of main memory)/($2^{10}$ bytes/frame) = $2^{22}$ frames. So 22 bits is needed to specify the frame.

（4）There is one entry for each page in the logical address space. Therefore there are $2^{16}$ entries.

（5）In addition to the valid/invalid bit, 22 bits are needed to specify the frame location in main memory, for a total of 23 bits.

## 五、**Answer**：（**20 pts**）

（1）Sequence with which processes will get 1 min of processor time:

| 1 | 2 | 3 | 4 | 5 | Elapsed time |
|---|---|---|---|---|---|
| A | B | C | D | E | 5 |
| A | B | C | D | E | 10 |
| A | B | C | D | E | 15 |
| A | B | | D | E | 19 |
| A | B | | D | E | 23 |
| A | B | | D | E | 27 |
| A | B | | | E | 30 |
| A | B | | | E | 33 |
| A | B | | | E | 36 |
| A | | | | E | 38 |
| A | | | | E | 40 |
| A | | | | E | 42 |
| A | | | | | 43 |
| A | | | | | 44 |
| A | | | | | 45 |

The turnaround time for each process:
A = 45 min, B = 35 min, C = 13 min, D = 26 min, E = 42 min
The average turnaround time is = (45+35+13+26+42) / 5 = 32.2 min

（2）

| Priority | Job | Turnaround Time |
|---|---|---|
| 3 | B | 9 |
| 4 | E | 9 + 12 = 21 |
| 6 | A | 21 + 15 = 36 |
| 7 | C | 36 + 3 = 39 |
| 9 | D | 39 + 6 = 45 |

The average turnaround time is: (9+21+36+39+45) / 5 = 30 min

（3）

| Job | Turnaround Time |
|---|---|
| A | 15 |
| B | 15 + 9 = 24 |
| C | 24 + 3 = 27 |
| D | 27 + 6 = 33 |
| E | 33 + 12 = 45 |

The average turnaround time is: (15+24+27+33+45) / 5 = 28.8 min

（4）

| Running Time | Job | Turnaround Time |
|---|---|---|

| | | |
|---|---|---|
| 3 | C | 3 |
| 6 | D | 3 + 6 = 9 |
| 9 | B | 9 + 9 = 18 |
| 12 | E | 18 + 12 = 30 |
| 15 | A | 30 + 15 = 45 |

The average turnaround time is: (3+9+18+30+45) / 5 = 21 min

六、**Answer：（15 pts）**

```
semaphores:
var car_available := n;
var passenger_wait := 0;

process passenger(i := 1 to num_passengers)
    wandering for a random time;
    signal(passenger_wait);
    wait(car_available);
end passenger

process car(i := 1 to num_cars)
    wait(passenger_wait);
    take passenger wandering;
    signal(car_available);
end car
```