

CS140 Operating Systems and Systems Programming Midterm Exam

February 11th, 2002

(Total time = 50 minutes, Total Points = 50)

Name: (please print) _____

In recognition of and in the spirit of the Stanford University Honor Code, I certify that I will neither give nor receive unpermitted aid on this exam.

Signature: _____

This examination is close notes and close book. You may not collaborate in any manner on this exam. You have 50 minutes to complete the exam. Before starting, please check to make sure that you have all 8 pages.

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Total	

Name: _____

1. Short answers (12 points, 4 points each)

a) Describe the mechanism used in modern computing systems to allow the OS to regain control of the CPU from a misbehaving application program (e.g. an application program in an infinite loop).

b) Describes the differences (if any) of using a global or a local page replacement algorithm in operating systems in which all threads share the same address space.

- c) Explain how position independent code (PIC) helps in implementing shared libraries.

2. Synchronization (16 points)

Consider a system that has many threads of two different types (typeA and typeB). All the threads call the below subroutine named `routine` passing their type as an argument.

```
enum { typeA, typeB } ThreadType;

Semaphore semaX = 0; // Initial value of semaX is zero.
Semaphore semaY = 0; // Initial value of semaY is zero.

void routine(ThreadType threadType)
{
    if (threadType == typeA) {
        P(semaX);
        V(semaY);
    }
    if (threadType == typeB) {
        V(semaX);
        V(semaX);
        P(semaY);
    }
    DoIt(threadType);
}
```

(a) (8 points) Given the above function, what can you say about the type of threads calling the function `DoIt()`?

(b) (8 points) Write a monitor that performs that same function as `routine`. You may use variables and condition variables in your monitor. You can assume it is safe to call `DoIt()` from within your monitor.

3.Memory management (12 points)

When implementing threads in an operating system on an architecture that supports hardware segmentation and paging, there are three possible implementation choices:

Choice A – Have threads share the same segment and page table.

Choice B – Have the threads use private segment tables and share the same page tables.

Choice C – Have the threads use private segment and private page tables that point at the same, shared memory.

For each of the following attributes of thread implementations, describe which of the choices has advantages in supporting the attribute. Note that the answer may be multiple choices. Be sure to justify your answer.

A) Supports fast, low overhead context switching between threads.

B) Allows for the most sharing of memory mapping resources.

C) Easily supports thread-private memory (i.e. memory that is visible to only one of the threads).

D) Allows one thread to pre-page (i.e. take all the page fault exceptions) for the other threads.

4. CPU scheduling (10 points).

A) Describe how a lottery scheduling algorithm could be made to approximate a CPU scheduling algorithm that always runs the job that hasn't run in the longest time.

B) In a modern computer system with a local page replacement algorithm and a multi-level feedback queue CPU scheduler there are two totally compute-bound jobs: JobA and JobB. JobA fits comfortably in memory while JobB suffers on average a page fault every 100 instructions.

Which job (JobA or JobB) will be given the higher priority? (Explain why)

Which job (JobA or JobB) will get the largest share of the CPU? (Explain why)