CS140
Operating Systems and Systems Programming

Midterm Exam
July 25th, 2006

Total time = 60 minutes, Total Points = 100

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 exam is closed notes and closed book.
• No collaboration of any kind is permitted.
• You have 60 minutes to complete the exam.
• There are 8 questions totaling 100 points. Some questions have multiple parts. Read all parts before answering!
• Please check that you have all 8 pages.
• Before starting, write your initials on each page, in case they become separated during grading.
• Please print or write legibly.
• Answers may not require all the space provided. Complete but concise answers are encouraged.
• SCPD students: If you wish to have the exam returned to you at your company, please check the box.

SCPD?

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1. [20] A processor has a 32 bit address space, and combines both segmentation and paging. 4 bits for the segment, 16 for the page, and 12 for the offset. A PTE is 4 bytes. Describe in detail what happens in the MMU and OS (use generic terms not the x86 terms) when:

(a) [10] A user process does a read of address 0xC0DEDBAD and it is in memory.

(b) [5] What different/more/less happens if it is paged out to disk?

(c) [5] What different/more/less happens if it is not a valid address?
2. [10] Briefly explaining what conditions cause a thread to move between each of the 3 states, and what causes each arrow. Label it N/A if it doesn’t happen.

Arrow 1:

Arrow 2:

Arrow 3:

Arrow 4:

Arrow 5:

Arrow 6:
3. [10] If you have an OS that’s designed for a single CPU, and you want to adapt it to a multi-CPU system, describe the types of changes/additions to the software or hardware you would need to make related to the synchronization primitives (locks, etc…) and why. List three.

4. [5] What do semaphores do that condition variables not do, that means you need to be careful how you start the threads?
5. [10] Deadlocks are bad.
   (a) [5] How can you prevent them?

   (b) [5] How can you detect them?
6. [10] A system you admin is thrashing, and the users are mad.
   (a) [5] What are some ways to get into this mess?

   (b) [5] How would you prevent it from happening in YourOS?
7. [20] Linking

(a) [15] Given the following code, list the data segment, text(code) segment, def’s and ref’s that the linker would create. Assume each line of code is magically 4 bytes, data is also 4 bytes.

```c
extern int printf( char * , ... );
extern float func( float );
float foo;
float bar;

float myfunction()
{
    printf( "hello world" );
    foo = func( 1 );
    printf( "foo 1 = %f\n", foo );
    bar = func( foo );
    return( bar );
}
```

(b) [5] If this function was placed in a dynamic shared library, describe how it gets called.
8. [15] Scheduling

(a) [3] What’s good and bad about First Come First Served?

(b) [3] What’s good and bad about Round Robin?

(c) [3] What’s good and bad about STCF?

(d) [3] What’s good and bad about Multi-Level Feedback Queueing?

(e) [3] What’s good and bad about Lottery scheduling?