CS 6210 Spring 2008 Midterm

Name:_____GT Number:

Tuesday March 11, 2008 (3:05 to 4:25 PM)

Note:

1. **Write your name and GT number on each page.**
2. The test is **CLOSED BOOK** and **NOTES**.
3. Please provide the answers in the space provided. You can use scratch paper (provided by us) to figure things out (if needed) but you get credit **only** for what you put down in the space provided for each answer.
4. For conceptual questions, concise bullets (**not wordy sentences**) are preferred.
5. Where appropriate use figures to convey your points (a figure is worth a thousand words!)
6. Illegible answers are wrong answers.
7. Please look through the whole test before starting so that you can manage your time better.

Good luck!

Question number		Points earned	Running total
1 (1 min)	(Max: 1 pts)		
2 (10 min)	(Max: 16 pts)		
3 (3 min)	(Max: 5 pts)		
4 (7 min)	(Max: 10 pts)		
5 (7 min)	(Max: 10 pts)		
6 (10 min)	(Max: 10 pts)		
7 (7 min)	(Max: 10 pts)		
8 (8 min)	(Max: 10 pts)		
9 (8 min)	(Max: 10 pts)		
10 (15 min)	(Max: 18 pts)		
Total (76 min)	(Max: 100 pts)		

1. (1 min, 1 point)
The next President of the United States is most likely
(Don't worry you get a point irrespective of your answer!)

   a. Barack Obama
   b. John McCain
   c. Hillary Clinton
   d. Ralph Nader
   e. Mike Huckabee
   f. John Hagee
   g. Rush Limbaugh
   h. Jesse Jackson
   i. Don't care

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2. (10 min, 16 points) (L3 kernel - problem)
Following Liedtke's arguments for constructing a microkernel, explain how context switching overhead of a microkernel may be mitigated in modern architectures. Specifically, discuss the difference in approaches to solving this problem for the PowerPC and Intel Pentium architectures. Both architectures support segmentation in hardware. PowerPC segmentation scheme allows mapping a 2^{32}-byte local address space to a 2^{52}-byte global address space. Pentium segmentation allows mapping a 2^{32}-byte local address space to a 2^{32}-byte global address space. Clearly explain the rationale and the expected performance impact of the approaches you propose.

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3. (3 min, 5 points) (OS structures - conceptual)
Place the letters S (for Spin), E (for Exokernel), or L (for L3) in the space provided to identify to which microkernel the particular attribute best applies to.

Assertions in the Kernel _____

Minimal non-portable abstractions _____

Dropping code in kernel at runtime _____

Extensions verified by the compiler _____

Visible resource revocation _____

4. (7 min, 10 points) (Virtualization - conceptual)
(a) Identify the fundamental difference between OS virtualization and kernel extension ideas such as SPIN

(b) Distinguish between full virtualization and para virtualization

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5. (7 min, 10 points) (Parallel system synchronization - conceptual)
(a) The following algorithm for mutual exclusion lock acquisition runs on a cache-coherent SMP that uses a write-invalidate protocol:

```
mutex L;   // L is in shared memory
           // one of two states: LOCKED = 1, UNLOCKED = 0
lock:
     while (T&S (L) == LOCKED) spin;
```

Enumerate the performance problems with this simple algorithm.

(b) Consider the following algorithm for mutual exclusion:

```
mutex L;   // L is in shared memory
           // one of two states: LOCKED = 1, UNLOCKED = 0
lock:
     while (T&S (L) == LOCKED) {
          delay();
     }
```

- What assumptions about the parallel system architecture would justify use of this algorithm?

- What is the downside to this algorithm?

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6. (10 min, 10 points) (LRPC - conceptual)
With pictures explain the “bind” call in the LRPC system. What are the objects created and/or communicated to the client and/or the server by the kernel as a result of the bind call? What purposes do these objects serve?

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7. (7 min, 10 points) (Tornado – conceptual)

- As an OS designer for an SMP, present three key objectives you have to pay attention to.

- Mention properties of a clustered object that help meet the above objectives.

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8. (8 min, 10 points) (Lamport clock - conceptual)

(a) Give an example scenario that would warrant the need for a physical clock as opposed to a logical clock.

(b) Let *k* be the individual clock drift; *e* be the mutual clock drift; *u* be lower bound on the IPC time between any two processors. Informally describe the relationship (using numerical values and/or figures) between these three to avoid anomalous behavior of the distributed system.

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9. (8 min, 10 points) (Thekkath-Levy (Limits to communication) - conceptual) As a designer of an RPC subsystem, what are the avenues available to you for shaving the marshaling and unmarshaling software overhead? Explain your answer with respect to the expected benefit, potential protection concerns for each such avenue.

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10.(15 min, 18 points) (Ensemble – problem)
Using Lamport's distributed mutual exclusion algorithm as an example, develop an abstract specification and a concrete specification. You do not have to adhere to any specific syntax (such as IOA), and can invent your own so long as it is straightforward and understandable.