1 September 2012   Max. Marks: 24

Determinism

1. Which of these synchronization abstractions are deterministic? Explain for each.   [4 marks]
   a. binary semaphore (max value = 1)   [0.5 marks]
   b. n-ary semaphore (max value = n)   [0.5 marks]
   c. barrier   [1.5 marks]
   d. wait/signal   [1.5 marks]

2. If Unix semantics are to be emulated on top of Determinator, how would you implement a global process-id (PID) namespace? Explain clearly (using diagrams if needed). [3 marks]

3. Consider the MPP programming model from the duality paper. Is this a deterministic programming model? If yes, why? If not, what is the minimum you need to record to make it deterministic? Whatever your answer, also comment on the dual of your solution for the SHM programming model.
[3 marks]

Flash paper

4. In Figure 12, the performance of "MP" declines rapidly with increasing number of clients. Why? This experiment simulates WAN conditions. Would the results be any different if the experiment was done in LAN conditions? How?   [2 marks]

SEDA/Capriccio papers

5. Multithreaded servers use a "bounded thread pool" to ensure high throughput (e.g., Apache uses 150 processes/threads). As the paper argues, this leads to unfairness and poor scheduling. For example, if some threads are serving inexpensive requests (e.g., small cached pages) and others are serving expensive threads (e.g., large pages not in cache), the server is unaware of this distinction and must discard some requests arbitrarily.

a. How can a SEDA-based web server handle this situation better? Explain clearly (with diagrams if needed)   [2 marks]

b. How can resource containers on a multi-threaded system be used to handle this situation better? [2 marks]

c. How will Capriccio handle this situation? [2 marks]

Stack Management

6. Does it make sense to use linked stacks (from Capriccio paper) with cooperative task management (from Adya et. al.'s paper)?   [2 marks]

Threads cannot be implemented as a library

7. a. If we are considering only uniprocessor systems, can threads be implemented as a library? Explain. [2 marks]

b. If we are considering only uniprocessor systems with cooperative task management (from Adya et. al.'s paper), can threads be implemented as a library? [2 marks]