CS 15-440: Distributed Systems
Mock Quiz 2
November 10, 2015

Total Time: 20 minutes

Instructions:

- Write your answers in the spaces provided below each problem. If you make a mess, clearly indicate your final answers.
- The quiz has a maximum score of 20 points.
- Keep up with time.

Good Luck!

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<tr>
<th>Question No</th>
<th>Max. Points</th>
<th>Earned Points</th>
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1. **No-Brainers (4 Points)**:

This section tests your understanding and recollection of the basic concepts we discussed in the class about programming models, and the replication and consistency concepts. *Answer the following precisely and concisely, or choose the correct answers.*

(a) A causally consistent distributed data-store is always sequentially consistent:

- □ True
- □ False

(b) The shared memory programming model can be applied over a machine with a Uniform Memory Access (UMA) architecture:

- □ True
- □ False

(c) For which of the following reasons is replication usually used?

- □ For performance reasons
- □ For fault tolerance reasons
- □ For scalability reasons
- □ For concurrency reasons
- □ For availability reasons
- □ For security reasons
- □ For redundancy reasons
- □ For all of the above

(d) Briefly explain why programmers parallelize sequential programs.
2. Consistency & Replication (10 Points):

(a) Why is continuous consistency used and how can it be measured? Can continuous consistency be used for client-centric models? Explain. (Points: 4)

(b) Consider three processes P1, P2 and P3 executing multiple instructions on three shared variables x, y and z. There are two replicas R1 and R2 that store x, y and z. Assume that all the variables are initialized to zero. (Points: 3)

Given that the operations are executed at the replicas in the following order, answer the following:
a. Is the order of updates at each individual replica sequential? Explain why (or why not).

b. By looking at the ordering across the replicas, identify if the data-store is sequentially consistent. Explain why (or why not).

(c) Imagine in the future, you decide to program your own web-browser which you proudly name Tartanet. Given that browsers implement caching, describe how you would implement read-your-rights consistency. The model shall ensure that an up-to-date web-page is displayed when the web-page is updated. (3 Points)
3. Programming Models (6 Points):

(a) Running an application $P$ on two processors yields a speedup of $S_2$. Use Amdahl’s Law to derive a formula for $S_n$, the speedup on $n$ processors, in terms of $n$ and $S_2$. (Points: 2)

(b) Typically, with parallelization, programmers observe only a sub-linear performance improvement. Discuss two reasons of why this is the case. (2 Points)

(c) Discuss two main conditions by which deadlocks in MPI can happen. (2 points)