CS 15-440: Distributed Systems
Mock Quiz 2
November 8, 2016

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!

Question No	Max. Points	Earned Points
1	4	
2	10	
3	6	
Total	**20**	

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

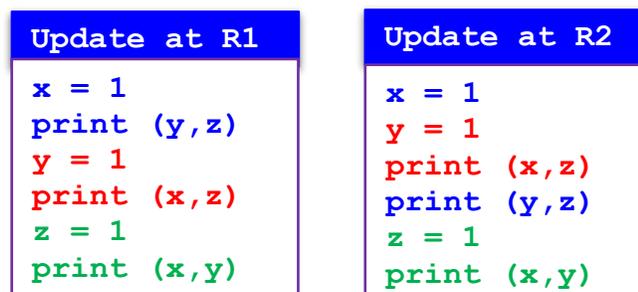   (d) Briefly explain why programmers parallelize sequential programs.

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)**

P1	P2	P3
`x = 1` `print (y,z)`	`y = 1` `print (x,z)`	`z = 1` `print (x,y)`
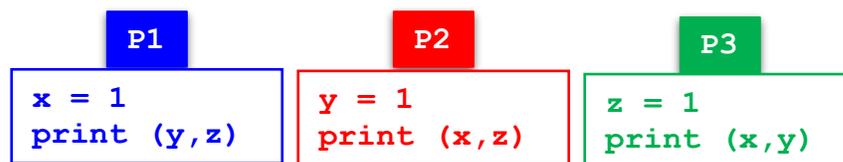
Given that the operations are executed at the replicas in the following order, answer the following:

Update at R1	Update at R2

`x = 1`
`print (y,z)`
`y = 1`
`print (x,z)`
`z = 1`
`print (x,y)`
	`x = 1`
	`y = 1`
	`print (x,z)`
	`print (y,z)`
	`z = 1`
	`print (x,y)`

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)**