Exam 1 - CS 682 - Spring 2017

Name:

Question	Awarded Points	Maximum Points
Question 1		5
Question 2		10
Question 3		5
Question 4		5
Question 5		5
Question 6		5
Question 7		5
Question 8		10
Question 9		15
Question 10		5
Question 11		5
Question 12		5
Question 13		10
Question 14		10
Total		100

1. (5 points) Discuss one disadvantage **and** one advantage of a monolithic web architecture.

2. (10 points) Project 1 supported two write operations via the following APIs. Do you think these APIs were well designed? Explain your answer and make sure to discuss *at least* all of the following: the URIs chosen, the HTTP methods used, and the parameters required.

   `/api/chat.postMessage -` An HTTP GET request to this endpoint will post a new message to a channel. Required parameters are `channel` and `text`.

   `/api/message.star -` An HTTP GET request to this endpoint will star a specific message. Required parameter is `messageid`.

3. (5 points) Briefly describe how congestion control works in the Internet. For full credit, address how BBR differs from traditional congestion control algorithms.

4. (5 points) Name at least three layers of the Internet protocol stack and briefly describe what happens at each layer.

5. (5 points) Discuss **two** advantages of geo-replication.

6. (5 points) Briefly explain at least ***two*** of the rules that define causality -- in other words, the *happens-before* relationship.

7. (5 points) In Cristian's time synchronization algorithm a process `p` sends a message to a time server and the time server replies with its local time `t`. The process measures the round-trip time of the message and sets its time to `t+(RTT/2)`. Explain **two** reasons this algorithm may result in an inaccurate time estimate for `p`. (Hint, one of these problems is addressed by NTP.)

8. (10 points) For Project 1, some students had a single version number for the entire data structure and some students maintained a version number for each channel. Which approach do you think is better? Discuss the advantages of the approach you choose.

9. (15 points) The following question refers to a system with three processes. The timestamps of the events at each process are as follows:

p1 = (1, 0, 0) (2, 4, 0)
p2 = (0, 1, 0) (1, 2, 0) (1, 3, 0) (1, 4, 0)
p3 = (0, 1, 1) (1, 3, 2)

(a) In total, how many messages are sent during the execution of the program?

(b) List the timestamps of all events that *happen-before* the event with timestamp (1, 4, 0).

(c) List the timestamps of all events that *happen-before* the event with timestamp (0, 1, 1).

10. (5 points) The Facebook consistency paper examines how often their eventually consistent system violates stricter consistency models. They do this by having web servers log requests to a separate server and then post processing those requests. How do they address the problem of clock skew on the web servers?

11. (5 points) Could Dynamo be used to implement a system that provides strong consistency? Explain your answer.

12. (5 points) Consider the multicast and logical clocks algorithm for mutual exclusion. Explain how it preserves causal ordering.

13. (10 points) Shown below, Figure 6 from the Dynamo paper illustrates the fraction of nodes that are out of balance over time using the original consistent hashing scheme.

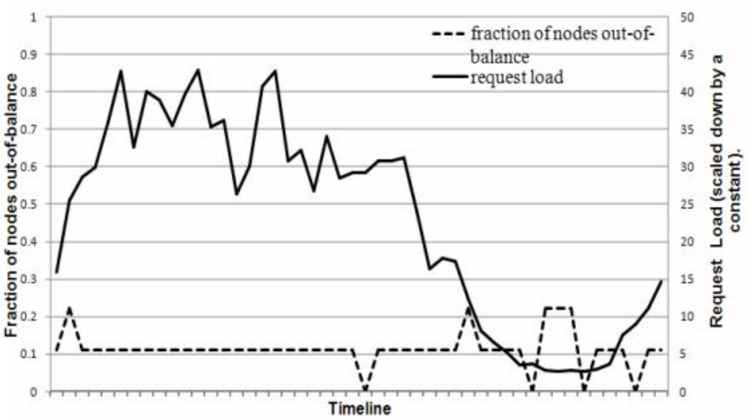

Figure 6: Fraction of nodes that are out-of-balance (i.e., nodes whose request load is above a certain threshold from the average system load) and their corresponding request load. The interval between ticks in x-axis corresponds to a time period of 30 minutes.

(a) Explain why the imbalance ratio can be *higher* during *lower* loads.

(b) Do you think the imbalance illustrated in the figure is a problem that needs to be addressed? Explain your answer.

14. (10 points) The Facebook paper discusses two types of anomalies: stale read and total order. Is it possible to have a stale read anomaly in Dynamo For full credit, thoroughly explain your answer providing specific examples where possible.