

CSCI-1380: Distributed Computer Systems

Homework #2

Assigned: 03/05/2019

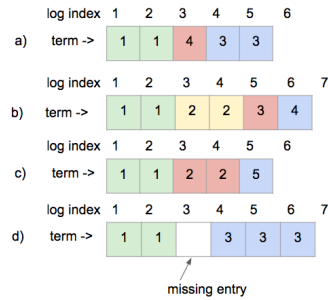
Due: 03/15/2019

1 RPC Semantics

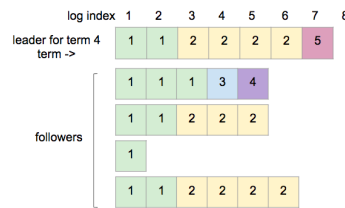
1. The idea with an RPC is to allow the programmer to "pretend" they are using a normal, local function call, allowing programs to be written more naturally without having to worry so much about the networked component. Identify at least 3 ways in which this abstraction breaks down / 3 considerations a programmer needs to make when using RPCS that they would not when using local function calls.
2. This course uses .proto files and Protobuf to handle serialization and sending data between machines. Identify the advantages and disadvantages of using this format as opposed to JSON, one of the other most popular formats for handling this issue. You may search the internet freely for help answering this problem, but your answer should be in your own words rather than just a directly copied answer from somewhere else.
3. Explain the differences between exactly once, at least once, and at most once semantics. Identify the benefits / issues with each, and a situation where each might be the best.

2 Raft

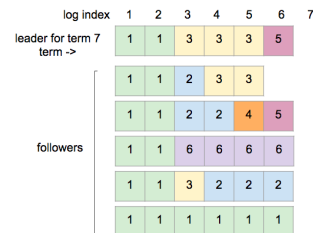
- Each figure below shows a possible log configuration for a Raft server (the contents of log entries are not shown; just their indexes and terms). Considering each log in isolation, could that log configuration occur in a proper implementation of Raft? If the answer is "no," explain why not.



- The figure below shows the state of the logs in a cluster of 5 servers. Which log entries may safely be applied to state machines? Explain your answer.



- Consider the figure below, which displays the logs in a cluster of 6 servers just after a new leader has just been elected for term 7. For each of the followers in the figure, could the given log configuration occur in a properly functioning Raft system? If yes, describe how this could happen; if no, explain why it could not happen.

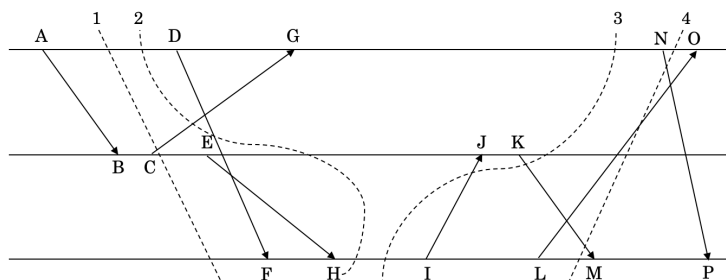


- Suppose that the nextIndex value stored by the leader for a particular follower is corrupted due to an error. Could this compromise the safety of the system? Explain your answer briefly.
- Each follower stores 3 pieces of state information on its disk: its current term, its most recent vote, and all of the log entries it has accepted. Consider the following scenarios assuming no modifications to the algorithm.
 - Suppose that the follower crashes, and when it restarts, its most recent vote has been lost. Is it safe for the follower to rejoin the cluster? Explain your answer.

(b) Suppose that the follower's log is truncated during a crash, losing some of the entries at the end. Is it safe for the follower to rejoin the cluster? Explain your answer.

3 Time and Global State

1. For the process timeline below, provide the vector timestamps of the following events: A, C, G, H, N, O. Assume all processes start with (0,0,0), and that they occupy indices 0,1,2 from top to bottom. Recall, sending and receiving a message counts as a distinct event.
2. For the process timeline below, provide the logical timestamps of the following events: A, C, G, H, N, O. Assume all processes start with 0. Recall, sending and receiving a message counts as a distinct event.



3. Say whether each of the cuts 1, 2, 3, and 4 are consistent or not, and justify why.
4. Consider the Chandy-Lamport algorithm for consistent global snapshots that we discussed in class. Explain why it may break down if the channel is not FIFO (i.e., if the channel can reorder messages).

4 Handing In

Once finished, you should hand in a PDF with your answers on Gradescope. Gradescope will allow you to select which pages contain your answers for each part of each question.

Please do not put your name on any page of your handin! This will allow us to do fully anonymized grading through Gradescope.

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