Homework Assignment 6 Solutions
ECE 151 / CMPSC 171 - Spring 2013

MARKING SCHEME:
Problem 6 - 40 points
Problems 1,2,3,4,5 - 12 points

1. Consider a k fault-tolerant group of process replicas.
(a) In a group whose function is to synchronize clocks, how many replicas are required to tolerate 5 faults? Justify your answer.

For the purpose of clock synchronization, (3k+1) replicas in total will be needed to tolerate 'k' faulty members. Hence to tolerate 5 faults, 16 replicas are required.

(b) If clocks are synchronized and the group contains 7 process replicas, how may faults can be tolerated? Justify your answer

Since the clocks are synchronized already, (2k+1) replicas are sufficient to tolerate 'k' faulty members. Hence having 7 process replicas an tolerate 3 faults.

2. In the checkout system for an online store, such as Amazon, explain, by example, why you would want to have both at-least-once semantics and at-most-once semantics.

At-least-once-semantics: The server guarantees it will carry out an operation at least once, no matter what (but it is possible that the operation is executed multiple times). In the check out system, this would help ensure that the order is placed and the item is reserved for you.
At-most-once-semantics: The server guarantees it will carry out an operation at most once (but it is possible that the operation may not be carried out at all). In the checkout system, this would ensure that you are not charged multiple times for same order.
Hence a combination of both is required to ensure that the operation is carried out exactly once.

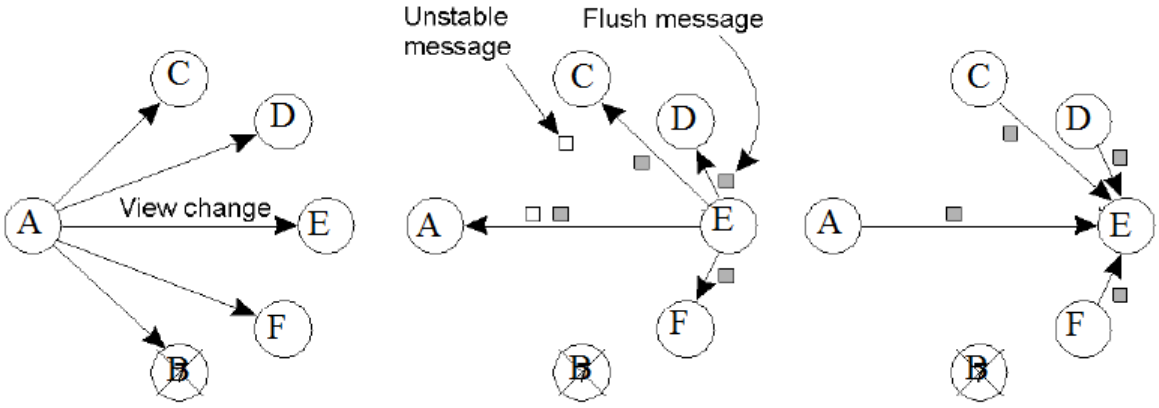
3. Consider a scenario in which the server crashes when it is in the middle of the computation of a result requested by the client. What mechanism would you have at the client to detect this crash in the case of
(i) synchronous RPC

In the case of synchronous RPC, the client would be in blocking state waiting for server's reply. In case if the server crashes in the middle of computation then the client may have to remain in the blocking state indefinitely. To avoid this, a time-out mechanism can be configured such that the client waits for only a definite period of time in the blocking state before it moves out of it in case of not having obtained any response from the server.

(ii) asynchronous RPC.

The client can be made aware of the server crash through any of the following means,
(i) The client can repeatedly poll its input message box to check for the response from the server. In case if the client does not get any response from the server for a fixed period of time it can consider that there is no chance of obtaining response from the server in future and the server has crashed.
(ii) When the server crashes, an message indicating 'exception' condition can be transmitted to the client. This message can interrupt the client to inform it that the server has crashed.

4. In a group of six processes, process A detects that process B has failed. Create diagrams that show the messages that are sent between the processes until the processes in the new view have installed the new view so that virtual synchrony is maintained, as in Lecture 11, Slide 13.



5. The following diagram comprises three processes, messages sent and received by those processes, and checkpoints taken by those processes. Show three consistent cuts (distributed snapshots), and mark the three coordinated checkpoints associated with each of the three consistent cuts and also the messages that are in flight at the time of the coordinated checkpoints.