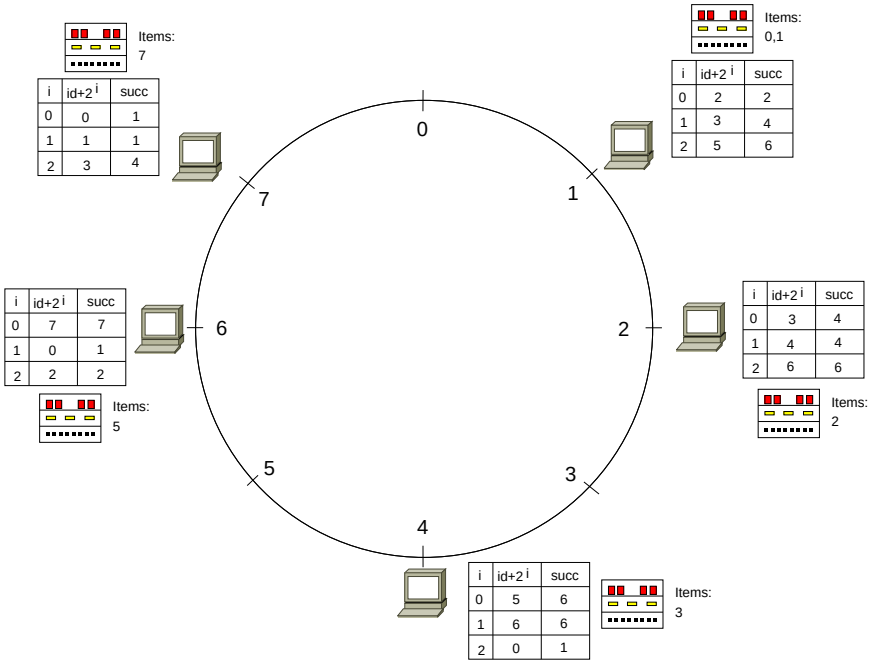
15-446 Distributed Systems
Homework 4

Due: April 21. 2009. Please type.

April 9, 2009

1. Srini set up a P2P network to share lame jokes with other professors, but he's worried that the LJAA will shut down his centralized server, just like they did to Napster. So he set up a Chord ring for lookups and routing in his peer to peer network. Sadly, Srini's network is not popular, consisting of only four peers. The peers contain the listed items (e.g., *Node 4* only has *Item 3*), and have successor tables as shown (the $id + 2^i$ column is there to remind you how the successor table is set up).



(a) List the nodes that will receive a query from *node 1* for *item 7*.

(b) List the nodes that will receive a query from *node 2* for *item 5*.

(c) Dongsu thinks that these jokes are awful, so he launches a DDoS attack and takes out node 4. Time passes, and the nodes converge on new routing tables that don't involve *Node 4*. Later, *Node 7* queries for *Item 5*. List the nodes that will receive this query.

2. As a system administrator of a large organization, you have to decide whether to use AFS or NFS. You observe that many people use their laptops at work and also use the same laptops at home to work when they need to. One of the important objective is to reduce the network load at your organization. Would you use AFS or NFS? What is reason for the choice? What might be different if you chose otherwise?

3. (a) Consider a basic 2PC protocol without any timeouts. What can the coordinator do when a participant crashes after receiving a VOTE_REQUEST but before responding to the VOTE_REQUEST message? Can it decide on the outcome of the transaction in this case?

   (b) Consider a basic 2PC protocol without any timeouts. What can the participants do when the coordinator crashes when they are waiting for the coordinators response in state READY?

   (c) Instead of the previous solution. We can make a participant P contact another participant Q to decide what to do in case of coordinator failure.
   a) What should P do if it finds out that Q has reached state COMMIT? Why?
   b) What should P do if it finds out that Q is in state ABORT? Why?
   c) What should P do if Q is in INIT state? Should it COMMIT or ABORT?
   d) What can P do if every other participants are in state READY? Can P decide to COMMIT or ABORT?

   (d) Let's consider the three-phase commit protocol (3PC). Assume the coordinator has crashed when a participant was blocking in the READY state or in the PRECOMMIT state. After a timeout, P tries to contact another participant Q to decided what he should do.
   a) What should P do if it finds out that Q has reached state COMMIT? Why?
   b) What should P do if it finds out that Q is in state ABORT? Why?
   c) What should P do if Q is in INIT state? Should it COMMIT or ABORT?
   c) What should P do if every other participants are in state PRECOMMIT?
   d) What should P do if every other participants are in state READY?

4. Hosts A and B are in the same subnet and joins the same multicast group (224.0.0.10) using IGMP. Andrew from another host C in the same subnet wants to find out the the hosts that joined the multicast group so he sends out the IGMP Host Membership Query for the multicast group (224.0.0.10).

   The membership query is destined to all-host group (address 224.0.0.1) asking who joined the multicast group 224.0.0.10. According to IGMP specifications, the hosts that joined the multicast group (224.0.0.10) should reply to the query by generating Host Membership Report.

   Andrew now looks at the response to the query and finds out only A has replied with the Host Membership Report. Andrew repeats the query and now finds the report generated by the host B. Andrew now logs into the router and sees that both host A and B are in the multicast group 224.0.0.10. But his IGMP Host Membership Query is answered only one of them.

   What is the reason that is causing this behavior? And why is IGMP implemented like this?