HW2 Solutions: CS425 FA15

1. (Solution and Grading by: <Guangxiang>)

2. (Solution and Grading by: <Guangxiang>)

3. (Solution and Grading by: Ayush Jain)
   i.  (C, 51, 51)
   ii. (C, 53, 51)
   iii. (C, 50, 33)
   iv.  (C, 100, 51)

4. (Solution and Grading by: Ayush Jain)
a. The remaining 10 processes will receive the message
b. The minimum TTL required to ensure all nodes receive the query is 3. For every relay, at most 4 new processes will receive the query.
c. In this case, the minimum TTL required is 2 - the query needs to reach the 12th process (coach), who then relays it to everyone else.

5. (Solution and Grading by: Qi Wang)

(1)

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(3) N2014

6. (Solution and Grading by: Qi Wang)
- p6 sends Election messages to p1, p2, p3, p4, p5. (5 msg)
- p6 receives OK messages from p2, p4. (2 msg)
- p4 sends Election messages to p1, p2, p3. (3 msg)
- p4 receives OK message from p2. (1 msg)
- p2 send Election messages to p1. (1 msg)
- After a timeout, p2 elect itself as leader, and sends Coordinator messages to p3,p4,p5,p6,p7,p8,p9. (7 msg)
  19 messages in total.

7. (Solution and Grading by: Yi Zhang)
   a. Process 33 is the new leader
   b. Total message = Election + Elected
      = (2 + 8) + 8 = 18

8. (Solution and Grading by: Yi Zhang)
   Each non-faulty process p detects the failure:
   - p sends out “Election” message to each process whose id is lower than p
   - if p receives less than or equal to k-1 “OK” messages, it sends “Coordinator” message to all non-faulty process in the system.
   A process that receives Election message reply with OK message.
   Nodes receiving the “Coordinator” message set their “elected” set only when they receive exactly k “Coordinator” messages.
   If nodes receive more than k “Coordinator” messages, they restart the protocol.
   The election terminates when all non-faulty process set their “elected” set.

   In the synchronous network, no message will get lost, so each non-faulty process will get same “Coordinator” messages. Each node set “elected” set only when they receive exactly k “Coordinator” messages, which satisfies safety requirement. If failure stops, the algorithm will obviously terminate.

9. (Solution and Grading by: Alex Zahdeh)
   Safety: No. Suppose node A’s state is WANTED and node B’s state is also WANTED. Each receives requests from each other with conflicting timestamps. They both reply to each other since their timestamp is not less than that of the other. Now it is possible for multiple nodes to enter the critical section.

   *Liveness: Yes. Since there can never be a scenario where, for vector timestamps t1 and t2, t1<t2 and t2<t1 (assuming for conflicting updates that neither is true), then each node must wait for at most n-1 replies to enter the critical section

   *This assumes that nodes update their own vector clocks upon granting requests

10. (Solution and Grading by: Alex Zahdeh)
    **2K-1.** If K is the size of a voting set, then N=2K would mean that it would be possible for two voting sets of size K not to intersect. N=2K-1 ensures that every pair of voting sets intersects in at least one node