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INFO-I 535 – MGMT ACCESS USE BIG DATA (Fall 2016)

CONSISTENCY IN DISTRIBUTED noSQL STORES

Question 1:
The figure shows twelve server machines that together implement a single noSQL store. The servers that are written to and the servers that are read from in the figure share a single node in common, node C. What would happen if node C crashes?

If C crashes, Nr = 2, Nw = 9 and N = 11. But we need Nr + Nw > N to prevent read-write conflicts. So if C crashes and nothing is done this distributed system will no longer be able to prevent read-write conflicts.

To restore the system to a setup that prevents read-write conflicts we need to add at least one node to at least one of the quorums, as demonstrated below.
Let Nra be the number of additional nodes we will add to the read quorum.
Let Nwa be the number of additional nodes we will add to the write quorum.
Nw + Nwa + Nr + Nra > 11
So, Nwa + Nra > 0, which means *at a minimum* we need to choose one of two options:

1. Increase Nr by selecting at least one node from D-L to add to the reading quorum (Nra=1, Nwa=0)
2. Increase Nw by assigning A or B to the write quorum (Nra=0, Nwa=1)

Of course, we could also use higher values for Nra and Nwa.

Question 2:
See (b) in figure. Is this a valid quorum configuration? If not, what type of conflict can occur? If so, what are the advantages? What are the drawbacks?

In the example (b) in the figure Nw = 6 and N = 12. This configuration is not a valid configuration because the rule that Nw > N/2 does not hold. This rule is required to prevent write-write conflicts, so in the configuration presented in example (b) write-write conflicts can occur.

Question 3:
See (c) in figure. Is this a valid quorum configuration? If not, what type of conflict can occur? If so, what are the advantages? What are the drawbacks?

In this configuration Nw = N =12 and Nr = 1.
This is a valid configuration because (1) Nr + Nw > N and (2) Nw > N/2 both hold.
The advantage of having only one node in the read quorum is that this setup enables fast reads; only node F needs to be accessed for read operations. On the other hand, this makes the system vulnerable to failure of a single node.
Regarding the write quorum we have a setup where Nw = N. The advantage of having this setup is a high level of consistency; all nodes will have the same data before any write can be confirmed. The drawback is that writes will take a longer time to complete and consequently a high number of write requests may fail.