Workshop Solution 08

Q1.   A file is replicated on 9 servers. List all the combinations of read quorum and write quorum that are permitted by the voting algorithm (Gifford's Quorum Scheme). Explain your answer.

List the best combination/s of legal read quorum and write quorum, that is, (N_R, N_W) that makes $N_R + N_W$ minimum.

A: Based on Gifford's Quorum Scheme, (1) to read a file of N replicas, a client needs to obtain a read quorum, an arbitrary collection of any N_R servers or more (up to N). (2) to modify a file of N replicas, a write quorum of at least N_W (and at most N) servers is required. Legal constraints are:
   ◆ $N_R + N_W > N$ (prevent read-write conflicts)
   ◆ $N_W > N/2$ (prevent write-write conflicts)
For the above scenario, N = 9, thus the combination of read quorum N_R and write quorum N_W can be any of (i.e., (N_W, N_R) =…):
   (9, 1), (9, 2), (9, 3), (9, 4), (9, 5), (9, 6), (9, 7), (9, 8), (9, 9),
        (8, 2), (8, 3), (8, 4), (8, 5), (8, 6), (8, 7), (8, 8), (8, 9),
            (7, 3), (7, 4), (7, 5), (7, 6), (7, 7), (7, 8), (7, 9),
                (6, 4), (6, 5), (6, 6), (6, 7), (6, 8), (6, 9),
                    (5, 5), (5, 6), (5, 7), (5, 8), (5, 9).
The best combinations are (any of): (9, 1), (8, 2), (7, 3), (6, 4), (5, 5).

The following question is Optional

Q2.   For active replication to work in general, it is necessary that all operations be carried out in the same order at each replica. Is this ordering always necessary?

A: No. Consider read operations that operate on non-modified data or commutative write operations. In principle, such situations allow ordering to be different at different replicas. However, it can be hard or impossible to detect whether, for example, two write operations are commutative.

END OF THE WORKSHOP SOLUTION