

## Homework 3

1. **Give two primary reasons for replicating data in a distributed system. [0.25 marks]**
  - a. To increase the reliability of the system.
  - b. To increase the performance (scalability) of the system.
2. **Give one similarity and difference between sequential and causal consistency. You should answer specifically in terms of the write operations as seen by all the processes in a distributed system. [0.5 marks]**
  - a. **Similarity:** In both sequential and causal consistency, writes that are potentially causally related must be seen by all processes in the same order.
  - b. **Difference:** In sequential consistency, concurrent writes should also be seen by all the processes in the same order while in causal consistency, concurrent writes may be seen in a different order by different processes.
3. **What is the main difference between blocking primary-backup protocol and non-blocking primary-backup protocol? [0.25 marks]**
  - a. In blocking primary-backup protocol, the acknowledgement of completion of a write operation is sent only after the write has been completed on all the replicas whereas in non-blocking primary-backup protocol, the acknowledgement of completion of a write operation is sent immediately after the write has been completed on just the primary replica.
4. **Give one advantage and disadvantage of non-blocking primary-backup protocol over blocking primary-backup protocol. [0.5 marks]**
  - a. **Advantage:** Write operations are faster in non-blocking as compared to blocking.
  - b. **Disadvantage:** Non-blocking protocol is less fault-tolerant as the write operation is completed only on the primary replica whereas blocking protocol is more fault-tolerant as the write operation is completed on all the replicas.
5. **Mention the two constraints which should be satisfied while deciding the size of read quorum ( $N_R$ ) and write quorum ( $N_W$ ). Assume that the total number of servers is  $N$ . [0.25 marks]**
  - a.  $N_R + N_W > N$
  - b.  $N_W > N/2$
6. **Give one advantage and disadvantage of Read-One, Write-All (ROWA) protocol. [0.25 marks]**
  - a. **Advantage:** Faster reads (as reads can be performed just by querying any one server)
  - b. **Disadvantage:** Slower writes (as writes need to be performed on all the replicas)