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Pre-class Assignments #21

1. Define the following terms:

Commit - The outcome of a transaction where all of its updates occur.

Roll Back - The outcome of a transaction where none of its updates occur.

Transaction - A group of operations that are applied persistently, atomically as a group or not at all, and independently of other transactions.

Intentions - The set of writes that a transaction will perform if the transaction commits.

Redo Logging - A way of implementing a transaction by recording in a log the set of writes to be executed when the transaction commits.

Group Commit - A technique that batches multiple transaction commits into a single disk operation.

Journaling - Journaling file systems apply updates to the system's metadata via transactions, but they update the contents of users' files in place.

Mirroring - A system for redundantly storing data on disk where each block of data is stored on two disks and can be read from either.

Rotating Parity - A system for redundantly storing data on disk where the system writes several blocks of data across several disks, protecting those blocks with one redundant block stored on yet another disk.

Stripe - A set of G1 data strips(group of sequential blocks) and their parity strip

Dual Redundancy Array - A RAID storage algorithm using two redundant disk blocks per array to tolerate two disk failures.

2. What are the four ACID properties?

- 1.) Atomicity
- 2.) Consistency
- 3.) Isolation
- 4.) Durability

3. Why do critical sections lack durability?

Adding the durability requirement significantly changes how we implement atomic updates.

4. How does undo logging differ from redo logging?

Undo logging allows writes to be sent to their final storage locations when they are generated and requires them to be persistently stored before a transaction is committed. Redo logging waits until the commit record is persistent in the log and then updates all the values at once.

5. Give at least one reason for a sector failure on a hard disk.

A sector failure can occur is when data on one or more individual sectors on a disk are lost but the disk continues to operate correctly. Permanent sector failures can occur from scratches in the coating where a contaminant was dragged across the surface by the head.

6. Give at least one reason for a page failure on a solid state disk.

A page failure can occur on a solid disk by wear-out from repeated write/erase cycles, making devices more susceptible to data retention errors.

7. Give at least one reason for a whole device failure of a hard disk.

A whole device failure can be caused by mechanical wear-out that makes it difficult for the head to stay centered over a track.

8. Describe the bathtub model of device lifetimes.

The bathtub model models the disk device failure combining device infant mortality and wear out. It shows three distinct groupings. There is a high chance of infant mortality early on, representing a high chance of device failure early. Once it passes through its early stages, it is very likely to stay reliable through the advertised rate. After the advertised rate of reliability, its chances of failure increase rapidly due to wear out.

9. Distinguish between RAID 0, RAID 1, RAID 5, and RAID 6.

Raid 0 has no replication. Raid 1 mirrors data across two or more disks. Raid 5 splits data across disks, with redundancy to recover from disk failure. Raid 6 is just like raid 5 but with extra redundancy to recover from two disk failures.

10. What is the purpose of a battery-backed write buffer in a RAID system?

A battery-backed write buffer ensures that any data in the write buffer is written to disk after a crash or power outage.