

This exam is closed book. You can have two sheets of self-prepared notes. UH expels cheaters.

1. What are *volatile witnesses*? (5 points) How do they recover from a crash? (5 points)

Volatile witnesses are witnesses that are stored in main memory and not in stable storage. As a result, the data they hold will not survive a crash: a recovering volatile witness will remain in an amnesiac state until it can copy the state of majority of the voting entities.

2. Consider a RAID-5 system with two data blocks per stripe (b_0, b_1) and one parity block p .

- a) How much of the total disk space is used by the parity blocks? (5 points)

33.3 (one third of the blocks) _ percent

- b) What is the minimum number of disk drives required to implement this organization? (5 points)

3 _ drives

- c) What is the most efficient way to update block b_1 ? (10 points)

Read block(s) b_0 _____

Compute XOR of b_0 and new block b_1 _____

Write new block b_1 and XOR of b_0 and new block b_1 _____

3. Why do Harp servers have uninterruptible power supplies? (5 points) Would it make sense to put the witness on the same uninterruptible power supply as one of the two copies? (5 points)

Harp servers have uninterruptible power supplies to protect the data they keep in main memory against power failures. Putting the witness on the same uninterruptible power supply as one of the two copies is a very bad idea as it would endanger the data whenever the other server fails.

4. How does Amoeba handles cross-domain calls? (10 points minus 5 points if no drawing)
5. What steps are required to access a data block in the Sprite log-structured file system assuming (a) that (a) we know the i-node of the file containing the block and (b) none of the information we need is cached? (3×5 points: your answer *must* be a sequence of steps).

6. What part of the design of the CMU MEMS is much more complex than its two competitors? (5 points: you *must* pick one specific part of the system) Why could not they use either one of the simpler designs used by its competitors? (2×5 points)

The head positioning mechanism of the CMU MEMS is much more complex than the ones of its two competitors because it is the only one to use magnetic recording. As a result the heads must hover very close to the recording surface without touching it. This is not the case for the IBM Millipede, whose recording heads touch the recording surface nor with the HP MEMS, which uses the same technology as CD-ROMs.

7. A Tiger video server has a declustering factor equal to 4.
- a) What percentage of the total disk space is occupied by redundant video data? (5 points)
- 50 ___ percent
- b) What is the absolute maximum server utilization at which the cubs can operate to be able to handle a single cub failure? (5 points)
- 80 _____ percent

8. The Sprite Network Operating System was designed for diskless workstations. Today's workstations have local disks. How would this affect the way Sprite would reimplement today process migration? (10 points)

Since today's workstations all have local disks, a new implementation of Sprite would probably store on the local disk all its temp files and its swap file. This would complicate process migration because we would have to migrate these files with the process being migrated.