Improving Reliability

with Log-Structured File system (LFS) and Journaling File System (ext3)

What happen when power loss or system crash?

✓ Sectors (but not a block) are **written atomically** by the hard drive device

◉ But an FS operation might modify several sectors

- modify metada blocks (free bitmaps and inodes)

- modify data blocks

➡ Crash-consistency problem
a crash has a high chance of corrupting the file system