

# Problem Set 11

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**1a)**

$$P_{0-3'} = B0 \oplus B1 \oplus B2' \oplus B3$$

**1b)**

$$P_{0-3'} = B0 \oplus B1 \oplus B2' \oplus B3 \quad (1)$$

$$P_{0-3'} \oplus B2' = B0 \oplus B1 \oplus B3 \quad (2)$$

$$P_{0-3} = B0 \oplus B1 \oplus B2 \oplus B3 \quad (3)$$

$$P_{0-3} \oplus B2 = B0 \oplus B1 \oplus B3 \quad (4)$$

$$P_{0-3} \oplus B2 = B0 \oplus B1 \oplus B3 = P_{0-3'} \oplus B2' \quad (5)$$

$$P_{0-3} \oplus B2 = P_{0-3'} \oplus B2' \quad (6)$$

$$P_{0-3} \oplus B2 \oplus B2' = P_{0-3'} \quad (7)$$

**2a)**

This system is a RAID5: striping with single parity shared across disks.

**2b)**

To write new content to block 8, we also need to write a new parity block, so  $W=2$ . Writing a new parity block requires reading the 4 data blocks, so  $R = 4$ . Computing the new parity is  $P_{8-11} = B8 \text{ xor } B9 \text{ xor } B10 \text{ xor } B11$  so  $N = 3$ .

**3a)**

RAID 4 strips data with a single parity disk, so  $N_{disks} = 4T + 1$ .

**3b)**

RAID 5 also strips data with the equivalent of 1 parity disk striped across the volumes, so  $N_{disks} = 4T + 1$ .

**3c)**

RAID 6 also strips data with the equivalent of 2 parity disk striped across the volumes, so  $N_{disks} = 4T + 2$ .

**3d)**

RAID 1 mirrors all the data with no parity, so  $N_{disks} = 2 \times 4T = 8T$ .

**4a)**

N = 2:

**4b)**

N = 2.

**4c)**

If disks 2 and 6 fail, only the RAID10 system will operate. In the RAID01 system, strips 1, 5, 9, 13 would no longer be accessible.

**5a)**

D, A, B, C

**5b)**

Device B would then not be able to have requests granted.