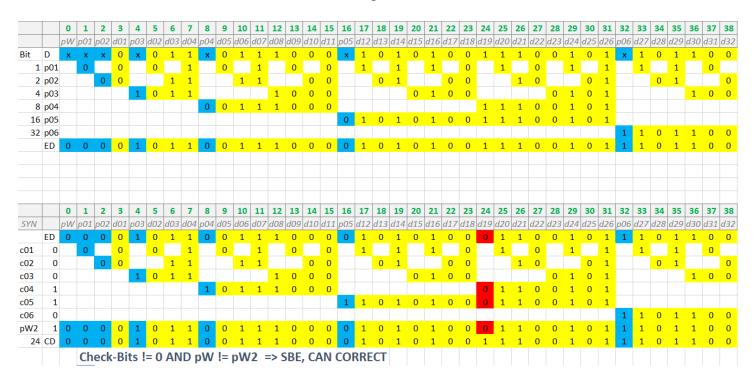
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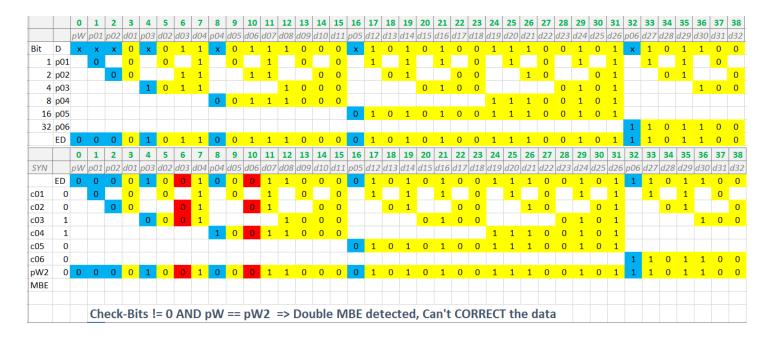
Homework set 4 Due 2019/04/16

These problems should be done individually, not with your project partner.

1. Develop an example of a 32-bit Hamming encoded word (39 bits total) and show a correctable SBE scenario. Show the data word in a table like Figure 5.6 in the book.



2. For the foregoing problem, now show an uncorrectable MBE scenario.



3. For the following Nand flash block update history for 2 sectors that contain 4 blocks each (e.g. 16K sectors, with 4K blocks), fill in the missing WRITE operations as needed and compute write-amplification.

```
#1 - Start
Sector Erased (S0, S1)
                             0,0
                                      1,1
                                                                2,1
                                            1,1
                                                   1,1
                                                          1,1
S1
                       PB7
                             FREE
                                    FREE
                                           FREE
                                                  LB3
                                                         LB3
                                                                LB3
                                                                      LB3
                                                  LB2 INVLD INVLD INVLD
                       PB6
                             FREE
                                    FREE
                                            LB2
                       PB5
                             FREE
                                            LB3 INVLD INVLD INVLD INVLD
                                     LB3
                       PB4
                             FREE
                                     LB2
                                           INVLD INVLD INVLD INVLD
SO
                       PB3
                             FREE
                                    FREE
                                           FREE
                                                  LB1
                                                         LB1 FREE
                       PB<sub>2</sub>
                             FREE
                                    FREE
                                            LB0
                                                  LB0 INVLD FREE FREE
                                                  INVLD INVLD FREE
                       PB1
                             FREE
                                     LB1
                                            LB1
                                                                      LB2
                       PB0
                             FREE
                                     LB0
                                          INVLD INVLD INVLD FREE
                                                                      LB0
FS LBs Updated
                                    0,1,2,3 0,2
                                                         0,2
                                                                0,2
                                                                       0,2
                                                   1,3
FS LBs Cached
                                                          0,2
                                                                0,2
Sector LBs Buffered
                                                                 1
                               #8
                                     #9
                                                  #11
                                                         #12
                                            #10
                                                                #13
                                                                      #14
Sectors Erased (S0, S1)
                               2,1
                                     2,2
                                            2,2
                                                   2,2
                                                          2,2
                                                                3,2
                                                                       3,2
                        2,1
S1
                        LB3 INVLD
                                    FREE
                                           FREE
                                                   LB<sub>2</sub>
                                                         LB<sub>2</sub>
                                                                LB<sub>2</sub>
                                                                      LB<sub>2</sub>
                       INVLD INVLD
                                    FREE
                                           FREE
                                                  LB0
                                                         LB0
                                                                LB0
                                                                      L<sub>B</sub>0
                       INVLD INVLD FREE
                                            LB3
                                                  LB3
                                                        INVLD INVLD INVLD
                       INVLD INVLD FREE
                                            LB1
                                                  LB1
                                                        INVLD INVLD INVLD
SO
                        LB1 INVLD INVLD INVLD INVLD INVLD FREE
                       FREE FREE FREE FREE FREE FREE
                        LB2 LB2
                                                  INVLD INVLD FREE
                                     LB2
                                            LB2
                                                                      LB3
                        LB0
                             LB0
                                     LB0
                                            LB0
                                                 INVLD INVLD FREE
                                                                      LB1
FS LBs Updated
                        0,2
                             1,3
                                    1,3
                                           1,3
                                                   0,2
                                                          1,3
                                                                1,3
                                                                       1,3
FS LBs Cached
                             1,3
                                    1,3
                                                          1,3
                                                                1,3
Sector LBs Buffered
```

```
#2 - Erase S0 & S1, WRITE LB 0, 1, 2, 3
#3 - Read LB 0, 2, Modify, WRITE LB 0, 2
#4 - Read LB 1, 3, Modify, WRITE LB 1, 3
#5 - Read LB 0, 2, Modify and Cache
#6 - Buffer LB 0, 1, 2, Erase S0
#7 - WRITE LB 0, 1, 2 to S0
Write Amplification = 11/10 = 1.1
#8 - Read LB 1, 3, Modify and Cache
#9 - Erase S1
#10 - WRITE - Back LB 1, 3 to S1
#11 - Read LB 0, 2, Modify, WRITE LB 0, 2
#12 - Read LB 1, 3, Modify and Cache
#13 - Erase S0
#14 - WRITE - Back LB 1, 3
Write Amplification = 17/16 = 1.0625
Total sector erases for both S0 and S1 = 2 + 3 = 5
```

#1 - All blocks FREE