CSE102 : File and Storage Structures

Solution Set for Assignment 3

1. The purpose of disk array declustering is to improve degraded mode performance. A degraded mode occurs when one or more disks has failed in the disk array. When a disk is unavailable, the reads directed to it must be implemented by reading all the remaining units of the stripe and reconstructing the missing data. This results in increasing the workload for the remaining disks. The total read load in degraded mode is almost twice the read load in the fault-free mode. Since the workload increases for each surviving disk, we lust utilize less than the full array capability in fault-free mode. Otherwise, we will not be able to meet the needs of our clients during the inevitable degraded operation. For read only loads, we can use only one-half the capability. This is achieved by having the client data spread over additional disks; *n* disks with stripe width *k*, typically $n > k$.

2. n = 5 disks and stripe width k = 3 disks.
   There are b = ${}_k^nC$ = 10 stripes per iteration. There are $k.{}_k^nC$ = 30 iterations per period. We give one iteration here as an illustration. The other two iterations can be obtained by changing the position of the parity stripe unit.

Stripe	Parity	Data0	Data1
A	0	1	2
B	0	1	3
C	0	2	3
D	1	2	3
E	0	1	4
F	0	2	4
G	1	2	4
H	0	3	4
I	1	3	4
J	2	3	4

3. n = 5 disks and stripe width k = 3 disks, user address a = 267, Number of data stripe units m = k-1=2.
   stripe s = $\lfloor a/m \rfloor \% {}_k^nC$ = $\lfloor 267/2 \rfloor \%10$ = 3. So it is stripe 3 with 13 iterations before it.
   stripe 3 has layout s $\mapsto$ {1,2,3}

   $\therefore$ iterations = $\lfloor 267/2 \rfloor$ / 10 = 13

   parity in iteration 13 = iterations % *k* = 13 % 3 = 1
   index = a % m = 267 % 2 = 1
   But since the parity disk is also disk 1, the index for data disk is therefore 2.
   We get, Parity Disk = d_1 = Disk 2

and Data Disk = d_2 = Disk 3

$$offset(267,1) = \sum_{j=0}^{0} {}^{d_j}_{j+1}C + \sum_{j=2}^{2} {}^{d_j-1}_{j}C = 1 + 1 = 2$$

$$offset(267,2) = \sum_{j=0}^{1} {}^{d_j}_{j+1}C = 1 + 1 = 2$$

Offset in Data disk = $iterations.{}^{n-1}_{k-1}C + offset(267,2) = 13*6+2 = 80$

Offset in Parity disk = $iterations.{}^{n-1}_{k-1}C + offset(267,1) = 13*6+2 = 80$