# Homework3

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## Q1. Cache

### i

The query sequence:

1,2,3,4,5,6,7,8,9,1,2,3,10,11,1,2,3,12,13,14,15,16,17,10,11

8 frames:

| query | cache | miss/hit |
|---|---|---|
| 1..8 | 1,2,3,4,5,6,7,8 | miss |
| 9 | 2,3,4,5,6,7,8,9 | miss |
| 1 | 3,4,5,6,7,8,9,1 | miss |
| 2 | 4,5,6,7,8,9,1,2 | miss |
| 3 | 5,6,7,8,9,1,2,3 | miss |
| 10 | 6,7,8,9,1,2,3,10 | miss |
| 11 | 7,8,9,1,2,3,10,11 | miss |
| 1 | 7,8,9,1,2,3,10,11 | hit |
| 2 | 7,8,9,1,2,3,10,11 | hit |
| 3 | 7,8,9,1,2,3,10,11 | hit |
| 12..17 | 10,11,12,13,14,15,16,17 | miss |
| 10 | 10,11,12,13,14,15,16,17 | hit |
| 11 | 10,11,12,13,14,15,16,17 | hit |

20 misses, 5 hits

9 frames:

| query | cache | miss/hit |
|---|---|---|
| 1..9 | 1,2,3,4,5,6,7,8,9 | miss |
| 1 | 1,2,3,4,5,6,7,8,9 | hit |
| 2 | 1,2,3,4,5,6,7,8,9 | hit |
| 3 | 1,2,3,4,5,6,7,8,9 | hit |
| 10 | 2,3,4,5,6,7,8,9,10 | miss |
| 11 | 3,4,5,6,7,8,9,10,11 | miss |
| 1 | 4,5,6,7,8,9,10,11,1 | miss |
| 2 | 5,6,7,8,9,10,11,1,2 | miss |
| 3 | 6,7,8,9,10,11,1,2,3 | miss |
| 12..17 | 1,2,3,12,13,14,15,16,17 | miss |
| 10 | 2,3,12,13,14,15,16,17,10 | miss |
| 11 | 3,12,13,14,15,16,17,10,11 | miss |

22 misses, 3 hits

### ii

No.
With LRU, 9 frames cache would contain whatever contained in 8 frames cache

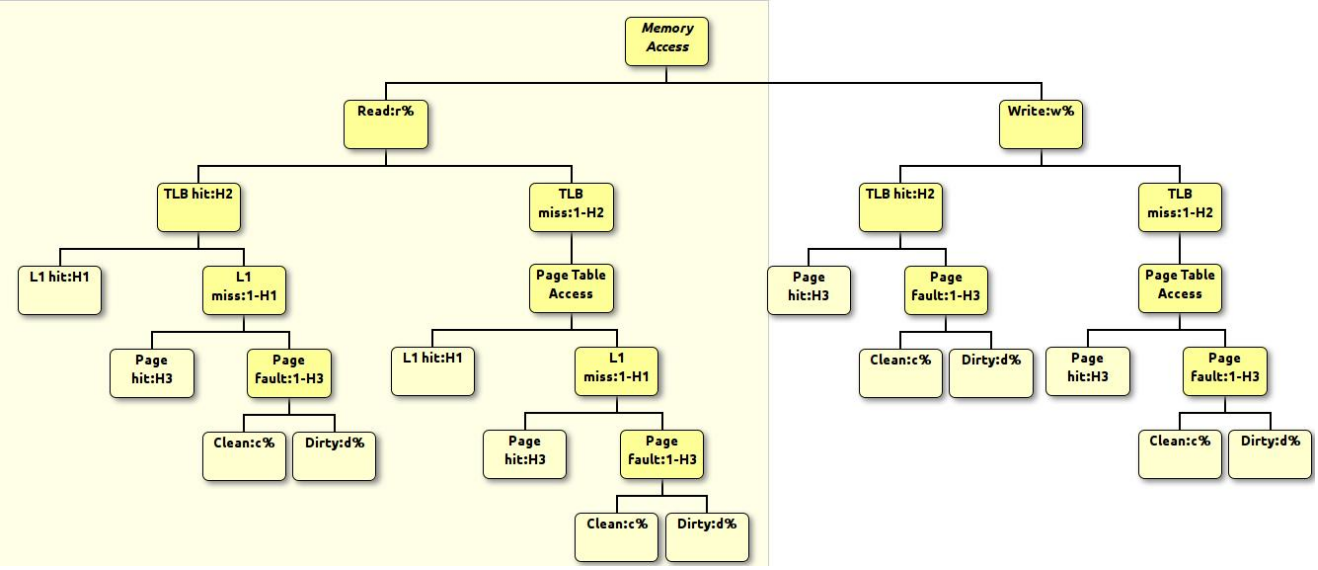
## Q2.Memory

### i

$$(M + 2D + 1) \times d\% \times (1 - H3) \times H2 \times w\%$$

### ii

zoom in please




# Q3.Hard Disk

## i

$$20000 \times 5000 \times 512 \text{ bytes} = 333.8\text{GB}$$

## ii

All the other disks need to be read and no other disks need to be written.

## iii

The write request of block 12, 23 and 66 can be paralleled.
Write request of block 6 would write P0 on disk 7.
Write request of block 27 would write disk 7.
Write request of block 28 would write disk 0.
Write request of block 50 would write P0 on disk 0.

# Q4.TLB

A=17bits
B=8bits
C=7bits
D=1024bits
E=17bits
G=13bits
H=7bits
I=12bits
J=17bits

# Q5.SimpleScalar Assignment

According to the table shown next page, 512 sets cache with 32 bytes frame and 8 associativity or 64 bytes frame and 4 associativity always performs the best.

| Test bench | number of sets | block size(byte) | associativity | miss rate | average access time (×hit time) |
|---|---|---|---|---|---|
| anagram | 1024 | 16 | 8 | 0.0267 | 1.32 |
| anagram | 1024 | 32 | 4 | 0.0204 | 1.29 |
| anagram | 1024 | 64 | 2 | 0.0156 | 1.28 |
| anagram | 1024 | 8 | 8 | 0.043 | 1.47 |
| anagram | 2048 | 16 | 4 | 0.027 | 1.32 |
| anagram | 2048 | 32 | 2 | 0.0209 | 1.29 |
| anagram | 2048 | 64 | 1 | 0.0172 | 1.31 |
| anagram | 2048 | 8 | 4 | 0.0433 | 1.48 |
| anagram | 256 | 64 | 8 | 0.0149 | 1.27 |
| anagram | 4096 | 16 | 2 | 0.0278 | 1.33 |
| anagram | 4096 | 32 | 1 | 0.0224 | 1.31 |
| anagram | 4096 | 8 | 2 | 0.0446 | 1.49 |
| anagram | 512 | 32 | 8 | 0.0201 | 1.28 |
| anagram | 512 | 64 | 4 | 0.0151 | 1.27 |
| anagram | 8192 | 16 | 1 | 0.0296 | 1.36 |
| anagram | 8192 | 8 | 1 | 0.0483 | 1.53 |
| cc1 | 1024 | 16 | 8 | 0.0072 | 1.09 |
| cc1 | 1024 | 32 | 4 | 0.006 | 1.08 |
| cc1 | 1024 | 64 | 2 | 0.0054 | 1.10 |
| cc1 | 1024 | 8 | 8 | 0.0204 | 1.22 |
| cc1 | 2048 | 16 | 4 | 0.0081 | 1.10 |
| cc1 | 2048 | 32 | 2 | 0.0071 | 1.10 |
| cc1 | 2048 | 64 | 1 | 0.0097 | 1.17 |
| cc1 | 2048 | 8 | 4 | 0.0212 | 1.23 |
| cc1 | 256 | 64 | 8 | 0.0041 | 1.07 |
| cc1 | 4096 | 16 | 2 | 0.0095 | 1.11 |
| cc1 | 4096 | 32 | 1 | 0.0114 | 1.16 |
| cc1 | 4096 | 8 | 2 | 0.0233 | 1.26 |
| cc1 | 512 | 32 | 8 | 0.0054 | 1.08 |
| cc1 | 512 | 64 | 4 | 0.0045 | 1.08 |
| cc1 | 8192 | 16 | 1 | 0.0144 | 1.17 |
| cc1 | 8192 | 8 | 1 | 0.0309 | 1.34 |
| go | 1024 | 16 | 8 | 0.0358 | 1.43 |
| go | 1024 | 32 | 4 | 0.0191 | 1.27 |
| go | 1024 | 64 | 2 | 0.0106 | 1.19 |
| go | 1024 | 8 | 8 | 0.0699 | 1.77 |
| go | 2048 | 16 | 4 | 0.0361 | 1.43 |
| go | 2048 | 32 | 2 | 0.0193 | 1.27 |
| go | 2048 | 64 | 1 | 0.0134 | 1.24 |
| go | 2048 | 8 | 4 | 0.0699 | 1.77 |
| go | 256 | 64 | 8 | 0.0103 | 1.19 |
| go | 4096 | 16 | 2 | 0.0364 | 1.44 |
| go | 4096 | 32 | 1 | 0.0207 | 1.29 |
| go | 4096 | 8 | 2 | 0.0701 | 1.77 |
| go | 512 | 32 | 8 | 0.0189 | 1.26 |
| go | 512 | 64 | 4 | 0.0105 | 1.19 |
| go | 8192 | 16 | 1 | 0.0376 | 1.45 |
| go | 8192 | 8 | 1 | 0.073 | 1.80 |