ECEN 651 HW6 Zhenlei Song

B.1

(a) average access time

= (1 − miss) · hit time + miss · miss time

= 0.95 × 1 + 0.05 × 105

= 6.2 cycles

B.2

(a) direct mapped

Block	set	way	blocks
0	0	0	M0, M8, M16, M24
1	1	0	M1, M9, M17, M25
2	2	0	M2, M10, M18, M26
3	3	0	M3, M11, M19, M27
4	4	0	M4, M12, M20, M28
5	5	0	M5, M13, M21, M29
6	6	0	M6, M14, M22, M30
7	7	0	M7, M15, M23, M31

(b) 4-way set

Block	set	way	block
0	0	0	M0, M2 ··· M30
1	0	1	M0, M2 ·· M30
2	0	2	M0, M2 ·· M30
3	0	3	M0, M2 ··· M30
4	1	0	M1, M3 ··· M31
5	1	1	M1 M3 ···M31
6	1	2	M1 M3 ·· M31
7	1	3	M1 M3 ... M31

2.8

(a) access time for direct map : 1.52504 ns

for 2-way : 2.22852 ns

for 4-way : 2.25661 ns

direct map cache is 2.23/1.53 = 1.46 46% faster than 2-way cache

is 2.25661/1.52504 = 1.47 47% faster than 4-way cache

(b) access time for 16kB : 1.02464 ns

for 32kB : ~~2.22852~~ 1.13332 ns

for 64kB : 2.25661 ns

∴ 16 kB is ~~2.22852~~ 1.13332 / 1.02464 = 1.106 10.6% faster than 32 kB

is 2.25661/1.02464 = 2.20 120% faster than 64 kB

(c) miss rate : direct map 0.00664/0.3 = 2.2%

2-way 0.00366/0.3 = 1.2%

4-way 0.000987/0.3 = 0.3%

8-way 0.000266/0.3 = 0.09%

cycles: direct map : 1.52504/0.86346 = 1.76 ~ 2 cycles

2-way : 2.22852/0.784306 = 2.84 ~ 3 cycles

4-way : 2.25661/0.784306 = 2.88 ~ 3 cycles

8-way : 1.44432/0.258975 = 5.57 ~ 6 cycles

continued

direct map miss cycles : $10/0.86 = 11.58 \sim 12$ cycles

2-way : $10/0.78432 = 12.75 \sim 13$ cycles

4-way 〃 〃 ~ 13 cycles

8-way $10/0.258975 = 38.6 \sim 39$ cycles

average time for

direct map : $(1-2.2\%) \times 2 + 2.2\% \times 12 = 2.22$ ~~cy cles~~

2-way : $(1-1.2\%) \times 3 + 1.2\% \times 13 = 3.12$

4-way : $(1-0.3\%) \times 3 + 0.3\% \times 13 = 3.03$

8-way : $(1-0.09\%) \times 6 + 0.09\% \times 39 = 6.0297$