Comp. Arch

DATE: 4/5/22

SIMPLE EXERCISE

- block size is 16 bytes
  two way associative cache
  # of sets is 2

0	4	0
1	3	1

28, 48, 32, 92, 68, 52, 4, 24, 64, 24

- **28** This is MISS (M)

  block # = $\frac{28}{16}$ = 1 no block 1 in cache

		0
1		1

Since it's a M, we load "block 0" from memory to a set:

Set# = 1 % 2 = 1 so set 1

- **48** This is MISS (M)

  block # = $\frac{48}{16}$ = 3 no block 3 in cache

		0
1	3	1

Since it's a M, we load "block 3" from memory to a set:

Set# = 3 % 2 = 1 so set 1

- **32** This is MISS (M)

  block # = $\frac{32}{16}$ = 2 no block 2 in cache

2		0
1	3	1

Since it's a M, we load "block 2" from memory to a set:

Set# = 2 % 2 = 0 so set 0

- 92 This is MISS (M)

block # = $\frac{92}{16}$ = 5 no block 5 in cache

2		0
~~1~~ 5	3	1

Since it's a M, we load "block 5" from memory to a set:

Set# = 1 % 2 = 1 so set 1

Set 1 is full so you replace one of the saved blocks by following LUR method. (least used recently) Block 3 was last used so we will replace block 1 with 5

- 68 This is MISS (M)

block # = $\frac{68}{16}$ = 4 no block 4 in cache

2	4	0
5	3	1

Since it's a M, we load "block 4" from memory to a set:

Set# = 4 % 2 = 0 so set 0

- 52 This is HIT (H)

block # = $\frac{52}{16}$ = 3 block 3 is in cache

2	4	0
5	3	1

- 4 This is MISS (M)

block # = $\frac{4}{16}$ = 0 no block 0 in cache

~~2~~ 0	4	0
5	3	1

Since it's a M, we load "block 0" from memory to a set:

Set# = 0 % 2 = 0 so set 0

Set 0 is full so you replace one of the saved blocks by following LUR method. (least used recently) Block 4 was last used so we will replace block 2 with 0

- 24 This is MISS (M)

block # = $\frac{24}{16}$ = 1 no block 1 in cache

0	4	0
~~5~~	3	1

1 ↗

Since it's a M, we load "block 1" from memory to a set:

Set# = 1 % 2 = 1 so set 1

Set 1 is full so you replace one of the saved blocks by following LUR method. (least used recently) Block 3 was last used so we will replace block 5 with 1

- 64 This is HIT (H)

block # = $\frac{64}{16}$ = 4 block 4 is in cache

2	4	0
1	3	1

- 24 This is HIT (H)

block # = $\frac{24}{16}$ = 1 block 1 is in cache

2	4	0
1	3	1

DIFFICULT EXERCISE

block # 64
# of sets 32
one-way associative
write-back
miss rate ?

```
.data

x: .word  _____
y: .word  _____
z: .word  _____
n: .word  4096

.text

la  t0, x
la  t1, y
la  t2, z
lw  t3, n

ciclo: lw  t4, 0(t0)
       lw  t5, 0(t1)
       add  t6, t4, t5
       sw  t6, 0(t2)
       addi  t0, t0, 4
       addi  t1, t1, 4
       addi  t2, t2, 4
       addi  t3, t3, -1
       bne  t3, zero, ciclo
```

remember, 2 instructions

- So, 1st block goes into cache
- data starts at 0x00400000
- to know block, divide by 64 (remember 0x00400000 is HEX)

  Result → 0x00010000
- 0x00010000 % 32 = 0

$$MISSRATE \cong \frac{\overbrace{8+15\cdot 6}^{b.1} + \overbrace{4\cdot 16}^{b.2} + \overbrace{3\cdot 16\cdot 30}^{b.3}}{\underbrace{12\cdot 6}_{b.1} + \underbrace{12\cdot 6}_{b.2} + \underbrace{12\cdot 6\cdot 30}_{b.3}}$$

1 block contains 16 instruction

Iteration 1 - 8 misses
12 accesses to the mem

2 - 6
12

3 - 6
12

⋮

15 - 6
12

16 - 4
12

17 - 4
12

⋮

31 - 4
12

$$\frac{8+15\cdot 6+4\cdot 16+3\cdot 16\cdot 30}{12\cdot 16+12\cdot 16+18\cdot 6\cdot 30}$$

$= 26\%$