

10-bit address

$$t = 64 - (s + b)$$

0101101010

t=4 s=2 b=4

Compare against each

tag 0101  
index 10 → set = 2  
offset 1010 ← ignore

	V	tag	lru
S=0	0		
S=1	0		
S=2	1	0101	0
S=3	0		

hit IFF tag == cacheline tag && valid

time = 0

access ( -- ) {

- placing {
1. mark as valid
  2. write tag
  3. write lru to be "current time"

} time;

10-bit address

0111 001110

t=4 s=2 b=4

tag 0111

index 00

offset 110 ← ignore

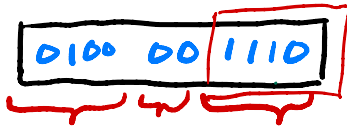
	v	tag	lru	v	tag	lru
s=0	1	0111	1	0		
s=1	0			0		
s=2	1	0101	0 ←	0		
s=3	0			0		

hit IFF tag == cacheline tag && valid

- placing {
1. mark as valid
  2. write tag
  3. write lru to be "current time"

time = 1

10-bit address



t=4 s=2 b=4

tag 0100

index 00

offset 1110 ← ignore

"E" is number of entries per set in the cache

2<sup>2</sup> S

	v	tag	lru	v	tag	lru
S=0	1	0111	1	1	0100	2
S=1	0			0		
S=2	1	0101	0	0		
S=3	0			0		

hit IFF tag == cacheline tag && valid

- placing {
1. mark as valid
  2. write tag
  3. write lru to be "current time"

time = 2

$E$  - associativity (# entries per set)

$s$  - bits used for set

$b$  - bits used for block offset / size

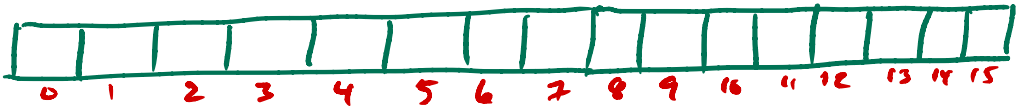
$S = 2^s$  - number of total sets

$B = 2^b$  - block size (ignore)

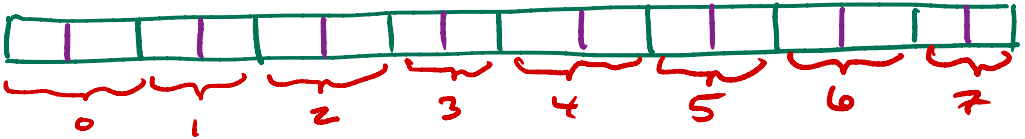
Total # of Cachelines:  $E \ll S$

$E \neq S$

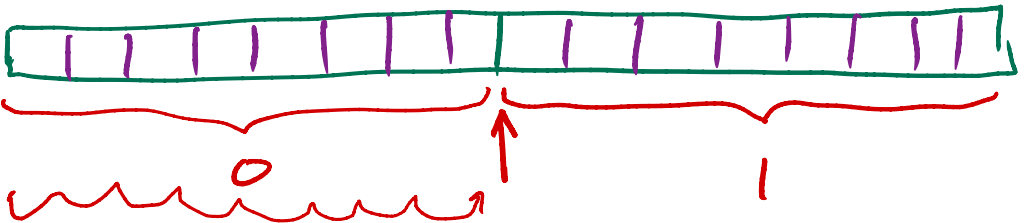
$s=4, E=1$



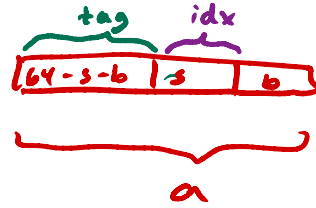
$s=3, E=2$



$s=1, E=8$



assume address  $a$   
given  $s, b$



$$\text{tag} = a \gg (s+b)$$

$$\text{idx} = (a \gg b) \& ((1 \ll s) - 1)$$

set  $x$  starts  
at offset  $x \cdot E$

$$s=3$$

$$8-1=7$$

$$111$$

$$s=5$$

$$32-1=31$$

11111

addr  
↓  
(tag, index)

Cache Lookup

→ found  
++hit  
line.lru = time

→ ++misses

Look for invalid

→ found  
place

→ ++evictions

Find lowest lru

↓  
place

\*tag used within the search  
\*index tells us where to search

place - write tag, valid, lru  
in the "current" line