

CE-1921 - Dr. Durant - Quiz 9
Spring 2018, Week 9

- (1 point) A 4096 B direct-mapped (1-way) cache is divided into 16 blocks. **Calculate** how many **set bits** there are.
- (3 points) Continuing, there are 20 address lines. **Show** how the address is broken down into set, offset, and tag bits.
- (2 points) **Calculate** an **example** of 2 read addresses used sequentially that will cause the first read data to be evicted from the cache.
- (2 points) **Show** how the address format will change if the cache is instead organized as a **4-way** set associative cache, but nothing else changes.
- (2 points) **Illustrate** the ^{how} contents of the set associative cache if the 2 addresses you calculated above are accessed sequentially.

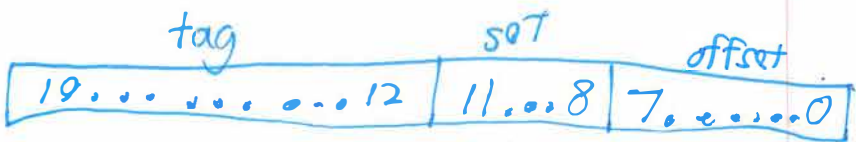
Fit into the new cache's blocks and explain why this is good when they...

①
$$\text{Sets} = \frac{\text{Blocks}}{\text{ways}} = \frac{16}{1} = 16$$

$$\text{Set bits} = \log_2(\text{Sets}) = \log_2 16 = \boxed{4}$$

②
$$\text{Block size} = \frac{\text{Total Size}}{\text{Block Count}} = \frac{4096 \text{ B}}{16} = 256 \text{ B}$$

$$\text{offset bits} = \log_2(\text{Block size}) = \log_2(256) = 8$$



③ Need: Same Set
Different Tag
Don't care about offset.

	T	S	O
A1	05	B	A5
A2	07	B	C3

④
$$\text{Sets} = \frac{\text{Blocks}}{\text{ways}} = \frac{16}{4} = 4$$

$$\text{set bits} = \log_2(\text{Sets}) = \log_2(4) = 2$$

⑤
$$A1 = \underbrace{0000}_{\text{tags still differ}} \underbrace{0101}_{\text{sets still same}} \underbrace{1011}_{\text{sets still same}} \underbrace{1010}_{\text{offset}} \underbrace{0101}_{\text{offset}}$$

$$A2 = \underbrace{0000}_{\text{tags still differ}} \underbrace{0111}_{\text{sets still same}} \underbrace{1011}_{\text{sets still same}} \underbrace{1100}_{\text{offset}} \underbrace{0011}_{\text{offset}}$$

So, these 2 blocks will be simultaneously in the cache, in ways 041 for set = 112 = 3