

Homework 5

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1.1 1MB direct cache, 16 byte line

$16 = 2^4$ so 4 bits are needed to index into the cache bytes. $\frac{2^{20}}{2^4} = 2^{16}$ lines in the cache, so we need 16 bits to index into cache lines. Bits remaining for the tag $32 - 16 - 4 = 12$.

1.2 2MB 8 way associative cache, 8 byte line

$8 = 2^3$ so 3 bits are needed to index into the cache bytes. $\frac{2^{21}}{2^3 \cdot 8} = \frac{2^{21}}{2^3 \cdot 2^3} = \frac{2^{21}}{2^6} = 2^{15}$ so, 15 bits are need to index into the sets. That leaves $32 - 15 - 3 = 14$ bits for the tag.

1.3 3MB 32 way associative cache, 16 byte line

$16 = 2^4$ so 4 bits are needed to index into the cache bytes. $\frac{2^{22}}{2^4 \cdot 2^5} = \frac{2^{22}}{2^9} = 2^{13}$ so, 13 bits are needed to index into the sets. That leaves $32 - 13 - 4 = 15$ bits for the tag.

2

2.1

$16 = 2^4$ so 4 bits are needed to index into the cache bytes. $\frac{2^{19}}{2^4} = 2^{15}$ lines in the cache, so we need 15 bits to index into the cache lines. Bits remaining for tag $32 - 15 - 4 = 13$

Memory Address	Tag	Index	Byte	Hit/Miss
0x1234AB22	0001_0010_0011_0 = 0x246	100_1010_1010_0010 = 0x4AB2	0010 = 0x2	Miss
0x1234AB20	0001_0010_0011_0 = 0x246	100_1010_1010_0010 = 0x4AB2	0000 = 0x0	Hit
0x1234D020	0001_0010_0011_0 = 0x246	100_1101_0000_0010 = 0x4D02	0000 = 0x0	Miss
0x1234D02F	0001_0010_0011_0 = 0x246	100_1101_0000_0010 = 0x4D02	1111 = 0xF	Hit
0x1234AB26	0001_0010_0011_0 = 0x246	100_1010_1011_0010 = 0x4AB2	0110 = 0x6	Hit
0x1234AB333	0001_0010_0011_0 = 0x246	100_1101_1011_0011 = 0x4AB3	0011 = 0x3	Hit
0x1234D023	0001_0010_0011_0 = 0x246	100_1101_0000_0010 = 0x4D02	0011 = 0x3	Hit
0x1234D02B	0001_0010_0011_0 = 0x246	100_1010_1011_0010 = 0x4AB2	1011 = 0xB	Hit
0x1234AB22	0001_0010_0011_0 = 0x246	100_1010_1011_0010 = 0x4AB2	0010 = 0x2	Hit
0x1234AB28	0001_0010_0011_0 = 0x246	100_1010_1011_0010 = 0x4AB2	0010 = 0x8	Hit

Hit rate = $\frac{8}{10} = .8$

2.2

$16 = 2^4$ so 4 bits are needed to index into the cache bytes. $\frac{2^{19}}{2^4 \cdot 2} = 2^{14}$ lines in the cache, so we need 14 bits to index into the cache lines. Bits remaining for tag $32 - 14 - 4 = 14$

Memory Address	Tag	Index	Byte	Hit/Miss
0x1234AB22	0001_0010_0011_01 = 0x44C	00_1011_1010_0010 = 0xAB2	0010 = 0x2	Miss