Homework 6

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Problem 5.3: 1
There are 2^5 bytes $*\frac{1}{4}\frac{word}{Bytes} = \frac{32}{4}$ words = 8 words.
Problem 5.3: 2
2^5 entries = 32 entries.
Problem 5.3:

Address	Address Binary	Tag	Index	Offset	HIT/MISS	Replace
0	00000000000000000000000000000000	...000	00000	00000	MISS	0
4	00000000000000000000000000010000	...000	00000	10000	HIT	0
16	00000000000000000000000000010000	...000	00000	10000	HIT	0
132	00000000000000000000000010000100	...000	00100	00100	MISS	0
232	00000000000000000000000011101000	...000	00111	01000	MISS	0
160	00000000000000000000000010100000	...000	00101	00000	MISS	0
1024	00000000000000000000010000000000	...000	00000	00000	MISS	1
30	00000000000000000000000000011110	...001	00000	11110	MISS	1
140	00000000000000000000000010001100	...000	00100	01100	HIT	0
3100	00000000000000000000110000011100	...000	00000	11100	MISS	1
180	00000000000000000000000010110100	...011	00101	10100	HIT	0
2180	00000000000000000000100010000100	...010	00100	00100	MISS	1

Problem 5.3: 4
We replace 4 blocks.
Problem 5.3: 5
Hit ratio = $\frac{4}{12} = \frac{1}{3}$
Problem 5.5: 1
We miss on address 0 and then the next time we miss is on address 32. So we miss every other $\frac{32}{2} = 16$ references so the **miss rate** is $\frac{1}{16}$.
As the cache gets smaller so do the block sizes therefore we have a **higher miss rate**.
We are experiencing **cumpolsury misses** since we are only missing when we reach a block we have not visited before.
Problem 5.5: 2
2^4 **Block Size:** Miss every other $\frac{16}{2}$ references so the **miss rate** is $\frac{1}{8}$.
2^6 **Block Size:** Miss every other $\frac{64}{2}$ references so the **miss rate** is $\frac{1}{32}$.
2^7 **Block Size:** Miss every other $\frac{128}{2}$ references so the **miss rate** is $\frac{1}{64}$.
We are exposing **spatial locality.**

Problem 5.6: 2
AMAT for P_1:

$$0.66 + .08(70) = 6.26\ ns \tag{5.1}$$

AMAT for P_2:

$$0.90 + .06(70) = 5.10\ ns \tag{5.2}$$

Problem 5.6: 4
AMAT for P_1 with L_2 cache:

$$0.66 + .08(5.62 + .95(70)) = 6.43\ ns \tag{5.3}$$

The AMAT is higher with an L_2 cache therefore it is not helping.
Problem 5.1: Exam

a: AMAT for CPU

$$1 + .30(10 + .20(80)) = 8.8\ cycles \tag{5.4}$$

b: TCPI

$$\begin{aligned} BCPI &= 1 + .20(.60)(1) + .30(.50)(1) && (5.5)\\ &= 1.27 && (5.6)\\ MCPI &= 1(.10)(10 + .20(80)) + .20(.30)(10 + .20(80)) && (5.7)\\ &= 4.16 && (5.8)\\ TCPI &= 1.27 + 4.16 = 5.43 && (5.9) \end{aligned}$$

c

Original $EX_{Time_1} = 5.43(10^6)(\frac{10^{-9}}{2}) = 2.72 \times 10^{-3}$
New TCPI, BCPI, MCPI

$$BCPI = 1 + \frac{2}{9}(.60) + \frac{2}{9}(.25) = 1.18 \tag{5.10}$$

$$MCPI = 26MR_{Inst} + \frac{2}{9}(.30)(26) = 1.73 + 26MR_{Inst} \tag{5.11}$$

$$TCPI = 2.91 + 26MR_{Inst} \tag{5.12}$$

$$EX_{Time_2} = 9 \times 10^5(2.91 + 26MR_{Inst})(\frac{10^{-9}}{2}) \tag{5.13}$$

$$2.72 \times 10^{-3} = 9 \times 10^5(2.91 + 26MR_{Inst})(\frac{10^{-9}}{2}) \tag{5.14}$$

$$MR_{Inst} \leq 12.05\% \tag{5.15}$$