Com S 321 **Homework 10** **John Collin Vincent**

1.

a)

$$\begin{aligned}\text{EMA} &= (\text{Hit ratio})(\text{Cache time}) + (1 - \text{Hit ratio})(\text{Mem time}) \\ &= (.9 * 100) + (1000 * .1) \\ &= 90 + 100 \\ &= 190\text{ns}\end{aligned}$$

b)

$$\begin{aligned}\text{EMA} &= (\text{Hit ratio})(\text{Cache time}) + (1 - \text{Hit ratio})(2\text{Mem time} * \text{block size} + \text{Cache time}) \\ &= (.9 * 100) + (((2 * 1000 * 8) + 100) * .1) \\ &= 90 + 1610 \\ &= 1700\text{ns}\end{aligned}$$

c)

$$\begin{aligned}\text{EMA}_2 &= (\text{Hit ratio})(\text{Cache time}) + (1 - \text{Hit ratio})(2\text{Mem time} * \text{block size} + \text{Cache time}) \\ &= (.9 * 100) + (((2 * 500 * 8) + 100) * .1) \\ &= 90 + 810 \\ &= 900\text{ns}\end{aligned}$$

$$\begin{aligned}\text{EMA}_{4w} &= (\text{Hit ratio})(\text{Cache time}) + (1 - \text{Hit ratio})(2\text{Mem time} * \text{block size} + \text{Cache time}) \\ &= (.9 * 100) + (((2 * 1000 * 2) + 100) * .1) \\ &= 90 + 410 \\ &= 500\text{ns}\end{aligned}$$

making the bandwidth between memory and cache 4 words wide would increase to speed by 400ns more than increasing the memory speed.

2.

a)

$$\text{ReadHitTime} = (1 - W) * t_c$$

b)

$$\text{WriteHitTime} = W * t_m$$

c)

$$\text{ReadMissPenalty} = (1 - W) * (\frac{B}{c} * t_m + t_c)$$

d)

$$\text{ReadMissPenalty} = W * t_m$$

3.

a)

$$\begin{aligned}\text{EMA} &= (h)(t_c) + (1 - h)(t_m) \\ &= 100 * .9 + (1 - .9) * (1000) \\ &= 90 + 100 \\ &= 190\text{ns}\end{aligned}$$

b)

$$\begin{aligned}\text{EMA} &= (h)(t_c) + (1 - h)(2 * t_m \frac{B}{c} + t_c) \\ &= 100 * .9 + (1 - .9) * (2 * 1000 * \frac{8}{2} + 100) \\ &= 90 + 810 \\ &= 900\text{ns}\end{aligned}$$

c)

$$\begin{aligned}\text{EMA} &= (h)(t_c) + (1 - h)(\text{read miss} + \text{write miss}) \\ &= 100 * .9 + (1 - .9) * (.7 * (2 * 1000 * \frac{8}{2} + 100) + .3 * 1000) \\ &= 90 + 597 \\ &= 687\text{ns}\end{aligned}$$

4.

a)

$$\begin{aligned}\text{EMA} &= (h)(t_c) + (1 - h)(t_m) \\ &= 100 * .95 + (1 - .95) * (1000) \\ &= 95 + 50 \\ &= 145\text{ns}\end{aligned}$$

b)

$$\begin{aligned}\text{EMA} &= (h)(t_c) + (1-h)(2 * t_m \frac{B}{c} + t_c) \\ &= 100 * .95 + (1 - .95) * (2 * 1000 * \frac{8}{4} + 100) \\ &= 95 + 205 \\ &= 300\text{ns}\end{aligned}$$

c)

$$\begin{aligned}\text{EMA} &= (h)(t_c) + (1-h)(\text{read miss} + \text{write miss}) \\ &= 100 * .95 + (1 - .95) * (.75 * (2 * 1000 * \frac{8}{4} + 100) + .25(1000)) \\ &= 95 + 166.25 \\ &= 261.25\text{ns}\end{aligned}$$

d)

$$\begin{aligned}\text{EMA} &= (h)(t_c) + (1-h)(\text{read miss} + \text{write miss}) \\ &= 100 * .95 + (1 - .95) * (.75 * (1000 * \frac{8}{4} + 100) + .25(1000)) \\ &= 95 + 91.25 \\ &= 185.25\text{ns}\end{aligned}$$