CMSC 411
Homework #5 Solutions (partial)

Exercise 5.7(a) Here we are asked to derive a new memory access model for the new pseudo-associative cache described in the exercise. The new configuration only has one cycle of additional time (instead of two) for accessing the alternate block. Given the derivation presented in the text, the following facts are relevant: the miss-rate/miss-penalty portion of the formula will be unchanged, the hit time formula is correct with the exception that the alternate hit rate is now only multiplied by 1 instead of 2.

Since the rest of the equation is the same, the new equation is:

$$\begin{aligned} AMT_{pseudo} &= Hit\ Time_{1-way} + \\ &\quad 1 \times (Miss\ Rate_{1-way} - Miss\ Rate_{2-way}) + \\ &\quad Miss\ Rate_{2-way} \times Miss\ Penalty_{1-way} \end{aligned}$$

This analysis is dependent upon the assumption that there will be no decrease in the hit rate to the fast blocks with the proposed configuration.

Exercise 5.7(b) Using the equation from Exercise 5.7(a) and plugging in the values used in the text's example yields:

$$\begin{aligned} AMT_{pseudo\ 2KB} &= 1 + (.098 - .076) \times 1 + (.076 \times 50) \\ &= 4.822 \end{aligned}$$

$$\begin{aligned} AMT_{pseudo\ 128KB} &= 1 + (.010 - .007) \times 1 + (.007 \times 50) \\ &= 1.353 \end{aligned}$$

This is a slight improvement over the normal pseudo-associate cache.

Exercise 5.9 To arrive at an expression for the average access time of a three-level memory hierarchy, we begin with the expression for a single level hierarchy presented in Section 5.2 of the text

$$Average\ Access\ Time = (Hit\ Time) + (Miss\ Rate) \times (Miss\ Penalty)$$

To extend the relationship to multiple level memory hierarchies, all you have to do is note that the miss penalty of level i is simply the average access time of level $i+1$. Thus, for a three-level hierarchy

$$Average\ Access\ Time = H_{L1} + M_{L1}\{H_{L2} + M_{L2}(H_{L3} + M_{L3}P_{L3})\}$$

where H_i is the hit time, M_i is the miss rate, and P_i is the miss penalty of cache level i.