13.03.2020 # Hit Rate and Miss Penalty (Hamacher)

•) Hit Rate = $\frac{\#\text{ Successful Access in Cache}}{\#\text{ Attempted Access in Cache}}$

Maximum val of Hit Rate = 1.

•) Miss Rate = 1 − Hit Rate.

•) Miss Penalty :-) Time required after cache miss to bring the mm address to cache and the required word to the CPU is called Miss Penalty

.) Comes into picture after Miss. (Cache)

*) Assume 30% of the instructions of a typical program needs read & write operations i.e., 130 memory access per 100 instructions.

-) Hit ratio in Cache = 0.95 for instruction and 0.90 for data.

Assuming :-
Accessing MM = 10 cycles
Accessing Cache = 1 cycle

*) Time required without cache
*) Time required with cache

Sol:)

$$\frac{\text{Time without Cache}}{\text{Time with Cache}} = \frac{130 \times 10}{100 \times (0.95 \times 1 + (1-0.95) \times 17) + 30 \times (0.9 \times 1 + 0.1 \times 17)}$$

Consider:- $100 \times (0.95 \times 1 + (1-0.95) \times 17)$

- 100 : No of instructions
- 0.95 : Hit rate
- 1 : Time taken to fetch from cache
- (1-0.95) : In case of miss
- 17 : Mememory interleaved time taken to bring from MM.

Consider: $30 \times (0.9 + 1 + 0.1 \times 17)$

- 30 : Data
- 0.9 : Hit of data
- 1 : Time taken to fetch from cache
- 0.1 : miss of data
- 17 : Mememory interleaved time taken to bring from MM.

$\therefore \frac{\text{Time without cache}}{\text{Time with cache}} = 5.03$

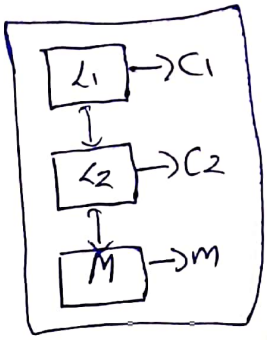
Time with cache is 5 times faster than Time without cache.

:) Now Consider, there is only Cache. (i.e., there is no miss) (No main memory)

$\frac{\text{Time without cache}}{\text{Time with cache}} = \frac{258}{130} \simeq 2$

As Hit rate = 1, Time with cache: $100 \times 1 + 30 \times 1$

$= 100 + 30 = 130$



Formula:

M: actually Miss Penalty

Avg Access time:

$$h_1 \times C_1 + (1-h_1) \times h_2 \times C_2 + (1-h_1)(1-h_2) \times M$$

:) A Computer has l_1 and l_2 cache. Hit rates in l_1 and l_2 0.95 & 0.9 respectively.

Access time in l_1 & l_2 is 1 cycle & 10 cycle respectively

Miss Penalty = 17 cycles

Find Average Access time. (363. Problem 5.13)

AVG Access time: $h_1 = 0.95$ $h_2 = 0.9$

$C_1 = 1$ $C_2 = 10$

$M = 17$. (Put in formula)