March 13,

Hit Rate & Miss Penalty

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- Hit-Rate:- $\frac{\#\text{Successful Access in Cache}}{\#\text{Attempted Access in Cache}}$

- Miss-rate: 1 − (Hit-Rate).

- Miss-penalty: Time b/w miss in cache and the instant at which required data gets available in cache. (i.e., to bring the MM. address to cache & the required word to C.P.U. is called miss-penalty.)

→ Assume 30% of instructions of a typical program needs read & write operations. (i.e., 130 memory access for 100 instructions). Hit Rate in cache = 0.95 for instruction & 0.90 for data.

Solution:-

Accessing MM. = 10 cycles

Accessing Cache = 1 cycle.

Time-required without Cache	130 × 10 = 1300
Time-required with Cache	100 × (0.95 × 1) + (1 − 0.95) × 17) + 30 × (0.9 × 1 + 0.1 × 17) = 258

Ratio of time required without Cache & with Cache = $\frac{1300}{258}$

= $\boxed{5.038}$

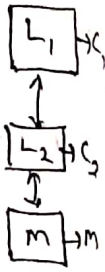
Formula: # Instructions × [(Hit Rate × 1) + (Miss Rate × 17)]
+ # Data × [(Hit Rate × 1) + (Miss Rate × 17)]

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

Then, $\frac{\text{Time with cache}(\text{without m.m.})}{\text{Time without Cache}(\text{with m.m.})} = \frac{130}{1300} \rightarrow \frac{1}{10}$ $\frac{130}{258} \simeq \boxed{\frac{1}{2}}$

So, It is more beneficial. But, it will be very costly.

☆ Avg Access-time = $h_1 \times C_1 + (1-h_1) \times h_2 \times C_2 + (1-h_1)(1-h_2) \times M$



Eg:- A Computer has l_1 & l_2 cache. Hit-Rates in l_1 & l_2 are 0.95 & 0.9 respectively. Access-time in l_1 & l_2 Cache are 1 cycle & 10 cycles, respectively. Miss-Penalty = 17 cycles (Page No. 363 Problem: 5.13)

Find access time.

Solution:-

Avg. Access-time = $0.95 \times 1 + (0.05) \times 0.9 \times 10 + 0.05 \times 0.1 \times 17$

$= \boxed{1.485}$