CS & IT ENGINEERING

Computer Organization Architecture

Cache Organization

DPP 01 Discussion Notes

[NAT]

#Q. A cache is used to reduce the effective memory access time of 200ns without cache to 65ns with cache. If cache access time is 50ns, then cache hit rate is _____%?

$t_{mm} = 200\,ns$

$t_{avg} = 65\,ns$

$t_{cm} = 50\,ns$

$65 = H * 50 + (1-H)\,200$

$H = \underline{\underline{90\%}}$ Ans.

[NAT]

#Q. A computer system has a cache with cache access time Tc = 10ns, hit ratio of 80% and average memory access time of Tm = 20ns. The access time for physical memory Tp is _____ ns?

↳ main

$T_{cm} = 10$ ns

$H = 80\%$

$T_{avg} = 20$ ns

$T_{mm} = ?$

$20 = 0.8 * 10 + 0.2 * t_{mm}$

$t_{mm} = \frac{12}{0.2}$ ns

$= 60$ ns Ans.

[NAT]

#Q. A cache line (block) has 128 bytes. The main memory has addressing latency 64ns and access bandwidth 1GB/s. The time required to fetch the entire cache line from the main memory is _____ ns?

= 1 Latency + 128 bytes read time

64 ns + 128 ns = 192 ns Ans.

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for 1GB, time = 1 sec

1 B, —11— = $\frac{1\text{sec}}{1G}$ = 1ns

128 B, —11— = 128 * 1ns = 128ns

[NAT]

Ans = 53%

#Q. Consider a system using a cache. The cache is having 70% hit ratio and is 9 times faster than main memory. The average memory access time then increased due to some program execution and the new average access time becomes 40% more than older one of 340ns. The hit ratio of new cache design is ___%?

$t_{cm} = \frac{t_{mm}}{9} \Rightarrow t_{mm} = 9 * t_{cm}$

$H = 0.7$

$t_{avg} = 340\,ns$

new

$t_{avg} = 340 + 340 * 40\% = 340 + \frac{340 * 40}{100}$

$= 1.4 * 340 = 476\,ns$

$H = ?$

Old execution :-

$$340 = 0.7 * t_{cm} + 0.3 * 9\, t_{cm}$$

$$340 = 3.4\, t_{cm}$$

$$t_{cm} = 100 \text{ ns}$$

$$t_{mm} = 9 * 100 = 900 \text{ ns}$$

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new execution :-

$$476 = H * 100 + (1-H)\, 900$$

$$476 = 100H + 900 - 900H$$

$$800H = 424$$

$$H = \frac{424}{800} = 0.53 = \underline{\underline{53\%}}$$

[NAT]

#Q. Consider a memory hierarchy which takes 500 nanoseconds for access when there is a miss in cache and takes 100 nanoseconds for access when there is a hit in cache. Assume if among all memory references 90% of the references are having a hit on cache then average memory access time is _____ nanoseconds?

$= 0.9 * 100 + 0.1 * 500$

$= 90 + 50$

$= 140$ ns Ans.

[MCQ]

#Q. A system has a write through cache with access time of 100ns and hit ratio of 90%. The main memory access time is 1000ns. 70% of memory references are for read operations. Average memory access time for read-write operations both and effective hit rate(in %) are?

A 433, 90%

B 433, 63%

C 190, 90%

D 190, 63%

$T_{avg\ read} = 0.9 * 100 + 0.1 * 1000 = 190\ ns$

$T_{avg\ write} = 1000\ ns$

$T_{avg} = 0.7 * 190 + 0.3 * 1000$

$= 433\ nsec$

Effective hit rate $= 0.7 * 0.9 = 0.63 = 63\%$

[NAT]

#Q. Consider a write through cache which can provide only 63.75% of effective hit rate. If among all memory references 75% references are for read, then the hit ratio of cache for only read operations 85 %?

$$0.6375 = 0.75 * H$$

$$H = \frac{0.6375}{0.75} = 0.85 = 85\% \quad \text{Ans.}$$

[NAT]

#Q. Consider a write through cache which can provide only 61.92% effective hit rate. If among all memory references 28% references are for write, then the hit ratio of cache for only read operations is ____?%

$0.6192 = 0.72 * H$

$H = 0.86 = 86\%$

THANK - YOU