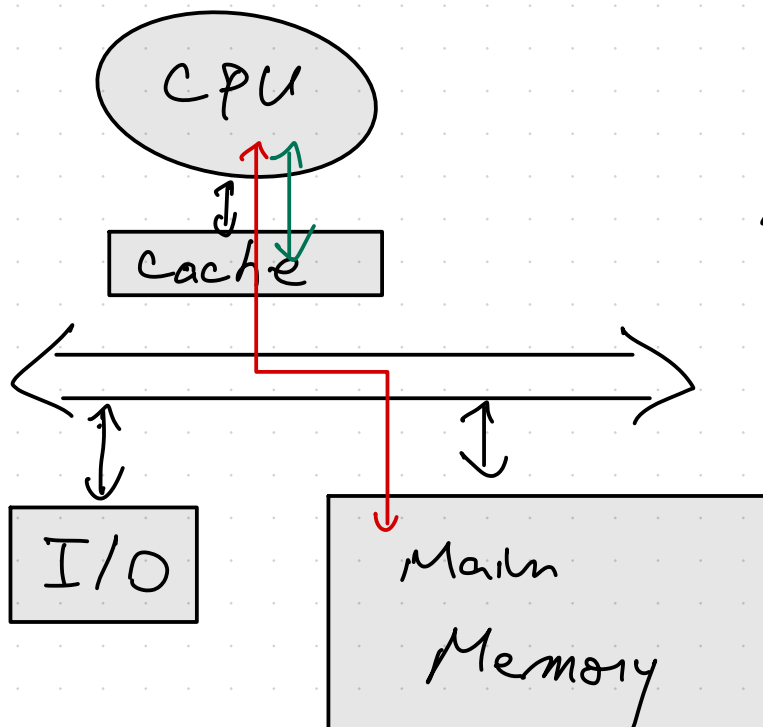


### 3.3 Write Policies

**Hit**  $\begin{matrix} \text{WT} & \text{write Through} \\ \text{WB} & \text{write Back} \end{matrix}$  - cache + write buffer

**Miss** Read  $\rightarrow$  Allocate  
write  $\begin{matrix} \alpha \\ \beta \end{matrix}$  write Allocate  
write no allocate

### 3.4 Cache Performance



DMA  
Direct  
Memory  
Access

% BUS Bandwidth

## Pilda 1

SIMS

Single  
Inst.  
Multiple  
Data

$$CPI_{ideal} = 0.5 \text{ C.C.}$$

$$Mem. Access / inst. = 3$$

$$Miss Rate = 11\%$$

$$Miss Penalty = 6 \text{ C.C.}$$

$$CCT = 4 \text{ ns}$$

AVX

$$AMAT = ? \quad \text{Avg. Mem. Acc. Time}$$

$$CPU_{time} = ?$$

(t)

$$AMAT = t_{ac.} + Miss Rate \times Miss Penalty$$

$$= 4 \text{ ns} + 0.11 \times \frac{4 \text{ ns} \times 6 \text{ C.C.}}{24}$$

$$Cache Access \rightarrow 1 \text{ C.C.} = \underline{\underline{6.64 \text{ ns}}}$$

$$CPU_{time} = IC \times \left( CPI_{ideal} + Mem \text{ Acc} / Inst. \right. \\ \left. + Miss Rate \times Miss Pen. (C.C.) \right) \times CCT$$

$$= IC \times (0.5 + 3 \times 0.11 \times 6) \times 4 \text{ ns}$$

$$= 41,92 \text{ ns} \times IC$$

$$\frac{\text{Performance Cache}}{\text{Perf. Ideal}} = \frac{\text{CPU}_{\text{time ideal}}}{\text{cache}} = \frac{\text{IC} \times 34}{\text{IC} \times 41.92} =$$

$$\text{score perf. } 0.189 \quad = 0.811$$

## Pilda 2

64k:B cache data

$$CCT = 20 \text{ ns}$$

$$\text{Mem acc / instr} = 1.3$$

$$CPI_{\text{ideal}} = 1.5 \text{ cc}$$

SA  $\rightarrow$  CLK degradation of 8.5%

	$\Delta M$	2-way SA	Miss Penalty = 200 ns
Miss Rate	3.9%	3%	

$$AMAT_{\Delta M} = 20 \text{ ns} + 0.039 \times 200 \text{ ns} = 27.8 \text{ ns}$$

$$AMAT_{SA} = 21.7 \text{ ns} + 0.03 \times 200 \text{ ns} = 27.7 \text{ ns}$$

$$CCT_{SA} = \underset{\text{clk. deg}}{1.085} \times CCT_{\Delta M} = 1.085 \times 20 \text{ ns} = 21.7 \text{ ns}$$

$$CPU_{\text{time}} = IC \times (CPI_{\text{ideal}} + \text{Mem. acc / instr} \times \text{Miss Pen} \times CCT)$$

$$CPU_{\text{time } \Delta M} = IC \times (1.5 \times 20 \text{ ns} + 1.3 \times 0.039 \times 200 \text{ ns})$$

$$CPU_{\text{time } SA} = IC \times 40.35 \text{ ns} \quad (1.5 + 21.7 + 1.3 \times 0.03 \times 200) \times 20 \text{ ns}$$

"Bossul, Samiannul Ti-ului"

H A I A E T

Pilda 3 BUS Bandwidth =  $10^9$  words/sec  
BUS width = 2 words  
Hit Rate = 90%  
1 block = 4 words

$10^8$  words/sec Proc. ref. rate writes/sec

30% writes

35% dirty blocks

write allocate for a miss

a)  $\times 1B$   
b)  $\times 4T$

$\frac{10^8 \text{ words/sec}}{\text{ref. rate}} \times 0.1 \left( 0.7 \times \text{Read Miss Pen} + 0.3 \times \text{write Miss Pen} \right)$   
miss rate

Read Miss Penalty  $\times 1B = \frac{\text{Block Size}}{\text{Bus width}} \times \text{BUS Reads}$   
Allocate

+  $\frac{0.35 \times \text{Block Size}}{\text{Bus width}} \times \text{BUS Writes}$   
dirty blocks

= 2 BUS Reads + 0.7 BUS writes  
= 2.7 BUS Accesses

$$\text{Write Miss Penalty}_{WB} = \underbrace{2 \text{ BUS Reads}}_{\text{Allocate}} + \underbrace{0.7 \text{ BUS Writes}}_{\text{update}} = 2.7 \text{ BUS Accesses}$$

$$\% \text{ BUS used} = \frac{10^7 \times 2.7 \text{ (Accesses)}}{10^9 \text{ words/sec}} = 2.7\%$$

$$\boxed{\text{WIT}} \quad 10^8 \times 0.1 \times \left( 0.7 \times \text{Read Miss Pen}^b + 0.3 \times \text{Write Miss Pen}^b \right) + 10^8 \times \underbrace{0.9}_{\text{hit}} \times \underbrace{0.3}_{\text{writes}} \times \text{Write Hit Penalty}^b$$

$$\text{Read Miss Pen.} = \underbrace{\frac{4}{2} \text{ BUS Reads}}_{\text{Allocate}} = 2 \text{ BUS Accesses}$$

$$\begin{aligned} \text{Write Miss Pen}^b &= \underbrace{\frac{4}{2} \text{ BUS Reads}}_{\text{Allocate}} + \underbrace{1 \text{ BUS Write}}_{\text{MM Write}} \\ &= 3 \text{ BUS Accesses} \end{aligned}$$

$$\text{Write Hit Pen.}^b = \underbrace{1 \text{ BUS Acc.}}_{\text{MM Write}}$$

$$10^7 \times (0.7 \times 2 + 0.3 \times 3) + 10^8 \times 0.9 \times 0.3$$

$$= 5 \times 10^7$$

$$\% \text{ BUS used} = \frac{5 \cdot 10^7}{10^9} = \underline{\underline{5\%}}$$