D-Link
Building Networks for People

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AC Sesión 2: 1.12, 2.1, 2.2, 2.5, 2.6

1.12 a) Tiempo medio hasta fallos: $MTTF_{sistema} = \left[\frac{1}{MTTF_{sistema}} = \frac{1}{MTTF_1} + \frac{1}{MTTF_2} + \dots + \frac{1}{MTTF_N}\right]$

$$MTTF_{sistema} = \left(\frac{1}{125000} + \frac{1}{1000000} + \frac{1}{700000} + \frac{1}{1000000} + \frac{1}{500000} + \frac{1}{1000000}\right)^{-1} =$$

$$= \boxed{10.000 \text{ horas}}$$

b) MTTR (Mean Time To Repair) = 20 horas
MTBF?

$$MTBF = MTTF + MTTR = 10000 + 20 = \boxed{10020 \text{ horas}}$$

c) disponibilidad (Availability) $= \frac{MTTF}{MTTF + MTTR} = \frac{10.000}{10000 + 20} = \boxed{0,998}$ ¿unidades?

2.1

expresión	binario	hex	expresión	binario	hex
x & y	00000010	0x02	x && y	00000001	0x01
x | y	11110111	0xF7	x || y	00000001	0x01
~x | ~y	11111101	0xFD	!x || !y	00000000	0x00
x & !y	00000000	0x00	x && ~y	00000000	0x00

$$\begin{cases} x = 0x66 = 01100110 \\ y = 0x93 = 10010011 \end{cases}$$

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AC Sesión 2

2.2

X		X<<4		(lógico) X>>3		(aritmético) X>>3	
hex	binario	hex	binario	hex	binario	hex	binario
0xF0	11110000	0x00	00000000	0x1E	00011110	0xFE	11111110
0x0F	00001111	0xF0	11110000	0x01	00000001	0x01	00000001
0xCC	11001100	0xC0	11000000	0x19	00011001	0xF9	11111001
0x55	01010101	0x50	01010000	0x0A	00001010	0x0A	00001010
0x80	10000000	0x00	00000000	0x10	00010000	0xF0	11110000
0x02	00000010	0x20	00100000	0x00	00000000	0x00	00000000

2.5

```
char A[256];
char tabla[256];
for(i=0;i<256;i++){
    A[i] = tabla[A[i]];
}
```

```
        movl    $A, %eax        // A
        movl    $tabla, %ebx    // tabla
        movl    $0, %ecx        // i=0
for:    cmpl    $256, %ecx      // compara contador amb inmediat 256
        jge     fi_for
        movl    (%eax, %ecx), %edx      A[i] -> %edx
        movb    (%ebx, %edx), %al       tabla[A[i]] -> %al
        movb    %al, (%eax, %ecx)       A[i] = tabla[A[i]]
        incl    %ecx                    ++i
        jmp     for
fi_for:
```

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AC Sesión 2

26

```
int *sorpresa(int i, int *x){
    if(i>-10 && i<10)
        *x = i;
    else
        x = &i;
    return x;
}
```

i = 8 (%ebp)
x = 12(%ebp)

```
sorpresa:
    pushl %ebp          // %esp-4 -> %esp
                        // %ebp -> M[%esp]
    movl %esp, %ebp
    movl 8(%ebp), %eax  // i -> %eax
    movl 12(%ebp), %ebx // x -> %ebx
    cmpl $-10, %eax
    jle else            // i > -10
    cmpl $10, %eax
    jge fi_sorpresa     // i < 10
    movl %eax, (%ebx)   // M[x] = i // *x = i
    jmp fi_sorpresa
else:
    leal (%eax), %ebx   // &i -> x
                        // x = &i
fi_sorpresa:
    movl 12(%ebp), %eax // x -> %eax
    popl %ebp           // %ebp <- M[%esp]
                        // %esp <- %esp+4
    ret
```

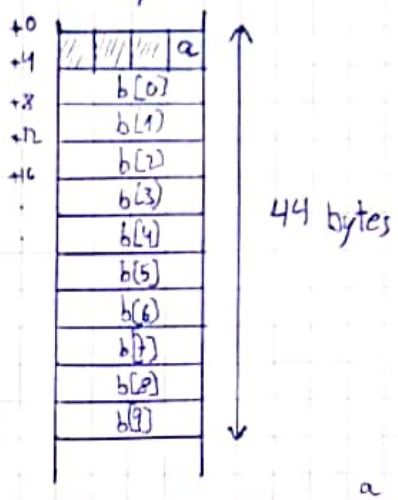
??

AC Problemas Sesión 3 : 2.9, 2.10, 2.14

2.9

```
typedef struct{
    char a;
    int b[10];
}elem;
elem s[100];
```

a)



%ebx = @s
%esi = i
%edi = j
%dl = x

b) s[i].b[j] → @s + 44·i + 4 + 4·j

```
leal
addl (%ebx,%esi,44),%ecx   // s[i] ecx: @s[i]
addl 4(%ecx,%edi,4),%ecx   // s[i].b[j]
```

c) x = s[s[i].b[j]].a ;

```
xorl %ecx,%ecx
leal (%ebx,%esi,44),%ecx
addl 4(%ecx,%edi,4),%ecx
addl (%ebx,%ecx,44),%ecx
movb (%ecx),%dl
```

AC Problemas Sesión 3

2.10

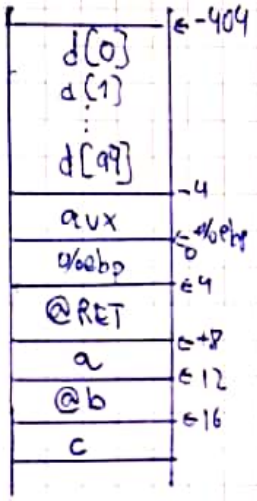
```
int calcula (int M[10][10], int m, int n){
    int i, suma, fila;
    suma=0;
    fila=0;
    for(i=m; i<n; i++)
        suma += Normaliza(M[fila][i], &fila);
    return (suma+1);
}
```


```
calcula: pushl  %ebp
         movl   %esp, %ebp
         subl   $12, %esp
         pushl  %ebx
         movl   $0, -8(%ebp)
         movl   $0, -4(%ebp)
         movl   -12(%ebp), %ebx
for:     cmpl   16(%ebp), %ebx
         jge    fi
         leal   -4(%ebp), %eax
         pushl  %eax
         movl   (%eax), %eax
         imull  $10, %eax
         addl   %ebx, %eax
         movl   8(%ebp), %edx
         movl   (%edx, %eax, 4), %edx
         pushl  %edx
         call   Normaliza
         addl   $8, %esp
         addl   %eax, -8(%ebp)
         incl   %ebx
         jmp    for
fi:      movl   -8(%ebp), %eax
         incl   %eax
         popl   %ebx
         movl   %ebp, %esp
         popl   %ebp
         ret
```

AC Problemas Sesión 3

2.14

a)



b)
```
leal  -4(%ebp),%eax
leal  -404(%ebp),%ecx
pushl %eax
pushl %ecx
pushl $0
call  examen
```

c)
```
      movl  $0,%edx
for:  cmpl  $100,%edx
      jge   fi
      leal  -404(%ebp),%eax
      movl  (%eax,%edx,4),%ecx
      movl  12(%ebp),%eax
      movl  %ecx,(%eax,%edx,4)
      incl  %edx
      jmp   for
fi:
```

d)
```
pushl 16(%ebp)
pushl 12(%ebp)
pushl 8(%ebp)
call  examen
```

AC Problemas Sesión 4: 2.18, 2.19

2.18

```
int mat1[M][N];
int mat2[N][M];
int SumaElemento(int i, int j){
    return mat1[i][j] + mat2[i][j];
}
```

a)

SumaElemento:

```
0  pushl %ebp
1  movl %esp, %ebp
2  movl 8(%ebp), %eax     //eax ← i
3  movl 12(%ebp), %ecx    //ecx ← j
4  sall $2, %ecx          //ecx *= ecx ← 4j
5  leal (,%eax,8), %edx   //edx *= 8 ← 8i
6  subl %eax, %edx        //edx = 8i - i = 7i
7  leal (%eax,%eax,4), %eax   //eax = i·4i = 5i
8  movl mat2(%ecx,%eax,4), %eax   //eax = M[&mat2 + 4j + 4·5i] = M[&mat2 + 4j + 20i] = mat2[i][j]
9  addl mat1(%ecx,%edx,4), %eax   //eax += M[&mat1 + 4j + 4·7i] = M[&mat1 + 4j + 28i] = mat1[i][j]
10 movl %ebp, %esp
11 popl %ebp
12 ret
```

mat1[i][j] ⇒ 4·(i·N + j)

mat1[i][j] ⇒ 4(i·M + j)

$4(i \cdot M + j) = 4iN + 4j = 20i + 4j \rightarrow M = \frac{20i}{4i} = 5$

$4(i \cdot N + j) = 4iN + 4j = 28i + 4j \rightarrow N = \frac{28i}{4i} = 7$

b) Tiene 13 instrucciones estáticas

c) Tiene 13 instrucciones dinámicas (todas)

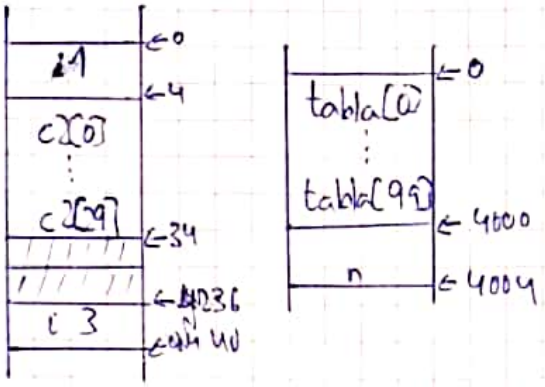
d) 4 accesos a Memoria (sobrallado) 1,25 2 (1)

e) $CPI_{FM} = \frac{1}{0,8}$ $CPI_{MM} = \frac{1}{0,5}$ $9\,instr.\left(\frac{1}{0,8}\right) + 4\cdot\left(\frac{1}{0,5}\right) =$ 19,25 ciclos

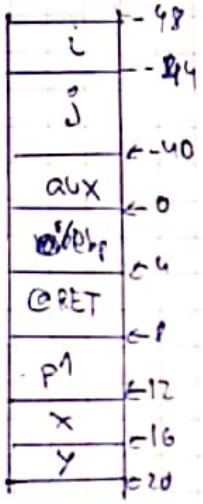
f) $CPI = \frac{1}{0,1} \rightarrow CPI_{DM} = 9\cdot\left(\frac{1}{0,9}\right) + 4\cdot\left(\frac{1}{0,6}\right) = 16,667$ ciclos $Speedup = \frac{19,25}{16,667} =$ 1,155 veces más rápido

2.19

a)



b)



c)
```
movl 12(%ebp), %eax
movl (%eax), %ebx
addl -4(%ebp), %eax
```

d)
```
movl 8(%ebp) %eax
movl -44(%ebp), %ebx
imull $40, %ebx
addl %ebx, %eax
movl 16(%ebp), %ebx
pushl %ebx
pushl %eax
call F
addl $8, %esp
movl %eax, -40(%ebp)
```

e)
```
movl -44(%ebp), %eax
movl 16(%ebp), %ebx
imull %eax, %ebx
movl %ebx, -48(%ebp)
```

f)
```
movb -13(%ebp), %al
leal -40(%ebp), %ebx
addl $4, %ebx
addl -48(%ebp), %ebx
movb %al, (%ebx)
```

g)
```
pushl %esi
movb $0, %ecx
movl 8(%ebp), %ebx
for: cmpl 16(%ebp), %ecx
jge fi_for
cmpl 4000(%ebx), %ecx
jge fi_for
imull $40, %ecx, %edx
addl %ebx, %edx
movl 36(%edx), %esi
addl %ecx, %esi
movl %esi, (%edx)
addl $5, %eax
jmp for
fi_for: popl %esi
```

':' = 46 = 0x2E '#' = 35 = 0x23

b)
```
movl -40(%ebp), %eax
cmpl 16(%ebp), %eax
je else
movl -48(%ebp), %ebx
jmp end
else: movl -44(%ebp), %ebx
end: movl %ebx, -4(%ebp)
```

i)
```
movl $0, %eax
leal -40(%ebp), %ebx
while: cmpb $0x2E, 4(%ebx, %eax)
je fi_while
movb $0x23, 4(%ebx, %eax)
incl %eax
jmp while
fi_while:
```

Tema 3

3.5 a) $T_{maI} = t_{acc} + t_{fallo} \cdot \frac{t_{pfs}}{\text{acceso}} = 1 + 0{,}004 \cdot 10 = \boxed{1{,}4\,c}$

b) $T_{maD} = t_{acc} + t_{fallo} \cdot t_{pfD} =$

$= 1 + \overset{nr}{0{,}1} \cdot (0{,}8 \cdot 15 + 0{,}2 \cdot 20) = \boxed{2{,}6 \text{ ciclos}}$

c) $T_{ma} = \frac{1 \cdot 1{,}4 + 0{,}6 \cdot 2{,}6}{1{,}6} = \frac{nrI \cdot t_{maI} + nrD \cdot t_{maD}}{nr} = \boxed{1{,}85 \text{ ciclos}}$

d) $T_{exec} = N \cdot CPI \cdot T_c$

↳ $CPI = CPI_{ideal} + \frac{nr}{nr.} \cdot (t_{ma} - t_{hit}) =$

$= 1{,}5 + 1{,}6 \cdot (1{,}85 - 1) = 2{,}8 \text{ ciclos}$

$T_{exec} = 1 \cdot 2{,}86 \cdot 10 = \boxed{28{,}6\,ns}$

4

c) 1 → 1000

3.4

a) $1 \rightarrow 1000$

$T_{ma} = 0,8 \cdot (0,9 \cdot 10 + 0,1 \cdot (10 + 100 + 10)) + 0,2 \cdot 80 =$

$= 32,8\ ns \Rightarrow 32,8 \cdot 1000 = \boxed{32800\ ns = T_{ma_{1000}}}$

b) $2 \rightarrow T_{ma} = 0,85 \cdot 10 + 0,15 \cdot (0,333 \cdot (2 \cdot 100 + 10 \cdot 2) + 0,666 \cdot (2 \cdot 10 + 100))$

$= 31,5\ ns \Rightarrow 31,5 \cdot 1000 = \boxed{31500\ ns = T_{ma_{1000}}}$

b) (Tasa Aciertos 1) > (Tasa aciertos 2)

La alternativa 1 es mejor a pesar de tener un Tma ligeramente superior.

c) Es por el tamaño de cada uno, un bloque es más grande que una palabra.

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Titulació

Assignatura

PALOMARES PERERA — Cognoms

MARTÍ — Nom

DNI

Pàgina _____ de _____

[3.6, 3.9, 3.12]

3.6 1.3 cpi → 1 cpi/inst I; 0,3 cpi/inst D

a) $T_{ma} = t_{sa} + m \cdot t_{pf} = 1 + 0,059 \cdot 10 = \boxed{1,59}$ cicles

$t_{ma} = t_{sa} + im \cdot t_{pf} = 1 + 0,6 \cdot 10 + 0,068 \cdot 10 = \boxed{2,54}$

b) $t_{exe} = N \cdot CPI \cdot T$

1) $1,3 \cdot 0,059 \cdot 10 \cdot 10 = \boxed{4,675} \cdot CPI^{1,5} = \boxed{11,505s}$

cicles $= 1 \cdot \frac{1 cpi}{1 inst.} \cdot 0,086 \cdot 10 \cdot 10 = 8,6s + 0,3 \cdot 0,068 \cdot 10 \cdot 10 = 2,04$

2) $\boxed{10,64s} \cdot 1,2 = \boxed{12,768s}$

c) Per la unificada, sempre acabes tenint una taxa de fallos menor, per tant menor temps d'execució $(0,059 < 0,068 + 0,086) = (0,059 < 0,154)$

d) Augmentant la mida de la Cache d'instruccions i Dada a 16kB, aconseguim un $T_{exe_{N=1}} = (0,036 \cdot 1 \cdot 10 \cdot 10 + 0,053 \cdot 0,3 \cdot 10 \cdot 10) \cdot 1,2 = \boxed{6,228s}$

9

a)

Acc MEM	73	55	43	45	73	45	13	43	73	55	45	73	15	43
Directa						X						X		
2-assoc.					X	X				X	X	X		X
Directa+VC					X	X		X	X		X	X		

VC

VC

conj	vía 0	vía 1
1	73 15	45
2		
3	73 13 43 43 73	43 13 43
4		

0 = hit

MC

0	
1	
2	
3	73 43 73 13 43
4	
5	55 45 15
6	
7	

VC

0	73 45 13 43
1	55 45 13

b) Dóna la casualitat que línia que entra primer (FIFO), o la que porta més temps sense ser utilitzada (LRU).

c) $CPI_{ID} = \frac{12 \cdot 10^9 \text{ cicles}}{10^{10} \text{ instr}} = 1{,}2 \text{ c/instr}$

d) $mr = \frac{3 \cdot 10^9 \text{ access}}{10 \cdot 10^9 \text{ instr}} = 0{,}3 \text{ acc/instr}$

e) Cicles = Nº Cicles · N · CPI

Problemas Sesión 8

3.13

a) L1 —8B— L2 (32B bloque)

$T_c = \frac{1}{f} = \frac{1}{2\cdot10^9} = 5\cdot10^{-10}\,s$

$T_a = 1c$

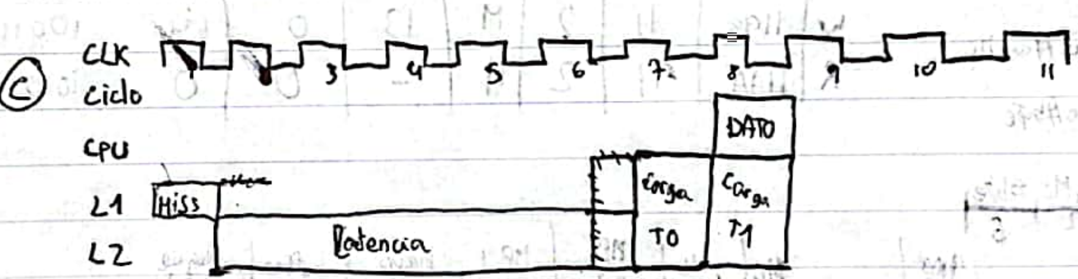
100% lecturas

$T_{exe} = N\cdot cpi\cdot T_c = \#ciclos\cdot T_c \to \#ciclos = \frac{T_{exe}}{T_c} = 4\cdot10^9$ ciclos

f = 2GHz
T_{exe} = 2s
100% hits
10^9 accesos
20% fallos L1

b) $\#ciclos_{pen.} = 5_{c\,latencia} + 4_{c\,T0\text{-}3} + 1_{c\,L1} = 10$ ciclos

c)



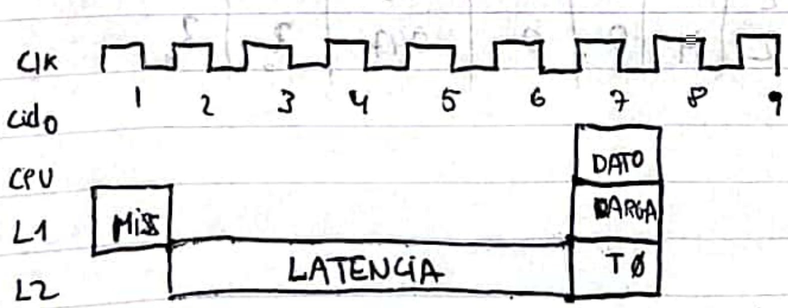
d) $\#ciclos_{pen} = 5 + 0{,}7\cdot1 + 0{,}1\cdot2 + 0{,}1\cdot3 + 0{,}1\cdot4 = 6{,}6$ ciclos

70% T0
100% T1-3

$T_{exe} = T_c\cdot\#ciclos = 5\cdot10^{-10}\cdot(4\cdot10^9 +$ [redacted]$) =$ [redacted]

T0 → $0{,}2\cdot0{,}7\cdot7$
\+ T1 → $0{,}2\cdot0{,}1\cdot8$
\+ T2 → $0{,}2\cdot0{,}1\cdot9$
\+ T3 → $0{,}2\cdot0{,}1\cdot10$
= 2,76 s

e)



f) [redacted]

$\#ciclos_{pen} = 5 + 1 = 6$ ciclos

$T_{exe} = \#ciclos\cdot T_c = 5\cdot10^{-10}\cdot(4\cdot10^9 + 10^9\cdot0{,}2\cdot6) = 2{,}6\,s$

⑨ ganancia C.A. $= \frac{3}{2,76} = \boxed{1,0869}$ continuación anticipada

ganancia $= \frac{3}{2,6} = \boxed{1,15384}$ transferencia en desorden

3.14

16 bits CPU
@16 bit

ⓐ

CACHE
3-assoc
LRU
12 bloques
64 B/bloque
cb+wa

tipo	@ Hex	TAG	Conj	H/M	Blog. reemp.	MP Bytes W	MP Bytes R	
R	B12B	B1	0	M	AC	0	64	00101011
R	B145	B1	1	M	AC	0	64	01000101
R	B1AF	B1	2	M	AC	64	64	10101111
R	B1C4	B1	3	M	AC	64	64	11000100
W	4387	43	2	H	–	0	0	10000111
R	1108	11	0	M	43	64	64	00001000
W	1199	11	2	M	13	0	64	10011001
R	11AA	11	2	H	–	0	0	10101010

$\frac{12b}{3assoc} = 4 = 2^2 \rightarrow 2$ #conj MC

@ → 6 bytes #byte
2 bytes x bloque

TAG	#conj MC	#byte
8	2	6

ⓑ

tipo	@	Nº de bloque	TAG	MC #conj	MC H/M	MP #B W	MP #B R	bloque actual buffer	buffer H/M	bloque prefetch buffer
R	B12B	2C4	B1	0	M	0	128	–	M	
R	B145	2C5	B1	1	M	0	64	2C5	H	
R	B1AF	2C6	B1	2	M	64	64	2C6	H	
R	B1C4	2C7	B1	3	M	64	64	2C7	H	
W	4387	10E	43	2	H	0	0	2C8	?	? NO HAY?
R	1108	044	11	0	M	64	128	2C8	F	
W	1199	046	11	2	M	0	128	045	F	
R	11AA	046	11	2	H	0	0	047	?	?

MARTÍ PALOMARES PERERA

(41)

AC Problemas Sesión 9

(3.18) a) $T_{exe} = N \cdot CPI_{ideal} \cdot T_C = 5 \cdot 10^9 \cdot 1,8 \cdot 10 \cdot 10^{-9} = \boxed{90s}$

$T_C = 10ns$

P { $N = 5 \cdot 10^9$ inst. ; $t_{am} = 1c$. ; $CPI_{ideal} = 1,8$ u.

b) accessos a L1 = $\boxed{5 \cdot 10^9 \text{ accessos}}$

c) $T_{pene} = (\text{sumar}) = \boxed{13c}$

d) $t_{mam} = t_h + m \cdot t_{pf} = 1 + 0,1 \cdot 13 = 2,3$ cicles

$t_{mam(s)} = 2,3c \cdot \frac{10ns}{1c} = \boxed{23ns}$

e) $CPI_{TOT} = CPI_{ideal} + CPI_{MEM} = 1,8 + 0,1 \cdot 13 = \boxed{3,1 c/i}$

CPI ?

f) $t_{exe(s)} = N \cdot CPI \cdot t_C = 5 \cdot 10^9 \cdot 3,1 \cdot 10 \cdot 10^{-9} = \boxed{155s}$

g) L2 { m = 0,3 ; 32B/bk.

$\frac{L1}{0,1} \cdot \frac{L2}{0,7} = 0,07 = \boxed{7\%}$

f) Speedup = $\frac{3,1}{2,2} = \boxed{1,359}$

h) $\frac{L1}{0,1} \cdot \frac{L2}{0,3} = 0,03 = \boxed{3\%}$

i) $t_{pene} = (\text{sumar}) = \boxed{5 \text{ cicles}}$

j) $t_{pf} = (\text{sumar}) = \boxed{16 \text{ cicles}}$

K) $t_{mam} = t_h + m_{L1} \cdot t_{pf_{L1}} + m_{L2} \cdot t_{pf_{L2}} = 1 + 0,1 \cdot 0,3 \cdot 16 = \boxed{1,48c}$

$t_{mam(s)} = 1,48c \cdot \frac{10ns}{1c} = \boxed{14,8ns}$ $1,48 \cdot 10_{ns} = \boxed{14,8ns}$

e) $CPI_{TOT} = CPI_{ideal} + CPI_{MEM} = 1,8 + 0,1 \cdot 0,3 \cdot 16 = \boxed{3,28 c/i}$