Problemas Tema 4

Problema 1. Discos, Ancho de banda, RAIDs

a) $t = \frac{\left(5000 \text{ sectores} * 512 \frac{\text{bytes}}{\text{sector}}\right) * 10^{-6}\text{Mbytes}}{256 \text{ Mbytes/s}} = \frac{2.56 \text{ Mbytes}}{256 \text{ Mbytes/s}} = 0.01 \text{ s} = 10 \text{ ms}$

b) $t = t \text{ bloque} + t \text{ seek} + t \text{ latencia} = 10 + 8 + 2 = 20 \text{ ms}$

c) Ancho de banda $= \frac{2.56 \text{ Mbytes}}{20 * 10^{-3} \text{ s}} = 128 \text{ Mbytes/s}$

d) $t \text{ total} = t \text{ fase } 1 + t \text{ fase } 2 + t \text{ fase } 3$

$t \text{ total} = 8 * 20 + 0.4 * t \text{ total} + 4 * 20 \Longrightarrow t \text{ total} = 400 \text{ ms}; \; t \text{ fase } 2 = 160 \text{ ms}$

e) Ancho de banda $= \frac{2.56 * 8 \text{ Mbytes}}{20 * 10^{-3} \text{ s}} = 1024 \text{ Mbytes/s}$

f) Ancho de banda $= \frac{2.56 * 4 \text{ Mbytes}}{20 * 10^{-3} \text{ s}} = 512 \text{ Mbytes/s}$

g) Speedup fase $1 = \frac{160}{20} = 8 \; (700\%)$

h) Speedup fase $3 = \frac{80}{20} = 4 \; (300\%)$

i) Speedup aplicación $= \frac{400}{200} = 2 \; (100\%)$

Problema 2. RAIDS, ancho de banda

a) RAID 6: $(60 - 2)$ discos $* 300$ GBytes $= 17400$ GBytes

RAID 10: $(60/2)$ discos $* 300$ GBytes $= 9000$ GBytes

RAID 50: $(9 * 6)$ discos $* 300$ GBytes $= 16200$ GBytes

RAID 51: $(60/2 - 1)$ discos $* 300$ GBytes $= 8700$ GBytes

b) $100 \text{ Mbytes/s} * 60 \text{ discos} = 6000 \text{ Mbytes/s} = 6 \text{ GB/s}$

c) 6 GB/s

d) RAID 6: $100 \text{ Mbytes/s} * 58 \text{ discos} = 5800 \text{ Mbytes/s}$

RAID 10: $100 \text{ Mbytes/s} * 30 \text{ discos} = 3000 \text{ Mbytes/s}$

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RAID 50: $100\ \text{Mbytes/s} * 54\ \text{discos} = 5400\ \text{Mbytes/s}$

RAID 51: $100\ \text{Mbytes/s} * 29\ \text{discos} = 2900\ \text{Mbytes/s}$

e) RAID 6: $100\ \text{Mbytes/s} * (60/6)\ \text{discos} = 1000\ \text{Mbytes/s} = 1\ \text{GB/s}$

RAID 10: $100\ \text{Mbytes/s} * (60/2)\ \text{discos} = 3000\ \text{Mbytes/s} = 3\ \text{GB/s}$

RAID 50: $100\ \text{Mbytes/s} * (60/4)\ \text{discos} = 1500\ \text{Mbytes/s} = 1.5\ \text{GB/s}$

RAID 51: $100\ \text{Mbytes/s} * ((60/4)/2)\ \text{discos} = 750\ \text{Mbytes/s} = 0.75\ \text{GB/s}$

Problemas Tema 5

Problema 1. Tipos de máquinas

a)
```
push D
push C
sub
push B
push A
sub
div
push C
sub
pop R
```

b)
```
load A
sub B
store R
load C
sub D
store tmp
load R
div tmp
store R
load C
sub R
store R
```

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Problema 2. RISC-CISC

(5.2)

a) $10^9 \times 0.3 + 2\,(10^9 \times 0.1) = 5 \cdot 10^8$ accesos

b) $T_{exe} = \dfrac{N \times CPI}{f} \Rightarrow f = \dfrac{10^9 \times 2.5}{2.5} = 1$ GHz

c) (?)

d) $f = \dfrac{1.75 \cdot 10^9 \times 1.2}{2.5} = 8.4 \cdot 10^8$ Hz $= 0.84$ GHz

e) CISC → $I_{de\ fuga} = 10$ A; $C = 50$ nF

$P_{de\ fuga} = 10\ A \times 1\ V = 10\ W$

$P_{conmutación} = 50 \cdot 10^{-9}\ F \times (1\ V)^2 \times 10^9\ Hz = 50\ W$

$P_{TOTAL} = 60\ W$

$E = P \times t = 60\ W \times 2.5\ s = 150\ J$

RISC → $I_{de\ fuga} = 8$ A; $C = 40$ nF

$P_{de\ fuga} = 8\ A \times 1\ V = 8\ W$

$P_{conmutación} = 40 \cdot 10^{-9}\ F \times (1\ V)^2 \times 8.4 \cdot 10^8\ Hz = 33.6\ W$

$P_{TOTAL} = 41.6\ W$

$E = P \times t = 41.6\ W \times 2.5\ s = 104\ J$

f) $ganancia = \dfrac{150\ J}{104\ J} = 1.44$ (44.23 %)

g) $f = \dfrac{1.5 \cdot 10^9 \times 1.3}{2.5} = 0.78$ GHz

h) $P_{TOTAL} = 8\ W + (40 \cdot 10^{-9}\ F \times (1\ V)^2 \times 7.8 \cdot 10^8\ Hz)\ W = 39.2\ W$

$E = P \times t = 39.2\ W \times 2.5\ s = 98\ J$

$ganancia = \dfrac{150\ J}{98\ J} = 1.53$ (53.06 %)

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Problema 3. Microoperaciones

5.3

a)

```
        movl  %ecx <- $0
loop:   cmpl  %ecx - $1.000.000
        jge   fin
load %eax <- x ->  load  %r1 <- V[%ecx * 4]
        imull %eax <- %eax * %r1
        load  %r2 <- suma
        addl  %r2 <- %r2 + %eax
        store suma <- %r2
        addl  %ecx <- %ecx + $1
        jmp   loop
fin:
```

b) instr. dinámicas = $1.000.000 \times 7 + 1 = 7.000.001$

vops dinámicas = $1.000.000 \times 10 + 1 = 10.000.001$

c) $1.3 \frac{vops}{ciclo} \Rightarrow \frac{1}{1.3} \frac{ciclos}{vop} \Rightarrow \frac{1}{1.3} \frac{ciclos}{vop} \times 10.000.001\ vops =$

$= 7692309$ ciclos

$CPI = \frac{ciclos}{instr.} = \frac{7692309}{7000001} = 1.0989$ c/i

d) $T_{exe} = \frac{N \times CPI}{f} = \frac{7000001 \times 1.0989}{3 \cdot 10^9} = 2.56 \cdot 10^{-3}$ s

e) Tamaño vops = $6 \times 11 = 66$ bytes

Tamaño código x86 = 44 bytes

- movl : 1 + 1 + 4 ✓
- cmpl : 1 + 1 + 4 ✓
- jge : 1 + 4 ✓
- movl : 1 + 1 + 1 + 4 ✓
- imull : 1 + 1 + 4 + 1 ✓
- addl : 1 + 1 + 1 + 4 ✓
- incl : 1 ✓
- jmp : 1 + 4 ✓

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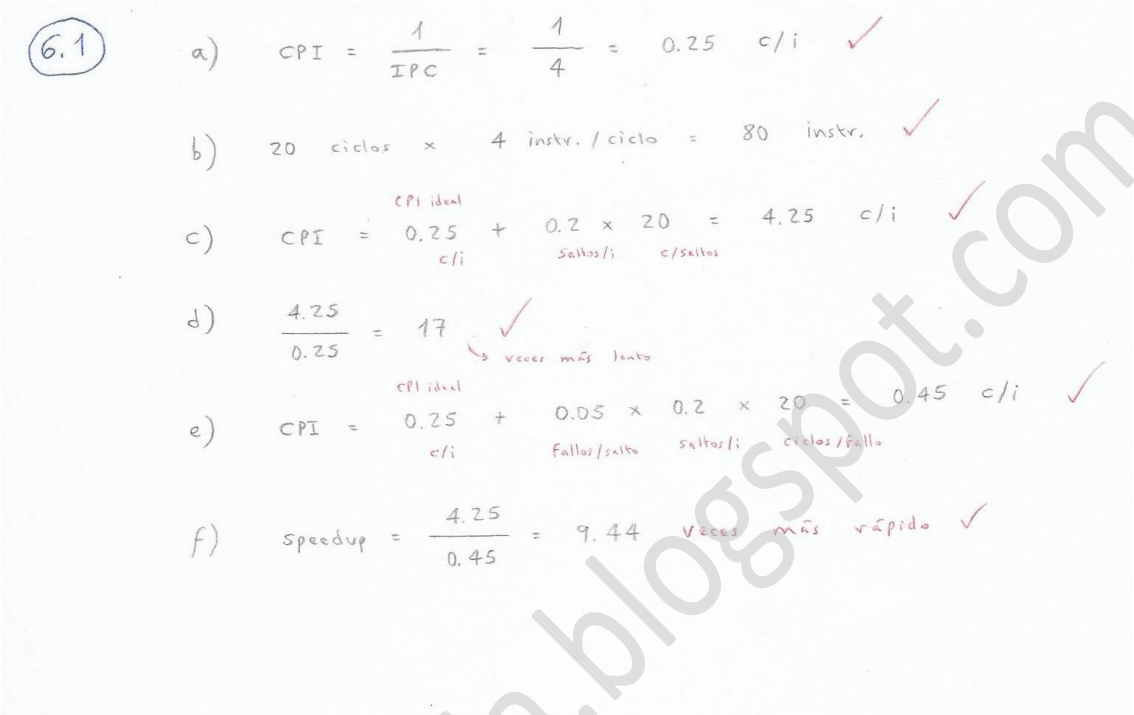
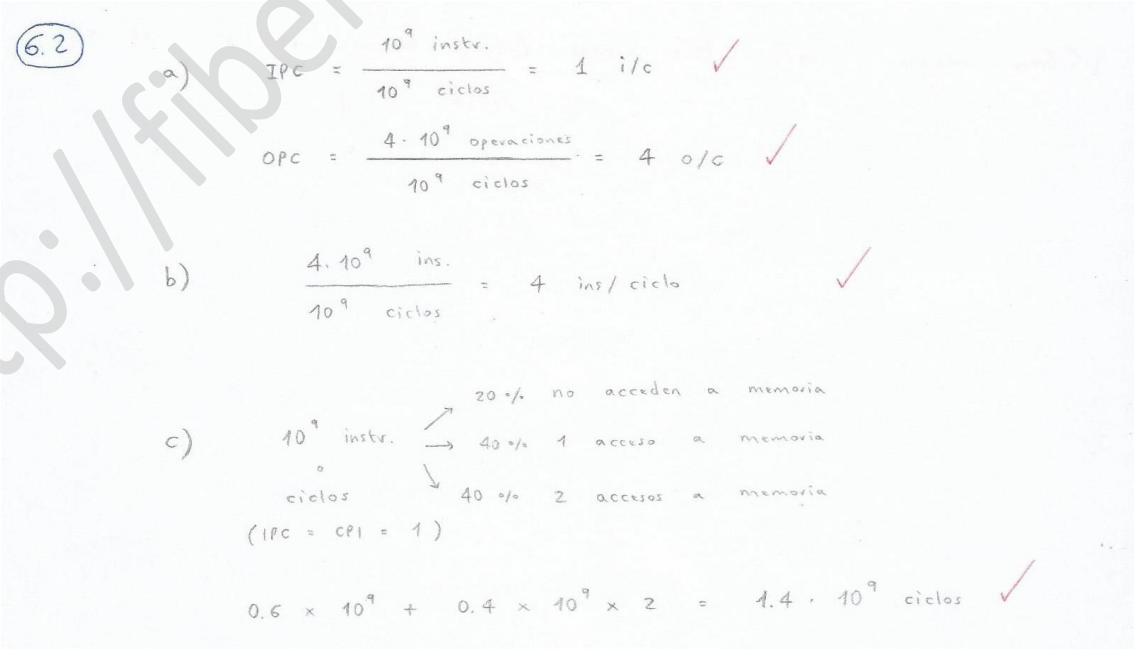
Problemas Tema 6

Problema 1. Segmentación, riesgos de control



Problema 2. VLIW, Jerarquía de memoria



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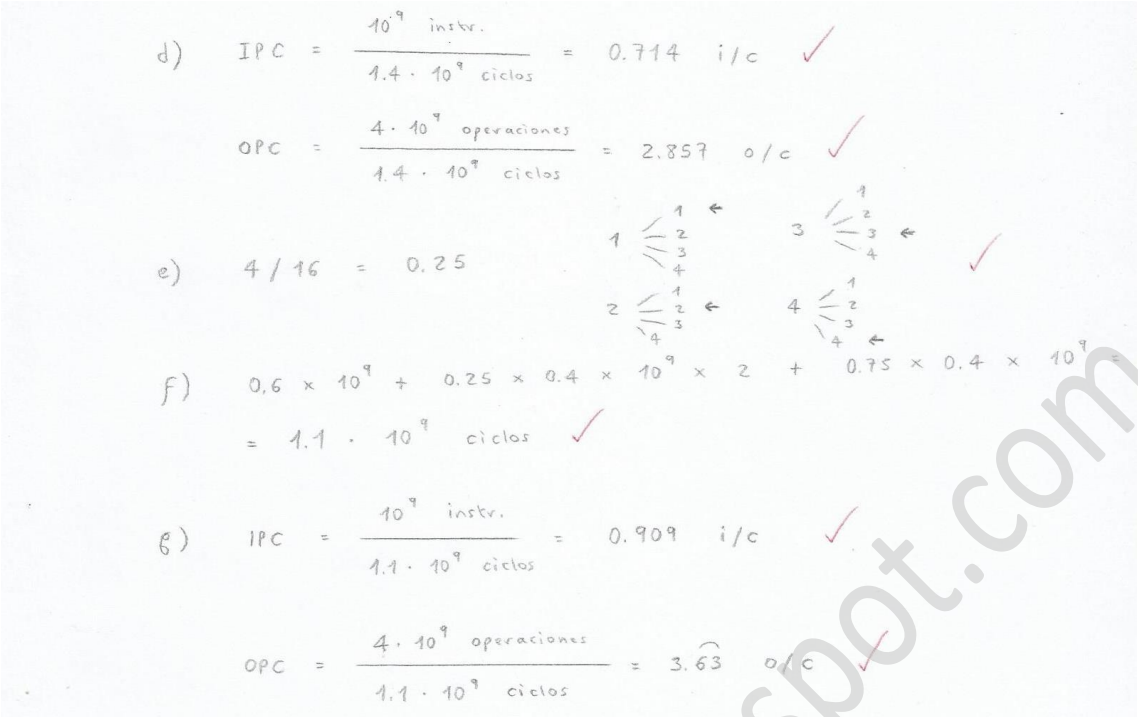

Problema 3.

a) Ganancia máxima $= \frac{200}{0.05 * 200 + 0.1 * 200} = \frac{200}{30} = 6.67$

b) $t(N) = 30 + \frac{170}{N} + N$

c) $0 = 30 + \frac{170}{N} + N \xrightarrow[\text{derivamos}]{} 0 = 1 - \frac{170}{N^2} \Longrightarrow N = \sqrt{170} = 13$ procesadores

d) Ganancia $= \frac{200}{30 + 26} = 3.57$

e) Ganancia $= \frac{200}{180 + \frac{20}{10}} = 1.1$

f) 5 horas

g) Ganancia $= \frac{200}{10 + 26 + 5} = 4.88$

h) $MIPS = \frac{648 * 10^{13}}{10^6 * 200 * 3600} = 9000$ $\quad MFLOPS = \frac{72 * 10^{13}}{10^6 * 200 * 3600} = 1000$

i) $MIPS = \frac{648 * 10^{13} + 13 * 10^{13}}{10^6 * (10 + 26 + 5) * 3600} = 44783$ $\quad MFLOPS = \frac{72 * 10^{13}}{10^6 * (10 + 26 + 5) * 3600} = 4878$

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j) PC : $\frac{1000\ \text{MFLOPS}}{120\ \text{W}} = 8.33\ \text{MFLOPS/W}$

Supercomputador : $\frac{4878\ \text{MFLOPS}}{(30 * 10 + 13 * 90)\ \text{W}} = 3.32\ \text{MFLOPS/W}$

k) $\frac{4878\ \text{MFLOPS}}{\left(\frac{90*13*26}{41} + \frac{90*1*15}{41} + \frac{30*10*5}{41}\right)\text{W}} = 6\ \text{MFLOPS/W}$

Ganancia $= \frac{6}{3.32} = 1.81$

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