① $F = 100\ MHz = 100 \cdot 10^6\ Hz$

$$MIPS = \frac{N^{o}I\ (\text{millones})}{T_{cpu}} = \frac{F}{CPI\ (\text{millones})} \qquad CPI_m = \frac{\sum (CPI_i \cdot N^{o}I_i)}{N^{o}I_T}$$

$$CPI_{m(1)} = \frac{(1 \cdot 5 + 2 \cdot 1 + 3 \cdot 1) \cdot 10^6}{5 + 1 + 1} = 1,42 \cdot 10^6 \qquad CPI_{m(2)} = \frac{(1 \cdot 10 + 2 \cdot 1 + 3 \cdot 1) \cdot 10^6}{10 + 1 + 1} = 1,25 \cdot 10^6$$

$$MIPS_{(1)} = \frac{100 \cdot \cancel{10^6}}{1,42 \cdot \cancel{10^6}} = 70\ mips \qquad MIPS_{(2)} = \frac{100 \cdot \cancel{10^6}}{1,25 \cdot \cancel{10^6}} = 80\ mips$$

Como $MIPS_{(1)} < MIPS_{(2)}$, el compilador 2 presenta un mejor rendimiento en MIPS.

$$T_{cpu} = \frac{N^{o}I \cdot CPI}{F}$$

$$T_{cpu(1)} = \frac{7 \cdot 1,42 \cdot \cancel{10^6}}{100 \cdot \cancel{10^6}} = 0,1\ seg \qquad T_{cpu(2)} = \frac{12 \cdot 1,25 \cdot \cancel{10^6}}{100 \cdot \cancel{10^6}} = 0,15\ seg$$

Como $T_{cpu(1)} < T_{cpu(2)}$, el compilador 1 presenta un mejor rendimiento en T_{cpu}.

2

$T_{CPU\,(viejo)} = 100$ seg, $F_m = 80\,\% = 0{,}8$, $S = 5$

$$S = \frac{1}{\frac{F_m}{S_m} + (1 - F_m)}$$

$$5 = \frac{1}{\frac{0{,}8}{S_m} + 0{,}2} \rightarrow 5\,\frac{0{,}8}{S_m} + 1 = 1 \rightarrow 5 \cdot 0{,}8 = 0 \cdot S_m$$

$\boxed{\text{Como no puede despejarse } S_m\text{, no es posible realizar la mejora.}}$

Ya que $S_m \geqslant 1$, la mejora S máxima ideal se logra con $S = \infty$, por tanto:

$$S_{máx} = \frac{1}{\frac{0{,}8}{\infty} + (1 - 0{,}8)} = \frac{1}{1 - 0{,}8} = \frac{1}{0{,}2} = 5$$

Como $S_{máx} = 5$, la mejora resulta $0 \leqslant S < 5$.

3

$$\left.\begin{array}{l} P1: \text{ Tipo de instrucciones } \{\underset{(1)}{A}, \underset{(2)}{B}, \underset{(3)}{C}, \underset{(4)}{D}\},\ 50\,MHz. \\ P2: \text{ Tipo de instrucciones } \{\underset{(3)}{A}, \underset{(5)}{B}, \underset{(5)}{C}, \underset{(7)}{D}\},\ 75\,MHz \end{array}\right\} N^{o}I_x = cte, \quad x \in \{A, B, C, D\}$$

$$MIPS = \frac{N^{o}I\ (\text{millones})}{T_{cpu}} = \frac{F}{CPI \cdot 10^6}$$

$$CPI = \sum_{i=1}^{4} \frac{N^{o}I_i \cdot CPI_i}{4}$$

$$\begin{cases} CPI_1 = \dfrac{n\cdot 1 + n\cdot 2 + n\cdot 3 + n\cdot 4}{4} = 2{,}5n \\ MIPS_1 = \dfrac{50 \cdot 10^6\ (Hz)}{2{,}5n \cdot 10^6} = 20n \end{cases}$$

$n :=$ Número de instrucciones

$$\begin{cases} CPI_2 = \dfrac{n\cdot 3 + n\cdot 5 + n\cdot 5 + n\cdot 7}{4} = 5n \\ MIPS_2 = \dfrac{75 \cdot 10^6\ (Hz)}{5n \cdot 10^6} = 15n \end{cases}$$

Como el NºI es constante, la medida de MIPS es fiable y, por tanto, el mejor rendimiento es el del P1: porque $MIPS_1 \geqslant MIPS_2$.

4

$T_{CPU(viejo)} = 10$ (seg), $F_m = 50\% = 0{,}5$, $S_m = 5$.

$$S = \frac{T_{CPU(viejo)}}{T_{CPU(nuevo)}} = \frac{1}{\frac{F_m}{S_m} + (1 - F_m)} \rightarrow S = \frac{1}{\frac{0{,}5}{5} - 0{,}5} = \frac{1}{0{,}6} = 1{,}\widehat{6}$$

$$1{,}\widehat{6} = \frac{10}{T_{CPU(nuevo)}} \rightarrow T_{CPU(nuevo)} = \frac{10}{1{,}\widehat{6}} = 6 \text{ (seg)}$$

Gana una mejora del 60%, pasando de 10 seg a tardar 6 seg mejorando la ejecución 4 seg.

5

$$F_m = \frac{5 \cdot 7}{5 \cdot 20} = 0{,}35 \,, \quad T_{cpu\,(v)} = 150 \text{ mseg} \,, \quad S_m = \frac{1}{1 - 0{,}20} = 1{,}25$$

$$S = \frac{T_{cpu\,(v)}}{T_{cpu\,(n)}} = \frac{1}{\frac{F_m}{S_m} + (1 - F_m)} \rightarrow$$

$$\frac{150}{T_{cpu\,(n)}} = \frac{1}{\frac{0{,}35}{1{,}25} + 0{,}65} \rightarrow T_{cpu\,(n)} = 150\left(\frac{0{,}35}{1{,}25} + 0{,}65\right) = 139{,}5 \text{ mseg}$$

$$\boxed{T_{cpu\,(nuevo)} = 139{,}5 \text{ mseg}}$$

6 $S = \dfrac{T_{cpu}}{\frac{T_{cpu}}{2}} = 2$, $S_m = 10$

$$S = \frac{1}{\frac{F_m}{S_m} + (1 - F_m)} \longrightarrow 2 = \frac{1}{\frac{F_m}{10} + (1 - F_m)} \rightarrow \frac{1}{5} F_m + 2 - 2F_m = 1 \rightarrow$$

$$\rightarrow 2F_m - \frac{1}{5} F_m = 2 - 1 \rightarrow \frac{9}{5} F_m = 1 \rightarrow F_m = \frac{5}{9} = 0,\widehat{5} = 55,\widehat{5}\,\%$$

$\boxed{\text{El porcentaje mínimo es } 55,5\,\%.}$

7

F_M, $F_S = 2F_M$, $T_{cpu_M} = 8{,}6 \cdot 10^{-3}$ (seg), $T_{cpu_S} = 4{,}1 \cdot 10^{-3}$ (seg), $N^o I_M = N^o I_S$

$$T_{cpu} = \frac{N^o I \cdot CPI}{F} \rightarrow CPI = \frac{T_{cpu} \cdot F}{N^o I}$$

$$CPI_M = \frac{8{,}6 \cdot 10^{-3} \cdot F_M}{N^o I} \qquad CPI_S = \frac{4{,}1 \cdot 10^{-3} \cdot 2F_M}{N^o I}$$

$$\text{Mejora} = \frac{CPI_M}{CPI_S} = \frac{\dfrac{8{,}6 \cdot 10^{-3} \cdot \cancel{F_M}}{\cancel{N^o I}}}{\dfrac{8{,}2 \cdot 10^{-3} \cdot \cancel{F_M}}{\cancel{N^o I}}} = \frac{8{,}6}{8{,}2} = 1{,}04$$

$$\boxed{CPI_M = 1{,}04 \cdot CPI_S}$$

$S_m = \dfrac{5 \text{ (antiguo)}}{3 \text{ (nuevo)}}$, $T_{cpu_{(nuevo)}} = 3{,}8$ (ms), $T_{cpu_S} = T_{cpu_{(viejo)}} = 4{,}1$ (ms)

$$S = \frac{T_{cpu(viejo)}}{T_{cpu(nuevo)}} = \frac{4{,}1}{3{,}8} = 1{,}078$$

$$S = \frac{1}{\frac{F_m}{S_m} + (1 - F_m)} \rightarrow 1{,}078 = \frac{1}{\frac{3F_m}{5} + (1 - F_m)} \rightarrow \boxed{F_m = 0{,}18 = 18\%}$$

$$F_m = \frac{T_{sub\text{-}MOV}}{T_{cpu}} = \frac{\dfrac{N^o I_{MOV} \cdot CPI_{MOV}}{\cancel{F}}}{\dfrac{N^o I \cdot CPI}{\cancel{F}}} = \frac{N^o I_{MOV} \cdot 5}{N^o I \cdot CPI} \rightarrow \frac{N^o I_{MOV}}{N^o I} = \frac{0{,}18 \cdot 5}{CPI}$$

% MOV que hay (piden)

Como falta CPI, no hay datos suficientes y resulta imposible saber el porcentaje de instrucciones MOV.

8

$Fm_{RAM} = 80\% = 0,8$, $Sm_{RAM} = 1,75$, $Fm_{DISK} = 60\% = 0,6$, $Sm_{DISK} = 3$

$$S = \frac{1}{\frac{Fm}{Sm} + (1 - Fm)}$$

$$S_{RAM} = \frac{1}{\frac{0,8}{1,75} + (1 - 0,8)} = 1,52 \rightarrow \text{Mejora un } 152\%.$$

$$S_{DISK} = \frac{1}{\frac{0,6}{3} + (1 - 0,6)} = 1,\hat{6} \rightarrow \text{Mejora un } 166\%.$$

Como $S_{RAM} < S_{DISK}$, recomendaría la mejora del disco duro.

(9)

$F_{(1)} = 1{,}8\ GHz = 1{,}8 \cdot 10^{9}\ Hz$, $CPI_{(1)} = 3$, $T_{cpu\,(1)} = 150\ ms = 150 \cdot 10^{-3}\ seg$

$F_{(2)} = \frac{1}{CC} = \frac{1}{0{,}3 \cdot 10^{-9}} = 3{,}\hat{3} \cdot 10^{-9}$, $T_{cpu\,(2)} = 100\ ms = 100 \cdot 10^{-3}\ seg$

a) Como se ha usado el mismo programa, $N^oI_{(1)} = N^oI_{(2)} = cte$.

$$S = \frac{T_{cpu\,(1)}}{T_{cpu\,(2)}} = \frac{150 \cdot \cancel{10^{-3}}}{100 \cdot \cancel{10^{-3}}} = 1{,}5$$

$$S = \frac{T_{cpu\,(1)}}{T_{cpu\,(2)}} \rightarrow T_{cpu\,(2)} \cdot S = T_{cpu\,(1)}$$

$$\left(\frac{CPI_{(2)} \cdot \cancel{N^oI_{(2)}}}{F_{(2)}}\right) \cdot S = \frac{CPI_{(1)} \cdot \cancel{N^oI_{(1)}}}{F_{(1)}} \rightarrow 1{,}5\left(\frac{CPI_{(2)}}{3{,}\hat{3} \cdot 10^{-9}}\right) = \frac{3}{1{,}8 \cdot 10^{9}} \rightarrow$$

$$\rightarrow CPI_{(2)} = \frac{1{,}\hat{6} \cdot 10^{9} \cdot 3{,}\hat{3} \cdot 10^{-9}}{1{,}5} = \frac{5{,}\hat{5}}{1{,}5} = 3{,}\overset{\frown}{703}$$

$$\boxed{CPI_{(2)} = 3{,}\overset{\frown}{703}}$$

b)

IV: Las afirmaciones anteriores son falsas.

(11)

•

•

$Sm_{(viejo)} = 2, \quad Fm_{(viejo)} = 0,1 \; ; \; Sm_{(nuevo)} = 2 - (2 \cdot 0,25) = 1,5$

$$S = \frac{1}{\frac{Fm_{(v)}}{Sm_{(v)}} + (1 - Fm_{(v)})} = \frac{1}{\frac{0,1}{2} + 0,9} = \frac{1}{\frac{1,9}{2}} = \frac{2}{1,9} = 1,05$$

Como S se mantiene:
$$S = \frac{1}{\frac{Fm_{(v)}}{Sm_{(v)}} + (1 - Fm_{(v)})} = \frac{1}{\frac{Fm_{(n)}}{Sm_{(n)}} + (1 - Fm_{(n)})}$$

$$1,05 = \frac{1}{\frac{Fm_{(n)}}{1,5} + (1 - Fm_{(n)})} = \frac{1,5}{Fm_{(n)} + 1,5(1 - Fm_{(n)})}$$

$$1,05\left(Fm_{(n)} + 1,5 - 1,5\,Fm_{(n)}\right) = 1,5 \rightarrow 1,05\,Fm_{(n)} + 1,575 - 1,575\,Fm_{(n)} = 1,5 \rightarrow$$

$$\rightarrow -0,525\,Fm_{(n)} = -0,075 \rightarrow Fm_{(n)} = 0,143$$

$$\boxed{Fm_{(n)} = 0,143}$$

(12)

$N^{o}I = 10 \quad , \quad CPI_{(viejo)} = 5 \quad , \quad CPI_{(NUEVO)} = 3$

$$T_{cpu\,(viejo)} = \frac{10 \cdot 5}{F} = \frac{50}{F} \qquad T_{cpu\,(nuevo)} = \frac{(9 \cdot 5 + 1 \cdot 3)}{F} = \frac{48}{F}$$

$$S = \frac{T_{cpu\,(viejo)}}{T_{cpu\,(nuevo)}} = \frac{\frac{50}{F}}{\frac{48}{F}} = \frac{50}{48} = 1{,}04$$

$$1{,}04 = \frac{\frac{10 \cdot 5}{F}}{\frac{10 \cdot CPI}{F}} = \frac{5}{CPI} \rightarrow \quad CPI = \frac{5}{1{,}04} = 4{,}8$$

$$\boxed{CPI_{(nuevo)} = 4{,}8}$$

(13)

$T_{cpu_{(viejo)}} = 35$ (seg), $T_{cpu_{(nuevo)}} = T_{cpu\,(viejo)} - 10 = 25$ (seg), $F_m = 40\% = 0{,}4$,

$S_m = \frac{?}{2} \rightarrow$ ¿CPI_{PF}?

$$S = \frac{T_{cpu\,(viejo)}}{T_{cpu\,(nuevo)}} = \frac{1}{\frac{F_m}{S_m} + (1 - F_m)} = \frac{35}{25} = 1{,}4$$

$$1{,}4 = \frac{1}{\frac{0{,}4}{S_m} + 0{,}6} \rightarrow \frac{0{,}4}{S_m} + 0{,}6 = \frac{1}{1{,}4}$$

$$\frac{0{,}4}{S_m} = \frac{1}{1{,}4} - 0{,}6 \rightarrow S_m = \frac{0{,}4}{\frac{1}{1{,}4} - 0{,}6} = 3{,}5$$

$$S_m = \frac{T_{sub-PF}}{T_{sub-PF}'} = \frac{N^{\underline{o}}I_{PF} \cdot CPI_{PF} \cdot \frac{1}{F}}{N^{\underline{o}}I_{PF} \cdot CPI_{PF}' \cdot \frac{1}{F}} = \frac{CPI_{PF}}{CPI_{PF} - 2} = 3{,}5$$

$$(CPI_{PF}' = CPI_{PF} - 2)$$

$$S_m = \frac{CPI_{PF}}{CPI_{PF} - 2} \rightarrow S_m\,(CPI_{PF} - 2) = CPI_{PF} \rightarrow$$

$$\rightarrow 3{,}5 \cdot CPI_{PF} - 7 = CPI_{PF} \rightarrow CPI_{PF} = \frac{7}{2{,}5} = 2{,}8$$

$$\boxed{CPI_{PF} = 2{,}8}$$

(14) $T_{cpu\,(nuevo)} = \frac{T_{cpu\,(viejo)}}{2}$, $N^{o}I_{CPU} = 500$, $F_m = \frac{3}{5}$, $F = cte$

a) $$S = \frac{T_{cpu\,(viejo)}}{T_{cpu\,(nuevo)}} = \frac{T_{cpu\,(viejo)}}{\frac{T_{cpu\,(viejo)}}{2}} \rightarrow S = \frac{2 \cdot \cancel{T_{cpu\,(viejo)}}}{\cancel{T_{cpu\,(viejo)}}} = 2$$

$$S = \frac{1}{\frac{F_m}{S_m} + (1 - F_m)} \rightarrow 2 = \frac{1}{\frac{\frac{3}{5}}{S_m} + \left(1 - \frac{3}{5}\right)} \rightarrow$$

$$\rightarrow 2\,\frac{\frac{3}{5}}{S_m} + 2\,\frac{2}{5} = 1 \rightarrow \frac{\frac{6}{5}}{S_m} = 1 - \frac{4}{5} \rightarrow S_m = \frac{\frac{6}{5}}{\frac{1}{5}} = \frac{30}{5} = 6$$

$$\boxed{S_m = 6}$$

b) ~~No, porque aunque el CPI_m variaría el $T_{cpu\,(viejo)}$, se especifica que con el nuevo procesador~~ $\cancel{T_{cpu(nuevo)} = \frac{T_{cpu(viejo)}}{2}}$, ~~por lo que S seguiría con el mismo valor y produciría el mismo Sm.~~ Sí, porque el Fm se vería afectado, ya que:

$$F_m = \frac{T_{cpu\,(ALU)}}{T_{cpu}} = \frac{N^{o}I_{ALU} \cdot CPI_{ALU} \cdot \frac{1}{F}}{N^{o}I_T \cdot CPI_T \cdot \frac{1}{F}} = \frac{N^{o}I_{ALU} \cdot CPI_{ALU}}{N^{o}I_T \cdot CPI_T}$$

c) $T_{cpu\,(viejo)} = 260$ nseg $= 260 \cdot 10^{-9}$ seg

$$S = \frac{T_{cpu\,(viejo)}}{T_{cpu\,(nuevo)}} \rightarrow T_{cpu\,(nuevo)} = \frac{260 \cdot 10^{-9}}{2} = 130 \cdot 10^{-9} \text{ seg}$$

$$MIPS = \frac{N^{o}I \text{ (millones)}}{T_{cpu\,(nuevo)}} = \frac{500 \cdot 10^{-6}}{130 \cdot 10^{-9}} = 3846 \text{ mips}$$

$$\boxed{MIPS = 3846 \text{ mips}}$$