

1) Mem 40%, Sum 20%, I/O 20%, Mul 20%

$$a) S_u = \frac{1}{(1 \cdot 4) + \frac{4}{5}} = \frac{1}{.6 + .8} = \frac{100}{68} = 1.47$$

$$\Rightarrow 1.47 = S_u$$

$$b) S_u = \frac{1}{.8 + \frac{2}{20}} = \frac{1}{.8 + .1} = \frac{100}{81} = 1.23$$

c) 20% + 40% = 60%

$$\Rightarrow S_u = \frac{1}{.4 + \frac{6}{4}} = \frac{1}{.4 + 1.5} = \frac{1}{.55} = \frac{100}{55} = 1.81$$

d) 20% + 40% = 60%

$$\Rightarrow S_u = \frac{1}{.4 + \frac{6}{3}} = \frac{1}{.4 + 2} = \frac{10}{6} = 1.66$$

2)

IS	a	b	c
clocks	2	6	7

$$350 \begin{cases} 40\% \text{ a} \rightarrow 140 \text{ a} \\ 20\% \text{ b} \rightarrow 70 \text{ b} \\ 40\% \text{ c} \rightarrow 140 \text{ c} \end{cases}$$

$$\text{all clocks} = 140 \times 2 + 70 \times 6 + 140 \times 7 = 280 + 420 + 980 = 1680$$

$$\text{cpi} = \frac{1680}{350} = 4.8$$

$$\text{performance} = n \times \overline{\text{cpi}} \times \frac{1}{f}$$

$$f_1 = 1.3 \text{ MHz} \quad f_2 = 2.8 \text{ MHz}$$

$$P_1 = 350 \times 4.8 \times \frac{1}{1.3 \text{ M}} = \frac{16800}{13} \times 10^{-6}$$

$$= 1292.30 \times 10^{-6} = 1.2923 \times 10^{-3}$$

$$P_2 = 350 \times 4.8 \times \frac{1}{2.8 \text{ M}} = \frac{1680}{2.8} \times 10^{-6}$$

$$= 600 \times 10^{-6} = 6 \times 10^{-4} = 0.6 \times 10^{-3}$$

مقدار زمان اجرا با performance دوی از ادبی 'کد' کمتر و بهتر است

$$P_2 < P_1$$

c) $c \rightarrow 5$

$$\text{all clocks} = 280 + 420 + 140 \times 5 = 700 + 700 = 1400$$

$$\text{cpi} = \frac{1400}{350} = \underline{\underline{4}}$$

$$P'_1 = \frac{n \times \overline{\text{cpi}}}{1400} \times \frac{1}{1.5M} = 1076.923 \times 10^{-6}$$

$$= 1.076923 \times 10^{-3}$$

$$P'_2 = 1400 \times \frac{1}{2.8M} = 500 \times 10^{-6} = 0.5 \times 10^{-3}$$

$$\Rightarrow \frac{P'_1}{P_1} \times 100 = \frac{1.076 \times 10^{-3}}{1.292 \times 10^{-3}} \times 100 = 83$$

$$\frac{P'_2}{P_2} \times 100 = \frac{0.5 \times 10^{-3}}{0.6 \times 10^{-3}} \times 100 = 83$$

سرعت در هر دو یک مقدار افزایش یافته execution time در 80٪

قبل است.

3)

$$T = 175 \text{ ns}$$

$K = 7$ steps, $t = 30 \text{ ns}$ cycle

$$T_1 = \text{Total time w/o pipe line} = nT = 100 \times 175 \text{ ns} = \underline{17500 \text{ ns}}$$

$$T_2 = \text{Total time with pipeline} = (K + (N-1)) \times t$$

$$= (7 + 99) \times 30 \text{ ns} = 3180 \text{ ns}$$

$$\Rightarrow \frac{T_2}{T_1} = \frac{3180}{17500} \times 100 = 18.17$$

speedup

با 18.17 زمان اجرای پایپ لاین در دسترس است این دستور اجرا دار
(در 100 بار اجرا)

$$N \propto \frac{T}{t} \Rightarrow$$

$$\frac{T}{t} = \frac{175}{30} = \underline{5.83}$$

اگر تأخیر هر stage برابر باشد $\text{speedup} = K$ می شود.

$$\frac{T}{\frac{T}{K}} = K = 7$$