20181210 유정훈

1.7

1.7.1) clock cycle = CPI × IC

P1 time = $(1\times10^5 + 2\times2\times10^5 + 3\times5\times10^5 + 3\times2\times10^5) \times \frac{1}{2.5\times10^9 s}$

$= \frac{26\times10^5}{2.5\times10^9} = \frac{26}{25\times10^3} = 1.04\times10^{-5} s$

P2 time = $(2\times10^5 + 2\times2\times10^5 + 2\times5\times10^5 + 2\times2\times10^5) \times \frac{1}{3\times10^9 s}$

$= \frac{20\times10^5}{3\times10^9} = \frac{20}{3}\times10^{-4} s$

$\frac{200}{3} < 104$ P2 is faster

1.7.2) CPI (P1) = $\frac{26\times10^5}{10^6} = 2.6$

CPI (P2) = $\frac{20\times10^5}{10^6} = 2$

1.7.3) Clock cycle (P1) = 2.6×10^6

clock cycle (P2) = 2×10^6

1.9 $power = \frac{1}{2} C_{pload} \times V^2 \times F$

1.9.1) Pentium 4

$90(dynamic\ power) = \frac{1}{2} C_{pload} \times 1.25^2 \times 3.6 \times 10^9$

$180 = C_{pload} \times 1.5625 \times 3.6 \times 10^9$

$C_{pload} = \frac{180}{1.5625 \times 3.6 \times 10^9} = 3.2 \times 10^{-8} F$

Core i5

$40(dynamic\ power) = \frac{1}{2} C_{pload} \times 0.9^2 \times 3.4 \times 10^9$

$C_{pload} = \frac{80}{0.81 \cdot 3.4 \times 10^9}$

$= 2.904 \times 10^{-8} F$

1.9.2) Pentium 4 static : dynamic = 1 : 9 % of total dissipated power by static power $^{10}/_{100} = 10\%$

Core i5 static : dynamic = 3 : 4 $^{30}/_{70} = 42.857\%$

1.11 1.11.1) Find the yield for both wafers

$$\text{die area} = \frac{\text{wafer area}}{\text{dies per wafer}}$$

$$\text{yield} = \frac{1}{(1+(\text{defects} \times \frac{\text{die area}}{2}))^2}$$

$$75 \times 75 = 5625$$

$$15\text{cm wafer die area} = \frac{7.5^2\pi}{64} = \frac{5625}{64}\pi$$

$$15\text{cm wafer yield} = \frac{1}{(1+(\frac{2}{100} \times \frac{5625}{84}\pi))^2}$$

$$= \frac{1}{(1+\frac{0.5625\pi}{64})^2}$$

$$\approx 0.9593$$

$$30\text{ wafer die area} = \frac{10^2\pi}{100} = 10\pi$$

$$30\text{ wafer yield} = \frac{1}{(1+(\frac{31}{1000} \times 10\pi))^2}$$

$$\approx 0.9093$$

1.11.2) Find the cost per die for both wafers

$$\text{Cost per die} = \frac{\text{cost per wafer}}{\text{dies per wafer} \times \text{yield}}$$

$$15\text{cm cost per die} = \frac{12}{64 \times 0.9593}$$

$$= 0.1469$$

$$30\text{cm cost per die} = \frac{15}{100 \times 0.9093}$$

$$= 0.1649$$

1.12

$\frac{1}{\text{clock rate}}$

1.12.1 $\frac{\text{exe clock cycles}}{\text{exe time}} = \frac{\text{ref clock cycles}}{\text{ref time}}$

CPU time = IC × CPI × clock cycle time

$CPI = \text{clock cycles} \times \frac{1}{IC}$

$$\text{exe clock cycles} = \frac{9650\text{s}}{0.333\text{ns}} \times 750$$

$$= \frac{9650 \times 10^{9}\text{ns}}{0.333\text{ns}} \times 750$$

$$\approx 2.24 \times 10^{12}$$

$$CPI = \frac{2.24 \times 10^{12}}{2389 \times 10^{12}}$$

$$= 0.9376$$

1.12.2 $\text{SPEC ratio} = \frac{\text{ref time}}{\text{exe time}}$

$$= \frac{9650}{750}$$

$$= 12.8666$$

1.12.3 $\text{CPU time} = IC \times CPI \times \frac{1}{\text{clock rate}}$

$$= 1.1IC \times CPI \times \frac{1}{\text{clock rate}}$$

+ 10% in CPU time

1.12.4 $1.1 \cdot IC \cdot 1.05\,CPI \cdot \frac{1}{\text{clock rate}}$

$$= 1.155\,IC \cdot CPI \cdot \frac{1}{\text{clock rate}}$$

+15.5% in cpu time

1.12.5

$$\text{new SPEC ratio} = \frac{\text{ref cpu time (old)}}{\text{exe time (new)}}$$

$$= \frac{1}{1.155}$$

$$= 0.8658$$

SPEC ratio has decreased about 14%.

1.12.6

$$700s = \frac{85}{100} IC \cdot CPI \cdot \frac{1}{4 \cdot 10^9 hz}$$

$$700 \cdot 100 \cdot 4 \cdot 10^9 \cdot \frac{1}{85} = IC \cdot CPI$$

$IC \cdot CPI = 2.389 \times 10^{12}$

$$13.7 \text{ (SPEC ratio)} = \frac{\text{ref cpu time (old)}}{700s \text{ (new)}}$$

ref cpu time (old) = 9590s

$$70 \cdot 4 \cdot \frac{1}{85} = 2.389 \cdot CPI$$

$$CPI = 1.3768$$

1.14

1.14.1

$\text{cpu time}_{fp} = 70 \times \frac{8}{10} = 56s$

$\text{total cpu time}_{(\text{before})} = 70 + 85 + 55 + 40 = 250$

$\text{total cpu time}_{(\text{after})} = 56 + 85 + 55 + 40 = 236$

14s is reduced, $\frac{236}{250} = \frac{944}{1000}$ 5.6% reduced.

1.14.2

$\text{cpu time}_{\text{total}} = 250 \times \frac{8}{10} = 200s$

$\text{total cpu time}_{(\text{before})} = 250$

$INT\ (old) = 250 - 70 - 85 - 40 = 55$

$INT\ (new) = 200 - 70 - 85 - 40 = 5$

50s is reduced, 91% reduced.

1.14.3

goal : 200s

70 (FP) + 85 (LIS) + 55 (INT) + 0 (branch reduced to max) = 210s

No