COSE 222-01 (37) assignment 2

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1.2.1

(a)(1) 1byte (8bits) × 3 colors × 640 × 480 = 921,600 bytes

= 900KB ≈ 0.879MB

(2) 1byte × 3colors × 1280 × 1024 = 3,932,160bytes

= 3.75MB

(b)(1) 1byte × 3colors × 1024 × 768 = 2,359,296bytes

= 2.25MB

(2) 1byte × 3colors × 2560 × 1600 = 12,288,000bytes

= 12000KB ≈ 11.719MB

1.2.2

(a)(1) 2GB / 900KB ≈ 2330 (frame)

(2) 4GB / 3.75 MB ≈ 1092 (frame)

(b)(1) 2GB / 2.25MB ≈ 910 (frame)

(2) 4GB / 12000KB ≈ 349 (frame)

1.2.3

(a) (1) 256KB / 100Mbit $= \frac{256 \times 8 \times 1024}{100 \times 1000000} \approx$ 20.971ms

(2) 256KB / 1Gbit $= \frac{256 \times 8 \times 1024}{1000 \times 1000000} \approx$ 2.097 ms

(b) (1) 256KB / 100Mbit = 20.971ms

(2) 256KB / 1Gbit = 2.097 ms

1.3.1

(a) Instructions per second : $\frac{\text{Clock Rate (C/s)}}{\text{CPI (C/I)}}$

- P1 : $\frac{3GHz}{1.5} = 2 \times 10^9$ inst/s
- P2 : $\frac{2.5GHz}{1.0} = 2.5 \times 10^9$ inst/s
- P3 : $\frac{4GHz}{2.2} = 1.81 \times 10^9$ inst/s

P2 has highst performance

(b)

- P1 : $\frac{2GHz}{1.2} = 1.67 \times 10^9$ inst/s
- P2 : $\frac{3GHz}{0.8} = 3.75 \times 10^9$ inst/s
- P3 : $\frac{4GHz}{2.0} = 2 \times 10^9$ inst/s

P2 has highst performance

1.3.2

(a) P1 : $3GHz \times 10s = 30 \times 10^9$ clock cycles

$30G \times \frac{1}{1.5} = 20 \times 10^9$ insts

P2 : $2.5GHz \times 10s = 25 \times 10^9$ clock cycles

$25G \times \frac{1}{1.0} = 25 \times 10^9$ insts

P3 : $4GHz \times 10s = 40 \times 10^9$ clock cycles

$40G \times \frac{1}{2.2} = 18.18 \times 10^9$ insts

(b) P1 : $2GHz \times 10s = 20 \times 10^9$ clock cycles

$20G \times \frac{1}{1.2} = 16.67 \times 10^9$ insts

P2 : $3GHz \times 10s = 30 \times 10^9$ clock cycles

$30G \times \frac{1}{0.8} = 37.5 \times 10^9$ insts

P3 : $4GHz \times 10s = 40 \times 10^9$ clock cycles

$40G \times \frac{1}{2.0} = 20 \times 10^9$ insts

1.3.3

$$\text{CPU Time} = \frac{\#\text{ of inst} \times \text{CPI}}{\text{Clock Rate}}$$

CPU Time → 70%

CPI → 120%

$$k(\text{Clock Rate}) = \frac{\#\text{ of inst} \times 1.2 \times \text{CPI}}{0.7 \times \text{CPU Time}}, \quad k = \frac{1.2}{0.7} = 1.714$$

(Increase by 71.4%)

(a) P1 : $3\text{GHz} \times 1.714 \approx 5.14\text{GHz}$

P2 : $2.5\text{GHz} \times 1.714 \approx 4.29\text{GHz}$

P3 : $4\text{GHz} \times 1.714 \approx 6.86\text{GHz}$

(b) P1 : $2\text{GHz} \times 1.714 \approx 3.43\text{GHz}$

P2 : $3\text{GHz} \times 1.714 \approx 5.14\text{GHz}$

P3 : $4\text{GHz} \times 1.714 \approx 6.86\text{GHz}$

1.3.4

(a) $IPC = \frac{1}{CPI} = \frac{\#\ of\ inst}{Clock\ Rate \times CPU\ Time}$

P1: $\frac{20.00 \times 10^9}{3GHz \times 7s} \approx \underline{0.9524}$

P2: $\frac{30.00 \times 10^9}{2.5GHz \times 10s} = \underline{1.2}$

P3: $\frac{90 \times 10^9}{4GHz \times 9s} = \underline{2.5}$

(b) P1: $\frac{20 \times 10^9}{2GHz \times 5s} = \underline{2}$

P2: $\frac{30 \times 10^9}{3GHz \times 8s} = \underline{1.25}$

P3: $\frac{25 \times 10^9}{4GHz \times 7s} \approx \underline{0.893}$

1.3.5

(a) $CPI = \frac{\text{Clock Rate} \times \text{CPU Time}}{\#\ \text{of inst}} \approx 0.833$

$$\eta_s = \frac{30 \times 10^9 \times 0.833}{\text{ClockRate}'}, \quad \text{ClockRate}' = \frac{30 \times 10^9 \times 0.833}{\eta}$$

$$= 3.57\ \text{GHz}$$

(b) $CPI = 0.8$

$$5_s = \frac{30 \times 10^9 \times 0.8}{\text{ClockRate}'}, \quad \text{ClockRate}' = \frac{30 \times 10^9 \times 0.8}{5}$$

$$= 4.8\ \text{GHz}$$

1.3.6

(a) $CPI = 0.833$

$$9_s = \frac{\#\ \text{of inst}' \times 0.833}{2.5\text{GHz}}, \quad \#\ \text{of inst}' = \frac{9_s \times 2.5\text{GHz}}{0.833}$$

$$\approx 27.01\text{E+09}$$

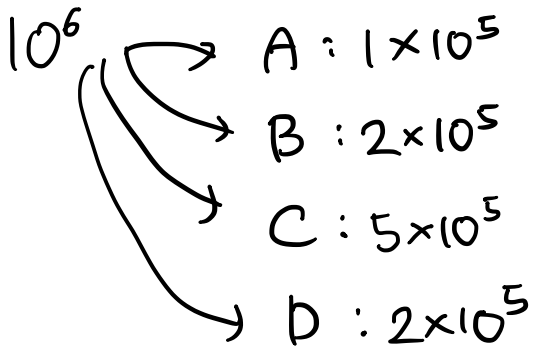
(b) $CPI = 0.8$

$$\eta_s = \frac{\#\ \text{of inst}' \times 0.8}{3\text{GHz}}, \quad \#\ \text{of inst}' = \frac{\eta_s \times 3\text{GHz}}{0.8}$$

$$= 26.25\text{E+09}$$

1.4.1

(a)




P1 : total cycle = $(1\times1 + 2\times2 + 3\times5 + 3\times2)\times10^5 = 26\times10^5$

$$\text{CPU Time} = \frac{26\times10^5}{2.5\text{GHz}} = 1.04\text{ms}$$

P2 : total cycle = $(2\times1 + 2\times2 + 2\times5 + 2\times2)\times10^5$

$$= 20\times10^5$$

$$\text{CPU Time} = \frac{20\times10^5}{3\text{GHz}} = 0.667\text{ms}$$

P2 is faster than P1

(b) P1 : total cycle = $(2\times1 + 1.5\times2 + 2\times5 + 1\times2)\times10^5$

$$= 17\times10^5$$

$$\text{CPU Time} = \frac{17\times10^5}{2.5\text{GHz}} = 0.68\text{ms}$$

P2 : total cycle = $(1\times1 + 2\times2 + 1\times5 + 1\times2)\times10^5$

$$= 12\times10^5$$

$$\text{CPU Time} = \frac{12\times10^5}{3\text{GHz}} = 0.4\text{ms}$$

P2 is faster than P1

1.4.2

(a) P1 : total CPI $= \frac{\text{clock cycles}}{\text{total inst}} = \frac{26 \times 10^5}{10^6} = 2.6$

P2 : total CPI $= \frac{20 \times 10^5}{10^6} = 2$

(b) P1 : total CPI $= \frac{17 \times 10^5}{10^6} = 1.7$

P2 : total CPI $= \frac{12 \times 10^5}{10^6} = 1.2$

1.4.3

(a) P1 : clock cycle $= 26 \times 10^5$

P2 : clock cycle $= 20 \times 10^5$

(b) P1 : clock cycle $= 17 \times 10^5$

P2 : clock cycle $= 12 \times 10^5$