Problem Set 1

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1.2)

(a) **Performance via Pipelineing**

(b) **Dependability via Redundancy**

(c) **Performance via Predication**

(d) **Hierarchy of Memories**

(e) **Performance via Parallelization**

(f) **Make the common case fast**

(g) **Design for Moore's law**

(h) **Use Abstraction to simplify design**

1.4)

a]

$$N_{bytes} = \frac{bits}{color} * n_{colors} * n_{pixels} * \frac{bytes}{bit} \tag{1}$$

$$N_{bytes} = 8 * 3 * (1280 * 1024) * \frac{1}{8} \tag{2}$$

$$N_{bytes} = 3,932,160 \tag{3}$$

The equations specified above yield $3,932,160$ bytes for the minimum size of the frame buffer.

b]

$$t_{sec} = \frac{\frac{bits}{color} * n_{colors} * n_{pixels}}{\frac{bits}{sec}} \tag{4}$$

$$t_{sec} = \frac{8 * 3 * (1280 * 1024)}{10^8} \tag{5}$$

$$t_{sec} = .315s \tag{6}$$

To calculate the time for a frame to be sent over a connection, we simply need to divide the total bits by the connection speed (also in bits/sec). For the values given in the problem, it would take .315 seconds to transfer a frame.

1.10)

Die 1 15cm diameter, 12 cost, 84 dies, .020 defects per cm^2

Die 2 20cm diameter, 15 cost, 100 dies, .031defects per cm^2

1.10.1]

$$yield = 1 - \frac{area * \frac{defects}{area}}{n_{dies}} \tag{7}$$

This equation provides an worst-case scenario to the yield, where each defect hits a different die and causes the maximum number of losses. Using this equation, the yield for Die 1 is 95.8% while Die 2 is 90.3%.

1.10.2]

$$cost_{die} = \frac{cost_{wafer}}{dies\_per\_wafer * yield} \tag{8}$$

Using Equations 7 and 8; Die 1 has a cost of $\frac{12}{84*.958} = .15$ per die while Die 2 has a cost of $\frac{15}{100*.0087} = .167$ per die.

1.12)

P1 : 4GHz, .9 CPI, 5E9 instructions

P2 : 3GHz, .75 CPI, 1E9 instructions

1.12.1]

$$t_{cpu} = \frac{N_{instructions} * CPI}{f_{CPU}} \tag{9}$$

For P1 equation 9 becomes $\frac{5E9*.9}{4E9}$ or 1.125 seconds, while P2 becomes $\frac{1E9*.75}{3E9}$ or .25 seconds.

1.12.2]

The time for P1 to compute 1E9 instructions will be $\frac{1E9*.9}{4E9}$ or .225 s. If P2 has this long to work, it would only be able to execute $\frac{.225*3E9}{.75}$ = 9E8 instructions.

1.12.3]

$$MIPS = \frac{f_{CPU}}{CPI * 10^6} \tag{10}$$

The MIPS for P1 is $\frac{4E9}{.9*10**6}$ = 4444.44, while P2 is $\frac{3E9}{.75*10**6}$ = 4000.