CS 506 homework 3

Due: Beginning of week 4

Problem 1

Assume a color display using 8 bits for each of the primary colors

(red, green, blue) per pixel and a frame size of 1280 × 1024.

**a.** What is the minimum size in bytes of the frame buff er to store a frame?

**b.** How long would it take, at a minimum, for the frame to be sent over a 100

Mbit/s network?

**a.**1 byte = 8 bits

One pixel uses 3\*1= 3 bytes,

Each color uses 1 byte i.e 1280\*1024 =1310720pixels

Therefore memory 1310720\*3= 3932160 bytes

**b** size of frame 3932160\*8 =31457280

time = size/ speed = 31457280/10^8 = 0.31457s.

Problem 2

Consider three different processors P1, P2, and P3 executing

the same instruction set. P1 has a 3 GHz clock rate and a CPI of 1.5. P2 has a

2.5 GHz clock rate and a CPI of 1.0. P3 has a 4.0 GHz clock rate and has a CPI

of 2.2.

**a.** Which processor has the highest performance expressed in instructions per second?

**b.** If the processors each execute a program in 10 seconds, find the number of

cycles and the number of instructions.

**c.** We are trying to reduce the execution time by 30% but this leads to an increase

of 20% in the CPI. What clock rate should we have to get this time reduction?

**A** 3e9/1.5= 2e9 instructions,

2,5e9/1= 2.5e9 instructions,

4e9/2.2= 1.81e9 instrctions.

i.e p2 seems to have highest performance

**b**  number of cycles= clock rate \* time

p1= 3e9\* 10= 3e10 cycles

p2 = 2.5e9\*10 = 2.5e10 cycles

p3 = 4e9\*10= 4e10 cycles

no. of instruction

3e10/1.5= 2e10

2.5e10/1= 2.5e10

4e10/2.2=1.81e10

**C** execution time = (number of instruction \*cpi)/ clock rate

To reduce 30% time

We can say

0.7 \* exection time = (number of instruction \*cpi\*1.2)/ **new** clock rate

**New** Clock rate = clock rate \*1.2 / 0.7

=1.71 \* clock rate

New clock rate will be

P1= 1.71\*3=5.13ghz

P2=1.71\*2.5=4.27ghz

P3=1.71\*4=6.84ghz

Problem 3

If the total dissipated power is to be reduced by 10%, how much

should the voltage be reduced to maintain the same leakage current? Note: power

is defined as the product of voltage and current.

Since P = V x I

10% reduction in power = 10% reduction in the product of voltage and current.

i.e, 90% of the original power .

9P = 9(V x I).

Assuming same current.

9P = (.9V) x I

voltage is also reduced by 10%

i.e. (100% - 90% = 10%)

problem 4

Suppose that we are developing a new version of the AMD

Barcelona processor with a 4 GHz clock rate. We have added some additional

instructions to the instruction set in such a way that the number of instructions

has been reduced by 15%. Th e execution time is reduced to 700 s and the new

SPEC ratio is 13.7. Find the new CPI.

CPI = exection time \*clock rate /number of instruction

Clock rate = 4 GHZ

Cpi = 700 \*4e9/ 2.389e12 \* 0.85 =0.996

Problem 5

Assume a 15 cm diameter wafer has a cost of 12, contains 84 dies, and has

0.020 defects/cm2. Assume a 20 cm diameter wafer has a cost of 15, contains 100

dies, and has 0.031 defects/cm2.

5. 1 Find the yield for both wafers.

5.2 Find the cost per die for both wafers.

5.3 If the number of dies per wafer is increased by 10% and the

defects per area unit increases by 15%, find the die area and yield.

5.4 Assume a fabrication process improves the yield from 0.92 to

0.95. Find the defects per area unit for each version of the technology given a die

area of 200 mm2.

Die area = area of wafer /dies per wafer

First wafer= 3.14\*7.5\*7.5/ 84= 2.103

Second wafer = 3.14\*6\*6/100= 3.14

1. yield =

first wafer = 1/ ( 1+ ( 0.02 \* 2.103/2))2

=1/(1.021)2

=1/1.0425

=0.959

Second wafer = 1 / (1.04867)2

= 1/1.0997

=0.909

1. cost per die = cost per wafer / (dies per wafer \* yield)

cost of first wafer= 12/ (84\*.959)

=0.149

Cost of second wafer = 15/ (100\*0.909)

=0.165

1. increasing number of dies

first wafer = 3.14\*7.5\*7.5/84\*1.15

= 1.82

Second wafer = 3.14\* 6\*6/100\*1.15

= 2.73

New yield

First wafer = 1/( 1+( 0.02\*1.15\* 1.82/2)^2)

= 0.999

Second wafer = 1/(1+(0.0031\*1.15\*2.73/2)^2)

=.99997