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CSE 331 COMPUTER ORGANIZATIONS
Homework #1 Answers

Q1 Answer: I have 2 solution for this question. The first one is more descriptive, another one is a shorter solution. (Cost per wafer decreases %20 Yield decreases %10 each year)

1st Way

Today's informations
Cost per wafer: 10.000 $
Dies per wafer: 120
Yield: %80 (0,8)

Cost per die: $\frac{10.000}{120 \times (0,8)} = 104,16\ \$$

× After 1 year
Cost per wafer: 8000
Dies per wafer: 120
Yield: %72 (0,72)

Cost per die: $\frac{8000}{120 \times (0,72)} = 92,59\ \$$

× After 2 years
Cost per wafer: 6400
Dies per wafer: 120
Yield: %64,8 (0,648)

Cost per die: $\frac{6400}{120 \times (0,648)} = 82,30\ \$$

× After 3 years
Cost per wafer: 5120
Dies per wafer: 120
Yield: %58,32 (0,5832)

Cost per die: $\frac{5120}{120 \times (0,5832)} = 73,15\ \$$

× After 4 years
Cost per wafer: 4096
Dies per wafer: 120
Yield: %52,488 (0,52488)

Cost per die: $\frac{4096}{120 \times (0,52488)}$

$= 65,03\ \$$

2nd Way

Cost per wafer decreases by %20 every year. In other words, the new cost is %80 of the previous year's cost.

In the same way, yield decreases by %10 every year. In other words, new cost is %90 of the previous year's cost. So after 4 years;

Cost per wafer: $10.000 \times (0,8)^4 = 4096$
Yield: $(0,8) \times (0,9)^4 = 0,52488$
Dies per wafer: 120

} We will use cost per die formula;

Cost per die = $\frac{\text{Cost per wafer}}{\text{Dies per wafer} \times \text{Yield}}$

$= \frac{4096}{120 \times (0,52488)} = 65,03\ \$$

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Q2-a) Instruction count and CPI factors affect compiler. So, for the compilers, the computations are below:

Clock cycle = Instruction count × CPI

Compiler A: $(50 \times 2 \times 10^6) + (10 \times 4 \times 10^6) + (2 \times 3 \times 10^6) = 146 \times 10^6$ cycles

Compiler B: $(80 \times 2 \times 10^6) + (5 \times 4 \times 10^6) + (1 \times 3 \times 10^6) = 183 \times 10^6$ cycles

$$\frac{\text{Performance A}}{\text{Performance B}} = \frac{\text{Exec. Time B}}{\text{Exec. Time A}} = \frac{183 \times 10^6 \times \text{Clock period}}{146 \times 10^6 \times \text{Clock period}} = 1,25$$

A is faster than B (1.25 times faster)

Q2-b) $$\text{CPU Time} = \frac{\text{CPU clock cycle} \times 1}{\text{Clock speed (rate)}}$$

100 ms = 0,1 second (CPU Time)

Clock cycle = 146×10^6 cycle (Because better compiler is A)

Clock speed = t

$$0,1 = \frac{146 \times 10^6}{t} \Rightarrow t = \frac{146 \times 10^6}{10^{-1}} = 1,46 \times 10^8 \times 10^1$$

$$t = 1,46 \times 10^9 \Rightarrow 1,46 \text{ GHz}$$