# - CSE 331 -

## Homework 1

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(1) Assume that, today, a wafer containing 120 processor dies costs 10000$. The yield decreases by 10% at each year while the wafer cost also decreases by 20% at each year. Then, what will be the cost of a single chip manufacturing after 4 years? Show your computations. Assume, today, there is a yield of 80%.

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

**Yield**

1\. Year → 80%
2\. Year → 72%
3\. Year → 64.8%
4\. Year → 58.32%

Decrease by 10% at each year

**Cost per wafer**

1\. Year → 10.000 $
2\. Year → 8.000 $
3\. Year → 6.400 $
4\. Year → 5.120 $

Decrease by 20% at each year

$$\text{Cost per die} = \frac{5.120}{120 \times \frac{58.32}{100}} = 73.159 \ \$$$

→ After 4 years, cost of a single chip will be 73.159 $

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② A compiler designer wants to compare the performance of two different compilers he designed. The compilers are generating MIPS machine code from a C program. He compiles the same C program using the two compilers.

a) According to the tables below, find which compiler is better and by how many times it is better than the other?

| | R-type ($\times 10^6$) | I-type ($\times 10^6$) | J-type ($\times 10^6$) |
|---|---|---|---|
| Compiler A | 50 | 10 | 2 |
| Compiler B | 80 | 5 | 1 |

| | R-type | I-type | J-type |
|---|---|---|---|
| Required Cycles | 2 | 4 | 3 |

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Instruction count → CPI

$$\text{Execution Time } A = (50 \cdot 10^6 \cdot 2) + (10 \cdot 10^6 \cdot 4) + (2 \cdot 10^6 \cdot 3)$$
$$= 146 \cdot 10^6$$

$$\text{Execution Time } B = (80 \cdot 10^6 \cdot 2) + (5 \cdot 10^6 \cdot 4) + (1 \cdot 10^6 \cdot 3)$$
$$= 183 \cdot 10^6$$

$$\frac{\text{Performance } A}{\text{Performance } B} = \frac{\text{Ex Time } B}{\text{Ex Time } A} = \frac{183 \cdot 10^6}{146 \cdot 10^6} = 1.25$$

→ Compiler A is 1.25 time faster than B.

b) What must be the clock speed of the processor so that the program compiled with the better compiler executes in 100 ms?

$$\text{CPU Time} = \frac{\text{Instruction Count} \times \text{CPI}}{\text{Clock Rate}}$$

$100 \text{ ms} = 0.1 \text{ s}$

Better compiler A

$$0.1 = \frac{146 \cdot 10^6}{x} \longrightarrow x = 146 \cdot 10^7 \text{ Hz}.$$

Clock speed must be $\underline{\underline{146 \cdot 10^7 \text{ Hz}}}$

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