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CS - 4515 - Homework 1

- 1.2 [20/20/20/20] <1.6> They will sell a range of chips from that factory, and they need to decide how much capacity to dedicate to each chip. Imagine that they will sell two chips. Phoenix is a completely new architecture designed with 7 nm technology in mind, whereas RedDragon is the same architecture as their 10 nm BlueDragon. Imagine that RedDragon will make a profit of \$15 per defect-free chip. Phoenix will make a profit of \$30 per defect-free chip. Each wafer has a 450 mm diameter.

a. How much profit do you make on each wafer of Phoenix chips?

Phoenix
area = 7nm
defects = 30

diameter = 450 mm

$$\text{Dies per wafer} = \frac{\pi * (\text{wafer diameter} / 2)^2}{\text{die area}} - \frac{\pi * \text{wafer diameter}}{\sqrt{2 * \text{Die area}}}$$

$$= \frac{\pi * (450/2)^2}{7} - \frac{\pi * 450}{\sqrt{2 * 7}}$$

$$= \frac{\pi * (50,625)}{7} - \frac{\pi * 450}{\sqrt{14}}$$

$$= 22,726.4469 - 377.8317$$

$$= 22,348.62$$

$$\text{Die yield} = \text{wafer yield} * 1 / (1 + \text{Defects per unit area} * \text{Die area})$$

→ assume wafer yield is 100%

$$= 100\% * 1 / (1 + 30 * 7)$$

$$= 1 * 1 / 1 + 210$$

$$= 1 / 211 \rightarrow 0.004739$$

$$\text{Profit} = \text{Dies per wafer} * \text{die yield} * \text{defects per area}$$

$$= 22,342.62 * 1/211 * 30$$

$$= 3,176.6758$$

$$\hookrightarrow 0.0003176$$

$$\text{Profit on Phoenix chips} = 0.003176$$

b. How much profit do you make on each wafer of Red Dragon chips?

Red Dragon

area = 10 nm

defects = 15

diameter = 450 nm

$$\text{Dies per wafer} = \frac{\pi * (\text{wafer diameter} / 2)^2}{\text{die area}} - \frac{\pi * \text{wafer diameter}}{\sqrt{2 * \text{Die area}}}$$

$$= \frac{\pi * (450/2)^2}{10} - \frac{\pi * 450}{\sqrt{2 * 10}}$$

$$= \frac{\pi * (50,625)}{10} - \frac{\pi * 450}{\sqrt{20}}$$

$$= 15,904.3218 - 316.1167$$

$$= 15,558.1961$$

$$\text{Die yield} = \text{wafer yield} * 1 / (1 + \text{Defects per unit area} * \text{Die area})$$

→ assume wafer yield is 100%

$$= 100\% * 1 / 1 + 15 * 10$$

$$= 1 * 1 / 1 + 150$$

$$= 1 / 151 \rightarrow 0.006622$$

$$\text{Profit} = \text{Dies per wafer} * \text{die yield} * \text{defects per area}$$

$$= 15,558.1961 * 1/151 * 15$$

$$= 1,545.5162$$

$$\rightarrow 0.00015455$$

Profit on Red Dragon chips = 0.0015455

c. If your demand is 50,000 Red Dragon chips per month and 25,000 Phoenix chips per month, and your facility can fabricate 70 wafers a month, how many wafers should you make of each chip?

$$\frac{\text{Red Dragon Chips per Month}}{\text{Dies per wafer for Red Dragon}} = \frac{50,000}{15,558.1961} = 3.213$$

$$\frac{\text{Phoenix Chips per Month}}{\text{Dies per wafer for Phoenix}} = \frac{25,000}{22,342.62} = 1.12$$

The most lucrative split would is 3 Red Dragon chips and 1 Phoenix chip.