

EECS 151/251A Discussion 2

Friday, Jan 26th, 2024

Problem 1: Die Cost

You are fabricating 150 mm^2 dies on 300 mm wafers with $\alpha = 3$ and a defect per unit area 0.005 mm^2 . Each wafer costs $\$20\text{k}$. How much does each die cost?

Solution:

$$\text{Die Yield} = \left(1 + \frac{0.005 \text{ mm}^2 \cdot 150 \text{ mm}^2}{3}\right)^{-3} = 0.512$$

$$\text{Dies per wafer} = \frac{\pi \cdot (300 \text{ mm}/2)^2}{150 \text{ mm}^2} - \frac{\pi \cdot 300 \text{ mm}}{\sqrt{2} \cdot 150 \text{ mm}^2} \approx 417$$

$$\text{Die Cost} = \frac{\$20,000}{417 \cdot 0.512} \approx \$94$$

Problem 3: Rank order for NRE, Recurring Costs, Flexibility, Performance

Imagine you are designing a product with embedded processing. Your job is to choose the appropriate implementation approach for the processing part of your product. You are given the following choices. Rank order the following design alternatives by filling in the table with 1,2,3,4 representing the relative ranking (1 being the lowest and 4 being the highest). Rank based on the best-case design in each category. If there is a tie, use the lower number (e.g. if tied for 2 or 3, use 2). Flexibility means flexibility after fabrication. Per-die cost of Processor is not required.

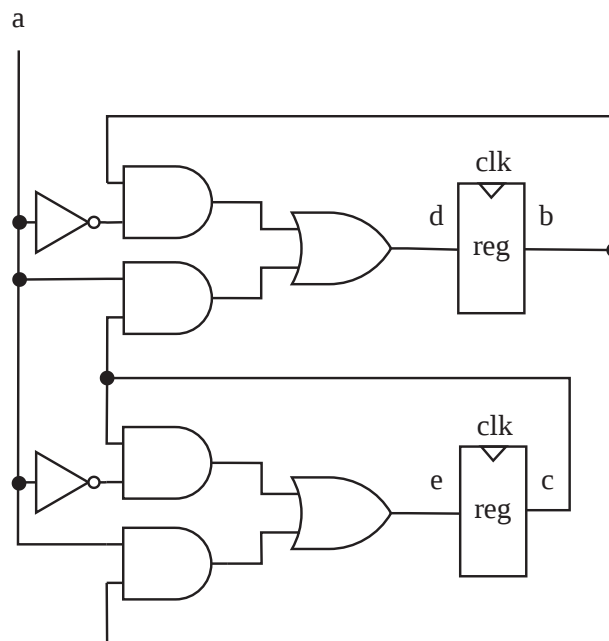
| | Full-Custom | Std Cell ASIC | FPGA | Processor |
|-------------------|-------------|---------------|------|-----------|
| NRE Cost | | | | |
| Performance | | | | |
| Energy Efficiency | | | | |
| Per Die Cost | | | | - |
| Flexibility | | | | |

Solution:

| | Full-Custom | Std Cell ASIC | FPGA | Processor |
|-------------------|-------------|---------------|------|-----------|
| NRE Cost | 4 | 3 | 2 | 1 |
| Performance | 4 | 3 | 2 | 1 |
| Energy Efficiency | 4 | 3 | 2 | 1 |
| Per Die Cost | 1 | 2 | 3 | - |
| Flexibility | 1 | 1 | 2 | 2 (or 3) |

Problem 2. Sequential Logic Circuit

For the sequential logic circuit with input a and output f shown below,



- (a) Show the truth table of the combinational part (use a , b , and c as input, and d and e as output).
- (b) Complete the following table.

| cycle | 0 | 1 | 2 | 3 | 4 |
|-------|---|---|---|---|---|
| a | 0 | 1 | 1 | 0 | 1 |
| b | 1 | 1 | 0 | | |
| c | 0 | 0 | 1 | | |
| d | 1 | 0 | | | |
| e | 0 | 1 | | | |

Solution:

| | a | b | c | d | e |
|-----|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 1 | 0 | 1 |
| | 0 | 1 | 0 | 1 | 0 |
| (a) | 0 | 1 | 1 | 1 | 1 |
| | 1 | 0 | 0 | 0 | 0 |
| | 1 | 0 | 1 | 1 | 0 |
| | 1 | 1 | 0 | 0 | 1 |
| | 1 | 1 | 1 | 1 | 1 |

| cycle | 0 | 1 | 2 | 3 | 4 |
|----------|---|---|---|---|---|
| <i>a</i> | 0 | 1 | 1 | 0 | 1 |
| <i>b</i> | 1 | 1 | 0 | 1 | 1 |
| <i>c</i> | 0 | 0 | 1 | 0 | 0 |
| <i>d</i> | 1 | 0 | 1 | 1 | 0 |
| <i>e</i> | 0 | 1 | 0 | 0 | 1 |