Phi Luu ECE_271_001_F2018 11/14/2018

INTERVIEW QUESTION

Question 5.1: What is the largest possible result of multiplying two unsigned N-bit numbers?

$$\underbrace{0\,1\,1\,1\ldots1\,1\,1}_{N\text{ bits}}{}_2 = (2^{N-2})_{10} + (2^{N-3})_{10} + \ldots + (2^2)_{10} + (2^1)_{10} + (2^0)_{10}$$

$$\times \quad \underbrace{0\,1\,1\,1\ldots1\,1\,1}_{N\text{ bits}}{}_2 = (2^{N-2})_{10} + (2^{N-3})_{10} + \ldots + (2^2)_{10} + (2^1)_{10} + (2^0)_{10}$$

$$\Rightarrow M = \text{result} = \left(2^{N-2} + 2^{N-3} + \ldots + 2^2 + 2^1 + 2^0\right)\left(2^{N-2} + 2^{N-3} + \ldots + 2^2 + 2^1 + 2^0\right)$$

$$M = \left(2^{N-1} - 1\right)\left(2^{N-1} - 1\right)$$

$$M = \left(2^{N-1} - 1\right)^2$$

$$M = 2^{2(N-1)} - 2 \cdot 2^{N-1} \cdot 1 + 1^2$$

$$\boxed{M = 2^{2N-2} - 2^N + 1}$$