

Outline

- ❏ Digital CMOS Design
- ❏ Arithmetic Operators
- ❏ Floating Point Arithmetic Operators
 - Square root
 - **division**



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Digital Design

February 2010

Division

Two real number y and z using floating point representation

Find a real number x such as

$$x + \varepsilon = \frac{y}{z}$$

- Calculation cannot be performed in one cycle
- Need iterative operation



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Division

- Direct method ➡ digit-by-digit
- Indirect method ➡ resolve a non-linear equation



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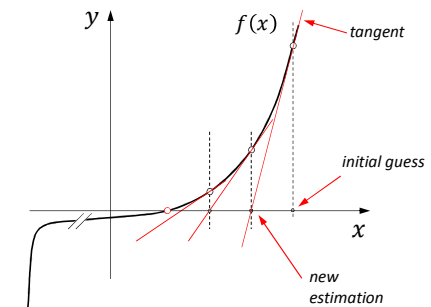
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Division - indirect

Resolving a non linear equation

$$f(x) = 0$$



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Division - indirect

Resolving $u = \frac{1}{z}$

Find a function f such as $f(u) = 0$ for $u = \frac{1}{z}$

$$f(u) = 1/u - z$$

$$f(u) \approx f(u_0) + f'(u_0)(u - u_0)$$

$$f(u) \approx \left(\frac{1}{u_0} - z\right) - u_0^{-2}(u - u_0)$$

$$f(u) = 0 \quad u = u_0 + \frac{(u_0^{-1} - z)}{u_0^{-2}}$$

$$u = u_0(2 - zu_0)$$



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Division - indirect

Resolving $u = \frac{1}{z}$

Each iteration $u_{i+1} = u_i(2 - zu_i)$

multiply !!

$$u = \frac{1}{z}$$

$$x = \frac{y}{z} = u \cdot y$$



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