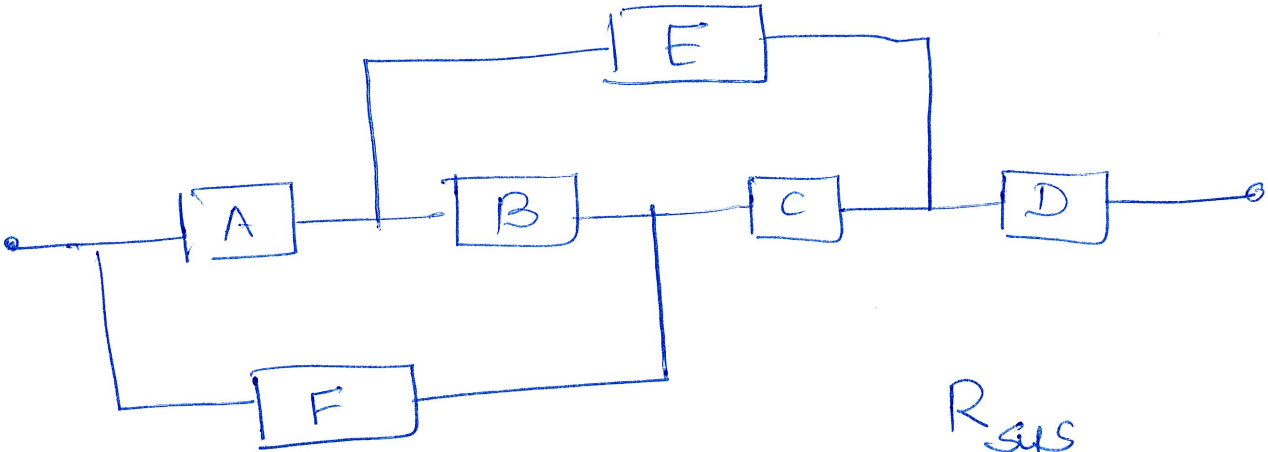
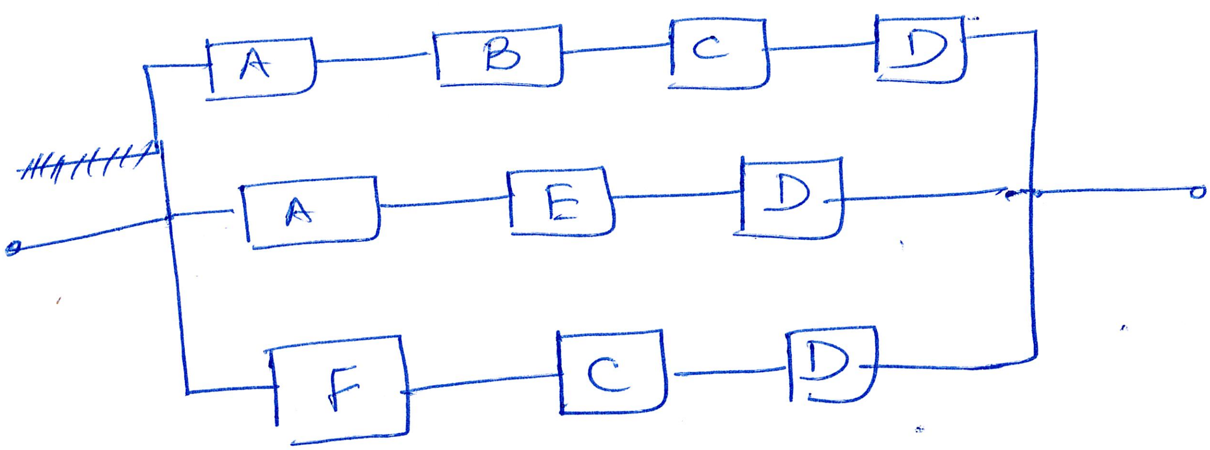
Upper bound estimate



R_{sys}

Simplification



$$\hat{R}_{sys} = 1 - \prod_{i=1}^{3} (1 - R_{p_i})$$

$$R_{p_1} = R_A . R_B . R_C . R_D = R^4$$

$$R_{p_2} = R_A . R_E . R_D = R^3$$

$$R_{p_3} = R_F . R_C . R_D = R^3$$

$$\hat{R}_{sys} = 1 - (1 - R^4)(1 - R^3)(1 - R^3)$$

$$R_{sys} \leq \hat{R}_{sys}$$

$$R_{M\text{-out-of-}N} = \sum_{i=0}^{N-M} Pr(i \text{ components failing})$$

$$= \sum_{i=0}^{N-M} C(N,i)\,(1-R_m)^{i}\, R_m^{\,N-i}$$

$N \rightarrow$ (constant)

$M \uparrow$ (increases)

$\Rightarrow R_{M\text{-out-of-}N} \downarrow$ (under the realistic case that $R_m \neq 1$)

KLOC 1000 lines of code

4 bugs/ KLOC.

$$R_{TMR} = R^3 + C(3,2)\,R^2\,(1-R)$$

$$= R^3 + 3R^2(1-R)$$

$$= 3R^2 - 2R^3$$

$$R = e^{-\lambda t}$$

$$R_{TMR}(t) = 3e^{-2\lambda t} - 2e^{-3\lambda t}$$

$$MTTF_{TMR} = \int_{t=0}^{\infty} R_{TMR}(t)\,dt = \frac{3}{2\lambda} - \frac{2}{3\lambda} = \frac{5}{6\lambda}$$

$$MTTF_{simplex} > MTTF_{TMR}$$