Series System

Case 1

Failures of components are independent

$$Pr(\text{System working}) = Pr(C_1 \text{ and } C_2 \text{ working})$$

$$= Pr(C_1 \text{ working}) * Pr(C_2 \text{ working})$$

$$R_{sys} = R_1 * R_2$$

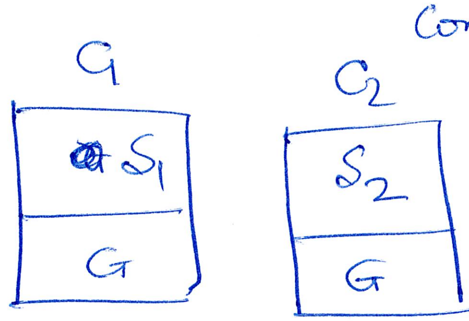
Case 2

Failures of components are dependent.

$$Pr(\text{System } \cancel{\text{not}} \text{ working}) = Pr(C_1 \text{ and } C_2 \text{ working})$$

$$= Pr(C_1 \text{ working}) * Pr(C_2 \text{ working} \mid C_1 \text{ working})$$

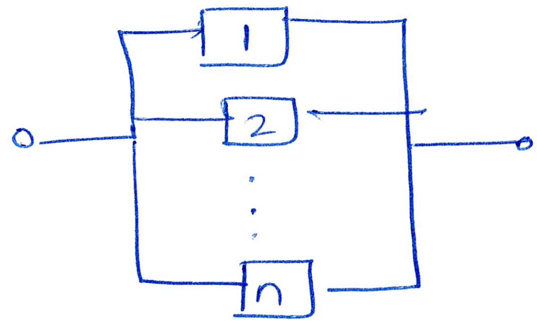
$$= R_1 * \underbrace{R_{2|1}}_{\text{Conditional reliability}}$$



$Pr(C_1 \text{ failing}) <$

$Pr(C_1 \text{ failing} \mid C_2 \text{ failed})$

Parallel Organization



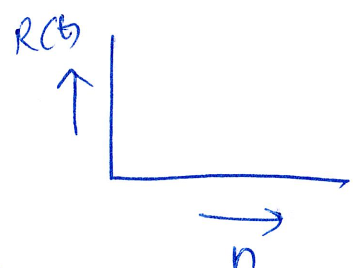
unreliability of C_i = $1 - R_i(t)$

∴ $Pr(\text{All components fail}) = \prod_{i=1}^{n} (1 - R_i(t))$

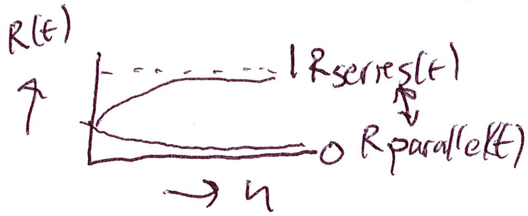
∴ $Pr(\text{System works}) = 1 - Pr(\text{All components fail})$

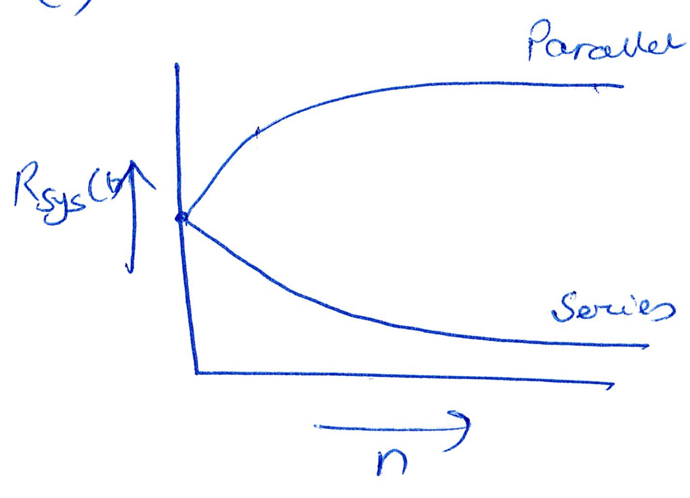
$$= 1 - \prod_{i=1}^{n} (1 - R_i(t))$$

$n \uparrow$ $R_{series}(t)$



$R_{parallel}(t)$





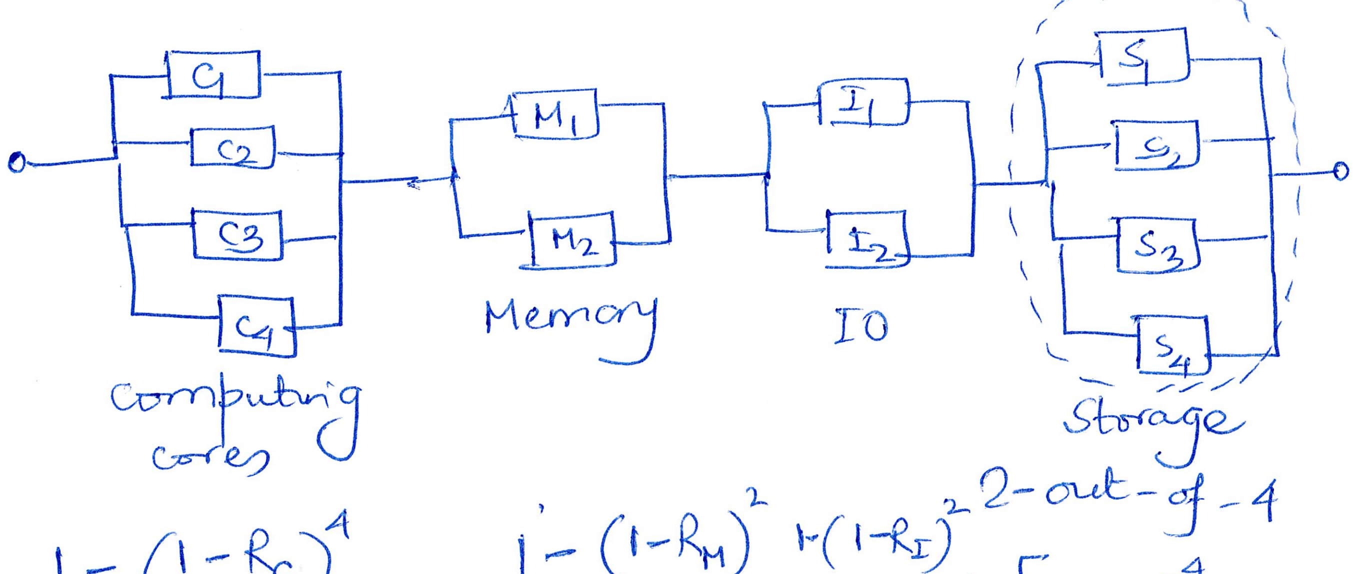
Hybrid Series Parallel systems

Computing system component	Requirement
4 cores	≥ 1
2 memory DIMMs	≥ 1
2 IO buses	≥ 1
4 RAID storage elements	≥ 2

TMR(2 out of 3)

k-out-of-m

$\geq$ k working correctly
out of m components
$\Rightarrow$ system working correctly.



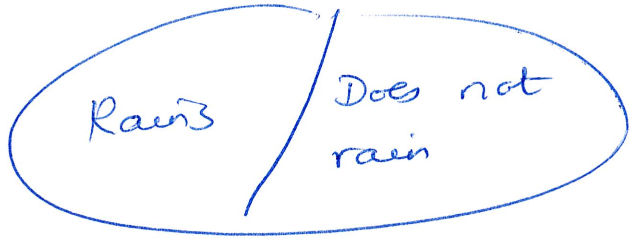
$1-(1-R_C)^4$

$1-(1-R_M)^2$

$1-(1-R_I)^2$

2-out-of-4

$1-\left[(1-R_S)^4 + C(4,1)\,R_S\,(1-R_S)^3\right]$



$$Pr(Soccer) = Pr(Rain) * Pr(Soccer \mid Rain) + Pr(!Rain) * Pr(Soccer \mid !Rain)$$