2. Übung, WS 2012/13
Zuverlässige Systeme/ Dependable Systems
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Assignment 1. Reliability of a Component

An electronic circuit has an exponential reliability with a constant failure rate λ.

1. Calculate the mean time (MTTF), as well as the $R(t)$ value at this mean time. Let $\lambda = 10^{-6}$.
2. Demonstrate that this MTTF corresponds to the time which is at the intersection of the tangent at the origin of the curve with the time axis.
3. With another technology the component has a failure rate equal to 10^{-7}. Compare the reliabilities of these two versions when $t = 10^4$ hours using different metrics.

Assignment 2. Composed Reliability

We wish to study the reliability of a system constituted of 2 basic modules (noted M_i) interconnected according to 'series' and 'parallel' reliability diagrams. The reliability of each module is modeled by an exponential law with a constant failure rate $\lambda : R_i(t) = e^{-\lambda it.}$

1. Determine the reliability of a 'series' reliability diagram of these modules. Calculate the global MTTF. Study the particular case where the two failure rates are identical (i.e. $i = 1$).
2. Carry out the same study for a 'parallel' diagram.
3. Consider the previous questions with $\lambda = 10^{-4}$ and compare the reliability of these structures at time $t = 1000h$.

Assignment 3. Comparison of two redundant Structures

Study the reliability of the two structures implementing component redundancy and system redundancy. All components have the same reliability R.

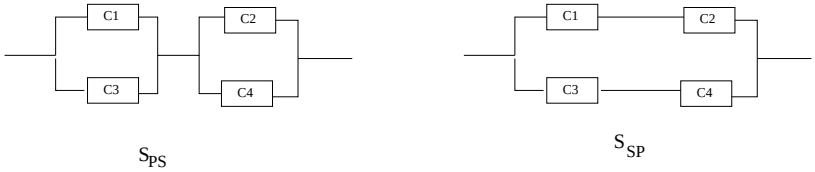

Figure 1: Series of parallels and parallel series components

Which of the two organisations has the better reliability?

Assignment 4. Reliability Block Diagram

Study the reliability of the following system, assuming that all components have the same reliability R.

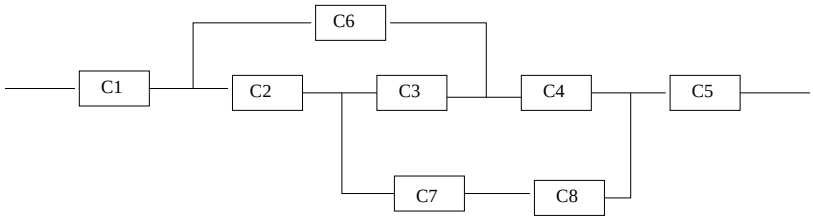

Figure 2: Complex system

Use the following methods:

1. Apply the conditioning method for an exact solution.
2. Determine a upper bound using success paths.
3. Determine an lower bound using minimal cut sets.
4. Draw the curves and determine the approximation error for $R = 0.8$.

Assignment 5. Reliability Block Diagram II

Your manager at the Reliability and Quality Department asked you to verify her calculation of the reliability of a certain system. The equation that she derived is

$$\begin{aligned} R_s &= R_C\,(1-(1-R_A)(1-R_B))\,(1-(1-R_D)(1-R_E)) + \\ &\quad (1-R_C)\,(1-(1-R_AR_D)(1-R_BR_E)) \end{aligned}$$

However, she lost her diagram. Can you draw the diagram based on the expression?

Write expressions for the upper and lower bounds on the reliability of the system and calculate these values and the exact reliability for the case $R_Z = R_B = R_C = R_D = R_E = R = 0.9$.