16. Exercise: Reliability

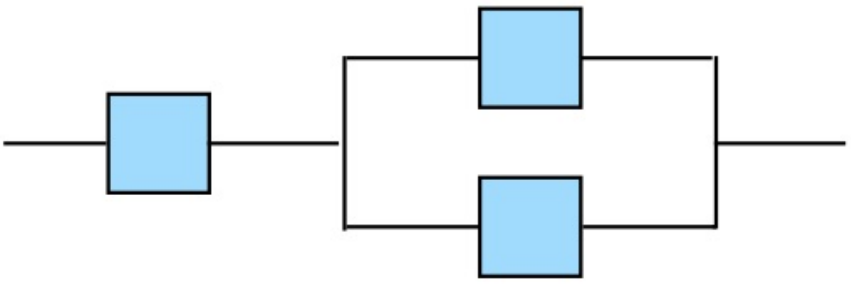
Exercises due Feb 12, 2020 05:29 IST *Completed*

Exercise: Reliability

4.0/4.0 points (graded)

Suppose that each unit of a system is up with probability $2/3$ and down with probability $1/3$. Different units are independent. For each one of the systems shown below, calculate the probability that the whole system is up (that is, that there exists a path from the left end to the right end, consisting entirely of units that are up).

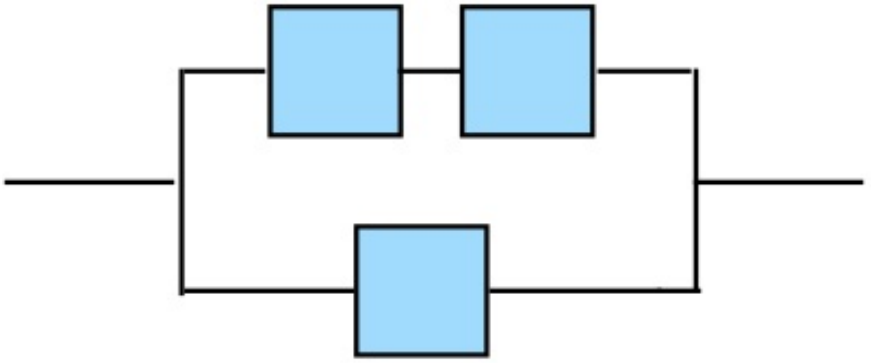
1. What is the probability that the following system is up?



16/27 ✔ **Answer:** 0.59259

2.

What is the probability that the following system is up?



65/81

✔ **Answer:** 0.81481

Solution:

1. In the first diagram, the parallel connection of the two units (on the right) is down when both units fail, which happens with probability $(1/3) \cdot (1/3) = 1/9$. Therefore the parallel connection is up with probability $1 - 1/9 = 8/9$. The overall system is up if the first unit is up (probability $2/3$) and the parallel connection is also up (probability $8/9$), which happens with probability $(8/9) \cdot (2/3) = 16/27$.

2. In the second diagram, the top path is up when both of its units are up – this happens with probability $(2/3) \cdot (2/3) = 4/9$. Thus it fails with probability $1 - 4/9 = 5/9$. The overall system fails when the top path fails (probability $5/9$) and the bottom path also fails (probability $1/3$). Thus the probability of failure is $(5/9) \cdot (1/3) = 5/27$. It follows that the probability that the system is up (does not fail) is $1 - 5/27 = 22/27$.

Submit

You have used 2 of 3 attempts

Answers are displayed within the problem

Discussion

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- Question2: Why using (A1 ∩ A2) ∪ A3 = (A1 ∪ A3) ∩ (A2 ∪ A3) in q2 does not lead to the right answer? — 1 new
  I got different results using: a/ (A1 ∩ A2) ∪ A3 = (A1 ∪ A3) ∩ (A2 ∪ A3) b/ Morgan's laws why using a/ is ...
- Submit button is disabled. and used none of the three attempt — 2
  Dear course committee, I am not able to submit. It is indicated that I have used 0 of 3 attempts, but the s...
- This video helped me out a ton — 3
  This video goes a little further into detail about how to divide and conquer these types of problems. http...
- Q2 clarification — 2
  I set up Q2 as (A intersection B) union C which equates to (A success * B success)*(1-C failure) = (2/3)^3 =...
- Q1: Can there be three paths? — 2
  Can 1st box success result in THREE options: Top path, Bottom path, Both paths. or is it top path OR bott...
- I don't like probability notation :(— 2 new
  Switching to fails instead of ups makes it much-much-much easier. Interesting. I would consider difficult...
- Q2, top path: daisy chain? — 4
  Hi, I am not sure if I'm wording that correctly. Are we to assume (for the top path of question 2) that one ...
- What helped me. — 2 new
  Break up the system in 2 sub-systems with two nodes and one node each. That way, I could easily apply ...
- why do we need to think about both when the system is up and down? — 6
  I'm confused about why we need to include (1-system fail) several times in this problem to get the correc...
- [deleted] — 4
  [deleted]