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Exercise: Reliability

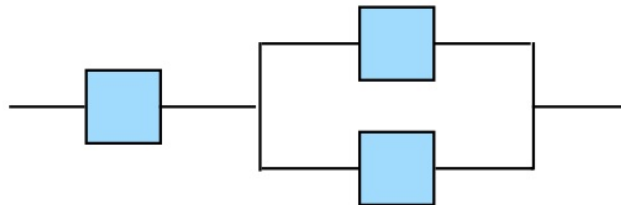
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Exercise: Reliability

4/4 points (graded)

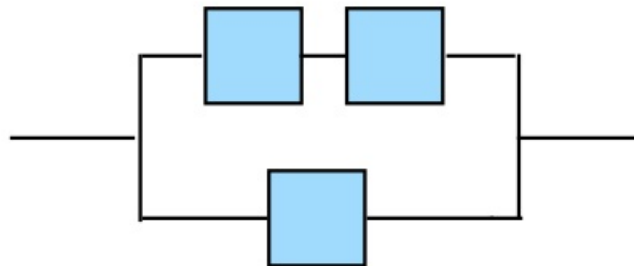
Suppose that each unit of a system is up with probability $\frac{2}{3}$ and down with probability $\frac{1}{3}$. Different units are independent. For each one of the systems shown below, calculate the probability that the whole system is up (that is, that there exists a path from the left end to the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

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



✓ Answer: 0.59259

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



✓ Answer: 0.81481

Answer:

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 $(\frac{1}{3}) \cdot (\frac{1}{3}) = \frac{1}{9}$. Therefore the parallel connection is up with probability $1 - \frac{1}{9} = \frac{8}{9}$. The overall system is up if the first unit

is up (probability $\frac{2}{3}$) and the parallel connection is also up (probability $\frac{8}{9}$), which happens with probability $(\frac{8}{9}) \cdot (\frac{2}{3}) = \frac{16}{27}$.

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

You have used 5 of 10 attempts

✓ Correct (4/4 points)

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