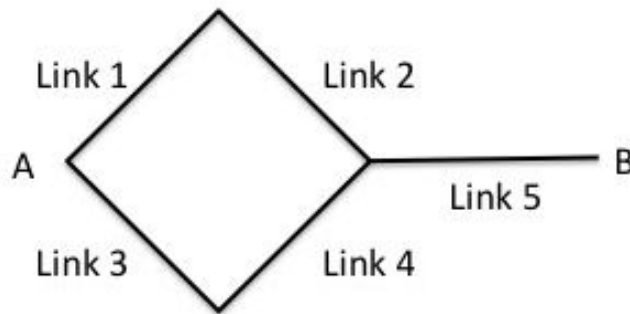## 2. A reliability problem

Problem Set due Feb 12, 2020 05:29 IST   *Completed*

Problem 2. A reliability problem

4.0/4.0 points (graded)

Consider the communication network shown in the figure below and suppose that each link can **fail with probability p**. Assume that failures of different links are independent.

1. Assume that $p = 1/3$. Find the probability that there exists a path from A to B along which no link has failed. (Give a numerical answer.)
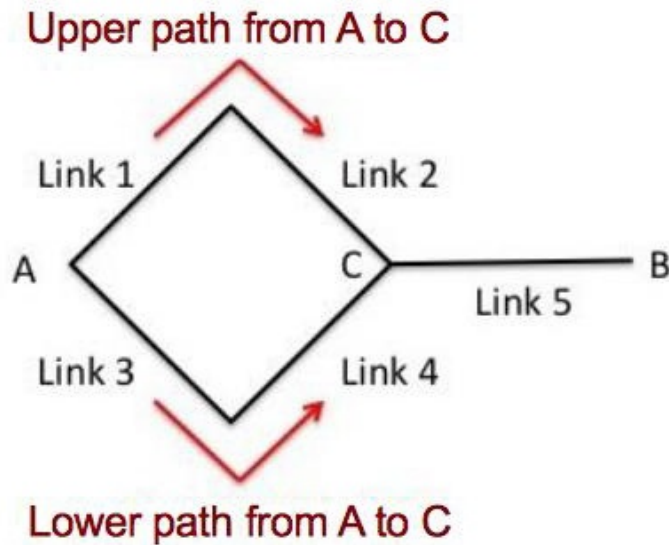
    | 112/243 | ✔ **Answer:** 0.46091

2. Given that exactly one link in the network has failed, find the probability that there exists a path from A to B along which no link has failed. (Give a numerical answer.)

    | 4/5 | ✔ **Answer:** 0.8

Solution:

Upper path from A to C

Link 1   Link 2

A   C   B

Link 5

Link 3   Link 4

Lower path from A to C

Let E be the event that there exists an operational path from A to B. Note that the probability that the Upper path from A to C is operational is $(1-p)^2$. So the probability that the Upper path fails is $1-(1-p)^2$. Similarly, the Lower path fails with probability $1-(1-p)^2$ as well.

1. For the event E to occur, that is, in order to have an operational path from A to B, two sub-events must occur: there must be an operational path from A to C, and Link 5 must be operational.

$$\begin{aligned} \mathbf{P}\left(E\right) &= \mathbf{P}\left(\text{there exists a path from } A \text{ to } C \text{ and Link 5 is operational}\right) \\ &= \left(1 - \mathbf{P}\left(\text{Upper path fails and Lower path fails}\right)\right) \cdot \mathbf{P}\left(\text{Link 5 is operational}\right) \\ &= \left\{1 - \left[1 - (1-p)^2\right]^2\right\} \cdot (1-p). \end{aligned}$$

When $p = 1/3$, this gives us $\mathbf{P}\left(E\right) \approx 0.46091$.

2. Since all links are equally likely to fail and since exactly one link has failed, each link has the same probability $1/5$ of being the one that failed. There will be no path from A to B only in the case where the link that failed is Link 5, which happens with probability $1/5$. Therefore, the desired probability is $1 - 1/5 = 4/5$.

Submit   You have used 2 of 3 attempts

ⓘ   Answers are displayed within the problem

Discussion

Topic: Unit 2: Conditioning and independence:Problem Set 2 / 2. A reliability problem

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? **Ques. 2: What's wrong with this intuition: P(no failure given 1 link failed) should be less than overall P(no failure)?** **2**

P(no failure) = .46 from question A. Now in question 2, it's given that 1 link has failed. This means that overall chances ...

💬 **Points for simple questions** **8**

Hello everyone, I think that the simpler a question the less points of total you should get. Therefore I think it will be a littl...

? **Q1 P(link up)=(1-p)... P=1/3.. so P(link up)=2/3 or complement of 1/9...?** 2 new

I have a question, related to the following: if we have that the probability of fail is 1/3 ... so for the working link is 2/3 and...

? **Oh no! Has the deadline passed? I thought it was midnight** **6**

Won't let me enter my second attempt.

☑ **Instructors please reply: Isn't it a sufficient condition for the first link to fail?** **4**

To make the Link1-Link2 combination to fail? We don't need Link 2 to fail if Link 1 has failed. We are assuming the path is...

💬 **Confusion about solution of part 1** **2**

I assume since the deadline is now over, we can discuss the solutions...... Part a asks for a path from A to B where no lin...

? **Easy way to verify intuition about conditional probability** **2**

Q2 can be solved using the intuitive method. My question is, Is there an easy way to verify that our intuition is correct, ot...

💬 **Hint on how to go about this** **2**

I have tried every possible way. Still not getting it. I would appreciate hint on how to solve this

? **Need a hint on how to start problem 2** 1 new

Hi everyone, For problem two we assume that at least one link has failed, and then find the probability that there is a pa...

? **Numerical precision for Q1?** **5**

I've provided 6 digits after comma, i.e., 0.xxxxxx, yet the answer gets rejected (am quite sure the formula I use is correct)...

? **Question 1** **2**

I am little confused with question 1. Link 1 and link 2 and link 3 and link 4 form a series path with (1-p)*(1-p) probability ...

💬 **Hint: Multiple links can fail** **2**

That is all. I missed it, but maybe it'll help someone else.

? **Is Q1 about the P(the network is "up")? Confused about the wording...** **3**