ECE 313 (Section G)
In-Class Project – Monday, Feb 6th 2017

Write your name and NetID here:

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A Petascale Computing Facility, which houses a supercomputer, needs chilled water cooling to keep the system operating within an acceptable temperature range. Figure 1, is an overview of the Liebert XDP unit which cools the compute cabinets of the supercomputer. As shown in the figure below, primary and backup pumps are used to maintain the flow of chilled water. An iCOM controller/switch monitors the status of the pumps and switches from primary to backup upon detecting a pump failure.

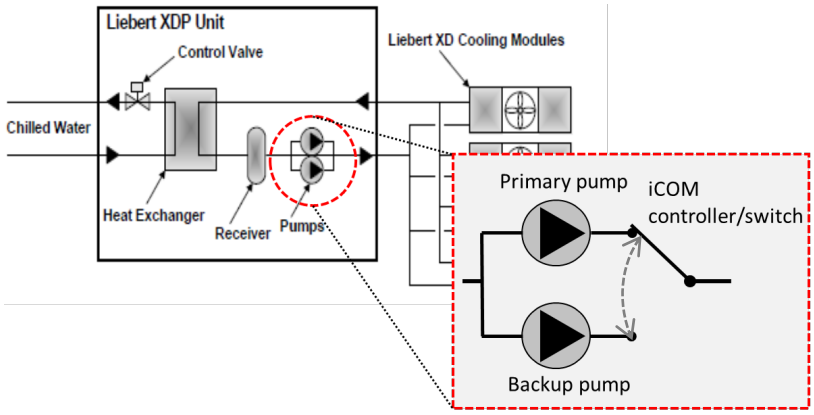

Figure 1. Overview of a Liebert XDP Unit

We define the following events:

A = "Primary pump functions correctly."
$\bar{A}$ = "Primary pump fails to function correctly."
B = "Backup pump functions correctly."
$\bar{B}$ = "Backup pump fails to function correctly."
D = "iCOM detects pump failure correctly."
$\bar{D}$ = "iCOM fails to detect pump failure
or **raises a false alarm while the primary pump is operational**."
F = "the pump system fails."
S = "the pump system is operational."

Assume that event pairs A and D as well as B and D are independent, but events A and B are dependent.

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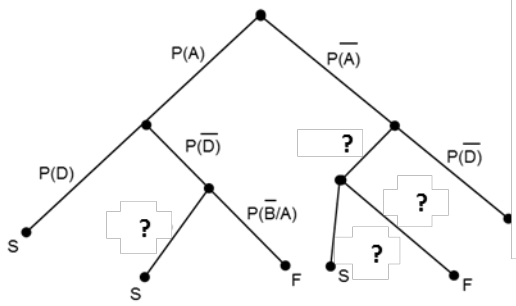
a) Complete the following tree by replacing the question marks with probability expressions. *S* stands for success and *F* represents a failure. Each path from the root to a leaf in the tree represents one of the ways that system would fail or succeed. (15 minutes)



A and B are not independent :

$P(A \mid B) \neq P(A)$

b) Derive an expression for the failure probability of the pump system highlighted in Figure 1. Make sure to simplify the expression. (10 minutes)

c) Failure diagnosis of the system. Derive an expression to find the probability of primary pumps fails, given that a failure has occurred. (5 minutes)

Hint: use Bayes theorem and the law of total probability