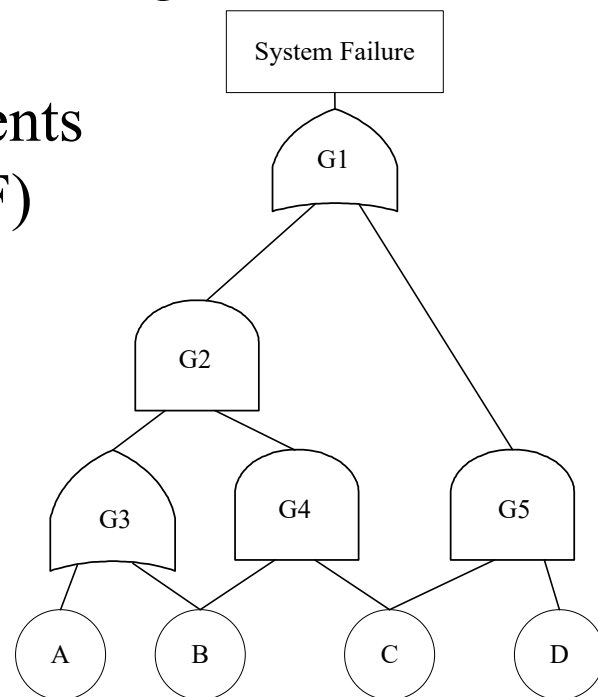
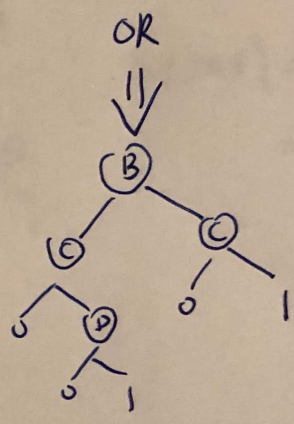
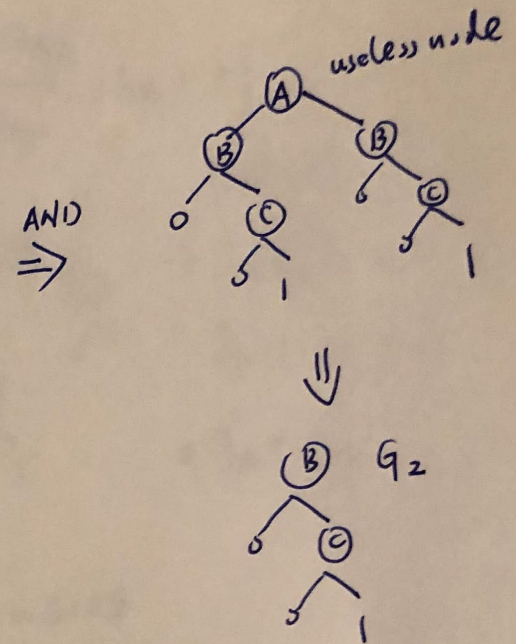
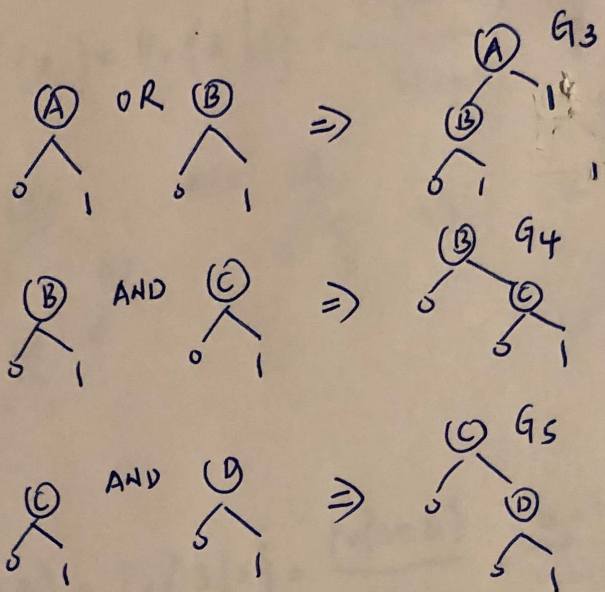


Review Questions

Consider a system whose failure is modeled by the following fault tree.

- Generate the system BDD
- All the system components fail independently. Assume each component has the same fixed failure probability of 0.1. Determine the reliability of the entire system.
- Rank importance of all system components using the Birnbaum's measure
- Rank importance of all the system components using the diagnostic importance factor (DIF)





$$U_{sys} = q_B q_C + (1 - q_B) q_C q_D$$

$$= 0.1^2 + 0.9 * 0.1^2$$

$$= 0.019$$

$$I^{BM}(A) = \frac{\partial U_{sys}}{\partial q_A} = 0$$

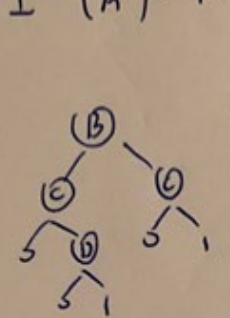
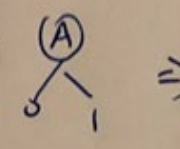
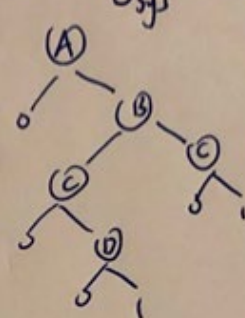
$$I^{BM}(B) = \frac{\partial U_{sys}}{\partial q_B} = q_C - q_C q_D = 0.1 - 0.1^2 = 0.09$$

$$I^{BM}(C) = \frac{\partial U_{sys}}{\partial q_C} = q_B + (1 - q_B) q_D = 0.1 + 0.9 * 0.1 = 0.19$$

$$I^{BM}(D) = \frac{\partial U_{sys}}{\partial q_D} = (1 - q_B) q_C = 0.9 * 0.1 = 0.09$$

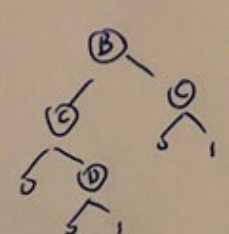
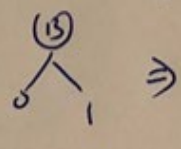
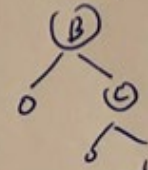
$C > B = D > A$

$$I^{DIF}(A) = Pr\{A|S\} = \frac{Pr\{SN A\}}{U_{sys}} = \frac{q_A U_{sys}}{U_{sys}} = q_A = 0.1$$


 AND 
 \Rightarrow 

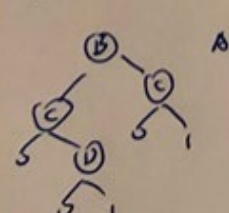
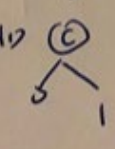
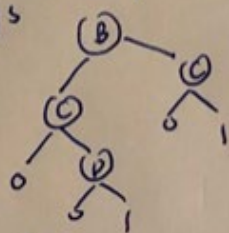
$$Pr\{SN A\} = q_A q_B q_C + q_A (1 - q_B) q_C q_D = q_A * U_{sys}$$

$$I^{DIF}(B) = Pr\{B|S\} = \frac{Pr\{SN B\}}{U_{sys}} = \frac{0.01}{0.019} = 0.5263$$


 AND 
 \Rightarrow 

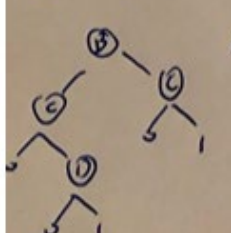
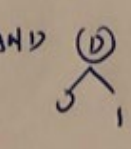
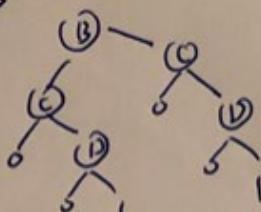
$$Pr\{SN B\} = q_B q_C = 0.01$$

$$I^{DIF}(C) = Pr\{C|S\} = \frac{Pr\{SN C\}}{U_{sys}} = 1$$


 AND 
 \Rightarrow 

$$Pr\{SN C\} = q_D q_C + (1 - q_D) q_C q_B = U_{sys}$$

$$I^{DIF}(D) = Pr\{D|S\} = \frac{Pr\{SN D\}}{U_{sys}} = 0.5263$$


 AND 
 \Rightarrow 

$$Pr\{SN D\} = q_D q_C q_B + (1 - q_D) q_C q_D = 0.1^3 + 0.9 * 0.1^2 = 0.01$$

Note node B is useless and can be removed

Ranking using DIF: C (1) > B=D(0.5263) > A(0.1)